A METHODOLOGICAL APPROACH TO THE UPGRADING, IN-SITU, OF INFORMAL SETTLEMENTS IN SOUTH AFRICA

J Abbott • D Douglas

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EXECUTIVE SUMMARY

This report presents a methodological framework for upgrading high-density informal settlements 'in-situ'. The evolution of this framework derives from two primary sources. The first is an extensive desk study of informal settlement internationally, carried out for the Water Research Commission as part of this same research contract (Abbott et al, 2001). The second is a practical experience of upgrading in the informal settlement of New Rest, Cape Town. Thus the first source provides the theoretical rationale, while the second source provides the practical experience of implementation.

The upgrading of informal settlements differs quite fundamentally from the development of vacant land for housing. Yet the majority of existing approaches continues to mirror traditional practice in developing an implementation strategy. Specifically they continue to place a great deal of emphasis on physical conditions, and the improvement thereof, and rely heavily upon the independent use of specific, sector-based activities. The result is a diverse range of approaches to upgrading which seek to achieve specific objectives, without thought being given to the longer-term development. The result is the prioritising of short-term objectives rather than the achievement of long-term sustainability.

There are a number of exceptions to this broad statement. In particular there are two experiences that provide a completely different approach, and in doing so demonstrate the potential of in-situ upgrading as a viable urban development strategy. These two experiences are the upgrading programme of Belo Horizonte in Brazil and the so-called 'Million Houses' project in Sri Lanka. This South African research project has drawn on the experience of both of these international programmes. At the same time, the research project has also been driven by an independent analysis based upon what is most appropriate for South Africa.

The underlying characteristics of informal settlements are poverty and social exclusion. All else flows from that. Thus any upgrading intervention should be able to define, and preferably quantify, its impact in ameliorating poverty and contribution to social integration. This means that any approach to informal settlement upgrading that seeks to be viable and replicable has to deal with these issues.

Taking this into account, an informal settlement can be seen to have two, albeit strongly inter-related facets. The one relates to the physical environment, and revolves around that dwelling that families occupy. The other relates to the families themselves, and their needs and circumstances. To accommodate both, it is necessary to deal with both place and people equally and inter-actively.

This requires an extremely flexible spatial management system with a rapid response time if it is to operate successfully. It cannot function with paper-based mapping, for example, as the time taken to track, map and act on changes in the physical environment would be too slow. By the time the responses had been developed, the spatial relationships between both shacks and families would have been changed. So what is required is a system that approaches real-time mapping as closely as possible. This can be achieved using a GIS-based information management system. However, in the same way that the planning process for greenfield sites evolved to suit the medium of paper-based output, so the new planning system for informal settlement upgrading has to be structured around the optimisation of geo-information. Hence, it is necessary to change not only the approach (which determines what is to be done) but also to change the means by which it is done.

The new planning paradigm that emerges from all of this is one that is heavily dependent upon a knowledge of what exists in the settlement. It is also one that is built around the twin goals of social sustainability and integration into the formal city. Neither of these can be achieved through spatial determinism. It can only be achieved by integrating spatial form and physical development with social and economic activity. That is the basis for the upgrading process described in this report.

The practical side of the methodology is based upon the construction of a suitable geospatial database management system, which in turn is built around two primary identifiers, the shack and the head of the household occupying the shack. In-situations where there are a number of separate households, this would require an additional identifier for each additional head of household. In assembling the database, the first step is a detailed spatial definition of the shacks as vectors in a digital format. This is best done using geo-referenced images of the site, which can be obtained from the new 1-metre satellite imagery, from aircraft or from helicopter.

Having defined the shacks that occupy the site, the data collection process then moves into two parallel streams. The first of these deal with the physical environment. This technical and spatial database contains information that pertains to the site, ie. that piece of land on which the informal settlement is situated. The construction of this data set necessitates the identification and evaluation of a range of spatially referenced technical information, which makes it an appropriate place to build the spatial information system. This means that, before the data can be assembled and attached, it is first necessary to construct a spatial information management system.

The underlying philosophy of informal settlement upgrading in-situ is minimum relocation, ie. the intent is to enable as many families as possible to remain on the site. However it is important to define what this term means. It does not mean no relocation. It means that relocations take place only for specific, agreed, and clearly defined reasons. Furthermore, the relocations should, wherever possible, be internal, ie. families may have to move their shacks, but they do not leave the settlement.

There are three major causes for relocation. The first relates to physical risk. The major causes of physical risk are unstable sloping ground (with the inherent risk of landslides), flood-prone land, whether from rivers or rising groundwater, and unstable flat land (eg. sinkholes or old landfills). The second cause of relocation is to create improved access. Again this requires clarification. With a minimum relocation policy it is not feasible or practical to define large swathes of land as roads and road reserves. Access has to be carefully considered and each route justified. The third cause of relocation stems from compliance with cadastral boundaries. In this new development paradigm, thinking about space is structured around (a) the individual shacks and (b) the line drawn around the external perimeter of the shacks (ie. the settlement). The cadastral boundaries are not the determinants of development. Nonetheless, it may be that, in some cases, certain cadastral boundaries are recognised, as was the case with New Rest.

The second parallel stream of data capture relates to social and economic data. Broadly, the collection of social and economic data can be seen to address four sets of needs, as follows:

1. Structural development. This requires demographic data in order to facilitate the short-, medium- and long-term physical development strategies. The approach within greenfield site development, whereby physical and social services are linked to the number of dwellings, is inappropriate for informal settlements at this stage. Too little is known of these settlements to be able to generalise on ratios for services such as water, schools or hospitals. This means that provision had to be based on site-specific information. In addition, the huge differential between demand and supply inevitably means that self-help programmes will play a major role in development. These programmes require accurate levels of information if they are to be optimal.
2. Social development. All communities have a degree of social stratification. Upgrading has to be an inclusive process, and this means that it is necessary to identify those less able to participate. In addition, the whole process of social integration means that there is the need to interact with each individual household in the settlement. This is crucial not only for land regularisation and the extension and connection of basic services, but also to deal with the fundamental issues of relocation and access.
3. Gender equity. People living in informal settlements also reflect many characteristics of the wider society. This includes a large gender imbalance and a strong bias towards male domination of the society. Yet women bear the brunt of the social dislocation. A good database is an essential pre-requisite to addressing this imbalance.
4. Economic development. This has to be built on what already exists. This requires information on the level of both skills and economic activity within the settlement.

The primary source of data collection is the survey questionnaire. The first step should be to reach agreement in principle among the primary stakeholders (in this case the community of New Rest and the local authority) that information would be gathered. Then, having agreed that the information collected would be owned by the community (a core issue), a series of workshops need to be held which focus on the detailed nature, and extent, of the information to be collected. From this process, as carried out in New Rest, six groupings emerged for the data set, comprising:

- Shack data, including details of ownership.
- Detailed information on the head of household.
- Employment and skills data related to the head of household.
- Information on the spouse/partner.
- Information on dependants.
- Information on other shack residents.

The integration of the shack data with the physical data for the site and the social and economic data pertaining to the community members enables a detailed analysis of needs to be carried out. From a physical point of view it identifies the areas of highest risk, where families should be moved for their own safety. From a social and economic point of view it provides the data that enables an analysis of quantifiable family conditions to be carried out. This provides an information base that deals with the four sets of issues described earlier, namely structural development, social development, gender equity and economic development.

Having reached this point in the process, it becomes possible to initiate an implementation strategy. At this stage a number of factors have to be considered, the majority of which relate to spatial structure and spatial relationships. Foremost among these is movement. The approach to movement corridors should be one that limits vehicular access, whilst recognising the need for access for emergency and delivery vehicles. This results in a hierarchy that is significantly different to that used for conventional township design. This is achieved through a greater integration of movement and accessibility within a wider framework of multi-functional social space. Taking this factor in conjunction with the need expressed earlier to meet social and economic objectives, this leads to a set of planning principles, the key objectives of which are seen as follows:

- to create a continuum or hierarchy of public spaces and movement systems, which attract and give order to activities, events and elements according to their need for public use and privacy;
- to create opportunities within the collective public social space network, where small scale economic activities and street trading can locate and be formally sustained over time;
- to create spatial opportunities in the landscape, where a network of public social facilities can locate and be consolidated into a public 'capital web', which offers optimal sustainable benefit to the community and meets their immediate basic needs.

The spatial definition of the major movement routes completes the assessment of the impact of physical and spatial features associated with the settlement that impinge on existing dwellings and are, therefore, likely to require internal relocation of families. By following this process in New Rest, the number of families needing to be relocated was reduced to below 200, representing less than 20% of the total number of dwellings currently on the site. This up-front planning of relocation supports the long-term social sustainability of the settlement whilst at the same time providing a sustainable basis for planning the infrastructure and dealing with the issue of land regularisation. At the same time it requires a completely different approach to both infrastructure provision and land management.

Taking infrastructure first, the most important point to emerge is that the different infrastructure services are independent of one another. They relate to different planning elements and thereby interact with the wider upgrading process at different points in time.

The first service to be considered is stormwater. An analysis of the impact of rainfall and runoff is crucial, and takes place in the early stages of analysis, since it provides one of the highest elements of risk. The major impact of stormwater runoff therefore is on relocation. The second service is that associated with the movement network. This is not determined in terms of a road hierarchy, but rather in terms of social space, with the recognition that there has to be a basic skeletal core of the network that can accommodate vehicular traffic. This definition of use of the movement network based upon internal, rather than external need has a significant impact upon pavement design, requiring it to be more accommodating of multi-functional usage and derived from a usage hierarchy that derives internally. Its direct impact on stormwater generation is therefore greatly reduced, as mentioned earlier, and this allows the two engineering elements of roads and stormwater to be de-coupled to a large degree.

Recent advances in knowledge and understanding of sanitation systems mean that different sanitation options can be used within a single project. For the upgrading of dense informal settlements in South Africa, two options are proposed. The first is conventional sewerage and the second what is known as shallow sewerage. The core network can be designed with conventional sewerage, while the smaller blocks defined by the primary road network use a shallow sewer system. The use of this hybrid sewerage system has the added advantage of situating the shallow sewerage component within a community management framework.

The remaining service is water. From an engineering perspective this is the most flexible service. It is also one that is easily accommodated to a two-stage design process. The critical issue is to determine when it should be installed, given its crucial importance in community health. Thus a distinction needs to be drawn between an emergency supply (which may be installed prior to upgrading) and a permanent supply, which will only be supplied much later.

Only once all of this work is carried out does it become possible to explore the issue of land regularisation. This framework for informal settlement upgrading provides the most flexible approach to land tenure and ultimate regularisation. It means that communities in informal settlements can choose one of three forms of land ownership. The first is full communal ownership, the second a more limited form of communal ownership based upon local blocks of land defined by the road network, and the third individual ownership. The final choice will lie with the community.

ACKNOWLEDGEMENTS

This report describes a methodology for the upgrading of informal settlements in-situ. It follows on a previous report into this topic that resulted from an in depth desk study. This project could not have taken place without that initial study and full acknowledgement is given in the first report to all those who supported and contributed to that study, both in South Africa and in Brazil. However, the fact that the desk study could translate into a pilot project that would give it substance is due primarily to three groups, two of whom had little or no involvement in the early desk study.

The first of these is CORDAID, a non-governmental organisation in the Netherlands that provided funding for one year to allow the methodology to be tested and developed with the community. This funding covered the social survey, a gender study, the technical survey, the aerial survey, all substantive analysis and the employment of a social worker and five community workers for one year. This project would not have existed without CORDAID, and the importance of this contribution will become ever more evident as South Africa moves towards a policy of in-situ upgrading over the next few years.

The second group comprises all of the residents of the New Rest community, who embraced this project whole heartedly, even though they knew it was a pilot study, and in particular their Resident's Committees from the different years from 1998 to 2001. Also the New Rest and Kanana Community Development Trust. The third group is made up of a small core within the City of Cape Town that continued to have faith in, and supported, this project. This group comprises Councillor Mama, the Ward Councillor from 1996 to 2000; Mike Marsden and Dave Hugo from Municipal Services, and Pete van Heerden from Spatial Planning.

Both acknowledgement and tribute is paid here to two wonderful people who died, both tragically, whilst involved with, and committed to, this project. Their deaths were unrelated to the project, but they are sorely missed. Those people are Siviwe Matika and Tricia Gibbons.

There are so many individuals who have played a role in this project. It is not possible to name all of them, but their contribution is gratefully acknowledged. Some people, though, played a special role. In the community we would like to acknowledge Morrison Mvumvu, Abe Tini and Vuysiwa Ndlalankulu. There was also Vuyiswa Mokoena, the social worker on the project. In the University was Iuma Martinez, who provided Figures 3.1 and 3.2, together with the descriptive material, and Marie Huchzermeyer, who gathered some of the information on poverty used in Chapter 1. Both were co-authors of the earlier desk study.

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1. INTRODUCTION

1.1 Introduction

The upgrading of informal settlements differs quite fundamentally from the development of vacant land for housing, in both the wider approach to the problem and the detailed implementation. The most obvious distinction between the two conditions, which underpins these differences, is that people are already occupying the land, and the intention is to develop the land with the absolute minimum of relocation. Secondly, there are often major physical constraints, in that the majority of informal settlements tend to occupy land that is either environmentally degraded or prone to natural disasters (floods, slides, collapse). Collectively this is termed marginal land. Thirdly, there are generally major financial constraints. Thus the majority of the population occupying informal settlements tends to be extremely poor financially, which makes it difficult for meaningful development to take place through conventional financial markets. And, finally, there are the broader issues associated with urban poverty. The lives of many of the population are themselves marginal, in relation to their basic survival needs. This makes the group generally extremely susceptible to what might appear to others with greater levels of security to be quite small changes in their external circumstances.

It is inadequate simply to recognise these factors, when planning for upgrading, although this is an important first step. The planning process has to go much further and place all of these factors at the core of the development process. If all of them cannot be addressed satisfactorily, then the upgrading is unlikely to be sustainable. It may provide some temporary relief, or address some immediate crisis, but it will not provide a long-term solution. The question is, how to find such a solution and, once identified, to determine how it changes the planning process itself.

This report is the second of two reports dealing with informal settlement upgrading. The first report (Abbott et al 2001) was a desk study of informal settlements from an upgrading perspective. This document is available from the WRC on request. Its original objective was to look at a specific methodology for informal settlement upgrading, developed in Belo Horizonte, Brazil, and termed Visual Settlement Planning (ViSP). This was a planning approach that utilised GIS to integrate physical planning and social processes to create an upgraded settlement. For a number of reasons, which are explained in that first report, the desk study was broadened in scope to examine settlement upgrading in a much wider context. Hence it looked at the international policy debate on informal settlements that has taken place over the past three decades, asking whether upgrading is an appropriate development practice (the answer was yes) and hence what is the most appropriate form of upgrading. It then went on to explore informal settlement processes, in an attempt to understand the internal dynamics of informal settlements and how this might influence, and be affected by, the upgrading process. The report identified a number of characteristics which, when taken together, divide the different approaches to internal settlements into specific, distinct categories. This will be returned to later. All of this proved to be extremely valuable and influenced thinking about settlement upgrading in a South African context. Overall, the report felt that the ViSP approach (which is analysed in depth in the first report) is still the most relevant approach to informal settlement upgrading for South Africa. However, the analysis of the alternative approaches was useful in identifying some of the weaknesses of the ViSP approach, and this led to substantial modifications to that approach. It is that modified approach that is described in this report.

1.2 Differing approaches to informal settlement upgrading

Chapter 7 of the first report (Abbott et al, 2001: 74-92) identified a number of different approaches to informal settlement upgrading that have been used in different projects internationally. These can be described as follows:

- *Water quality/public health improvement as a basis for upgrading*
- Infrastructure provision as the basis for upgrading
- Community choice as a basis for upgrading
- Housing as a basis for upgrading
- Formal tenure as a basis for upgrading
- The integrated approach to upgrading

These approaches, in turn, can be divided into two broad types or categories. The first type is ad-hoc, sector-based upgrading, and covers the first four approaches. Here there is no long-term vision or plan, as expressed in terms of spatial relationships. The primary objective is to address a specific need, whether defined internally by the community or externally by government or a third party (e.g. development professionals). Although what is most interesting about the majority of these approaches is the extent to which they reflect external perceptions of the "problem", i.e. as viewed from the perspective of politicians and professionals.

The second type of approach is one where an attempt is made to define a long-term vision, towards which an upgrading programme will work. Approaches five and six are of this type. This second type then has two subsets. The first, represented by approach five, may be seen as more of a masterplan, whereby the final spatial relationship is determined and this then becomes the primary focus of the upgrading. With current spatial technologies this does not necessitate the wholesale removal of families (the so-called rollover upgrade). It is based instead on the creation of a formal cadastral plan, constructed wherever possible around the existing dwellings. The second subset is represented by approach six. This takes a different view, although it retains the long-term vision. This approach has a much stronger social and economic focus. Thus it seeks to promote social sustainability rather than spatial integrity.

A common feature of both of these approaches is that formal tenure (i.e. the cadastral definition of each individual site) only comes as the final step in the process, not as the first step. Their view of physical infrastructure and housing is also different to other approaches. Although they recognise the importance of these elements to development, neither allows them to dominate the process. Instead, both seek to integrate these with the social and economic needs. The difference then is in the weighting given to the physical and social aspects of upgrading and the relationship between them.

The two most important international pilot projects that demonstrate this type of approach are Belo Horizonte, in Brazil and the so-called million houses project in Sri Lanka. In effect, these two examples represent the two poles of thinking within the integrated approach. The difference between them lies in the emphasis that they place on the different components and in particular to the relationship between the physical aspects on the one hand and the social aspects of the development on the other. Thus Belo Horizonte seeks to achieve physical cohesion and spatial integrity, whilst seeking to accommodate social and economic needs. The Sri Lankan experience, on the other hand, places a much greater emphasis on community decision-making and individual growth and development. This is a simplification of a complex issue. Both approaches seek to accommodate a wider range of physical, social and economic needs. Nonetheless there is a significant divide between them in terms of their underlying philosophy. This difference can be explained, to a large degree, by the different geo-political environments that the two projects find themselves situated in. But the net result is the generalised distinction made earlier.

This report will be developing a methodology and guidelines for a replicable approach that is appropriate to South African cities. In doing this it will argue that the integrated approach is the only sustainable approach in the long-term. Thus it has to take cognisance of both the Brazilian and Sri Lankan experiences. Before it can take the methodology further, however, it is necessary to elaborate a little on the nature of informal settlement typology, since there are a number of different patterns in South Africa, and the same methodology may not be suited to all of them.

1.3 Types of informal settlements and their impact on the choice of upgrading methodology

It is important to state at this point that the report is not necessarily arguing that there is one 'correct' approach to upgrading that is applicable to all informal settlements, and this is particularly so in the South African situation. Both local context and circumstance can, and should, influence the choice of approach. Having said that however, it does not follow that all approaches are supportive of sustainable development. To understand this distinction, it is useful to look briefly at the nature of informal settlements in South Africa where, unlike the majority of developing countries, a number of different settlement patterns exist. In an analysis of different approaches to urban infrastructure provision carried out in 1996, Abbott identified three broad categories of settlement (Abbott 1996, 595). The first comprises dense informal settlements on tribal land on the outskirts of major towns and cities. This pattern is to be found primarily in KwaZulu-Natal. The second pattern of informal settlement growth occurs in large tracts of peri-urban land close to cities, which were situated under the apartheid government within homeland boundaries. The Winterveld area north of Pretoria is a good example of

this pattern. Finally there are dense informal settlements that take up small tracts of land within existing urban boundaries (so-called in-fill settlements). This pattern of growth is to be found in most major cities in South Africa.

With the first two patterns of growth, it may be that a specific sectoral approach can be beneficial to the community, and is therefore appropriate. A good example of this is the provision of water and sanitation to large areas of Inanda in Durban, which is an example of pattern one. There, land tenure is tribal, and any changes in spatial form are going to take place slowly over a long period of time. However, there are specific reasons why this is so. The nature of the society, the structure of land ownership and the level of integration into the urban economy mean that any significant change to the urban fabric is going to be slow. This provides the space for specific sector-based initiatives that improve particular aspects of peoples' lives.

A similar situation exists in peri-urban settlements, but for different reasons. Here density is the issue. These settlements tend to be low-density settlements, varying from 15 to 40 dwellings per hectare. Under these circumstances, it is possible to introduce sector-based improvements without compromising the opportunities for structural change to the layout of the area in the future. Clearly it is not ideal, but it is possible.

The net result is that specific sector-based improvements will probably have a net positive benefit for both of these two settlement patterns. Hence a range of upgrading approaches is available for these areas. Dense in-fill settlements, on the other hand, provide a very different condition. These settlements have been formed within areas that have already been developed and formalised. Planning professionals tend to see these infill settlements, therefore, as obstructions, disturbing and interfering with orderly development. In seeking solutions different professionals have different priorities. For engineers, the central issue is that of infrastructure provision. For urban planners, it is the restoration of spatial order. And for surveyors it is the re-establishment of a formal cadastre. All of these views drive sector-based approaches. Yet all of them reflect only one element of what is a complex problem. The sector-based interventions that engineers, surveyors and housing specialists wish to impose may provide a short-term improvement to the quality of life in a specific area. But the settlement will remain an informal settlement, and the opportunity for restructuring the spatial form will most probably be lost, or at best severely compromised. If some services, and in particular water and sanitation, are needed, then it is better that these are provided as emergency services. This means that they do not dictate the future restructuring of the development, but can be taken up if necessary and re-laid later.

If sector-based upgrading is inappropriate, then what is the alternative? In traditional planning, the alternative is the masterplan. By this is meant a physical plan that shows the final layout after restructuring down to the last detail. That is not the solution advocated here. The comment was made earlier that dense informal settlements are situated within formal areas. That is why people moved there, to be part of the city. Hence the two core issues, and this comes out clearly from the Recife Declaration (1996), are integration into the urban economy and social inclusion. The spatial structuring of the area is an important element in ensuring the achievement of these two objectives, but it is not an end in itself. Hence this approach is clearly not talking of a spatial masterplan. On the contrary, it argues that the imposition of a structured layout at the beginning seriously weakens the capacity to develop a socially sustainable settlement in the longer term. Instead, what this approach is describing is a process of urban integration that is flexible and that can take place over a period of time.

The recognition of different informal settlement categories is an important one. While all three categories exist now, the peri-urban condition, which was a specific legacy of apartheid, is in decline. Fringe development will continue in KwaZulu-Natal for some time. These are the two areas where sector-based improvement can still play a valuable role. But this will not generate a replicable methodology. This is because the major thrust of informal settlement growth in South Africa in the future will be dense urban infill. Hence any methodology has to address this last category. And this is the category that is dealt with in this report and in the methodology and guidelines described here.

As mentioned earlier, there are at least two integrated approaches that have sought to do this. However, while they both provide some important lessons, neither of them provides a fully replicable solution. In looking at the differences in the approaches encompassed by the Belo Horizonte and Sri Lanka projects, this study has evolved an approach that lies between the two. Both of these projects represent important milestones in the evolution of a sustainable upgrading methodology. At the same time though, because

they were situated with specific geo-political contexts, they both have weaknesses that limit their wider applicability.

In the Belo Horizonte case, which relied on a total redevelopment of the settlement, two major problems were identified. The first related to cost. This approach has elements of a structure plan to it. Although it follows a social process, it does seek to provide a final solution. This is the Plano Global. The problem here is that, once all the elements have been identified, it is necessary to work on all of them simultaneously, as they tend to be inter-connected. This has a major cost implication, which the Alvarado programme in Belo Horizonte recognised. This project showed that the cost of a full upgrading carried out in accordance with the Plano Global is not feasible once the methodology moves from a case study dealing with a limited number of projects to full-scale implementation. The second flaw, which follows from this, relates to the way in which incrementalism is incorporated into the process. The Plano Global defined its own sequence of upgrading. However, if this sequence is no longer appropriate, and has to be changed, for whatever reason, the system does not have enough flexibility to introduce a different, more appropriate sequence.

The Sri Lankan approach raised a different set of issues. The circumstances in Sri Lanka are significantly different to those in South Africa's urban centres. As a result, the degree to which the spatial relationships between shacks needed to change was much lower in Sri Lanka than would be the case in South Africa. In addition, affordability levels are also much lower. This reduces the level of services significantly, with much greater use being made of collective services (in particular water and sanitation). The use of paths instead of roads is much more dominant, and this has a significant impact of relocation needs. Densities are higher and the pattern of living provides for a much greater sharing of space. As a result it is so much easier to build a settlement around social and economic needs and make the physical support systems fit with a minimum of disruption. This is not the case in South Africa. Relocation, albeit internal within the settlement, is a much greater issue. It can be seen from this brief description, that the social and economic conditions in Sri Lanka are much more akin to those in the fringe areas of KwaZulu-Natal. Hence this may provide a more directly applicable model there. Nonetheless the Sri Lanka programme does have important lessons for dense settlement upgrading, which lie mainly in the area of participatory processes and decision-making.

The net result of the extensive analytical work carried out by this project, and described fully in the first report, is the evolution of a methodology that sits between the two international experiences of Belo Horizonte and Sri Lanka. This has attempted to draw on the strengths of both, while recognising the specific context that exists in South Africa. Greater attention is given to the provision of access and greater levels of physical services than is the case in Sri Lanka. But this comes at a cost, which is not only economic but also social, resulting primarily from its impact on relocation needs. This is exacerbated by the extent to which many of South Africa's informal settlements are situated on physically marginal land. This is where the experience of Belo Horizonte is particularly useful. At the same time, the dominance of social and economic development, which was at the heart of the Sri Lanka programme, is fully recognised and endorsed, and the methodology is built around that.

1.4 Urban poverty and the different rationalities of development

'The physical manifestations of urban poverty are evident in all cities in developing countries: vast neighbourhoods of squatters - barriadas, bidonvilles and bustees - living outside the legal framework of the city, lacking water, sanitation, urban transport and adequate shelter, and unserved by social services such as health and education. Poor quality of life is worsened further amidst a deteriorating local environment' (Cohen & Leitman, 1994:122). From this statement of Cohen and Leitman, it is evident that there is a strong relationship between urban poverty and informal settlements.

At the same time, there is also a strong link between perceptions of urban poverty and intervention in informal settlements. Perceptions of poverty inform the way in which poverty is measured, which in turn informs alleviation policy and the design of intervention strategies. Wratten explains this interconnection as follows: 'Perceptions about the nature of poverty, and the policy responses which follow from these perceptions, are central in deciding how best to study, measure and analyse the phenomenon' (Wratten, 1995:35). Shifts in the perception of poverty have been paralleled with shifts poverty measurement, policy and intervention.

The point that is being made here is that it is not only poverty itself, but also the perception of poverty, that is important. This in turn leads to a third issue, which relates to the way in which poverty is dealt

with. In the context of informal settlements, this is generally perceived, externally, as a development issue. Certainly development plays a role, but it is not the only issue. Furthermore, development itself is perceived differently. It is useful at this stage, in order to understand and elaborate on the significance of what is being said, to revisit Goulet's analysis of this subject, where he identifies three rationalities in development (Goulet, 1986).

Goulet argues that development decisions are made by three different categories of actors: technical specialists; politicians (or their bureaucratic agents) and persons pressing some special or general concern (ibid, 301). In the context of upgrading, the first relates to professionals, the second to politicians, and the third to NGOs and community organisations. Goulet argues that the first two categories of decision makers apply distinct rationality systems, the technological and the political. Those who plead for moral values pursue ethical rationality (the third category) (ibid, 301-2). After defining the three rationalities in greater detail, he then goes on to say that "All interlocutors in decisional arenas may no doubt be motivated by ethical values in playing out their roles. But the dominant form and content of their contributions to rationality mirror their special roles and express the formal warrant they possess for engaging in decision making" (ibid, 302-4).

The important point that Goulet makes in regard to these different perceptions of development is this. That "when they converge in common decision making arenas, the three rationalities impinge upon one another, not in the mode of horizontal mutuality, but at cross purposes and in a vertical pattern. Each brand of thinking tends to approach the others in triumphal, reductionist fashion, and leads either to unfruitful conflict or abdication, both of which generate poor decision making" (ibid, 304-5).

This is an extremely important issue, which goes to the heart of the discourse, and the ensuing approach, to informal settlement upgrading. Different groups see informal settlements from within totally different rationalities. The question then becomes 'whose rationality is going to determine the solution'? The basis of the framework constructed in this report is that it has to be the community's rationality that dominates the process. Professionals and politicians have, therefore, to adapt their own rationality to think in this way. Only then can they apply creative and appropriate methodologies.

The starting point for this change lies in the thinking about urban poverty. Thus the solution to urban poverty does not lie in the provision of new housing per se. The next section looks at this issue in greater detail, and in doing so lays the framework for the methodology and guidelines that are described in the chapters that follow.

1.5 Understanding urban poverty and its role in informal settlement upgrading

At the core of the debate on poverty is the dominance of economic definitions of poverty. Chambers ascribes this partly to the dominance, in number, of economists over social anthropologists and sociologists in the World Bank (Chambers, 1995). This economic bias has resulted in a focus on labour market participation, the informal economy and household income measures. In turn, this focus on households as an economic unit obscured individual actors and their command over household resources. A particular shortcoming was the invisibility of women, children and unemployed dependants and their particular burden in poverty, in relation to 'non-monetised components of household survival strategies' (Beall, 1993:13).

In respect of informal settlements, this economic dominance creates a mutually supportive linkage with spatial determinism in influencing housing policy towards new housing provision. Yet this is not the only view. Thus Wratten refers to another body of alternative interpretations to the economic definitions. These were 'developed largely by rural anthropologists and social scientists working with poor rural communities in the Third World.' They allow for 'local variation in the meaning of poverty, and expand the definition to encompass perceptions of non-material deprivation and social differentiation' (Wratten, 1995:12). Theirs was partly a reaction to the 'passive notion of the poor, implicit in Oscar Lewis' "Culture of Poverty" theory' (Drakakis-Smith, 1999:692) of the 1960s. This hypothesis claimed that the poor adapted and reacted to their marginal position by developing a sub-culture of values and characteristics, which was believed to be perpetuated from one generation to the next, and which prevented their integration into the mainstream society. A counter-hypothesis in the 1970s was Janice Perlman's "Myth of Marginality," which emphasised the organisational sophistication and optimism in poor urban societies (Wratten, 1995:30). Similarly, Beall refers to the impact that the Women-In-Development lobby has had on poverty analysis. There, the disaggregation of poverty data has primarily focused on women, with the

result that more women-headed households have become targets in poverty alleviation programmes (Beall, 1993).

It was Caroline Moser (1995a) who finally compared economic and social policy in poverty reduction. She argued that it was a combination of the two which, together, have been adopted in a dualistic methodology for the World Bank Assistance Strategies to Reduce Poverty of 1991. In this discussion a number of poverty concepts pertinent to this debate have been clarified. Thus, from Moser's article and other literature explored here, it appears that poverty concepts are best reviewed in some form of dichotomy, which captures the opposing as well as complementing angles from which poverty can be interpreted. Moser notes an interesting point regarding the dichotomy between social and economic policy. She refers to a general consensus in literature that this duality cannot be considered a true dichotomy, as the objectives are socio-economic (and therefore neither purely social nor purely economic). She agrees with this at the level of abstract discourse about broad development objectives. However, she makes a distinction at the 'level of concrete planning practice'. Here she argues that ' "hard" economic determinism' has dominated over ' "soft" social policy,' and states that the two have yet to be brought 'together into a comprehensive framework for urban social policy that is appropriate for operational practice' (Moser, 1995a:171).

The starting point, which provides the basis for thinking about the nature of informal settlement upgrading, is to review the many dichotomies, which concepts of poverty bring to the fore. These move from a policy level down to the level of the individual household and even the individual, and they have been listed in that order. However, the section on perceptions of professionals and communities is particularly relevant, while the sections following that give concrete illustrations that demonstrate the crucial importance of perceiving upgrading from the perspective of the community.

1.5.1 Social Policy vs. Economic Policy

Economic policy places emphasis on the economic and infrastructure factors, promoting economic development objectives. It is 'concerned with the efficient allocation of economic resources for increasing productivity... The basic measure of welfare is income and consumption, supplemented by measures of access to basic needs such as health, education and shelter' (Moser, 1995a:164). Social policy in turn focuses on the social structure of society and the political context of decision-making, promoting social development objectives, namely 'the development of an equitable society in terms not only of income but also gender, ethnicity and race. To achieve this objective social policy prioritises poverty reduction, increased employment and societal cohesion' (Moser, 1995a:163).

1.5.2 Sectoral vs. Holistic Approach to Social Policy

The sectoral approach isolates sectors that are defined as being social. 'With its objective the promotion of human welfare, or human resource development, this has traditionally meant the welfarist provision of individual, family and community welfare services ranging from health to education to social security' (Moser, 1995a:162). The holistic approach emerged in reaction to the isolation of economic and social policy, and seeks to address the broader and neglected aspects in which the sectoral concerns are rooted, such as equity, participation and national integration. Moser's article on the role of social policy in poverty reduction (1995a) focuses on the holistic approach.

1.5.3 Absolute vs. Relative Definitions of Poverty

Poverty defined in absolute terms implies the existence of a fixed level, at which household and basic service expenditure and subsistence are met. Inherent too is an absolute definition of needs, ignoring that these vary socially and over time. 'The concept of relative poverty is more flexible, and allows for minimum needs to be revised as standards of living in society alter' (Wratten, 1995:14). Relative deprivation is defined by those factors which prevent participation in society (Wratten, 1995). Moser (1995a) argues that social policy is concerned with relative poverty, over and above absolute standards of living. On the other hand Beall argues that relative poverty 'still stands accused of subjectivity and political malleability. However, it does allow poverty to be treated not as a state but as a **process**' (Beall, 1993:12, emphasis in the original)

1.5.4 Supplementary vs. Composite Poverty Indicators

It is generally accepted that income and consumption-based measures of poverty are not adequate. Standardised supplementary social indicators, such as 'life expectancy, infant mortality, nutrition, the proportion of household budget spent on food, literacy, school enrolment rates, access to health clinics or

drinking water' have, however, given conflicting perspectives on the pattern of deprivation (Wratten, 1995:15). Wratten argues that therefore income and consumption measures have remained 'the key way poverty is defined' (Wratten, 1995:15). Composite poverty indices have been developed to overcome this deficiency. These combine several weighted variables, examples being the Human Development Index (UNDP), the Physical Quality of Life Index, the Food Security Index and the Relative Welfare Index. Wratten argues that even these 'inevitably miss out important aspects of well-being, since a limited number of variables can be brought into the calculation' (Wratten, 1995:15). She further criticises that they represent the view of external professionals rather than the poor.

1.5.5 Poverty as Defined by Professionals, vs. Poverty as Experienced by the Poor

While the poverty indices mentioned above have dominated the economic policy and reflect perceptions of professionals, Moser argues that social policy 'recognises the importance of the poor's own perception of poverty and their context specific identification of priorities' (Moser, 1995a:166). This is the theme of Chambers' article Poverty and livelihoods: Whose Reality Counts? (1995). He contrasts the two opposing perceptions in Table 1.1:

Table 1.1: Contrasting tendencies in professionals' and poor people's realities
(Chambers, 1995:185)

PROFESSIONALS	POOR PEOPLE
Universal	local, specific
Simplified	complex
Reductionist	holistic
Standardised	diverse
Physical	experiential
Quantified	unqualified
Income-poverty	multi-dimensional deprivation
Employment	livelihood

Chambers argues that 'self-critical analysis, sensitive rapport, and participatory methods can contribute some valid insight into the values, priorities and preferences of the poor people' (Chambers, 1995:185). Insights gained through such methods 'illustrate the multi-dimensionality of deprivation and disadvantage as poor people experience them' (Chambers, 1995:188). Chambers adds that 'if anything, there is more diversity among the poor than the non-poor' (1995:188). In an attempt to capture 'some of the poor people's reality', he lists dimensions of deprivation as follows:

- **Poverty** (lack of physical necessities, assets and income);
- **Social inferiority** (disadvantage resulting out of gender, caste, race, ethnic group, class, social group, occupation, age, genetic characteristics);
- **Isolation** (being peripheral to society due to location, illiteracy, lack of communication and information, lack of access to social services, markets or social and economic supports);
- **Physical weakness** (seeing a healthy body as a resource and a sick or disabled household member as an added strain - with particular implications for AIDS);
- **Vulnerability** (exposure and defencelessness - externally this refers to shocks, stress and risk; internally it implies a lack of means to cope without damaging loss, such as increasing physical weakness, economic impoverishment, social dependency, humiliation or psychological harm; for poor households there are often trade-offs between income and security/risk);
- **Seasonality** (seasonal dimensions of deprivation are brought about by factors such as agricultural cycles, food shortages, money scarcities, indebtedness, sickness, pregnancy and diminishing access to services);
- **Powerlessness** (physical weakness and economic vulnerability reduce the poor's ability to organise and bargain, therefore they are easily ignored or exploited);
- **Humiliation** (self-respect with freedom from dependence is the dimension most overlooked and undervalued by professionals).

(Chambers, 1995:189-190)

1.5.6 Vulnerability vs. Entitlement

Wratten explains how the concept of entitlement supplements Chambers' concept of vulnerability in the above list of poverty dimensions. It 'refers to the complex ways in which individuals or households

command resources' (Wratten, 1995:17). It explains 'how poverty affects different people - even within the same household - in different ways. This disaggregation is central to the analysis of household survival strategies during periods of stress, and their implications for the work burdens of women, men and children and intra-household resource allocation' (Wratten, 1995:18).

1.5.7 Employment vs. Livelihood

Chambers motivates for a distinction between employment and livelihood as follows: 'Livelihood refers to the means of gaining a living, including livelihood capabilities, tangible assets and intangible assets. Employment can provide a livelihood but most livelihoods of the poor are based on multiple activities and sources of food, income and security' (Chambers, 1995:174). He further argues that employment should 'rather be seen as a subset or component of livelihood' (Chambers, 1995:183).

1.5.8 Shocks vs. Trends

The understanding of impacts on poverty, such as shocks and trends, is paralleled with an understanding of strategies to adjust to the changed circumstances. Amis defines shocks as 'short-term incidents that push a previously self-sufficient household over the edge' (Amis, 1995:149). Shock or stress events with the greatest impact on households were found to be the illness of an income earner. Other events are expensive celebrations. Two major responses to such events are the increase in female employment and indebtedness (Amis 1995). Trends are long-term changes caused by policies such as structural adjustment, which affect crucial factors, for instance the labour market. Amis highlights a further trend, namely the increasing commercialisation of urban assets, with the result that 'the urban poor must now pay for services and basic needs which they used to obtain for free' (Amis, 1995:149). Amis links the following policy implications to the concepts of shocks and trends: 'Protective security aims to protect against the one-off shock associated with temporary poverty. The aim of promotive security is to increase incomes and capabilities in the case of poverty which is permanent or structural' (Amis, 1995:155). He adds that 'shocks are the most important element of urban poverty and protecting the urban poor from such shocks is a critical policy area' (Amis, 1995:156).

1.5.9 Vulnerability vs. Assets

Most authors agree that the level of understanding of poverty directly informs the level of alleviation policy and intervention strategies. It can be argued that while policy makers identify simplistic strategies for policy alleviation, based on generalised understandings of the problem (Chambers, 1995), the poor respond to the multiple dimensions of their deprivation with diverse and complex strategies. It is in this context that Chambers refers to the saying: 'The fox has many ideas but the hedgehog has one big idea' (Chambers, 1995:192). In this sense, Moser's work complements Chambers' definition of vulnerability (in the list of poverty dimensions above), by focusing not on the negative concepts of exposure and threat, but on the positive concept of resilience 'in exploiting opportunities and in resisting or recovering from the negative effects of the changing environment. The means of resistance are assets that individuals, households or communities mobilise in the face of hardship. Thus vulnerability is closely linked to asset ownership. The more assets people have, the less vulnerable they are. And the greater the erosion of their assets, the greater their insecurity' (Moser, 1995b:2).

Moser gives the following classification of assets: Labour, being 'the poor's greatest asset' (1995b:5); Human Capital referring to the connection between, on the one hand, social and economic infrastructure (the former being health and education, the latter being municipal services such as water, transport, electricity) and, on the other hand, a household's immediate and long term income-earning capacity; Productive Assets, a concept that Moser does not explain explicitly, other than mentioning that an important productive asset is housing, as it has direct implications for a household's capacity to earn an income; Household Relations being 'a household's composition and structure and the cohesion of family members' (1995b:10); and Social Capital being 'the trust, reciprocal arrangements, and social networks linking people in the community' (1995b:vi). These five assets are categorised according to the three levels through which people experience vulnerability, namely the individual, the household and the community. Labour and Human Capital are associated to the individual level, Productive Assets (specifically housing) and Household Relations to the household level, and Social Capital to the community level. Moser's made the following findings in her study on household responses to poverty and vulnerability:

Labour: 'With labour the poor's greatest asset, a frequent response by poor households to declining real income is to mobilise additional labour - principally women's labour, but in the poorest households even children's labour' (1995b:5).

Human capital: 'Where the improvements in social and economic infrastructure of the 1970s have not been maintained through the 1980s and into the 1990s, there have been implications for the ability of poor households - less able to substitute private for public services - to earn incomes' (1995b:7).

Productive assets: 'Housing is an important productive asset that can cushion households against severe poverty, and land market regulation can either create opportunities to diversify its use or foreclose them' (1995b:9).

Household relations: 'Changes in household structure to strengthen family support networks are both a result of vulnerability and a strategy to reduce vulnerability... . Strategies to reduce vulnerability sometimes impose unequal burdens on household members. Women, because of their multiple responsibilities, have frequently assumed a disproportionate share of the burden of adjusting to adverse economic circumstances, thus limiting their ability to respond to new opportunities' (1995b:10,12).

Social capital: 'The pressures of economic crisis can exert opposing forces on social capital - both strengthening it, as reciprocity networks are increasingly called into play, and eroding it, as households' ability to cope deteriorates and community trust breaks down' (1995b:14).

On the theme of social capital, Moser emphasised the value of trust and reciprocity networks in the community. She mentions short-term reciprocity, which focuses on money and usually responds to household crises, and long-term reciprocity, which might focus on childcare, food, water or questions of space. The reciprocities are 'a precondition for the trust and cooperation that underlie community-based organisations (CBOs) (Moser, 1995b:14). Moser observes that where communities have not gone through a process of conflictual negotiation with governments, CBOs are less developed. From experiencing democratisation in Latin America, Max-Neef goes further to point out that 'during repressive regimes... the poor are capable of organising themselves in systems of solidarity of all kinds. ... The paradoxical thing that has occurred in the four Latin American countries I mentioned [Brazil, Argentina, Uruguay, Chile] is that what dictatorship was incapable of destroying, a bureaucratic democracy dismantles with great ease' (Max-Neef, 1996:65).

1.5.10 Tangible vs. Intangible Assets

Chambers' (1995) and Amis' (1995) interpretation of assets differs from Moser's. They differentiate between tangible assets as being stores and resources, and intangible assets as being claims and access. The two are understood as determining livelihood capabilities, that is their ability to cope with shock. Amis argues that for the urban poor these assets 'are likely to be more monetised' (Amis, 1995:154). His consequent finding was that 'in the Indian context, indebtedness represents a critical survival strategy for the urban poor'. However, he calls for more research particularly in Sub-Saharan Africa, where donors are replicating 'South Asian models of credit delivery to the assetless' (Amis, 1995:154), which again illustrates the close connection between perceptions of poverty and alleviation and highlights the danger of global generalisation.

1.5.11 Individual Commodified vs. Communal Assets

The differentiation between monetised and non-monetised assets is a strong theme in Amis's work comparing urban and rural poverty. Amis argues that a major difference between rural and urban poor is that urban communities lack 'communal assets to fall back upon which makes assets and debt the critical strategies to withstand shocks for urban groups' (Amis, 1995:153). Wratten supports Amis' point in referring to the widespread commoditisation of housing in cities and predicts that this 'may lead to a greater widening of intra-urban income differentials' (Wratten, 1995:25). Drakakis-Smith contrast the urban with the rural situation in that the urban poor 'must pay for virtually all their needs and consequently must have a cash income'. In addition, 'almost all basic needs cost more in the city and, ironically, are often more expensive per unit for the poor than for the non-poor' (Drakakis-Smith, 1996:693). With respect to tenure, Douglass observes that research and literature on common property regimes have focused virtually purely on rural areas or small-scale societies. However, common property resource management concepts are evident in 'grassroots organisations among poor households at the community scale in Asian cities' (Douglass, 1992:20). With this as an example, it can be argued that there is a connection between, on the one hand, the rural bias in research into communal and non-commodified assets and, on the other hand, the belief that such assets exist to a lesser degree in urban areas. However, Amis' argument is founded in urban research, his findings on 'Squatters or Tenants: The Commercialisation of Unauthorised Housing in Nairobi' being published under that title as early as 1984 (Amis, 1984).

1.6 Poverty alleviation as the basis for development

Chambers summarises that there has been a shift in development objectives from 'reducing income poverty to diminishing deprivation and enhancing well-being; and from increasing employment to sustaining livelihood' (Chambers, 1995:199). He goes on to highlight the components of an agenda aimed at fulfilling these objectives, which comprise the following:

- Peace and equitable law and order
- Rights and information ['the poorer the people are, the more they need, and can gain from, secure rights and information about those rights,' - this also includes effective justice (1995:200)]
- Infrastructure and access to basic services
- Access to affordable basic goods
- Safety nets (to prevent the poor from having to dispose of livelihood assets in order to survive).

Chambers supplements this with a new agenda that requires a paradigm reversal, in order to be 'people centred, participatory, empowering and sustainable' (Chambers, 1995:200). Here, he emphasises, that 'many measures which make a big difference to poor people have low financial costs. Rights, security, the rule of law, information, access, changes in procedures, removals of restrictions, polite behaviour by officials, timing actions for the right season, timely delivery, providing diverse "baskets of choices"' (Chambers, 1995:201). This new agenda consists of the following four aspects:

Analysis and action by local people, and putting first the priorities of the poor [Here Chambers refers to 'the basic human right of poor people to conduct their own analysis.' He adds that 'putting first the priorities of the poor can refer to whole communities which are poor but equally to those who are disadvantaged - the poor, weak and marginalised, whether women or a social or economic group - within communities. To find, convene and facilitate groups of the disadvantaged demands commitment to the analysis of difference' (1995:201)];

Sustainable livelihoods [Practical implications are secure rights, removal of restrictions, access to effective health services];

Decentralisation, democracy and diversity ['ownership shifts downwards' and 'every activity should be carried out as low down as feasible' (1995:202). This requires decentralisation, participation and diversity in procedures, appraisal, action, monitoring and evaluation, the result being that the 'poor people then monitor and evaluate the programmes and actions of development professionals and organisations' (1995:203)];

Professional and personal change [implications being more participatory management in development organisations, interactive learning {entailing 'a shift from top-down teaching to learning which is shared, lateral and experiential' (1995:204)} and experiential learning from poor people].

There is a general agreement in the reviewed literature with the new agenda set out (above) by Chambers. Some authors pick up specific aspects, which are reviewed here as they have implications for an appropriate upgrading methodology for informal settlements.

Max-Neef, a Chilean development economist, strongly supports the downward shift of project or programme ownership, stating that the first principle to be accepted for any programme that seeks to overcome poverty is "to believe in the poor" (Max-Neef, 1996:63). His challenging observation is that the poor are considered creditworthy for consumption but not for production. He calls for greater trust in the poor. He equally agrees with Chambers' principle of experiential learning: 'you will never solve the problem of poverty through the government. You must go to the grassroots to do so. The government never reaches the grassroots in any real sense. To reach the grassroots you have to be there. You have to be living with the people, eating with them, sleeping with them. Overcoming poverty is not a matter for experts. It is a matter for people who are committed to it and are willing to co-exist and co-live the experiences of poverty' (Max-Neef, 1996:66). For this reason he calls for partnerships between government and NGOs that are close to the beneficiary communities. It is in the NGOs where he believes the participatory professionals, which Chambers calls for, can be found.

Douglass argues that empowerment 'requires a mode of planning which moves away from the paternalism of societal guidance designed and carried out by the state and corporate economy toward one which emanates from processes of social mobilisation' (Douglass, 1992:25). This requires that hierarchical and non-democratic structures of government be opened up. 'The key word is legitimisation, without which households cannot sustain their collective voice in public affairs and the state can have no "partners" in development' (Douglass, 1992:25).

Beall notes that there has been increasing involvement of NGOs and CBOs in the management of infrastructure and services. Through such partnerships women's participation has been harnessed, in order to prevent the under-utilisation of a valuable resource. However, Beall argues that partnerships involving women have to extend beyond implementation to the formulation, design and allocation phases. 'Because women are often less visible or less vocal in articulating their needs, policies, programmes and projects need to devise imaginative strategies to hear the voices of women' (Beall, 1993:23). Beall also emphasises the need for analysis to be not only disaggregated according to gender, but also to capture gender roles and relations.

On the principle of empowerment and sustainability, Moser states that 'the more the poor are recognised as subjects of empowerment, and not merely as a working force to lower costs, the greater are the chances of achieving sustainable projects in the long term' (Moser, 1995a:170). She continues with the following implications for a project methodology:

> 'Inputs change during implementation through a process of negotiation, such that outputs may be very different. This requires the identification and implementation of operational interventions that are based on a continuous and cyclical planning process. The details of such a process are complex, ... they need to ensure flexible and incremental action in response to felt needs. Whilst the identification of opportunistic entry points is based on negotiation and compromise, these must be grounded in longer-term strategic directions. This will require changes in operational procedures which may well make them more costly at the planning stage, as well as requiring new and different social and economic skill mixes in the staffing procedures of many agencies' (Moser, 1995a:170-171).

Moser further emphasises the need for a cross-sectoral planning methodology, as individual sectoral interventions have no guarantee of significantly impacting on urban poverty reduction. In a supply-driven approach 'planning agencies plan at the sectoral level' (Moser, 1995a:161) and, therefore, households are unable to make contextually and culturally specific cross-sectoral trade-offs. Moser argues that households and individuals do in fact plan cross-sectorally, therefore a demand-driven approach and inter-sectoral policy linkages are critical (Moser, 1995a).

1.7 Poverty alleviation planning and informal settlement upgrading

With implications for an informal settlement upgrading methodology, Chambers summarises: 'The problem is one of balance between two realities - ours, which is powerful, and theirs, which is weak. Standing back and standing down, we need to search for overlaps where their realities and aspirations

can give rise to practical concepts which we can then use to help empower them' (Chambers, 1995:191). The purpose of this report is to turn this idealistic statement into a practical reality.

This reality begins by recognising two important factors. Firstly, that successful settlement upgrading arises from a partnership between local government and local communities, enabled by an appropriate policy framework. Secondly, that professionals have a key role to play in this process. However, this chapter has tried to show the importance of professionals moving their position to see the situation form within the community and with the eyes of the community. Chapter 2 deals with this issue in two ways. Firstly, it describes the changes that need to be made to the way in which professionals view development, and particularly housing development, and sets out a new framework appropriate to informal settlement upgrading. Secondly, it translates this in a series of steps that provide the basis for this changing perception based upon an alternative workflow. Together, these two elements provide the foundation for a new paradigm, which clearly differentiates informal settlement upgrading from greenfield site development.

At the core of this paradigm is a new relationship between the spatial and technical aspects of upgrading on the one hand, and the socio-economic perspectives on the other. The specific elements are then expanded upon in the following six chapters that together provide a set of guidelines that also constitute an upgrading methodology. The methodology is then reviewed in a concluding chapter.

As the second of two reports, this report seeks to bring together the experiences discussed in, and the lessons learnt from, the first report, in the form of a methodology. At the same time it seeks to use the experience gained in practice in New Rest to create a series of guidelines. As a result, Chapter 2 becomes a key chapter, which shapes the remainder of the report. For that reason the remaining chapters have not been discussed here, as would be the normal procedure for a report of this kind. The section that deals with the structure of the report can instead be found at the end of Chapter 2.

2. DEVELOPING THE BROAD APPROACH TO UPGRADING

2.1 *Introduction*

The previous chapter argued that the basis of upgrading should be economic development and social integration. At the same time, however, it showed the immense social complexity of poverty. Integrating these factors, it is clear that informal settlements are complex, multi-functional and multi-faceted environments. And specific interventions cannot address all of these factors adequately. They may alleviate some of the symptoms, but they cannot provide a sustainable solution. Hence any attempt to upgrade them in a sustainable manner has to recognise and deal with all of these factors together. This does not mean a masterplan designed down to the last detail. The Belo Horizonte experience has shown that such an approach has too many variables and is affected by too many constraints. What it means, though, is that all facets of growth and development have to be taken into account. This has then to be balanced by an implementation programme that is flexible, and which caters for a range of different affordability/expenditure patterns. What this means is the use of individual project- or sector-based interventions, but taking place from within a multi-variable and multi-functional programme. Furthermore, such specific interventions should only take place once there is an integrated development plan for the settlement.

What does this mean in practice? At a conceptual level it means a new planning paradigm. This in turn has two major elements. The first is a shift from a deterministic approach to planning to a much more strategic approach. This requires a fundamental rethinking of what constitutes the basic building blocks of the settlement from a spatial perspective. The second element comprises a management framework that can integrate projects a wider programme, whilst at the same time accommodating social processes. This is made possible through the use of a spatially referenced information management system, which uses a GIS as its operating environment. However, the power of this technology should never be used to over-ride or diminish the social processes that make up the other core of the methodology.

2.2 A new spatial form

Section 1.4 discussed the need to explore informal settlements from within the "rationality" of the community. This does not mean abandoning good professional practice. What it does mean though is a willingness to re-think the way in which things are done, as well as being prepared to re-define what is to be done. The term "good professional practice" should not be synonymous with the term "traditional practice". A useful starting point in this process of changing the way that problems are approached is to look at the basic difference between a greenfield site housing development and an in-situ upgrading development. The key points of difference are given in Table 2.1 below.

Table 2.1: Key points of difference in the development of greenfield and informal sites (Abbott, 2000)

In-situ upgrading	Greenfield development
Identifiable community	Non-identifiable community
Community-driven	Developer-driven
Planning for social integration	Planning for physical development
Requires planning "zone of special interest"	Accommodated within generic zoning legislation
Requires flexible standards	Accommodated within existing by-laws
Based upon an integrated development plan	Based upon a land-use plan
Security of tenure is primary objective	Ownership-driven development
Construction for internal benefit	Construction for external benefit
Primary thrust economic/social development	Primary thrust residential development

Following from this are the contrasting realities of poverty listed by Chambers and shown in Figure 1.1 of Chapter 1. Finally, there are the key elements of a poverty-stricken environment that need to be accommodated. These are covered in section 1.5, but can be summarised as follows (Table 2.2):

Table 2.2: Key points of a poverty-stricken environment

Core elements of poverty to be recognised and addressed
Vulnerability
Livelihood
Ability to withstand shocks
Ability to withstand negative trends
The recognition of intangible assets
The social value of tangible assets
The social value of communal assets
The key role of informal sector activity
The importance of social space

The next phase is then to explore the spatial implications of accommodating these factors within a development framework. There are three sets of professionals involved in the development of a greenfield site: Land Surveyors, Physical/Spatial Planners and Civil Engineers. Each of these brings to the development process a specific focus that shapes their broader technical "rationality". The focus for the three groups of professionals respectively can be described as:

- The basic spatial unit used for measurement (Land Surveyors).
- The basic planning unit used for the spatial layout (Physical Planners).
- The role and purpose of physical infrastructure (Civil Engineers).
- In addition to these there is a common professional element that defines how all three of these groups perceive their role and their relationship with the community.

The starting point in the development of a new planning methodology is to change the basis and perception of each of these three focal areas. This is done for each one in turn below.

2.2.1 The basic spatial unit used for measurement

The basic spatial unit (also known as a BSU) is a graphical element that is used as the basis for constructing or building a map where is it necessary or important to delineate an area. Visvalingam (1991: 12) defines it in the following way: "Basic spatial units are the smallest spatial units for which information is collected and/or made available". In western society, where private ownership of land is a key element of the culture, the allocation of land is carried out via a deed of ownership, but the mechanism through which this is achieved is the cadastre, which constitutes a complete record of all site boundaries. All Land Surveyors (and indeed all development professionals) accept this fact automatically. The result is that, in the conventional development process for a new site, the basic spatial unit indirectly governs the entire planning process. This happens in the following way. Firstly, development has to take place within a recognised (i.e. legally defined) piece of land, which would itself be situated within a larger area zoned for a particular type of development. At this point the BSU is the site itself. The purpose of development (assuming this is a housing development) is to give a number of individuals their own piece of land defined within the cadastral framework. Thus, while the ultimate goal may be a house, this has to proceed via a legally definable piece of land. This is achieved by sub-division. In this process of sub-division, land is also allocated to other purposes, such as roads and public open space, all of which has to be legally defined. Once this is done, then the individual erf (also know as a plot or site) boundary forms the smallest legally accepted unit for the cadastre, and hence becomes the new BSU.

This simplistic description may appear to be self-evident. But that is exactly why it has been described. It is so self-evident to a development professional that it is automatically taken as the basis for development. In informal settlements, however, it is not the basis for development.

With informal settlements there are no formal boundaries. The piece of land that is important is that on which the structure (generally a self-constructed shack) is situated. The piece of land and the shack are one and the same. They do not exist independently. Thus if a shack burns down, for example, the person has nowhere to live, regardless of the fact that the piece of land is still there. And if the shack-dweller needs to move (perhaps because the shack is flooded) then he/she moves, and the new piece of land merges with the shack. This is fundamentally different conceptually to conventional development. The net result of this shift in thinking is that the basic spatial unit is no longer the erf boundary. Instead it is the individual shack. This is the situation at the micro level, i.e. within the settlement. At a macro (i.e. settlement) level, the basic spatial unit has no relationship to the formal cadastre. Instead it is defined by the boundary of the area occupied by the dwellings.

The importance of this distinction should not be underestimated. For it requires a shift in thinking about space and the use of space. People live in shacks. These shacks have to be grouped according to the needs of the families that occupy them, not according to externally determined, professionally defined criteria. Hence the whole development process takes place in space that is undefined in conventional terms. This is extremely difficult for professional surveyors to accept. All sorts of legal arguments are given out to oppose it, simply because it is totally outside of conventional thinking. Yet it is perfectly workable, as the New Rest and Belo Horizonte projects have shown. Of course the situation will have to be formalised at some stage. However, the difference is that, whereas with greenfield site development, formalisation of the cadastre is the first step, with informal settlement upgrading it is the very last step in the development process.

2.2.2 The basic planning unit

The basic planning unit is the lowest building block in the planning process. Because of the dominance of the cadastre, as described above, the basic planning unit for a greenfield housing development is the same as the basic spatial unit, namely the erf. The cadastre again determines the outer boundary of the site and the space within that boundary is then grouped into one of four main categories (for residential development), sites or erven, roads and road reserves, communal facilities and public open space. The division between them, influenced by the topography, determines the site layout.

In settlement upgrading, the situation is completely different. The impact of the changed basic spatial unit carries across to the planning process in a number of different ways. For the reasons described above basic planning unit is not a spatial one. At a macro level it is the community, and at a micro level it is the family (or families) occupying the individual shacks. The planning is constructed around the social and economic needs of the wider community and then of the individual families, and the spatial relationships are created to support and enhance these relationships.

2.2.3 The infrastructure servicing focus

The next area where a paradigm shift is required in professional thinking relates to the provision of physical services. In a conventional (greenfield) housing development, there are a number of characteristics that define the method used to define services. Thus:

1. The design is carried out in accordance with specific codes or guidelines. This, by definition, creates a uniformity of approach.
2. All physical services tend to be designed together, by the same person, and retain that linkage through the project cycle into construction and even maintenance.
3. There is a strong linkage between the roads and the stormwater, both in terms of stormwater generation and integrated design.
4. Services move out from the individual erf, which is seen as the point of delivery and collection.

With the in-situ upgrading of informal settlements, this approach changes completely. The primary objectives of the upgrading are economic development and social integration. The impact of this moves through to the Basic Planning Unit. And this in turn defines the approach to physical infrastructure. This results in the following changes.

1. The services are disaggregated. As will be shown in the detailed methodology described later, the design tends to follow a two-stage process, dealing first with the settlement as a whole and only later moving down to the level of the individual dwelling.
2. Stormwater and roads are disaggregated, as they now have different functions. Roads play a much less important part in the process. What is much more important is the issue of access, in keeping with the evolution of the BSU and BPU described above. Stormwater is a major issue, but is now concerned with the site as it exists, not with a future road layout. Thus stormwater becomes an element of physical risk, which has to be addressed in the initial analysis of the site. Access now moves from being an engineering issue to being much more a planning issue.
3. The two-stage approach requires a much greater flexibility in the design of the water and sanitation systems, and particularly the latter. The past few years has witnessed a rapid growth of alternative sanitation options for low-income communities. In-situ upgrading requires that the full range of options be explored in order to adapt the water and sanitation provision to the housing layout that exists.
4. Finally, there is a general issue, which evolves from the planning approach described above. This now requires that all infrastructure be viewed in terms of a collective function and an individual function. Each service must then be demarcated at some point (or points) between the two. The methodology described in this report adopts a hierarchical approach that differentiates the two levels. Families are organised through a grouping exercise (which is influenced by the findings of the social survey and the need for re-location) into smaller spatially defined sub-areas. The initial planning of infrastructure seeks to operate at a communal level to service these sub-areas, with the individual servicing of parcels coming later and being dependent upon a different set of criteria.

2.2.4 The relationship between professionals and community

The traditional view of this relationship between professionals and community derives from three historical features. The first is the traditional western view on the division of labour, which seeks to allocate tasks to groups of people according to their education and training. The second is the adoption of standards as the basis for urban design. The third is the concept of professional responsibility (which includes also professional liability). The outcome is a definition of a professional role which is quite narrow, and which has very clear parameters. This determines the professional approach to community participation, and forms the basis for the means and ends debate around community participation that was so clearly elucidated by Moser in the 1980s (Moser, 1983; 1989).

In this model professionals make the decision. The role of communities is to provide an input, to set out clearly their needs, and even to express their preferences. That provides the professionals with sufficient information to tailor the correct approach as closely as possible (given the constraints of such an approach) to the needs of the community. Ultimately, however, the approach remains a spatially deterministic one.

Informal settlement upgrading requires a very different relationship between professionals and the community. The reason for this is simple. The objectives of upgrading are social integration and economic development. Any physical development should therefore be supportive of these goals. At the same time it is important to seek to achieve as much spatial integrity as possible, as this constitutes an important element of a sustainable urban environment.

The achievement of these goals necessitates a change in the basic relationship between professionals and community. This is influenced by the changes in professional approach and prioritisation described earlier. It also reflects the change in thinking that comes from moving from seeing upgrading as a planning process to seeing it as an urban renewal project. The shift is from spatial planning to urban design. But it also goes further than both of these. Perhaps the most appropriate analogy is that of an architect modifying a house for an owner/occupier. A good product stems is dependent upon the architect being able to understand fully the needs of the owner and to create a house that is, at the same time, satisfying to the client functionally and aesthetically pleasing. So it is with settlement upgrading. The end result has to be functional for the community whilst ensuring the spatial integration of the area with its surroundings. This can only be achieved by a close partnership between the professionals and the community. Hence informal settlement upgrading is not about community participation; it is about partnerships.

2.3 The information management system

The new planning paradigm described above requires an extremely flexible spatial management system with a rapid response time if it is to operate successfully. It cannot function with paper-based mapping, for example, as the time taken to track, map and act on changes in the physical environment would be too slow. By the time the responses had been developed, the spatial relationships between both shacks and families would have been changed. Even if this were not the case, paper-based mapping would still be unsuitable for an inter-active planning process with the community. What is required is a system that approaches real-time mapping as closely as possible. This can be achieved using a GIS-based information management system. However, in the same way that the planning process for greenfield sites evolved to suit the medium of paper-based output, so the new planning system for informal settlement upgrading has to be structured around the optimisation of geo-information. Hence it is necessary to change not only the approach (which determines what is to be done) but also to change the means by which it is done. It is that second element that is discussed here.

The starting point is an assembly of geo-spatial information, always bearing in mind that this is now being collected to support a broad-based development. Hence it is not information that is being collected as an end in its self, but as a means to an end. This determines the amount of information needed.

From the beginning it is important to look beyond the information to take into account the way in which the information gathered will be structured. This is because the foundation for the development is a spatially referenced GIS system, and the logic of information management needs to be based on the principles of good database management, whilst at the same time recognising the way in which a GIS system uses information.

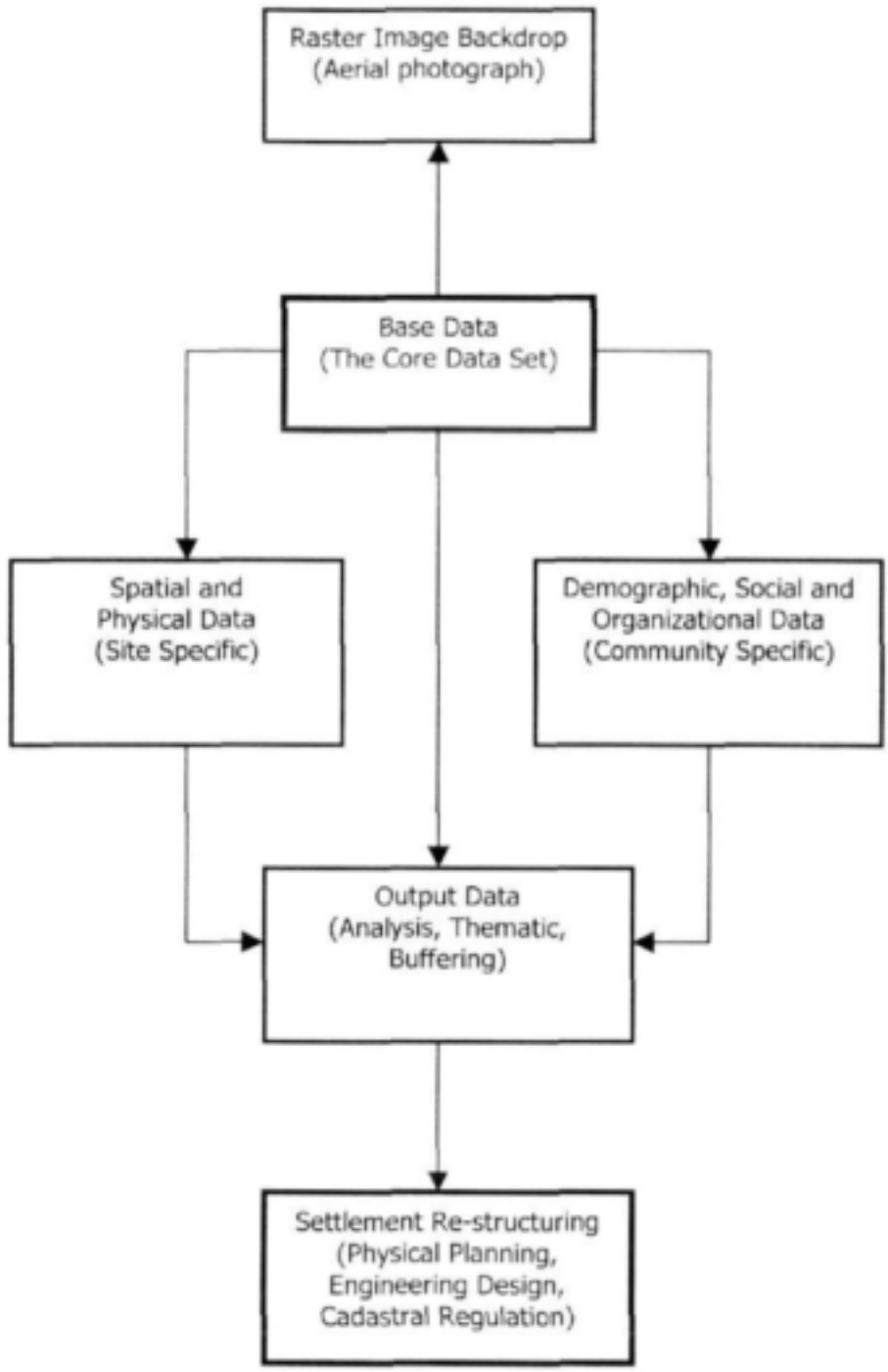
The software used by this project is built around Intergraph[1] GeoMedia® Professional® and Microsoft[2] Access®. This is a shift from the early software, which utilised Intergraph's Suite of MGE® products and Oracle[3]. In fact both of these continue in use. However the technology improvements in low end platforms have resulted in their being used for specific tasks, which require a greater level of complexity or organisation than is the case for most applications.

GeoMedia Professional® utilises a series of linked databases that can be drawn from a number of sources or created directly in Access®. These include the major CAD systems of AutoCad and Microstation, other major GIS platforms such as ArcView® and Autodesk® World, as well as major DBMS systems such as Oracle®. The information is read directly in the format used by the different systems, rather than being converted into GeoMedia format. GeoMedia Professional can also access directly a wide variety of different raster image formats, which can then be inserted into the GIS project as backdrop images. All of this lends itself to the linked database approach.

In building the database structure, the data can be sub-divided according to need and allocated to different databases accordingly. The intention here is to create a series of logical databases that do not contain more datasets than are absolutely necessary. This will facilitate good management practice in the maintenance of data. The approach to data adopted here can be illustrated in Figure 1.1 below.

[1] Intergraph is the registered trade name for the Intergraph Corporation of the United States of America.
[2] Microsoft is the registered trade name for the Microsoft Corporation of the United States of America.
[3] Oracle is the registered trade name for the Oracle Corporation of the United States of America.

Figure 2.1: Flow diagram of the database structure



Thus the data structure has five major categories, which comprise the following:

i. Base data.
ii. Raster Image.
iii. Demographic, social and organisational data.
iv. Spatial and physical data.
v. Output or generated data.
vi. Design data

Each of these is described briefly below.

2.3.1 Base data

The base data comprises a single feature set with one attribute data attachment (excluding GeoMedia's own generated reference number). The feature set is made up of the vector outline of the shacks, with the shacks then representing the individual features. If raster image is in full colour then this will probably have to be generated through a process of "Heads Up" digitising directly from the image. Similarly, if the image is grey scale. However, if it is simple two-tone scale, then an automated digitising process could be employed.

The attribute data set attached to the feature set is the list of shack numbers. While this could be generated by the computer, it is important that the mechanism be seriously considered. In New Rest and Kanana the communities defined their own numbering system and were responsible for the numbers on the shacks. This is the recommended route, which shows a commitment on the part of the local authority and the development professionals to full and meaningful community involvement. This community-based numbering could operate within some guidelines that make it compatible across the entire municipal area. However, if the numbering were to be generated totally from outside the community then this would be a clear indication that the project is being driven as a top-down, externally imposed solution.

2.3.2 Raster Image

There are three ways of capturing images of the settlement, all aerial based. The first is via satellite, the second using fixed wing aircraft following a flight path prescribed by the methodology for the generation of ortho-rectified images, and the third is with a helicopter. This project used both fixed wing aircraft and helicopter, and the advantages of each are discussed more fully later in the report. The raster image is geo-referenced and modified to provide a true reflection of the settlement. This does not necessarily mean full ortho-rectification. This image then provides the backdrop from which the shack features are transformed into the GIS.

2.3.3 Demographic, social and organisational data

This data is captured on the ground by means of a survey, and covers the inhabitants of every shack. Again this is a community–driven process. The information collected is used to gain an understanding of the community structure, composition and profile. This in turn forms the base information for the upgrading in two distinct ways. The first is that of providing a social and economic development plan for the area. The second is to define the structure of the physical development. This issue is discussed in greater detail in section 1.5 below.

2.3.4 Spatial and physical data

As the heading implies, this dataset incorporates all data that relates to the site itself, i.e. the piece of land on which the settlement is located. It will generally be found in a series of CAD files, and will cover surveying, planning and civil engineering details. Included here also will be any physical information that is digitised from the image.

2.3.5 Output or generated data

This is the warehouse for all generated data. This will generally be drawn from a combination of the three previous datasets, and will comprise mainly thematic maps and queries.

2.3.6 Planning and design data

This data set comprises the output of surveying, spatial planning and engineering design. The important point to note here is its position in the hierarchy. It is to be found at the bottom of the data hierarchy. This is an accurate reflection of where it should be situated in the upgrading process, and indicates that it can only be done effectively if it is used as a support system in the upgrading process, rather than as a driving force. This is also demonstrated by examining its inputs. Thus it is informed not only by the technical dataset but also, more importantly, by the output or generated dataset described above.

2.4 The structure of the report

Once these three important differences have been identified and defined, the next step is to follow them through into practice. That is the purpose of this report. As mentioned earlier, these changes cannot be dealt with simply by adding community participation to the conventional planning process, which is spatially driven. For this assumes that economic and spatial sustainability can be ensured by physically restructuring the community into spatial patterns that suit external perspectives rather than internal needs. If spatial planning and its associated disciplines are to play a meaningful role in ensuring long-term sustainability, then they have to support and enhance the social and economic growth and development framework.

The report therefore represents both a methodology and a set of guidelines for the new informal settlement upgrading paradigm. In its structure, it begins by following the flow path illustrated in Figure 2.1, with the current chapter having presented the overarching conceptual and philosophical approach. Chapter 3 begins this process by exploring the image capturing process. This looks in particular at the differences between helicopter photography and conventional aerial photography, and discusses the benefits and disadvantages of the two. The integration of the community into a full planning partnership is shown to begin at this stage. The same chapter then goes on to discuss the core data set. This incorporates a section on shack numbering, which shows the importance of full community involvement at this early stage. This is important, since this phase of data assembly is where the wider planning of the geo-spatial data framework is established. This then determines the linkages between the core data set and the remaining datasets.

Chapter 4 describes the spatial and physical dataset. This represents all the external information related to the site and the surrounding area that has an influence on the development. Of particular interest here are those features that will necessitate relocation, although a second, very important issue is that of the linkages between the site and the formal city that surrounds it.

Chapter 5 discusses the social survey and the way in which this was structured. It begins by looking at the importance of accurate social and economic data in meeting the needs of the community, moves to a description of the questionnaire, and then goes on to discuss two different ways of structuring the database. The first is through the creation of a single database accommodating the bulk of the information, while the second discusses a linked database. Both have advantages and disadvantages, while the most appropriate choice is determined by the way in which the data will be used. The choice of structure has been shown to provide a further indicator of the development route being taken by the project.

Chapter 6 explores the generated data. This data emanates from two primary sources. The first is that obtained from linking the core and the social datasets. Here the information in the database is translated into thematic maps that provide a geo-spatial representation of the key elements of the data. A second source utilizes all three of the previous data sets. This operates through a series of queries that link different data and enable information to be obtained that provides the framework for the social and economic development processes. This data highlights the importance of understanding some of the wider implications of upgrading, particularly those that pertain to the issues of poverty and gender, and this then leads into chapter 7.

Chapter 7 moves away from the datasets and explores the issue of the institutional framework. The previous chapters have focussed on the more technical details of the methodology. However, this cannot exist in a vacuum. It is located within a functioning community, in an environment where the community is a full partner in the process. Hence it is crucial to understand the nature of the organizational surround that enables this partnership to work. The chapter will discuss some of the lessons learnt from the pilot project and make suggestions as to what might constitute effective structures and appropriate relational models. The chapter focuses on four areas. The first is the relationship between the community and the wider society. The second is gender equity. The third is the partnership between the community and the local authority. The fourth is that of internal organisational relationships, while the last one is the social support system.

Chapter 8 then moves back to the datasets and looks at the issues of access and spatial relationships. This takes into account both the internal needs of the community and the external linkages between the community and the surrounding areas that are crucial if the settlement is to be integrated into the formal

city. This aspect of the methodology deals with the broad spatial elements that need to be put into place, but does not move down to the level of the individual shack. The objective here is to integrate all the previous information, determine how many families will need to relocate, and create a development plan for the settlement. This also enables all of the remaining physical components of upgrading (water, sanitation, housing) to be integrated into the upgrading process in a coherent way. The aspects of upgrading covered by this chapter thus complete the first phase of the upgrading process.

3. GENERATING THE IMAGE AND THE BASE DATA SET

3.1 Introduction

The basis of any upgrading is an understanding of the existing situation within the settlement. This covers both the physical situation and the social dynamic. This chapter deals with the first of these. The easiest way to begin this process is through the generation of some form of aerial photograph. The question then becomes what type of photography? There are three ways of obtaining imagery from the air. The first is satellite, the second fixed wing aircraft and the third helicopter. Each of these methods has strengths and weaknesses. Satellite imagery is not cost effective at this stage in South Africa, since there is an extensive aerial photography service which operates at a reasonable cost and high quality. This may change once the new one-metre resolution satellite imagery becomes commercially available, but at present the resolution is of too poor a quality to use for upgrading.

This chapter discusses the collection of raster imagery in some detail. In particular, it focuses on the method of helicopter-based aerial surveys, based upon the experiences in New Rest. A discussion of the advantages and disadvantages of helicopter surveys, as compared with conventional fixed wing aircraft surveys, follows this. Examples of the two different types of graphical output have been included.

Once the image has been ortho-rectified or a mosaic created, this is followed by the raster to vector conversion, which is where the base data set is generated. Although technically this is a simple exercise, it is important to recognise that it also provides one of the underlying reference systems for the information management system, and this forms part of the digitizing process. Also included in this exercise is the numbering of the shacks, and the chapter ends with a discussion of this important issue.

3.2 The helicopter survey

When the New Rest upgrading project began, there was aerial photography available at a scale of 1:20 000, dated May 1996. By 1997 this was already outdated and new up-to-date photography was needed. At that time it was not necessary to have accurate photography. What was important was the limited budget (R2 500). A helicopter was hired for an hour and a series of photographs taken of the site. The helicopter was flying at 250m and a series of images were produced at an equivalent paper scale of approximately 1:750. This provided all of the information needed at the time. However, the photography was random, and the control of height poor. As a result the mosaic that was generated had very poor joins and the resultant merged image was of low accuracy. Nonetheless the exercise was cost-effective and valuable lessons were learnt.

By the beginning of 1999, when the pilot project at New Rest was moving towards implementation, it was decided to run a second helicopter flight. This took place in March. By that time the helicopter company had installed a fixed camera mount, and the process of photography was much more tightly controlled. The section that follows describes this second helicopter survey in some detail.

3.2.1 The flight plan

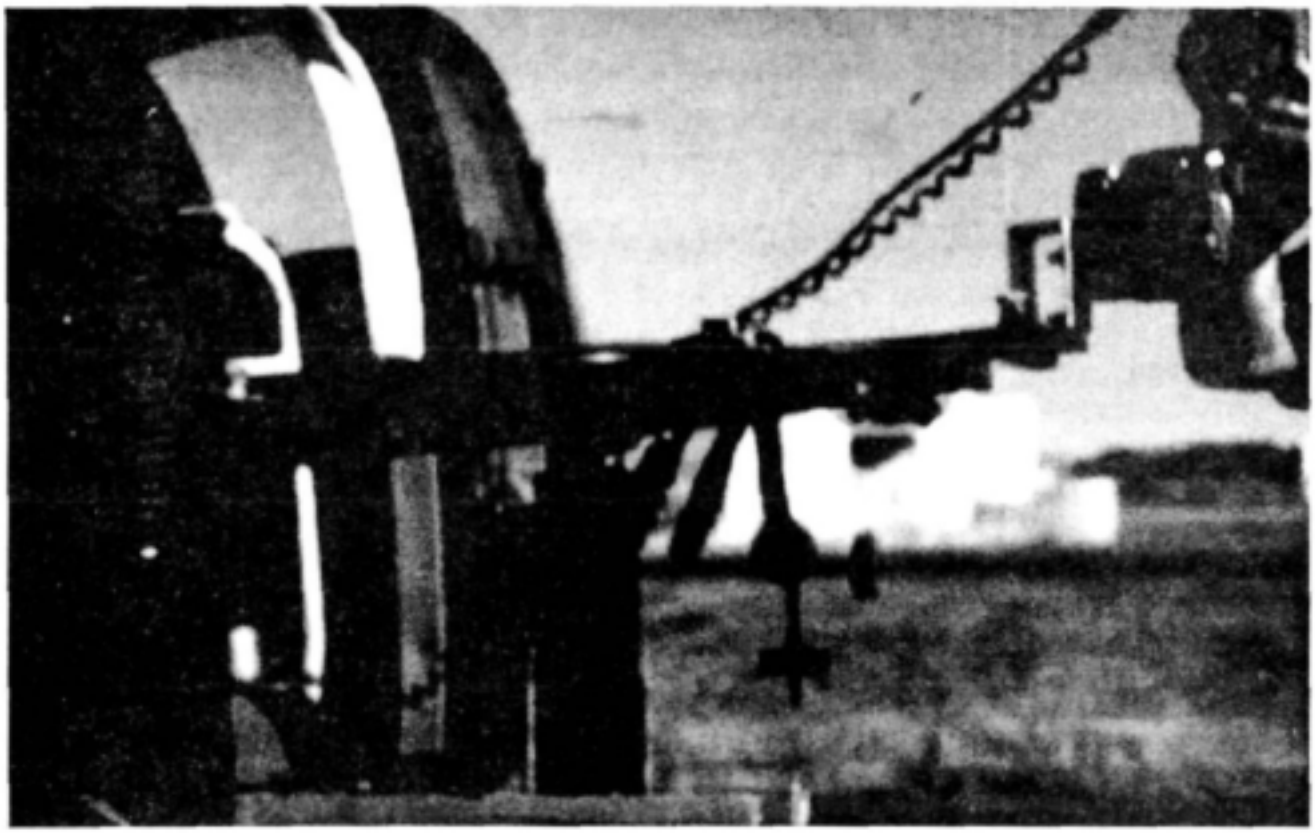
The aerial survey was carried out using a helicopter provided by the Aviation Business Centre. The flight plan was constructed on a plot of an image of New Rest extracted from a 1996 (1:20 000) aerial photograph (see Figure 3.1), which had been ortho-rectified. Eight strips were flown across the width of the settlement along a north to south direction. The flying altitude was set to 200 m and ten frames were taken along each strip to ensure a minimum overlap of 60% along the direction of flight. The image footprint was thus set to 200 X 200 m. The first strip was flown along the railway line adjacent to New Rest. Subsequent strips were flown from along the N2 towards the south. To maintain a constant direction of flight, houses in the formal settlement area to the north of New Rest and other fixed points to the south of the informal settlement were selected before the flight. An additional ninth strip was flown along the length of the settlement for interest. The total flying time was 55 minutes. A large fraction of this time was spent on landing the helicopter on two occasions in order to change the film.

Figure 3.1: The flight plan constructed on the 1996 aerial photography
(Note: the arrows indicate the direction of flight)

3.2.2 The instrumentation used

The instrumentation that was used in the helicopter survey included a specially created camera platform (see Figure 3.2). This platform was attached to a ladder that was placed across the floor of the helicopter once the back seats had been removed. The platform itself was comprised of a pivot-based weight constructed in a manner to ensure that the camera would remain horizontal throughout the flight. Furthermore, a special triggering device was set up to facilitate the photographing procedure. A video camera was also attached to the photographic camera itself. This video camera enabled the pilot and the author to ensure that the camera was being used to take photographs along the flight plan strips indicated in Figure 3.1.

Figure 3.2: The camera mount that was set up for the helicopter survey



3.3 Image conversion

3.3.1 Selection of images

Approximately 20% of the approximately 110 photos that were taken during the helicopter flight were selected for scanning (see section 3.3.3 below). These images were selected to ensure, firstly, that the whole of New Rest would be covered and, secondly, that the overlap required for geo-referencing these images would be met.

3.3.2 Selection of scanning resolutions

The selection of the scanning resolution depends on several issues. The variation in image quality with increasing scanning resolution between the three key imagery types (helicopter, aerial and satellite) is quite wide. The key issue is the image resolution required for the specific mapping exercise at hand. In the case of a shack counting exercise it is essential to be able to distinguish individual shacks easily. Two other key factors that will determine the appropriate scanning resolution are the availability of the imagery (see above) and the extent of the memory storage space on the system.

The scanning exercise for this project began with the 1:20 000 December 1995 imagery, which was scanned specifically for this project by the Directorate of Surveys and Mapping within the National Department of Land Affairs and Agriculture. This was finally carried out at a resolution of 72 dots per inch (dpi) using a specialised high resolution scanner.

Before the 1: 20 000 imagery was scanned by Surveys and Mapping, the scanning resolution and image file size most suited to the UCT GIS Research Centre system was determined by trial and error. For each scanning resolution setting, the extent of 'zoom-in' that could be achieved on the resulting image, before individual shacks become unrecognisable or too difficult to map, was noted. For the aerial photography, the best results using the A3 scanner were achieved with a tiff file size of about 300 MB for each image. Thus Surveys and Mapping was requested to select the maximum scanning resolution that would enable at least two images to be saved per CD and still enable shacks to be clearly defined. Scanning by Surveys and Mapping took eight hours per image for complete ortho-rectification. The result was file sizes of

297.7 MB. On the whole, the scans enabled shacks to be easily identified. More recent work on a related project has shown that in the case of helicopter imagery, the choice of scanning resolution is less critical as the initial imagery is already of a high resolution. In practice, 200 dpi has been found to be sufficient for the treatment of the helicopter imagery.

3.3.3 Image-to-image warping

The helicopter imagery captured for New Rest was positioned in space by using image-to-image and image-to-map warping procedures. The photograph from the 1996 1:20 000 aerial survey of Cape Town that included the New Rest settlement was used as the reference image. This was first positioned in space using the affining transformation procedure (although the images were ortho-rectified they had not be geo-referenced). Using extracts from this image as the control images, two warping methods were then tested to position the helicopter imagery.

In order to test the first warping method 21 overlapping photographs, from the 110 photographs captured during the helicopter flight, were selected to represent the entire settlement. An extract corresponding to each of these helicopter images was the created from the 1996 aerial image. Using each 1999 image and its corresponding extract, approximately 15 identical points were identified and annotated in a design file. These annotations were used to facilitate recognising corresponding control and input points during the warping process. For each image, once the input and control points had been selected, a Helmert transformation procedure was applied. This procedure was selected because it required only three fixed points to be set before the programme commenced interpolating source points on the input image.

In the second method, the image-to-map warping procedure that was applied involved the warping of only 17 of the helicopter images. In this case, only one extract, which covered New Rest entirely, was created from the 1996 image. Each of the helicopter images was then individually warped to points overlying this extract using a second order affine transformation procedure. Unlike the Helmert procedure, this procedure enabled six control points to be set before the programme commenced interpolating source points on the input image.

In both methods, once each image had been warped, the image was resampled to a pixel size of 0.25 m. The largest rectangular image was then extracted from the warped image. This extraction procedure was essential to facilitate the generation of a mosaic procedure. This was particularly important for the second warping method, which often resulted in large distortions towards the image edges and significantly modified the shape of the image.

3.3.4 Generating a mosaic

Two methods were tested to mosaic the helicopter images. The first mosaic was produced by geo-referencing only one of the helicopter images to the 1996 aerial images. The helicopter image that was used covered the north-western most corner of the New Rest settlement (positioned at the intersection of the N2 and the railway line). Each of the remaining images was then geo-referenced to the first geo-rectified helicopter image. The result of the mosaic produced using this image-to-image warping procedure can be seen in Figure 3.3. This figure clearly illustrates the way in which the spatial error increases significantly the further the distance from the first helicopter image.

The second mosaic was produced by geo-referencing each of the helicopter images, on an individual basis, to the 1996 ortho-rectified image. Here the mosaic produced by the helicopter imagery has itself been mosaiced with an extract from the 1996 image. The accuracy of this second mosaic generating procedure proved to be much more accurate and corresponded well with the 1996 backdrop.

Figure 3.3: Mosaic generated by cumulative matching of photographs to the control image

3.4 Conclusions on the use of helicopter photography

The warping of the photographs and the creation of the mosaic described above was a time-consuming exercise, which took a number of weeks to complete. Some of this was lost time caused by a lack of familiarity with the more specialist applications of the software, and the exercise could be completed in a much shorter time the next time. Of greater concern, though, was the uncertainty around accuracy. It was not clear how well the shacks shown in the mosaic reflected the true position on the ground.

As part of the analysis of the site, discussed in the next chapter, it was decided to carry out a theodolite survey on the ground. The primary objective was to provide accurate information for a stormwater analysis. However, it also provided the opportunity to test the accuracy of the warping and mosaic creation exercise. Two corner points from each shack were recorded and the result plotted. Shack vectors were then repositioned on these coordinates. The results for a small part of the site are shown in Figure 3.4 below, where the shack vectors reflecting the outcome from the theodolite survey have been superimposed on the vectors generated from the mosaic.

Figure 3.4: A comparison of shack vectors derived from a helicopter survey and a ground survey.

The ground survey points have an accuracy of 50mm. What this figure shows then is a wide variation in the accuracy of the shack vectors created from warping. All of the shacks show an overlap between the two. Given a mean wall length of 4m, this means a variation from the true position of up to 2m. Although this situation has been improved with the use of new image processing software, the comparison does illustrate the major weakness of the system of taking individual photographs and then warping them and creating a mosaic. The result is an output that has an accuracy that varies across the site and which cannot be stated with any degree of precision.

Having given the major disadvantage, it is important to state that the method has many advantages. The flow diagram in Figure 2.1 shows the varied needs of the backdrop image. Essentially, the shack vectors are needed at the beginning primarily to attach attribute data and label dwellings and families. The accuracy is not critical at this stage, provided that the generated vector map provides an accurate indication of the number of shacks and their approximate location. The positional accuracy is required later when the upgrading moves towards the detailed design stage.

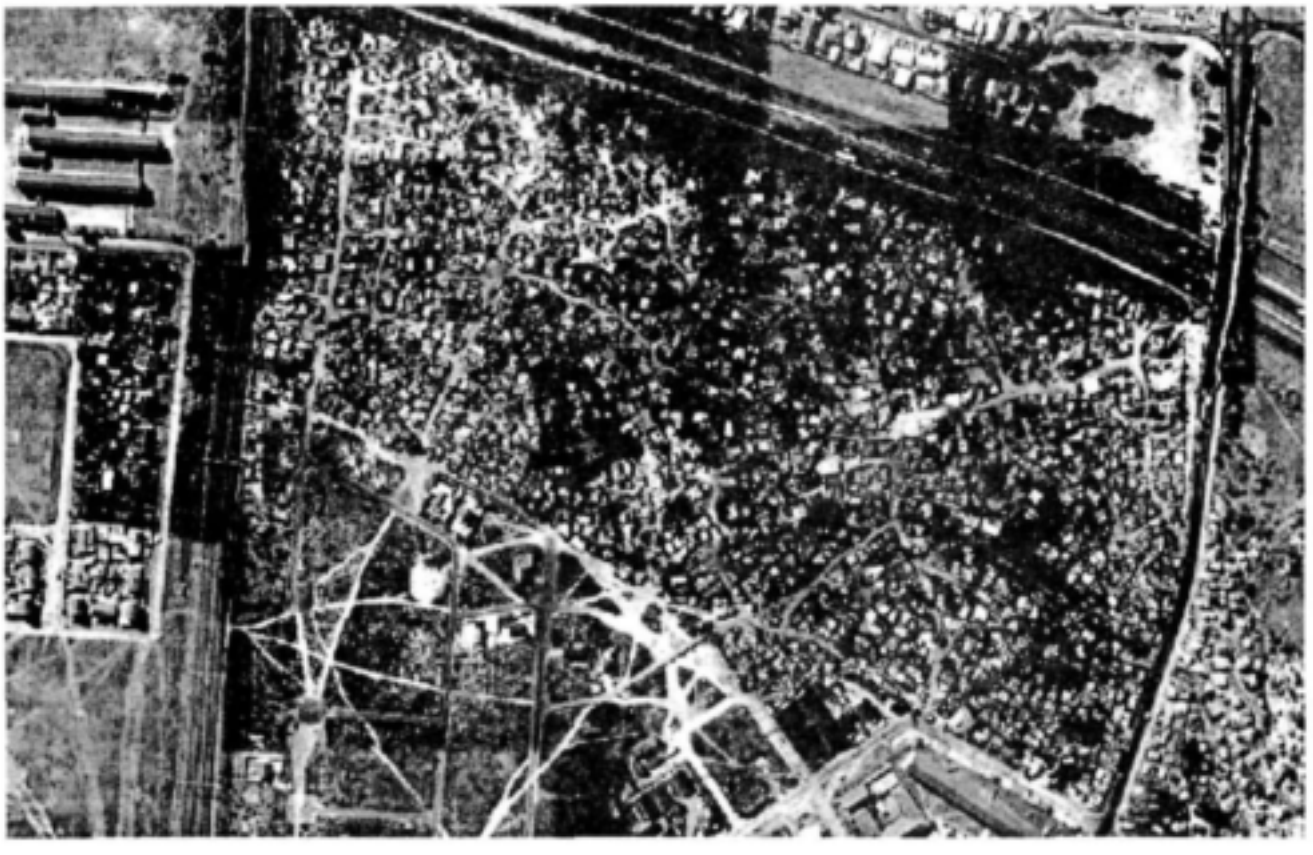
Clearly taking an aerial photograph from a fixed wing aircraft would overcome this problem. The risk here though is that the position on the ground, in respect of shack numbers and relative positions, could change substantially during the period of project establishment and social analysis. Under these circumstances it may well be necessary to take a second set of photographs. This certainly proved to be the case with New Rest. The change between the two sets of helicopter-based images has already been mentioned. In addition though, there were also substantial changes during 1999. The influx to the settlement had been stabilised as part of the early negotiating process, so there were no new shacks constructed. However, a number of families with subsidies elsewhere left, while improvements to the road system resulted in the internal relocation of approximately 30 shacks. As a result, and due to the need for an accurate map, a new aerial photograph was taken in December 1999.

Finally, there is the issue of data storage. Images require large amounts of computer storage space. While this problem is becoming less important due to growing hard disk capacity, there is also an issue of processing time associated with large files. Helicopter photographs can reduce file sizes by working at lower resolutions. On the other hand, current methods of storing aerial photographs tend to use computer packages that have high compression ratios. Thus the latest New Rest aerial photograph used MrSID format, which resulted in an image file size of approximately 2MB. This can be read by GeoMedia Professional, and hence used as a backdrop for integration and for digitizing. However, if it is necessary to convert this to a JPEG format for use elsewhere, then this is going to result in a file size of approximately 60MB for the same image.

On balance it is recommended that helicopter photography is used for settlement upgrading where this has a significant cost benefit. This allows a series of backdrop images to be taken over time, thereby retaining a visual record of changes as well as ensuring that the backdrop image provides the maximum amount of useful information. Conventional aerial photography should then be considered at the point when the project requires spatial information of a high level of accuracy. In New Rest the existence of servitudes had a major impact on shack relocations, making accurate information essential in order to minimise relocations.

Figure 3.5 shows the helicopter image for New Rest superimposed on the 1:20 000 aerial photograph from 1996. This illustrates how the two systems can be merged. The helicopter image provides an updated view of New Rest, necessary for planning purposes, while the 1:20 000 provides accurate information of the surrounding area to position external services in relation to the informal settlement.

Figure 3.5: Mosaic of warped 1999 helicopter images of New Rest superimposed on a 1996 1:20 000 aerial photograph



3.5 Data capturing and processing techniques employed

3.5.1 Creating the shack vector data

Once the image has been processed, then the shack vectors can be generated. In the original analysis of the settlement in 1997, the shacks were digitized within the Modular GIS Environment (MGE) project environment using the Microstation CAD interface. Once all of the shacks had been digitized as closed

polygons, the data featurization tool was run within the Base Mapper[1] (MGMAP) application in order to convert the polygonal elements into shack features[2]. The centroid to each shack was then generated using the centroid-placing tool in the MGMAP application.

The data was subsequently imported into GeoMedia, the low-end GIS platform of the Intergraph suite. This was done using the CAD server utility available within Geomedia. In the first instance, a GeoMedia warehouse was set up for the local-level database. Each of the levels in the design files was then examined in order to set up a CSD file.

Later, following the aerial survey of December 1999, when a new backdrop image was created, it was decided to re-digitise the shacks rather than moving them. This also coincided with a restructuring of the database, and a major review of shack numbers following the movements of 1999. In the second vectorisation, the shacks were digitised directly into GeoMedia Professional, the new higher end platform from Intergraph.

3.6 The role of shack numbering in informal settlement upgrading

The numbering of the shacks in an informal settlement appears, superficially, to be a simple and straightforward task. Numbers can simply be allocated. With a GIS system it is even easier. Numbers can be generated automatically as part of the digitising and generation of shack vectors. But this simple approach is not recommended.

In practice shack numbering is not only a complex task, it is also one of the most crucial in terms of demonstrating community commitment to the project (and here a distinction is drawn intentionally between the words 'support' and 'commitment'). There are three aspects that are critical to successful settlement upgrading, all of which come to the fore at this point in the process. These are:

1 Community commitment.
2 Community involvement.
3 Freezing of the site.

Each of these is dealt with in turn below.

3.6.1 Community commitment

This brings out a further element of the paradigm shift that has to take place in external perceptions of settlement upgrading and which, in this case, relates primarily to development professionals working within government and to politicians.

The normal way in which informal settlements would be chosen for redevelopment would be on the basis of externally perceived living conditions. The poorer the (perceived) conditions of the settlement, the higher the priority given to its re-development. In practice, the choice of settlement for upgrading should be dependent upon very different criteria. Upgrading is a partnership between the community and the local authority. Like any partnership (and here there is a great deal of relevance to public-private partnerships) the key to success lies in the commitment of both parties to the partnership project. The same is true here. The most important element underpinning the choice of an informal settlement for upgrading is the commitment of the community to the process. If that does not exist, then the chances of achieving a successful project are greatly diminished.

Shack numbering plays a small but very important role in determining commitment. By giving them full responsibility for the numbering of the shacks, a community provides an early indicator of the extent of their commitment.

[1] MGMAP is Intergraph Corporation's application in the Modular GIS Environment (MGE) family for capturing, generating, validating, and managing GIS data in an MGE project. It contains tools for capturing, generating, cleaning, validating, and managing project data in both the interactive and batch environments. MGMAP can be configured for both standalone and networked applications. MGMAP configuration requires MGE Basic Nucleus (MGNUC) and MicroStation on the machine seat, one copy of MGE Basic Administrator (MGAD) and a relational database on the network.

[2] Features are spatially distributed geographic elements that, displayed graphically, make up a map. Features are represented by sets of graphic elements such as points, lines, and areas, and may be associated with an attribute table. In the MGE project environment, a feature is linked to a record in the feature table.

3.6.2 Community involvement

The technical elements of the process underpinning upgrading, and particularly the spatial elements linked to the GIS, require a degree of understanding before their role and purpose can be clearly understood. Experience at New Rest indicates that there are many people within the community that can grasp, and relate to, the concepts that underlie the methodology, and in particular the spatial elements generated by the computer.

The shack numbering provides the first opportunity to integrate the community into the technical aspects of upgrading. The map that is generated by the GIS package is used by the community as the basis for numbering, and they take responsibility for ensuring that every shack is included. By the end of that process those members of the community that will be involved extensively with the project will have a basic understanding of the underlying spatial framework of the database.

3.6.3 Freezing the site

The approach to in-situ upgrading described in this report is dependent for its success on creating a relatively static situation on the ground, physically, for the duration of the project. This obviously requires a degree of stability within the community, which in turn is linked to the issue of commitment. However, it is also linked to the culture of settlement formation. In Brazil, the freezing of the settlement is almost directly linked to commitment. In South Africa there is a much greater degree of internal relocation that takes place between settlements.

In New Rest, work on this aspect was ongoing from the time the project was initiated in October 1998. A series of workshops was held with the community, where the need for freezing was explained. Interestingly, this freezing was carried through successfully in New Rest. However, in Kanana, the Resident's Committee was unable to put it into practice at that time, as there was still a significant influx and the committee was not well supported. It was this aspect that changed the focus of the project away from Kanana and towards New Rest, even though it was Kanana that had first voiced the greatest support for the principle of in-situ upgrading.

From that point, all incoming movement was stopped there and the committee then developed a numbering system for their area. Paint was purchased for them from a grant, and they painted numbers on all the shacks. By the second half of 1999, the residents of Kanana were beginning to see the benefits accruing to New Rest. A new committee was elected and, with the support of the New Rest committee (deriving from their own successful experience), all influx into Kanana was stopped by the end of the year. By the beginning of 2000 a numbering system had been devised for Kanana and all the shacks were numbered.

Problems then arose due to the long delays being experience by the project. This meant that it was not possible to maintain the project area in this frozen state. The outcome of the social survey (which is described in Chapter 5) had identified a number of families that had subsidies elsewhere, and these families were encouraged to move. In addition a process of continuous improvement of road access within the site was undertaken in association with the City, particularly after the severe winter floods that occurred during 1999. This too resulted in some relocation of shacks. It was this that necessitated a new aerial survey at the end of 1999. Once this had been done shack vectors were re-digitised as mentioned earlier, and the numbering system checked thoroughly by a re-sampling exercise on the ground. On the whole, however, the Resident's Committee was able to maintain a tight control over movement and the freezing process can be said to have been a success. Figure 3.6 provides an illustration of the shack numbering system at New Rest.

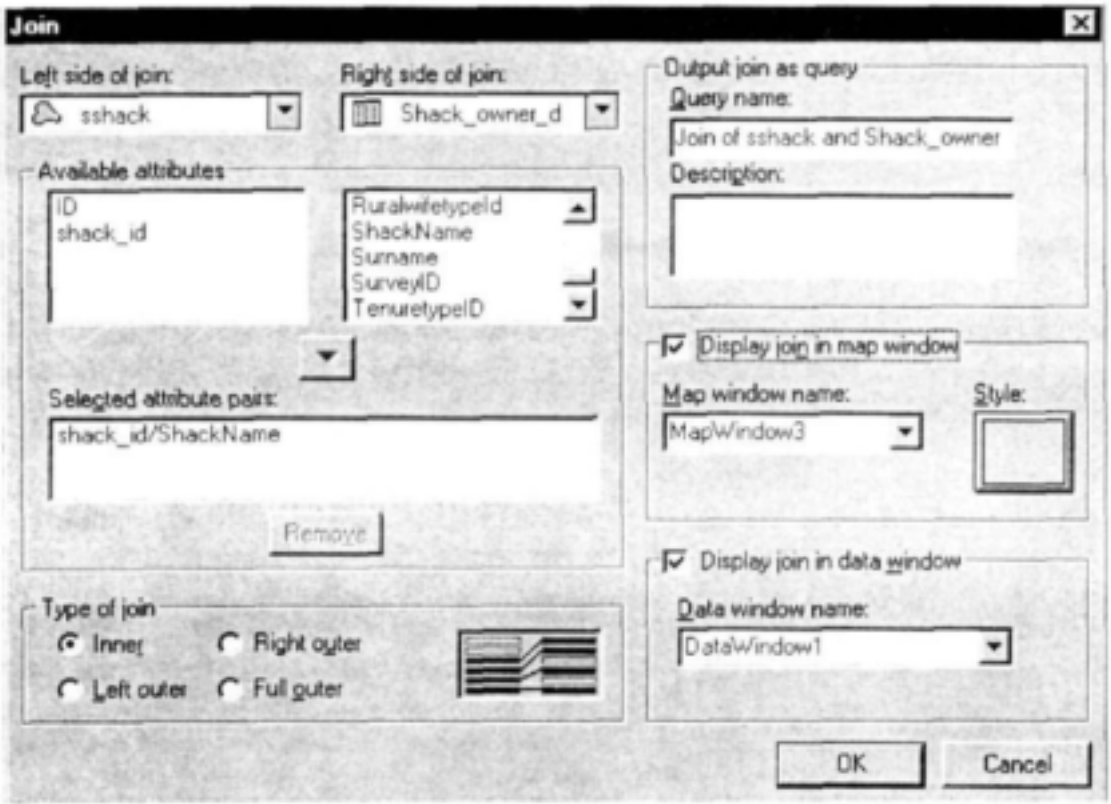
Figure 3.6: An illustration of the shack numbering system at New Rest superimposed on the shack vectors

3.6.4 The shack numbering system

The community in New Rest decided, of their own accord, to base the shack numbering system on the demarcation of the settlement that had been initiated for the 1998 census. This produced a perfectly workable solution. At the same time, there is no reason why a numbering system should not be integrated into a wider metropolitan system. In fact, this is to be recommended once a local authority adopts in-situ upgrading at a policy level. This does not detract from the ability of the community to control the numbering process. What this discussion does do, however, is to illustrate the importance of creating the correct linkage with the database as early in the process as possible.

New Rest had its own numbering system. As this is a pilot, no attempt was made to create a generic numbering system. Figure 3.7 provides an illustration of the integration of the numbering system with the shack vectors through the use of a join in GeoMedia. Each number is attached to the associated shack as attribute data.

Figure 3.7: An illustration of the database linkage in GeoMedia



4. TECHNICAL AND SPATIAL DATA

4.1 Introduction

The technical and spatial database contains information that pertains to the site, i.e. that piece of land on which the informal settlement is situated. The construction of this data set necessitates the identification and evaluation of a range of spatially referenced technical information, which makes it an appropriate place to build the spatial information system. Hence, this chapter looks first at the construction of the spatial information system, and then describes the collection and structuring of the information collected.

The underlying philosophy of informal settlement upgrading in-situ is minimum relocation. However it is important to define what this term means. It does not mean no relocation. It means that relocations take place only for specific, agreed, and clearly defined reasons. Furthermore, the relocations should, wherever possible, be internal, i.e. families may have to move their shacks, but they do not leave the settlement.

There are three major causes for relocation. The first relates to physical risk. If families are seriously at risk by staying where they are, then they will need to move to another position. The major causes of physical risk are unstable sloping ground (with the inherent risk of landslides), flood-prone land, whether from rivers or rising groundwater, and unstable flat land (eg. sinkholes or old landfills). The attitude of the past, which tended to condemn a large tract of land if a portion of it was risk-prone, is clearly not acceptable. The boundaries of the risk prone land need to be defined as specifically as possible, and different levels of risk attached to different areas.

The second cause of relocation is to create improved access. Again, this requires clarification. With a minimum relocation policy it is not feasible or practical to define large swathes of land as roads and road reserves. Access has to be carefully considered and each route justified.

The third cause of relocation stems from compliance with cadastral boundaries. It was stated in Chapter 2 that the thinking about space is structured around the individual shacks and the line drawn around the external perimeter of the shacks. The cadastral boundaries are not the determinants of development. Nonetheless, it may be that, in some cases, certain cadastral boundaries are recognised. In New Rest, for example, the perimeter of the shacks corresponds closely, but not exactly, with the cadastral boundary. Legally it becomes much simpler for the community to upgrade if they choose to accept the cadastral boundary, but this would require a number of families to relocate.

In addition to establishing the possible extent of relocation, it is also important to obtain an estimate of the cost of improving the land, to make it more suitable for housing. Here the issues are primarily 'what are the conditions below the surface' and 'what is the storm management capacity of the site?'

These are the issues that relate to the site and define the information that needs to be gathered about the site. This chapter reviews these different elements and shows how they are integrated into the information management system.

4.2 The information management system

Figure 2.1 showed the flow diagram for the collection of information. This section describes how that information system is structured in practice. As was mentioned in Chapter 2, the project began initially by being built around what was termed a high level GIS system, specifically Intergraph's modular MGE system linked to an Oracle database. A high level system is a complex operating environment, which requires a high level of technical understanding. This arises because the use relates to that of a programming language, albeit simplified and because of the technical complexity of the mathematical transformations used by the system when manipulating spatially referenced objects. During the course of the project this situation changed, as the rapid increase in computer operating speed and hard drive memory enabled many of the tasks to be performed via a much simpler user interface integrated with the OLE functions of the Microsoft product range. Examples of these simpler platforms, which can also be described as low-level platforms, are Intergraph's GeoMedia and ESRI's ArcView. This project has used the first of these for three reasons.

1. The company is committed to supporting this project and provides a high level of technical support.
2. The system derives from an engineering base, and this makes it an excellent platform for integrating the output from other technical design programmes. This will prove to be particularly valuable when a project moves into the implementation phase, as it means that all the planning and design work can be done within a single GIS platform.
3. The system can read the contents of other GIS and database systems directly and integrate this information with its own data sets. This is immensely valuable when information has to be drawn from a wide variety of sources.

One of the benefits gained from working with MGE was that it required a high level of pre-planning if it was to function effectively. This meant creating the information management system in advance. This remains a valuable exercise, even though the low-level platforms do not need this as a pre-requisite. It imposes a discipline that pays a dividend later when the amount of material grows and new material is constantly being added. The construction of the flow chart in Figure 2.1 is one benefit of this structured approach.

The different data types that might be encountered by a project such as this one comprise the following:

1. Images of various types deriving from different sources (aircraft, satellite, including the visual light band, infrared and multi-spectral, helicopter, photographs).
2. Constructed vectors.
3. Non-spatial attribute data (such as the social and economic survey data).
4. Engineering design files (eg. Autocad, Microstation).
5. Paper prints.
6. Written documents.
7. Other non-spatial design packages.

It is important that the information system can accommodate all of these in a structured manner, as well as being able to create the appropriate linkages between them that make them all accessible. This should also incorporate a degree of long-term strategic planning, wherein the information management system could be integrated into a wider metropolitan information management system (see Abbott, 2001, for a more extensive discussion of this issue).

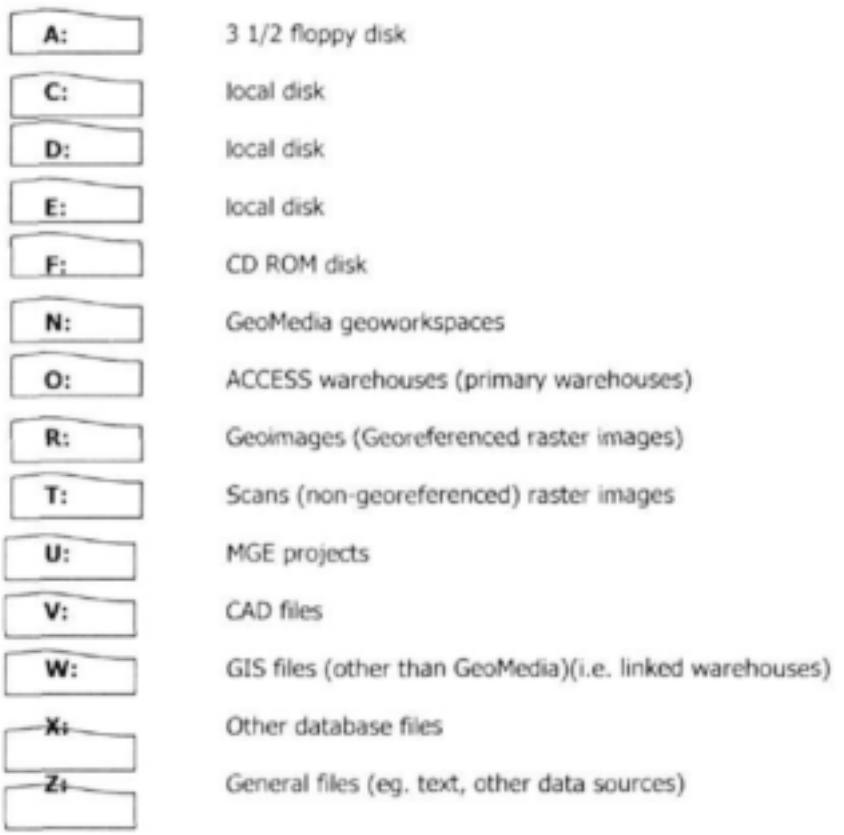
4.3 Building the filing system for the information management system

When a GIS operating system is first installed on a computer, it generally creates two directories. In GeoMedia these are referred to as 'Workspaces' and 'Warehouses'. "A Geo Workspace is the container for all [your] work in this product [GeoMedia]. Within its confines are the warehouse connections to your map and data windows, toolbars, coordinate-system information, and queries you have built" (Intergraph, 1999:11). Warehouses are data storage spaces.

It is primarily within the warehouse area that system planning is required. The approach taken on this project was to create a number of shared drives on the file server. These are shown in Figure 4.1 below. Within each of these drives information can then be sub-divided according to its source. This is not necessarily the most efficient or effective system. The point being made here is the importance of creating a long-term viable data filing structure in advance.

The system set up here, and shown in Figure 4.1, is created around the flow diagram illustrated in Figure 2.1. The GeoWorkspaces define the wider projects, and hence come first. Following from that come the warehouses that will be directly associated with the project. These are stored by GeoMedia as Access databases. Thus all the vector data, including the shack vectors described in Chapter 3, are stored in a database format. This then constitutes the primary warehouse drive. Following from this are two drives for raster images, one relating to geo-referenced images and one to non geo-referenced images. MGE projects, CAD files and Other GIS-based files follow next, then space has also been provided for additional database material and for general files.

Figure 4.1: The file structure employed for the Urban GIS system at UCT



4.4 Structuring the relationship between data sets

The data sets that make up the information base for an informal settlement can be divided into five categories. These categories are determined by the nature of the data and by the extent to which that data can be manipulated (using this term in a spatial context). These categories can be defined as follows:

1. Raster data that is, or can be, spatially referenced.
2. Vector data that can be manipulated.
3. Vector data that is read only.
4. Non-spatial attribute data that can be stored in a database format.
5. Raster data which cannot be spatially referenced, and which becomes another form of non-spatial attribute data.

Each of these is discussed briefly below.

4.4.1 Spatially referenced raster data

At this point in time raster data which is supplied either in full colour or in continuous grey scale cannot be automatically digitised. Thus it cannot be used by the GIS system in the same way as other data (eg. for queries). Its purpose, therefore, is to provide backdrop imagery which can be used for manual digitising of vector data in the first instance and then for reference and visual detail later. A series of such raster files can therefore be generated for the same vector base. This is a useful way of tracking changes over time, but the vector data would normally be linked to the current raster set.

4.4.2 Vector data that can be manipulated

This is the data that provides the core data set for upgrading and which also provides the bulk of the output from graphical analysis (queries, buffering etc.). Thus it is important to ensure that there are active linkages between these data sets. This means that if information is changed in one of the data

sets, it also changes wherever it appears in other data sets. Data that enters the system in the first instance as a read only file should, therefore, only be converted to a read-write format if the linkage to the core data set is an active one.

4.4.3 Vector data that is read only

A major benefit of GeoMedia, which was mentioned in section 4.2, is the ability of the software to read the data directly from a wide range of other software systems, covering GIS, DBMS and CAD software. This provides access to a large amount of data that could be used to support the upgrading process. However, the data from these systems cannot be modified, as it is not converted to a new format. It can only be read. This places the information in the category of reference data.

One example of this data that should possibly be treated differently is the CAD file. CAD files are constructed of multiple layers of information. Using this as a reference only file means that these layers cannot be differentiated. There are merits in converting all CAD based information via the transformation programme within GeoMedia. This separates the information into its original layers and then stores each layer separately. The benefit of this is that it can be stored as a database rather than as a CAD file, a format that is both simpler and much more universally transferable later. It is strongly advised that all CAD files be stored in a database format.

4.4.4 Non-spatial attribute data that can be stored in a database format

All data operated on within the GIS platform that can be spatially manipulated is stored in a database format. A major benefit of GeoMedia in this regard is its use of standard database systems. This is different from other GIS software, which tend to favour proprietary database systems. The standard system used is Access from Microsoft. This is useful as Access is widely available and simple to use. However, GeoMedia also operates with Oracle's Spatial Cartridge. This makes Oracle the preferred database system for large or complex databases or where security of access to the database is an issue.

Non-spatial attribute data which can be stored in a database provides data that can be manipulated by GeoMedia, and therefore constitutes an active data source. Once a connection had been set up to the Access database which incorporates the data described in section 4.4.2 above, then it becomes possible to link the vector data to the attribute data. This is a simple operation, which uses what is termed the join utility within GeoMedia. Such a join provides for a relationship between two feature classes or queries to be created, so that the attributes of each can be shared between them in a single resulting query. Finally, data windows can be opened in parallel with map windows and the spatial and non-spatial data used together in an interactive manner. What all of this means though, is that great care must be taken with this type of data to ensure that it remains accurate and cannot easily be modified by unauthorised users.

4.4.5 Raster data which cannot be spatially referenced

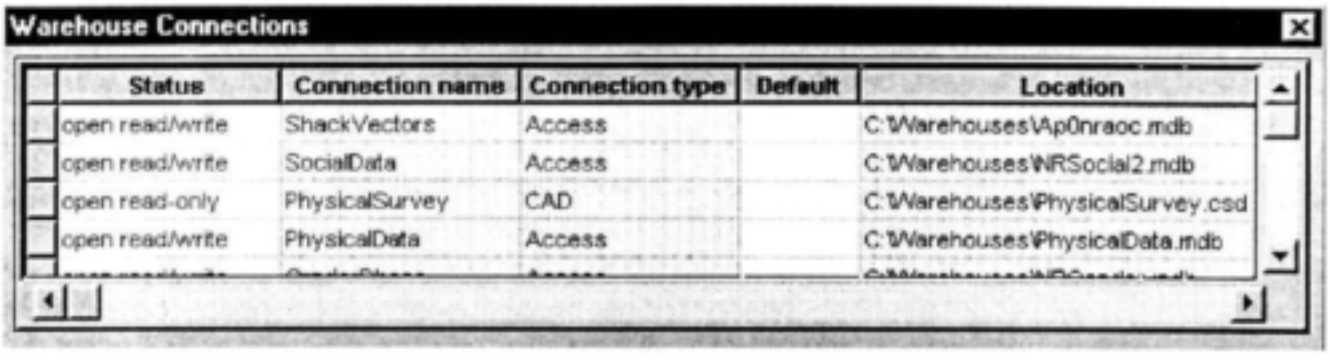
The final category of data set is that which is raster based but which is not spatially referenced. Two examples are given in section 4.10 below. The whole structure of the process that underpins informal settlement upgrading is built upon the management of, predominantly spatial, information. The objective is to benefit people living in the settlement, but the primary vehicle for achieving the goals and objectives centre around the effective collection, collation, management and dissemination of information.

An integral part of a good information management system is the linkage and easy access to all information pertaining to the area and to the upgrading process. All of the categories discussed above fit logically into this concept. What is not so obvious is the use of other information. Yet virtually all information pertaining to the project can be linked to the system. Reports relating to the area or the community, or technical design data, can (and should) be attached, so that everything can be accessed from within one single management system. The important decision relates to the choice of feature to which it will be attached. This leads back to the importance of pre-planning that was raised in section 4.2.

4.5 Managing the warehouses via the GeoWorkspace

The GeoWorkspace manages the project. It contains the map windows, legend tables and coordinate system, as well as the connections to all the warehouses. Their function is to manage the coordinate system, establish warehouse connections, run queries, display data and perform spatial analyses (Intergraph, 1999:11). It is important to note that all warehouse connections are read-only except for Access. This protects the integrity of the data source (Intergraph, 1999:39). All of this information can be accessed by the creation of one or more warehouse connections, following which the map windows and data windows can be used to display the data. If some of this information needs to be manipulated or changed, then it can be saved as read-write data in an Access warehouse specially created for the purpose. Figure 4.2 below shows the warehouse connection system within GeoMedia.

Figure 4.2: Example of different warehouse connections for New Rest



4.6 Physical and spatial data collection

The collection of physical and spatial data can be divided into a number of phases, each of which requires an increasing level of sophistication of technical input. These move outwards from the use of 'own' data through searches for other relevant data sets to the generation of new material. Typically this would comprise the following stages:

1. Collection of information from the geo-referenced raster images.
2. Collection of information from the geo-referenced cadastral data from the Surveyor General's Office or the Directorate of Surveys and Mapping.
3. Collection of information from the geo-referenced vector data sources (typically other GIS-based data in local government or consultancies).
4. Collection of information from the non geo-referenced raster images (typically paper-based maps and drawings).
5. Generation of material from commissioned studies (eg. a geotechnical survey or a stormwater analysis).

This chapter will cover stages 1, 2, 4 and 5 in the four sections that follow. The use of other geo-referenced vector data is similar to the process described for the use of cadastral information, except that each GIS/CAD format will work through its own specific default spatial filter. Each connection will also require knowledge of the coordinate system used in the source file.

4.7 Vector data from the geo-referenced raster images

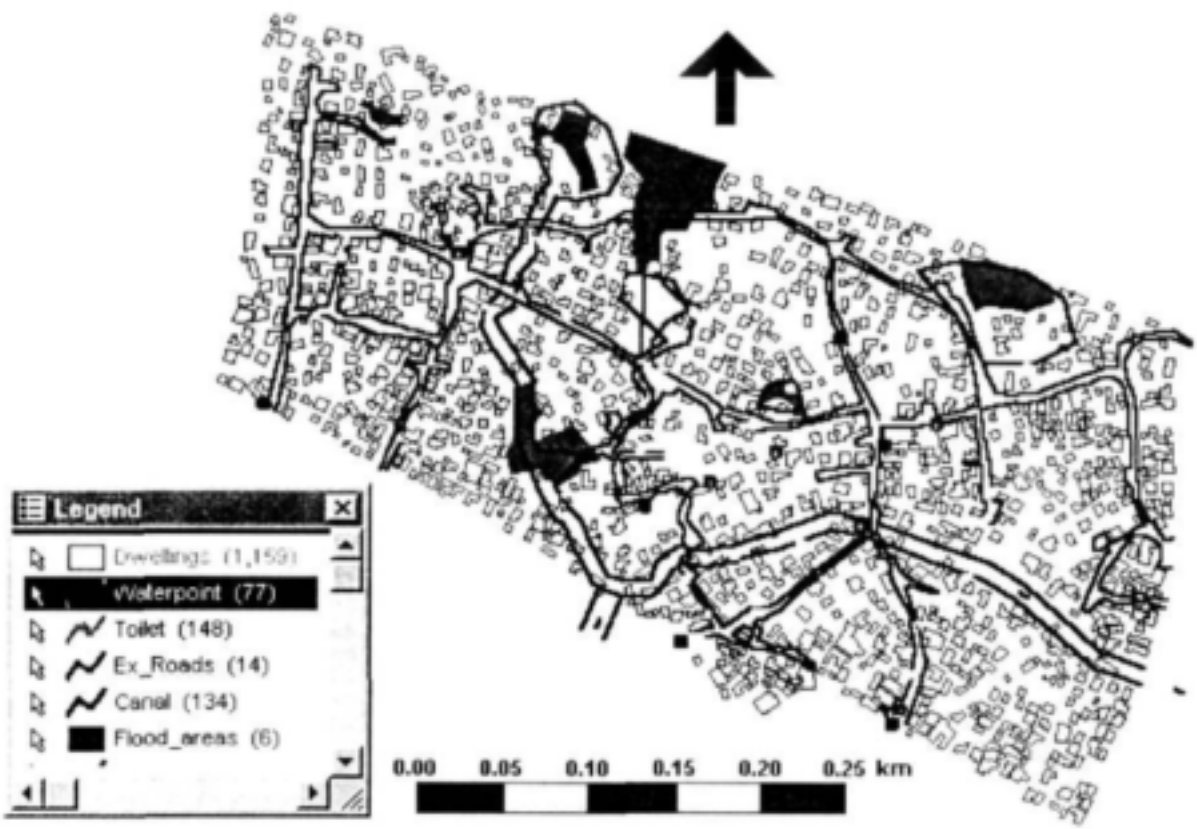
The easiest and most obvious way of exploring conditions on the site is through the extraction of data from the image, which may or may not be combined with site observation. This exercise uses information that is available directly and does not require technical analysis, at least in the first instance. Typical physical data collected in this way for New Rest comprises the following:

- Contour lines (from the associated DTM)
- Vegetation
- Roads
- Shack outlines
- Water standpipes

- Streams
- Telephone poles
- Electricity poles
- Toilets
- Tracks

Figure 4.3 shows the generated map of New Rest with the relevant physical data attached. For New Rest, this information was later verified by an 'on-the-ground' survey. This was done primarily to provide a higher level of accuracy with respect to ground levels across the site than could be obtained by the DTM. This data was then used as input data for the stormwater analysis. This degree of accuracy may not be required for other upgrading projects.

Figure 4.3: Physical site data for New Rest obtained from the aerial survey



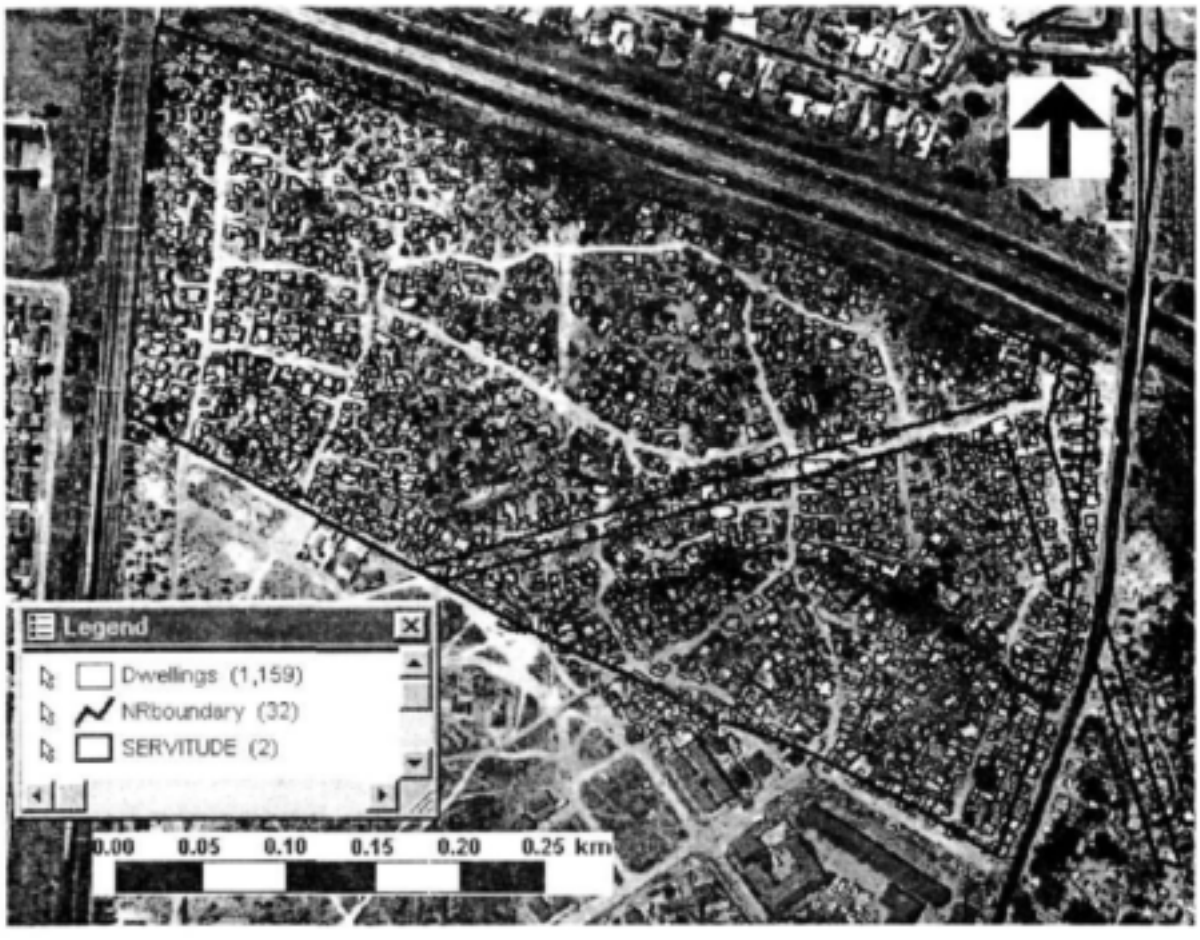
4.8 Cadastral data

Although cadastral data does not necessarily constitute a formative planning input to the upgrading process, it is nonetheless an important data source. Figure 4.4 below shows the cadastral information superimposed upon the shack vector data. The data itself can be divided into two elements. The first of these is the external boundary. At the time the project began nothing was known of cadastral boundaries. As it turned out, New Rest was constituted exclusively from one erf. This meant that there was no need for consolidation. At the same time, the shacks on the periphery of the development ran over this cadastral boundary in a number of areas. However, it was a relatively simple operation to determine which shacks were affected, and this enabled the community to take the decision that all shacks would be brought within this boundary, and that the cadastral boundary would be adopted as the New Rest delineation line.

The second cadastral element that emerged from the records was made up of a number of servitude boundaries. These were found to be marking out trunk water mains. These are a lot more problematic, since they not only affect a large number of shacks, but also distort the access network quite significantly if they have to be accommodated as open space. No final decision has been taken on these servitudes at this stage. However, one compromise could be to reduce the width of the servitudes significantly, and

then create a feature of the routes. The point here is not so much what happens in terms of a solution. The issue in this discussion is really limited to the identification of cadastral boundaries as areas of potential risk and relocation. Determining what exists enables the issue to be defined in terms of its potential impact on the community and then turned into an issue for negotiation.

Figure 4.4: Cadastral data for New Rest superimposed on the image of the settlement and the shack vector data



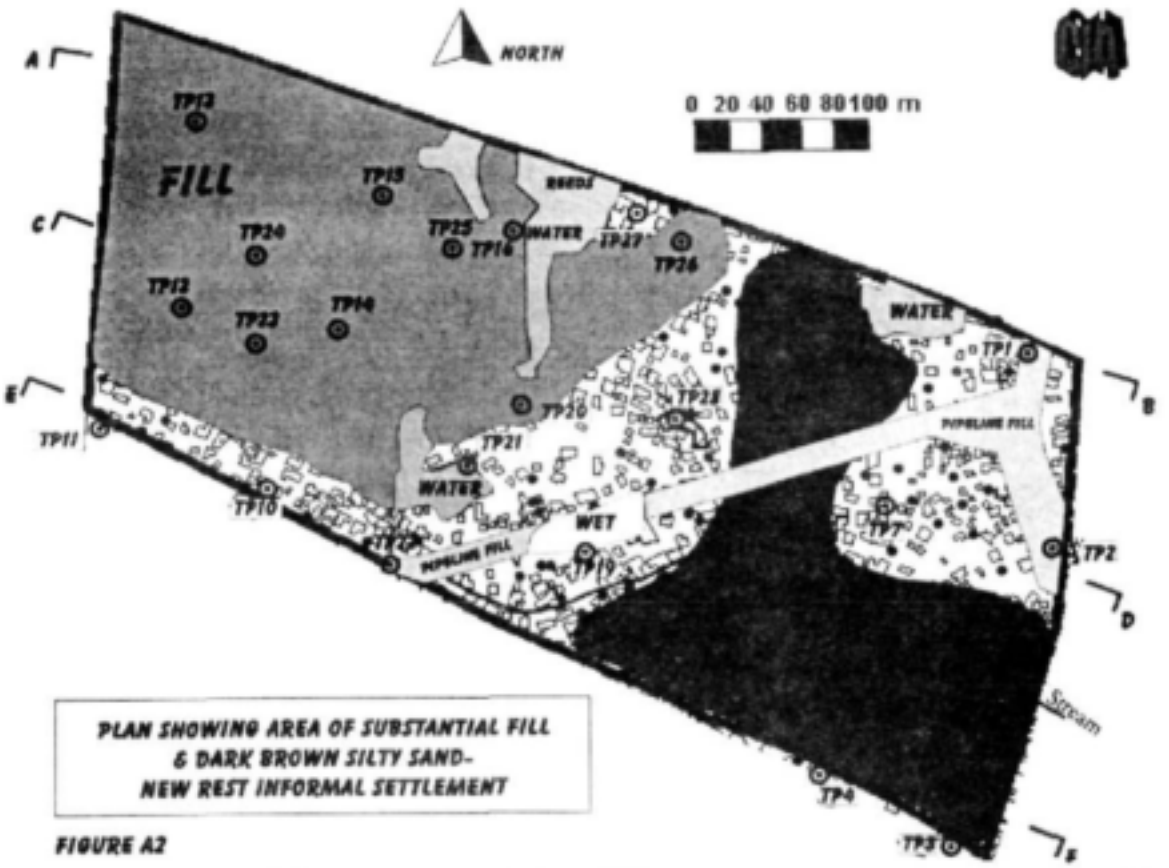
4.9 Geotechnical data

The previous two sections deal with the integration of spatial data that already exists. This can be extended to other data types, such as ArcView or Autocad files. This section deals with the next level of technical sophistication in data collection, which is the commissioned technical survey/study.

New Rest has a number of serious physical problems. Part of the land is low-lying and prone to flooding in the winter. Other parts are founded on fill material of very poor quality. To quantify the extent of the technical difficulty, and provide a basis for evaluating the financial impact on survey provision, a geotechnical survey of the site was commissioned. This provided full details of the extent and scope of the problem/risk areas as defined from a geotechnical perspective.

The main results are shown in Figure 4.5 below. These show the extent of the areas of ground that have been filled with low grade/biodegradable material, and those areas prone to flooding from a high water table in the winter months (this being a winter rainfall area). The flooding risk in New Rest arises from two distinct sources. The first is the rising water table and the second an overflow of stormwater. The impact of the first of these is shown in Figure 4.3 above, while the latter has been quantified by a stormwater analysis carried out by the local authority. The results of the stormwater analysis have not been included here primarily because the major cause of flooding from stormwater derives from water entering the site from upstream. Since it is possible to divert this water before it enters New Rest, this will eliminate the risk completely. And an in-principle decision has been taken to do this. This example demonstrates that the primary purpose of a stormwater analysis in an upgrading situation is to assess risk and derive a cost-benefit analysis.

Figure 4.5: The results of the geotechnical survey of New Rest superimposed on the shack vectors

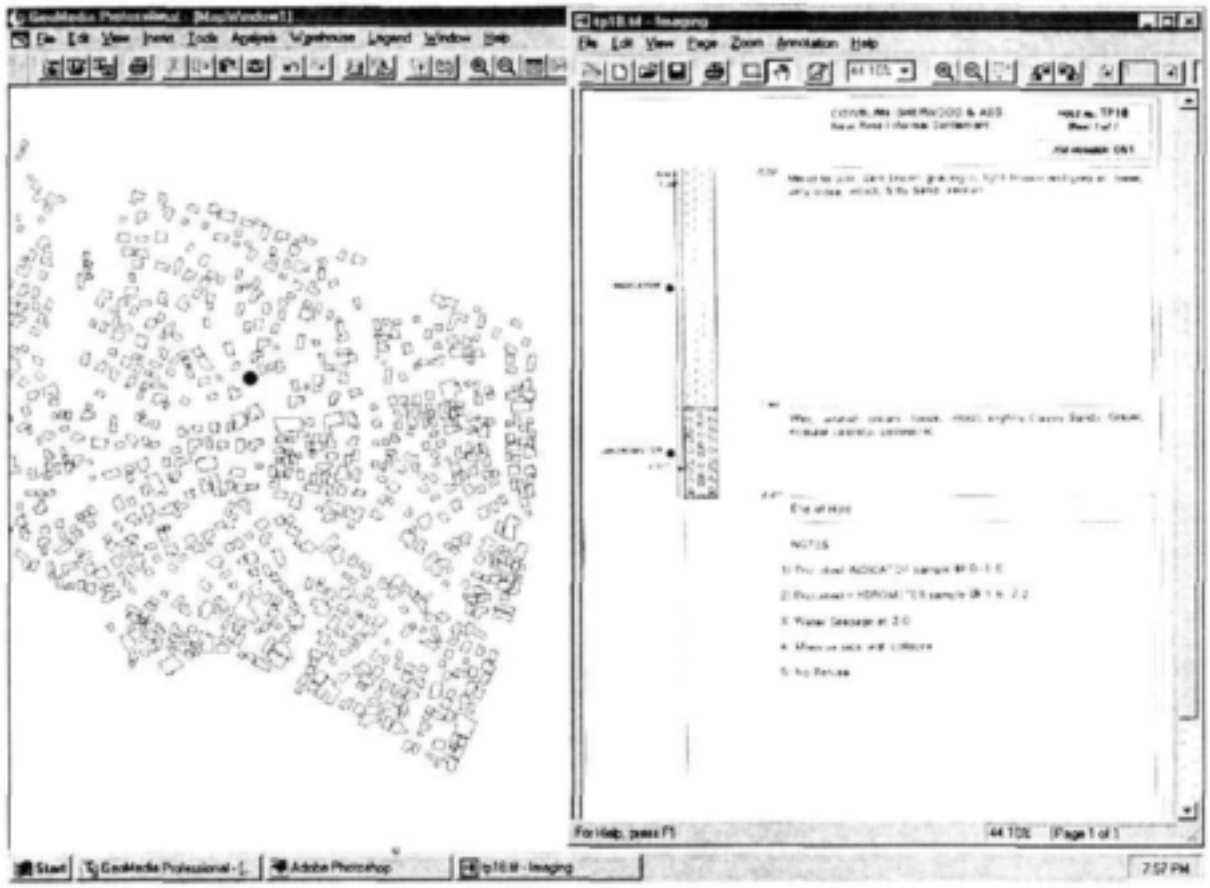


4.10 Attached data

The final discussion that will be provided in this category of physical and spatial data relates to information that has value for the project, but which tends to be specific rather than generic, ie. it may relate to a specific feature. In this case it can be attached as attribute data to that feature. Two examples of this type of data are discussed here.

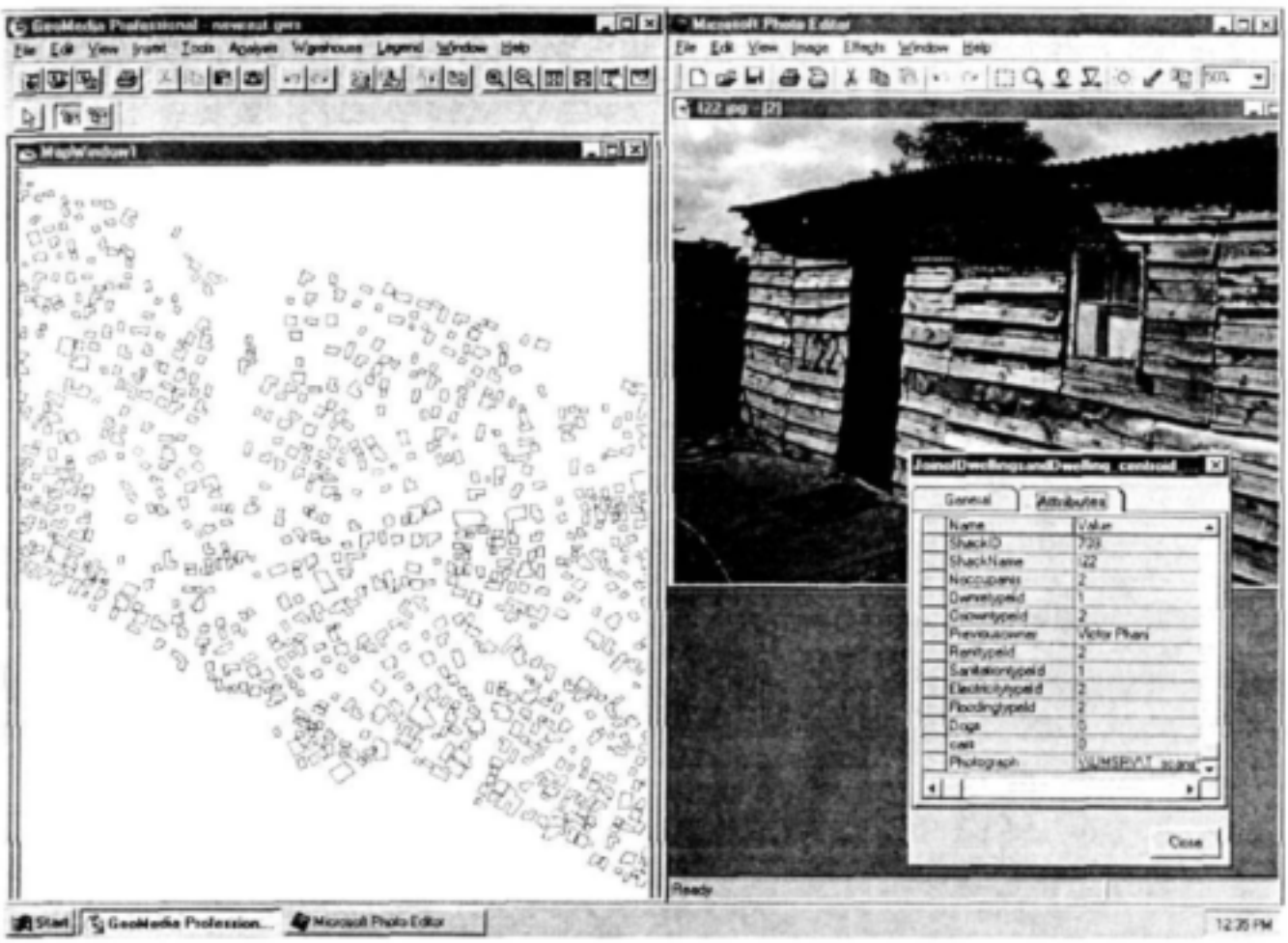
The first example links back to the geotechnical survey described above. The output given in Figure 4.5 above relates to the site as a whole, and is simple to depict on the plan, as well as being most useful in this graphical form. However, there is an extensive amount of additional data that has been generated by the geotechnical study. It is likely that some of this will be required later, at the design stage. In the past the base report could be used as a reference source. However, it should be remembered that what is being constructed here is a full management information system for the informal settlement upgrading process. Hence associated information such as the geotechnical study should be integrated into that wider information system. The way in which this is done is to attach the information to the associated graphical feature as non-spatial attribute data. Thus the whole report could be attached to the cadastral boundary for example. However, the illustration here relates to a more specific item. The output from the geotechnical survey was obtained through the interpretation of soil analyses across a range of depths below the surface. These were extracted from strategically sited trial pits (boreholes could also be used for this purpose). The result is an analysis of the properties of different soils and an interpolation of points of change of soil type to create soil profiles. Figure 4.6 below shows one of these profiles attached to the trial pit, which is itself referenced spatially to the site. The trial pit is therefore a feature and the soil profile is non-spatial attribute data attached to that profile.

Figure 4.6: A diagrammatic output of a trial pit linked to a feature of shack vector data, with the soil profile attached as a non-spatial attribute



The second example relates to the shacks themselves. Each shack is defined as an area (polygon) and has a unique identifier and non-spatial attribute data (in the form of the shack number). The intent in the longer term is to initiate a programme of shack improvement. To this end it is useful to know something of the shack. The New Rest project included a pilot study of housing typologies, which sought to provide a basis for a housing improvement programme. Digital photographs were taken of fifty shacks, representing a range of sizes and construction materials, and an analysis carried out of the materials of construction and the shack layout. Figure 4.7 shows the photograph attached to the shack vector as non-spatial attribute data, together with a house plan of the shack and a description of the shack (which will later be extended to include details of the materials of construction). At present this last one is also attached as non-attribute data, but this could easily be translated into a database format as was done in Brazil.

Figure 4.7: A raster image (photograph) of a shack, plus shack details, all linked to a specific shack polygon as non-spatial attribute data



5. THE SOCIAL AND ECONOMIC ENVIRONMENT

5.1 Defining the objectives for social and economic information

The upgrading of informal settlements seeks to achieve social integration and economic development. This centrality of social and economic goals requires a high level of understanding of the community structure and dynamic. Often much of this is known within the community in a broad qualitative way. However, it is important to add a quantitative dimension to this knowledge if it is to be used effectively.

Broadly, the collection of social and economic data can be seen to address four sets of needs, as follows:

1. Structural development. This requires demographic data in order to facilitate the short-, medium- and long-term physical development strategies. The approach within greenfield site development, whereby physical and social services are linked to the number of dwellings, is inappropriate for informal settlements at this stage. Too little is known of these settlements to be able to generalise on ratios for services such as water, schools or hospitals. This means that provision had to be based on site specific information. In addition, the huge differential between demand and supply, inevitably means that self-help programmes will play a major role in development. These programmes require accurate levels of information if they are to be optimal.
2. Social development. All communities have a degree of social stratification. Upgrading has to be an inclusive process, and this means that it is necessary to identify those less able to participate. In addition, the whole process of social integration means that there is the need to interact with each individual household in the settlement. This is crucial not only for land regularisation and the extension and connection of basic services, but also to deal with the fundamental issues of relocation and access.
3. Gender equity. People living in informal settlements also reflect many characteristics of the wider society. This includes a large gender imbalance and a strong bias towards male domination of the society. Yet women bear the brunt of the social dislocation. A good database is an essential pre-requisite to addressing this imbalance.
4. Economic development. This has to be built on what already exists. This requires information on the level of both skills and economic activity within the settlement.

This chapter deals with the collection of data for use in addressing the needs outlined above. The actual use of the data is discussed in Chapters 6 and 7.

The chapter begins by discussing the questionnaire, the mechanism by which information is gathered. A great deal of experience has been gained in this regard from the Belo Horizonte experience. However, conditions vary from country to country, and this is one area where it is important to structure the data to the specific needs of the location.

Following this discussion, the chapter then moves on to discuss the building of the database. This aspect is absolutely crucial to the project's viability, and became one of the major areas of both debate and research within the New Rest project. Again Belo Horizonte pioneered this work, but the New Rest project revealed some important flaws in that system, and worked extensively to optimise the database structure.

Having gathered the data and created a database structure, the database then has to be populated. This issue is discussed and is followed by a discussion on the dissemination of the information gathered, an issue which is extremely important, and which is a definitive element of local authority-community-professional relations.

5.2 Developing the questionnaire

Chapter 6 of the first report on settlement upgrading (Abbott et al, 2001, 54) provides a comprehensive description of the data gathered in the survey questionnaire for the Alvorada Programme in Belo Horizonte. This data proved to be extremely valuable as a starting point for the Cape Town study. At the same time it was evident, both from studying the Belo Horizonte data and from discussions with AVSI team members in Belo Horizonte, that the data collection process had attempted to cover every single aspect of life in the settlement. In reviewing this experience, the New Rest study concluded that it does

not appear to be necessary to gather such a large quantity of data. To illustrate this with an example, the differences in settlement pattern and housing means that less data is required on housing typology in South Africa. At the same time, on a more general level, the analysis of the Alvorada database revealed that only a small fraction of the data that was stipulated in the data table was actually collected.

The result of this extensive desk study was the adoption of a much more community-driven process of data collection. The starting point was the aerial photograph and shack count, which revealed that there were approximately 1200 families. This was discussed with the development committee, and there was consensus that such a community-driven process was feasible, and that it was possible to carry out a comprehensive survey that would include every family.

A workshop approach was adopted towards the creation of the survey questionnaire, and then a strict methodology was followed in its implementation. Two afternoon workshops were held with the committee to discuss the nature and use of information. In the first of these workshops, the role of the information database within the wider upgrading process was debated. Having agreed in principle that information would be gathered, and having agreed that the information collected would be owned by the community (a core issue), then the second workshop focussed on the detailed nature, and extent, of the information to be collected. From this process six groupings emerged for the data set, comprising:

- Shack data, including details of ownership.
- Detailed information on the head of household.
- Employment and skills data related to the head of household.
- Information on the spouse/partner.
- Information on dependants.
- Information on other shack residents.

Each of these groupings was then found to require a different level of detail.

The second workshop culminated in a draft questionnaire. It was also agreed at that workshop that the survey would be carried out in English. This decision was made by the committee, who felt that it was unnecessary to translate the survey into Xhosa. This worked reasonably well, but did create some problems when the interviewers were asked to elaborate on questions. When this process was reviewed, the feeling of the social worker in particular was that these problems would have been significantly less had the questionnaire been in Xhosa. This is clearly an issue that requires further discussion debate in a wider forum.

In respect of the survey mechanism, 12 people were identified from within the community to carry out the survey. 10 of these were to interview, giving them approximately 120 interviews each, while two were given further training and made responsible for checking and validating the questionnaires. All twelve were taken through the techniques of interviewing, and then split into two groups, with an interviewer and an interviewee chosen within each group. The resulting questionnaires were discussed and modified in the light of that discussion. Each of the interviewers then conducted two surveys within the community, and the twenty questionnaires were again discussed and analysed. From this second discussion the final changes were made. Once this had been done the full survey was carried out. It was not considered necessary to carry out a five percent survey as an intermediate step, as was done in Brazil, and this remains the view of the team. There was a final checking process when the data was entered into the computer. This is an important distinction when compared to random surveys. Because information is related to specific households, there is this further checking element built into data capture. The final list of questions, converted to attribute data structure format, is shown in Table 5.1 below. This shows a total of 61 records, which will further increase as several of the categories (eg. child data) are duplicated. This issue is discussed further in the next section.

Table 5.1: The attribute data types captured from the new Rest questionnaire

Dwelling	
	ShackID
	ShackName
	Number of people living in shack
	Is the shack owner resident?
	Is the owner of the shack the original owner?
	Name of previous owner
	Is the owner paying rent or other money for staying in this shack?
	Type of sanitation used
	Does the shack have electricity?
	Does the shack get flooded in winter?
	How many dogs belong to the residents of this shack?
	How many cars belong to the residents of this shack?
Shack owner	Surname
	First names
	Id number
	Year of birth
	Gender
	Marriage status
	Whether the marriage is legally registered
	How many children does the owner have
	Nationality of owner
	Home language of family
	If the owner is male, has he a wife elsewhere?
	Number of years staying in New Rest
	How many children are staying with the owner at the time of survey
	How many children are staying elsewhere at the time of survey
	Previous residence
	How many relatives are staying with the owner at the time of survey
	How many friends or lodgers are staying with the owner at the time of survey
	Does the owner (legally) own any other property/house elsewhere
	Tenure type (ownership/rent /tenant /none)
	How much time during the year does the owner spend in New Rest
	When the owner visits elsewhere for more than three days, where do they usually go to?
	Has the owner any other relatives staying in New Rest
	When the owner reaches pension age, where would he / she like to stay
Employment	Employment (none/ informal inside New Rest/ informal outside New Rest/ formal)
	If inside New Rest, what is the nature of the business
	What is the income of the shack owner
	Amount of any other additional income from the owner's spouse and children
	Highest standard of school education of owner
	Highest skills/ training qualification of owner
Spouse	Surname
	First names
	Year of Birth
	Gender
	Number of years staying in New Rest / Kanana
	Highest standard of school education of spouse
	Highest skills / training qualification of spouse
	Previous residential area of spouse (where spouse stayed before moving to New Rest / Kanana)
Children	Year of Birth
	Gender
	Current / Highest education level
Others	Surname
	First names
	Year of Birth
	Gender
	Nationality
	Relation to owner
	Number of children
	Highest education qualification
	Highest skills of qualification

A period of two months was allowed for completing the survey. It was anticipated that the interviewers would carry out four surveys a day (it being recognised that they were not professional interviewers), and that they would also need some time to revisit families once checking had been carried out. Interviewers were paid fifteen rands per survey and validators five rands per survey. This amount was high, but it was felt important to motivate the interviewers to carry out an intensive, accurate and detailed survey. The

time scale that was programmed proved to be a good estimate for the initial survey, although checking and correction of data took longer than expected, due to its linkage with the data entry process. Overall the survey took approximately four months to complete.

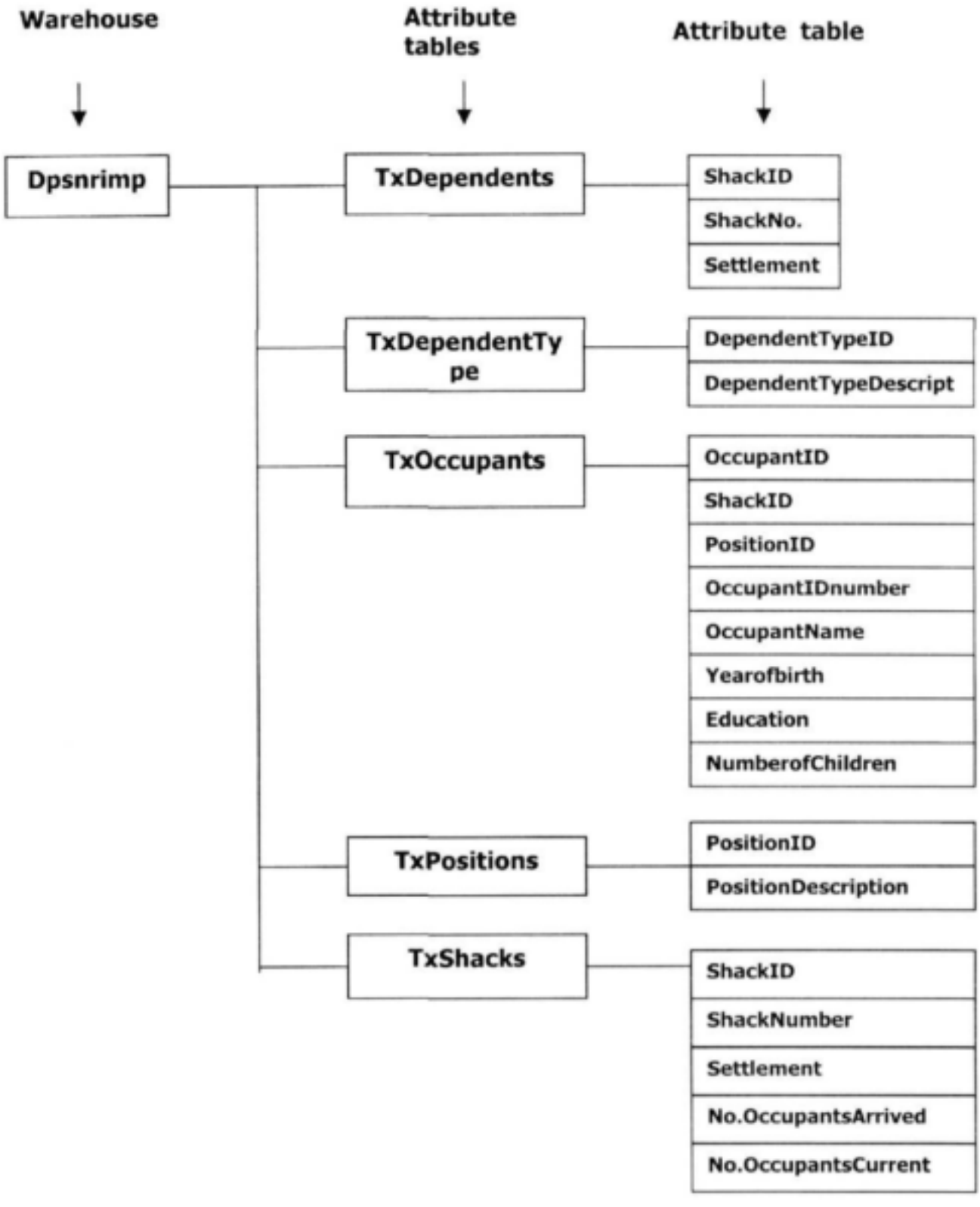
In reviewing the process, it should be remembered that this project was a pilot for South Africa and was breaking new ground in the type of work it was performing and the scale that it was working. Hence the response of community members to this type of probing survey, for example, was not known. In practice the survey proved to be quite feasible, and well supported in the community, and was later extended to a further 1500 families in Kanana. Certainly if this methodology was adopted on a wider scale it would be possible to streamline this entire process quite significantly.

5.3 Building the database

There are a number of ways of organising a relational database. The Belo Horizonte approach was to construct one single, large database, where all of the information collected on one questionnaire would constitute a single record. However, an analysis of this database showed it to be very inefficient, both in its use of space and its accessibility. Each question requires its own field. This is manageable when the majority of fields have information attached. However, there are problems when it comes to the issue of children and other residents. There, provision has to be made for the maximum number of children and the maximum number of additional residents. In New Rest these numbers were 12 and four respectively. For each child there were three questions and for each additional resident nine questions. Thus 12 children generated 36 fields and four residents a further 36 fields. For those shacks where there were no children and no other residents (the extreme case) this would leave 72 empty cells populated by zeros. When this is averaged over 1 200 families (for New Rest) or even 2 700 families (New Rest plus Kanana), this clearly becomes both wasteful and difficult to manage.

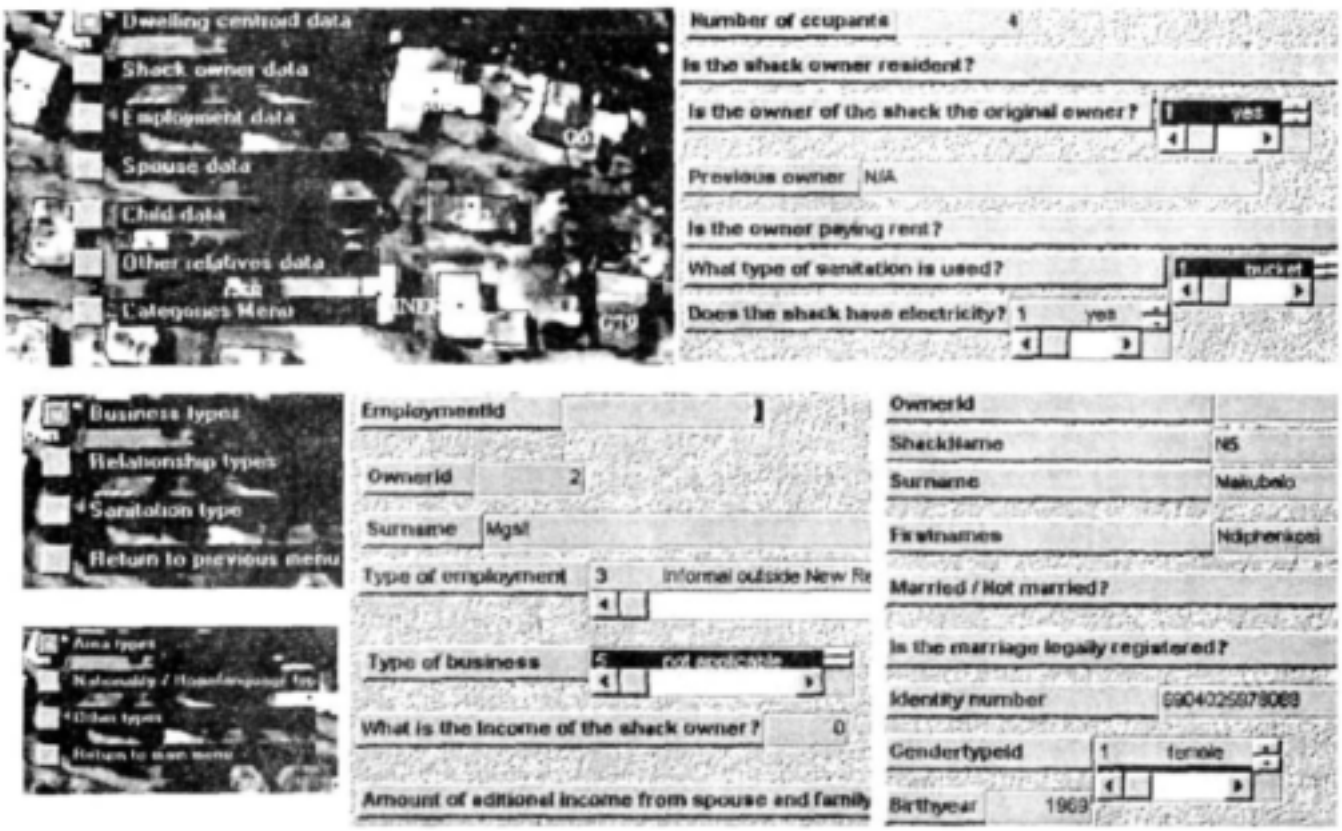
Based upon this analysis, and a subsequent internal review of options, the first solution that was proposed was to create the skeleton of the attribute database within GeoMedia itself. The structure of the tables that was set up is shown in Figure 5.1 below. Having worked with this idea for a while, however, it became obvious that it would be far more convenient to retain the attribute database on Access, and then to create linkages between the GIS platform and the Access database.

Figure 5.1: The structure, contents and linkages of the attribute database within GeoMedia



The preferred option then moved back to an Access database, but an alternative was required to the single database. The solution chosen was a linked database, which was to be built around the six groupings of data described in section 5.2 above. In order to facilitate the data capturing process, a specialised Access database interface was developed. This comprised a main menu and several sub-menus and forms. The forms were developed to aid community members in the process of typing in or selecting the attribute data for each of the record tables. Figure 5.2 below shows the Access interface that was developed for entering the attribute data. Shown here are the main menu, the sub-menus and several of the forms.

Figure 5.2: The Access database interface

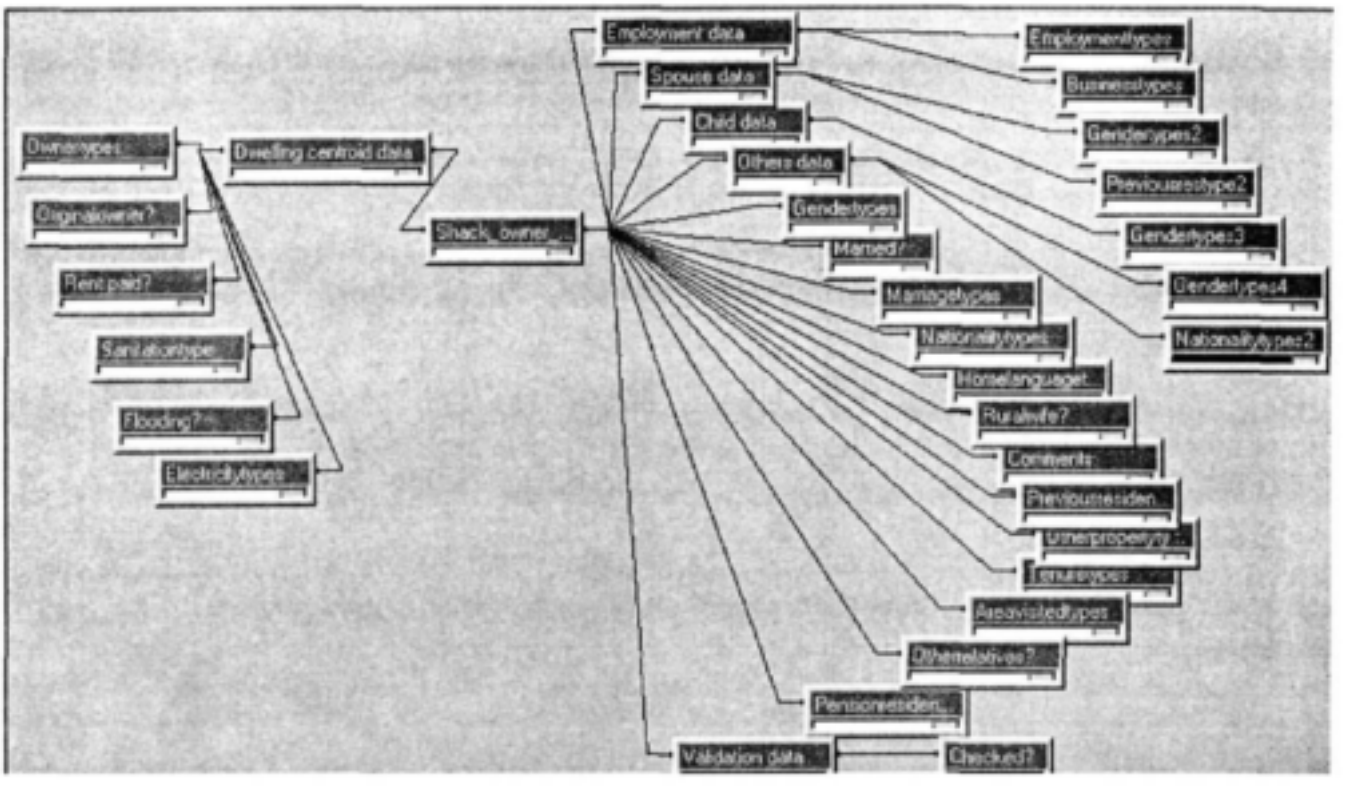


The various elements shown in the interface diagram in Figure 5.2 are linked through a series of auto-numbers. The auto-number data type represents a field data type that automatically stores a unique number for each record as it is added to a table. The numbers generated by an auto-number field cannot be deleted or modified. An example of a data field in the New Rest database that was set up as an auto-number data type is the "OwnerId" field in the shack owner data table. Similarly, other tables that were generated to contain information associated less directly with the shack owner (ie. data on the spouse, children, relatives of the shack owner and on the employment of the owner) were also set up with auto-number fields (eg. "SpouseId" etc.). However, in addition to these table-specific auto-number and other data fields, each of these tables also contain a text data type field called "OwnerId". The value for this field is determined for each record from the shack owner data table. The reason for repeating the "OwnerId" field in the different tables, as an auto-number field in the first case and subsequently as a text field, is to enable the various tables to be linked and analysed as a single database.

The linkages between the different tables in the New Rest database is shown in the relationships diagram in Figure 5.3 below. The database has been structured in this manner in order to conserve space. Furthermore, where possible, the interface has been designed in such a manner as to reduce the amount of typing. This has been possible by creating list boxes. An added benefit of applying such list boxes in the form design is that it reduces the total database size. For example, the data on the gender of each individual shack owner is stored as a value of either 1 (female) or 2 (male). The same is true for the data on business types, home language, previous residence and several other data types. In retrospect, it is worthwhile to spend a significant amount of time up front in incorporating the list box concept as far as possible into the design of the attribute database interface. An example of where the application of list

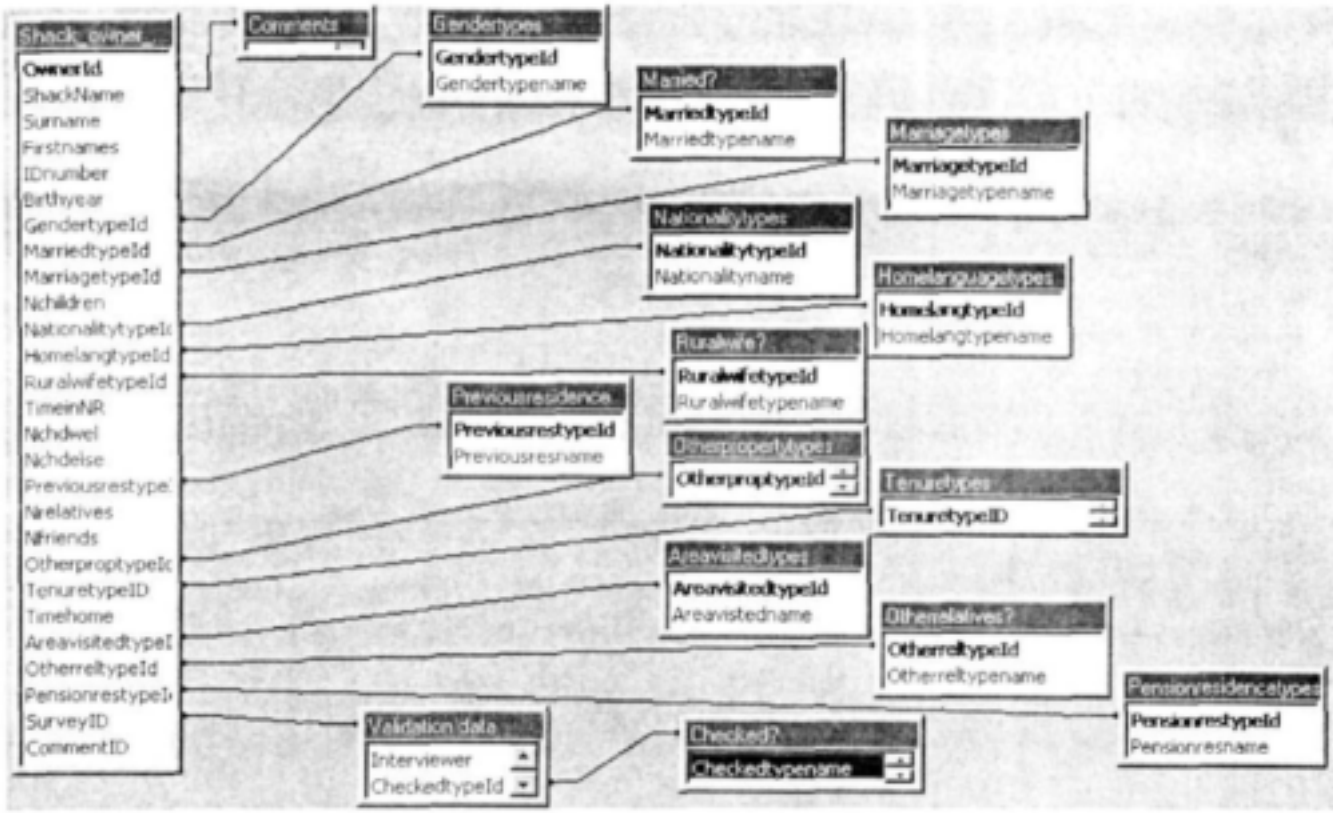
boxes would have avoided problems in the New Rest database development process is in the definition of the level of education data box. In the current interface this data field was set up as a text box. As a result, a multitude of spelling mistakes and inconsistencies in character spacing and case occurred during the entering of this data.

Figure 5.3: The relationship table for the New Rest database



The primary disadvantage of this application of list boxes in the design of forms for the attribute database interface is the resultant, quite significant, increase in the complexity of the database. In particular, there is a significant increase in the number of tables. Figure 5.4 illustrates the large number of sub-tables embedded within the shack owner data table alone.

Figure 5.4: An example of over-extensive use of sub-tables as illustrated by the shack owner data table



Initially, it appeared as if this database structure was working well. A wide range of thematic maps was generated and this provided extremely useful information for the community leadership and the wider community. In this way at least it demonstrated the benefit of having the social and economic information for structural development. However, it proved to be extremely ineffective as a database management tool. There were three reasons why this was so. The first related to the logic structure. The range of different auto-numbers generated proved to be far too great, and caused confusion among those capturing the data. Later analysis, discussed briefly in section 5.4 below, showed that different auto-numbers had been used for cross-linking purposes, leading to incorrect linkages. Following from this was the second reason why it was ineffective, and this related to quality control. The complexity of the cross linkages made the checking of the data meaningless (although this was not discovered until later). Thus a record would be checked, and would appear to be correct, but it the checking focussed on data and did not extend to the auto-numbers. Hence the faulty linkages were not picked up. Finally there was a problem with data analysis. The difference between a random survey and a comprehensive survey was mentioned earlier. Initially this was also thought to extend through to the use of data, and to some extent it does. Thus while the primary objective of the random survey is to generate statistical data about the community as a whole, the primary objective of the comprehensive survey is to generate data at the level of the household, for attachment to the shack vector.

This worked well for the first set of thematic maps (which provided information grouping individual families). However, when the gender analysis began it was necessary to separate male- and female-headed households, and there the linked database proved to be extremely inefficient and ineffective. Thus it showed itself to be a very poor database structure for analysis.

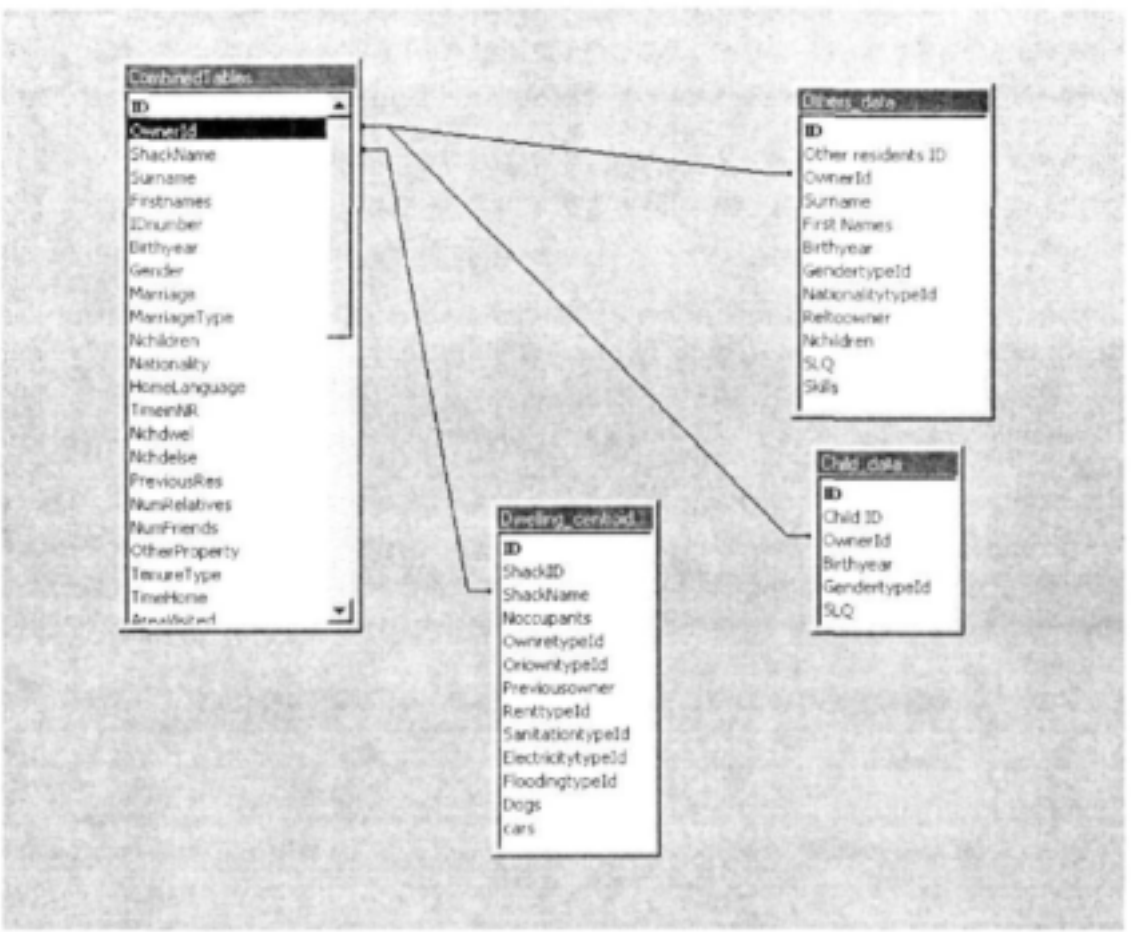
When the December 1999 aerial photograph was analysed in February 2000, it became clear that the changes in shack layout required an update to the social and economic survey. The need to review the data, coupled with the problems described earlier, led to a rethinking of the structure of the database. The outcome was a new, hybrid, database structure. The first four information groups discussed in section 5.2 were combined into a single database table. This was quite effective as this represented the bulk of the data captured and thus limited the number of empty cells. However, the data relating to children and other occupants was retained in separate tables and linked to the main table as described earlier, although with a much simplified auto-numbering system.

This transformation proved to be relatively straightforward and was carried out by using Excel as an intermediate data storage system. The different data tables were moved across to a set of corresponding spreadsheet tables, which had been set up to provide the same field headings. These were then merged into a single spreadsheet using the shack auto-number ("ShackId") and the owner auto-number ("OwnerId"). Errors in cross linkage were eliminated at this stage and all excess auto-numbers removed. Child and other residents data was also verified, although the separate data tables were retained. A new Access table was created with the same field headings and the transformation from Excel to Access carried out.

The structure of this hybrid database is shown in Figure 5.5 below. This has proved to be the most successful database structure and is the one recommended for large-scale use.

The last point to note about the database structure relates to the definition of the core auto-number. In the Belo Horizonte project, this began as the shack identifier. However, this proved to be problematic when there was more than one family per shack, since there was no way of de-linking the family from the shack. Hence two identifiers were established, one for the shack and one for the family. This system was retained for New Rest and is recommended for widespread use.

Figure 5.5: The final hybrid database structure adopted for New Rest



5.4 Populating the database

Four members of the community were identified who had received basic computer training. These four were then set a basic test in computer literacy and word processing and the best two were employed by the project and trained to enter data into the Access database. They worked reasonably well, to the extent that one of those trained remained on the project and is being trained as a GIS operator. Once all the data capturing work is completed for Kanana she will then return to the community and operate the community's own GIS system.

The biggest single problem in this exercise of populating the database was quality control. This proved to be almost impossible in the multi-category linked database structure, although this did not become evident until later. The transformation from a linked database back to a single database was carried out by converting the Access databases into Excel format and then merging the different spreadsheets. The newly merged spreadsheet could then be converted back to Access. This highlighted the problem of multiple identifiers described in the previous section. Where common identifiers were used these could be used to match the different data sets in a single spreadsheet. Often though, these were shown to be inaccurate and matching simply did not occur. To correct this problem the data was re-entered almost in its entirety in a spreadsheet format and then converted back to the unified Access data table.

The populating of the database, and the problems associated with this, led to a major revision in the questionnaire format. The initial questionnaire had used direct inputs rather (eg. numbers and place names) than using ticks in boxes, as would be common in the random social survey. This was a deliberate choice, which was heavily influenced by the decision to use a linked database structure. The evaluation exercise, which incorporated the experience described above, showed this to be the wrong decision. This, of course is something that would have become evident had the survey gone the route of having a five percent sample survey first, and carrying this through into the data capture and input process.

Finally, in respect of quality control, this was carried out in the unified database by random checks of questionnaires. But this was simply not possible with the linked survey, due to the complexity of the cross linkages and the difficulties of following these through. Effectively they ran vertically through distinct information sets, whereas the questionnaire represented a horizontal cut through all of the individual data sets.

There is no doubt that this experience of constructing and using such a comprehensive database has proved to be one of the most important lessons gained from the New Rest study. The construction of a workable and replicable social and economic database is absolutely essential to the mainstreaming of the upgrading methodology.

5.5 Ownership and disseminating of the social and economic data

An important element within the upgrading process relates to the ownership of the data. This type of survey differs significantly from a random survey. The primary purpose of a random survey is to generate statistical data. This data is generally owned either by the body paying for the survey or by the company carrying out the survey. Rarely, if ever, is it owned by those being surveyed. Whilst this might be questionable in terms of basic principles, it is an academic debate, since it does not provide information that can be linked back to individuals.

The community survey used for upgrading represents a very different situation. The community database is extremely detailed, and goes far beyond the random social survey both in scope and in depth. Thus it covers not only very family, but also every individual living in the settlement. It also provides extremely detailed information on some of those individuals, particularly the heads of household. For this reason ownership and use of the data becomes extremely important. It is argued here, and this is the case for both New Rest and Kanana, that the database should be the property of the community, and should only be used with the permission of the community. In this project the study has been funded by an external donor, and the community has accepted that the project is a case study. For this reason it is important to disseminate the findings. Even so the level of information published here is quite general, and is presented in such a way that it cannot easily be traced back to a specific family or individual.

This acceptance of the ownership of the data belonging to the community is an important test of both the local authority and the professionals. If there is a real commitment to partnership between the local authority and the community, then the ownership of the data will not be in dispute. Ownership will lie with the community regardless of who funds the survey. If this is not the case, then the project is not a partnership and the community is being used and probably manipulated by an external party.

This does not mean that others should not have access to the information. The construction of such a database provides the framework for an inter-active education process between community and professionals, which operates in two directions. Because each family is interviewed, this presents an opportunity for everyone to be informed of the project and to discuss it. This is a process that has immense value in deepening the community participation process and has been shown to work in South

Africa as well as Brazil[1]. At the same time it allows the professionals to get to know the community on the ground and to obtain an understanding of the problems to be dealt with at first hand. Again, this has immense value, particularly when it comes to defining infrastructure needs and the relationship between people and place. What is important is that the use and extent of the information by others is clearly defined at the beginning of the project before the survey is carried out.

[1] The first author carried out two comprehensive surveys of this type on upgrading project in the 1980s, both of which demonstrated the value and validity of this method (see Abbott, 1989 and Abbott and Russell, 1991).

6. THEMATIC MAPPING

6.1 Introduction

Chapter 5 set out the four sets of needs to be addressed by the social and economic survey of the community. These related to structural development, social development, gender equity and economic development. This chapter deals with the way in which the data gathered in the survey can be used to provide a spatially referenced graphical output that will then provide the information base for these four different areas of need.

This section seeks to illustrate the difference in the way that information is used, between a greenfield development and an in-situ upgrade. In the former, basic statistical data can be used to provide the input for a wide range of public and private services, with location being determined externally by professionals. With in-situ upgrading, not only does the information vary from settlement to settlement, it can also vary significantly across a settlement. Hence much of the information needs to be spatially reference. A good example of this is economic activity. If the development is to provide economic benefit, then an important element has to be the existing economic activity. At the same time, it is possible to extract more general statistical data for planning purposes.

The purpose of this chapter is not to provide a comprehensive example of every set of data output. Rather, it seeks to set out the framework and give examples for each of the four main sections. At the same time, however, it is recognised that there is very little detailed data available on informal settlements in South Africa. Hence this chapter seeks to illustrate how a profile of the community might be generated, that would then assist in developing a deeper understanding of settlement dynamics. The chapter does not go into an analysis of the information per se.

Finally, a comment needs to be made about the focus of the data. The primary objective is developmental. However, the major focus is on the head of household (being considered here as the person owning or leasing the shack). This contradicts to some extent one of the wider goals of settlement upgrading, namely social integration. To meet this goal effectively there should be a more equitable distribution of the focus to cover all residents, including tenants. This contradiction is recognised. The reason for the bias in focus derives from the need to situate the development within the national housing policy, which recognises only the head of household for subsidy purposes. This is not an ideal situation and creates a number of social problems in its own right.

6.2 Structural development

This section deals primarily with the basic demographic data. Informal settlements in South Africa tend to have young populations. At the same time they are also characterised by fragmented families. A major unknown with respect to the future growth pattern of the settlement relates to the extent to which upgrading will reduce this fragmentation by, for example, bringing children currently at school in the rural areas into the settlement.

The important issues to be identified under this section are as follows:

- What is the density distribution of the settlement population (ie. the occupancy level of the shacks) (Figure 6.1)?
- What is the age profile of the settlement (Figure 6.2)?
- How many children are of school going age, and how many of these live elsewhere (Figures 6.3 and 6.4)?
- How many tenants are living in the settlement (Figure 6.5)?
- What is the household income distribution (Figure 6.6)?

Figure 6.1: Density distribution in New Rest

Figure 6.2: Age distribution in New Rest

Figure 6.3: Number of dependents (children under 18) in New Rest

Figure 6.4: Number of children of school-going age currently living elsewhere

Figure 6.5: Number of tenants in New Rest

Figure 6.6: Household income distribution in New Rest

6.3 Social development

Social development objectives apply to the wider community (the social integration of the informal settlement into the wider community) and to the individual within the settlement. The mechanism for dealing with this is the social support system, which is discussed more fully in Chapter 7. By its nature, this system collects information by detailed open questions. These questions are not included in the broad questionnaire used for the social and economic survey, which is highly structured and where the

questions generally fall into the "closed" category (ie. each question requires a specific, clearly defined answer). Hence the role of the questionnaire for social development is limited to providing an overview of social structure.

The important issues to be identified under this section are as follows:

- Nature of ownership of the shack (not shown as ownership is almost 100% in New Rest).
- Length of stay in the area (Figure 6.7).
- Place of previous residence (Figure 6.8).
- Home language (not included here as all residents have the same home language, namely Xhosa).

In addition, the information provided in the next two sections, which relate to economic activity and gender, also provides important base data for social development.

Figure 6.7: Length of stay in New Rest

Figure 6.8: Previous place of residence

6.4 Economic development

Economic development is one of the two primary objectives of informal settlement upgrading. Clearly then this data set is an important one for the process. The first issue is to determine the nature of the employment status within the area. This section deals only with the head of household, but can be extended to incorporate all residents of working age.

The survey defined four categories of employment, namely formal employment, informal employment outside of New Rest, informal employment within New Rest, and no definable income stream (Figure 6.9). The survey did not include urban agriculture, which is not of major significance in New Rest, but could be in other areas. Nor was it considered viable to obtain a breakdown of activities classified as illegal (eg. soft drugs dealing), although much was known of these activities in the settlement.

Once the initial breakdown has been obtained, then the next step is to look at the nature of employment within the settlement itself (Figure 6.10). This group of self-employed people will become one of the building blocks of the future development.

The second building block of economic development is the existing skills base, particularly among the unemployed. This information has not been shown. This data can be used to provide an indication of where training can be targeted for most benefit, for providing skilled labour and expertise once the physical development of the area commences, and for helping individuals to find employment outside the settlement.

The third building block of economic development is academic educational level. Figure 6.11 provides a breakdown of highest qualification obtained.

Figure 6.9: Breakdown of employment by category in New Rest

Figure 6.10: Informal sector activity within New Rest

Figure 6.11: Standard of education

6.5 Gender equity

Gender inequity, like poverty, is a complex and multi-faceted issue, which goes far beyond quantitative analysis. Some of these wider ramifications are covered in Chapter 7. This chapter focuses on providing the data related to gender inequity and, as such, is intended as one of the inputs into the broader qualitative analysis.

The previous three sections have focused on the direct representation of data through the medium of thematic maps. They have not dealt with the analysis of the data per se. This is a project specific process while the purpose of this report is to demonstrate a generic methodology. In this section on gender, however, the report will go a little deeper into the use of the GIS, by illustrating the power of this medium to provide analytical data through the filtering and merging of primary data sets.

The starting point for data analysis, from a gender perspective, derives from answering two questions. The first gives the overall gender breakdown across the entire settlement population, while the second looks specifically at the gender composition of head of household. The first piece of information can be obtained from running a query on the database. This indicates that there is a relatively even demographic balance between the genders in New Rest. Of the total population (adults and children) there are 51.4% males and 48.6% females. Moving on from there, Figure 6.12 shows the gender breakdown of head of household. From this figure, it can be seen that women head approximately 40% of households.

To gain a greater insight into the implications of this split, the first step is to divide the main database table into two separate but parallel tables. Much of the information that was described in the previous three sections can then be duplicated on a gender specific basis. The second step is to filter or merge data sets in order to see the impact that this has on women in the settlement. Four sets of data have been generated to demonstrate this (ie. the data is shown separately for male- and female-headed households). Some implications of this data are discussed in Chapter 7, where the gender issue is discussed in greater detail. This section limits itself to the description of the data sets generated. Because this data provides valuable information for the settlement as a whole, it has been provided here in the form of a bar chart, rather than being spatially referenced, although clearly the latter format is also important.

The first data set (Figure 6.13) deals with the total number of occupants per household. The second data set (Figure 6.14) shows the (average) number of dependants per household actually staying in the settlement, while the third, related data set (Figure 6.15) shows the total number of dependants (again as an average figure). The figures clearly indicate that, in New Rest, the burden on female-headed households is significantly greater, ie. they have more children in total as well as more staying with them in the settlement. When coupled with the fact that these are predominantly single parent households, this responsibility clearly reduces their opportunities for both interaction in the upgrading process and for improving their own personal conditions. This is then reinforced by the last data set (Figure 6.16), which shows the income distribution by head of household. Again the situation is worse for women, with median incomes being significantly lower in female-headed households.

Figure 6.12: Gender breakdown of head of household

Figure 6.13: Number of occupants

Figure 6.14: Average number of dependents (children under 18) living in New Rest, by gender of head of household

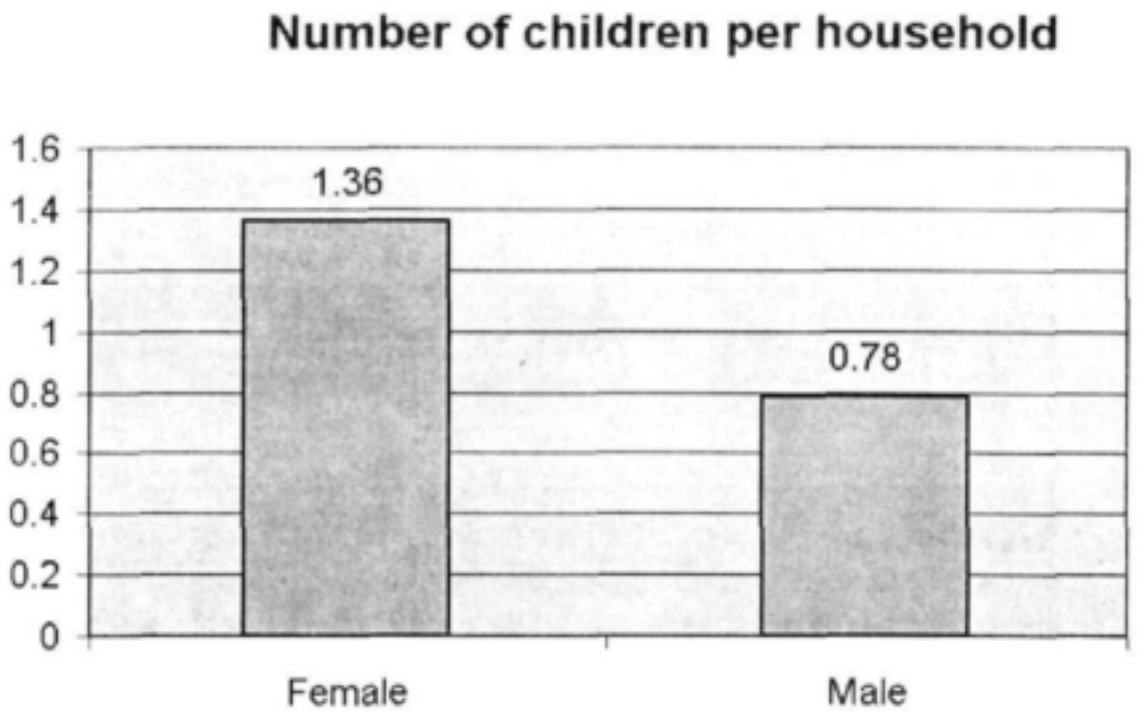


Figure 6.15: Average number of dependents (children under 18) living in New Rest and elsewhere, by gender of head of household

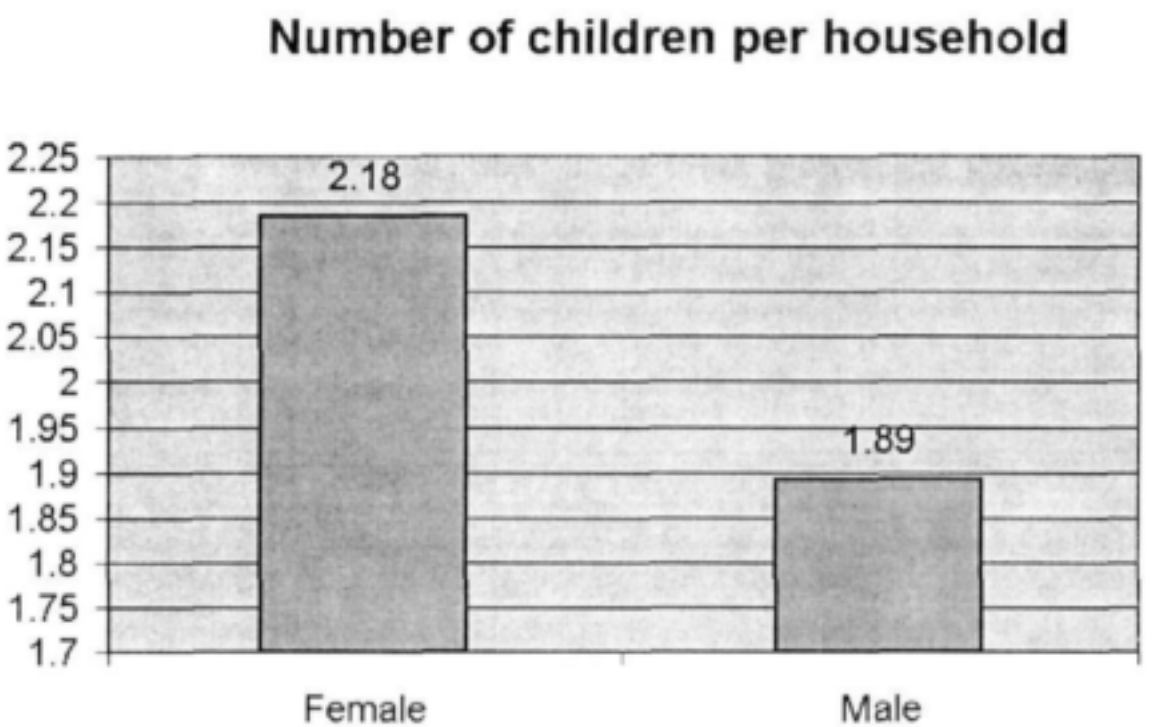
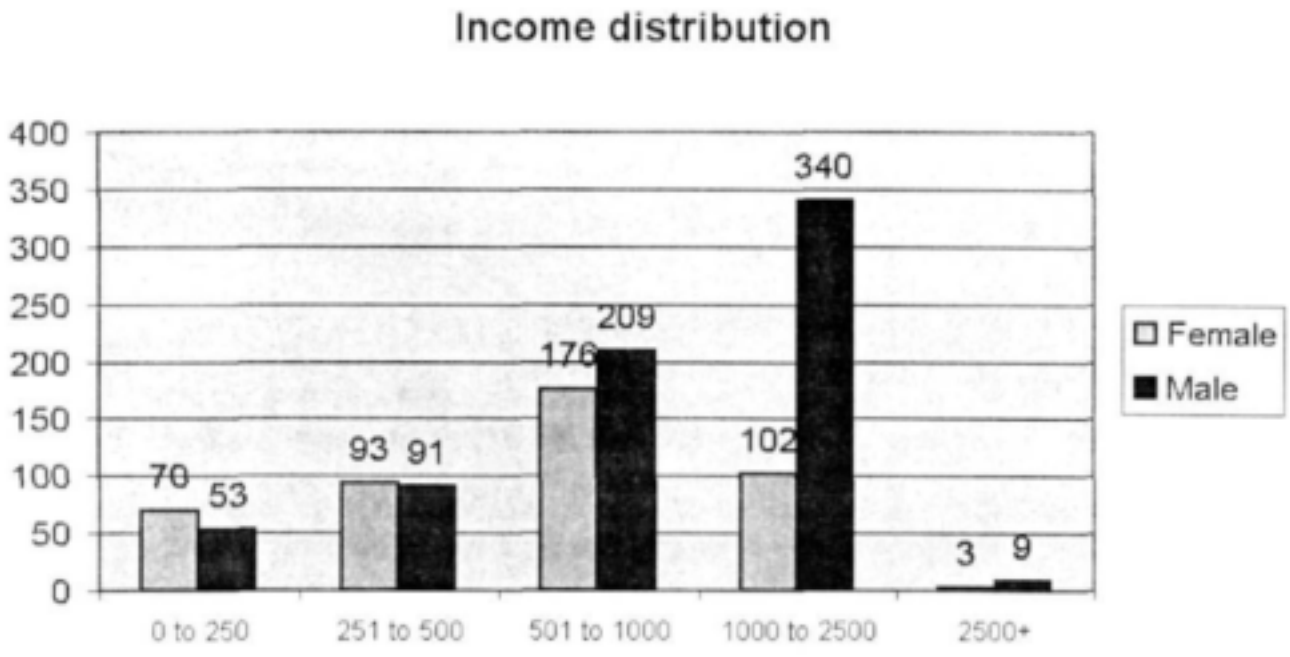


Figure 6.16: Household income distribution in New Rest by gender of head of household



6.6 The importance of social and economic data

There is clearly a vast amount of information that can be obtained from data sets such as those presented here. However, as mentioned above, the primary objective is to describe the wider methodology rather than detail the project. However, the information that has been provided shows the vital role that the social and economic study plays in in-situ upgrading. If social integration and economic development are to be the primary goals of upgrading, then this information becomes the most important building block in the long-term development of the project.

7. THE INSTITUTIONAL FRAMEWORK FOR INFORMAL SETTLEMENT UPGRADING

7.1 Introduction

Chapters 3 to 6 dealt with different facets of data capture and data management. However, the tasks described there can only succeed if there is a social and institutional framework within which they can operate. It is the creation of that framework that is the subject of this chapter.

Chapter 2 talked of the community participation used in greenfield development, and the inappropriateness of that approach for in-situ upgrading. A greenfield development is technically driven. People may be consulted but the final decisions lie with development professionals. With in-situ upgrading, the people are already living on the site, and every decision that is made affects them in their daily lives. In addition, the primary goals of social integration and economic development necessitate a completely different approach to organisational structures and relationships between the different parties involved with the settlement upgrading process.

This report draws from a number of different experiences. There is the extensive desk study that was carried out, and which is described in the first report (Abbott et al, 2001). Coupled with this there is the experience of Belo Horizonte. There is extensive personal experience of project-based community participation in South Africa extending back 20 years. There is a strong theoretical base, which culminated in a theory of community participation (Abbott, 1996) and there is the recent important experience of the UNCHS (Habitat) Community Development Programme (CDP). Three key findings emerge from combining the wealth of material contained in this collective experience. The first is that communities do not work in isolation. They do not work alone outside of institutional frameworks. The second is that communities do need to be enabled and empowered if they are to be effective, and capacity building is an integral part of this process. The third is that communities are not homogeneous units. On the contrary, they are extremely heterogeneous and often seriously affected by internal tensions and rivalries that are the natural by-product of a resource-stressed living environment.

There is often a tendency, in the rush towards community empowerment, for those intervening from outside to idealise communities. An example illustrates what is meant by this statement. In the third report by the Ministerial task team on short-term housing delivery (Department of Housing, 1997) some basic principles for the design of a peoples' housing process programme were laid out. The first two guiding principles stated that (a) People are at the centre of the process, they take key decisions and actions, and (b) It is not participation of people in a process designed by the authorities but participation of the authorities in a process of the people. These statements are extremely idealistic. Idealism is an important element of value-based decision-making. In this case however, the statements move beyond that, to become naïve. For the reality is that a community does not exist in isolation; it is part of a wider social structure. Hence decisions cannot be taken in isolation. Instead, what is required is the formation of partnerships. At the same time there has to be accountability. It is recognised increasingly that local authorities have to be accountable to their constituency. But equally, communities have to be held accountable to the same standards as the wider society of which they are a part.

The institutional and organisational framework is the operational mechanism for dealing with relationships. As such, therefore, it is absolutely crucial to successful settlement upgrading. Taking into account what has been said above, it is suggested here that there are five elements to the organisational and institutional framework. These are as follows:

1. The normalising of relationships between the specific community and the wider society. This includes both the immediate neighbours in adjacent areas and the local government.
2. A policy of gender equity within the community. The greatest internal divide within the majority of informal settlements is that based on gender. Unless this is dealt with and equity restored it is difficult to see how the settlement can be transformed into a sustainable living environment.

3. The creation of a partnership between the community and the local authority. There is an extensive literature base internationally dealing with public private sector partnerships, which serves to highlight the dearth of material on public sector-community partnerships. Yet both are of equal importance.
4. There has to be a structured set of organisational relationships within the community that have the capacity to deal with a multi-faceted upgrading process.
5. The process requires a social support system to function effectively.

Each of these aspects is dealt with in greater detail below.

7.2 The relationship between the community and the wider society

A primary goal of in-situ upgrading is social integration of the community. The Recife Declaration, 1996, refers to the informal city and the need to integrate this into the formal city. If this is to be done, then it is important to recognise that it is a two way process. There is not only a need for change within the settlement, but equally there is also a need for change outside of the settlement.

This is an absolutely crucial issue. There is little point in having a successful upgrading methodology if those outside the settlement continue to have a negative attitude towards such settlements. This section sets out the New Rest experience in this regard, and describes the process that was followed in an attempt to change these perceptions.

Broadly, the project identified three different levels where barriers lie in the integration of the informal city. These are:

- At a political level in the local administration.
- Within the local authority with the officials.
- In the surrounding communities.

This excludes the attitudes of development professionals, which was dealt with in Chapter 2.

The elements that need to be dealt with in doing this are as follows:

1. In respect of the first level, the major step lies in convincing those in political authority of the need to recognise the permanence of informal settlements, and thence create a climate for the political acceptance of upgrading.
2. At the second level (which is the most complex) there are a myriad of complex issues to be dealt with, arising from the particular perspective of professionals within local government. Essentially though they can be divided into two major issues. The first is to convince the professional departments that the major need in prioritising upgrading is social acceptability rather than physical risk. This is difficult as it represents a significant departure from the traditional view of development, particularly for engineers. The second is to be confident of the solution offered. This is important since the solution will go against many of the accepted norms by which professionals operate.
3. At the third level, the key is commitment to change on the part of the community. A major problem with informal settlement upgrading is that the focus is turned inwards, towards what needs to be done. Often this is incremental, and while it may have a major impact on the quality of life of residents, it will not necessarily impact on those outside the settlement. Hence it is important for those in informal settlements to have a vision, which they can impart to their neighbours.

Each of these three elements is dealt with in slightly more detail below. An expanded review of these issues can be found in Abbott (2000).

7.2.1 Changing the attitude and perceptions of politicians

The first report (Abbott et al, 2001) provided an historical review of the UCT research programme into informal settlement upgrading. The point was made that the original desk study began early in 1996. Further, the City of Cape Town, which was the MLC containing the majority of informal settlements in Cape Town at that time, supported the study in principle and agreed to provide all necessary background and supporting information on their area.

As this research progressed during 1996, and work on the development of the wider methodology began, it became clear that sufficient information and expertise existed to begin the implementation of an

upgrading programme, in parallel with the ongoing development of the methodology. This led to the choice of New Rest as the pilot project area. The ensuing series of meetings and consultations with the community confirmed the suitability of this area and a proposal was prepared and submitted to the Council and was formally adopted in December 1997.

This negotiation took two years. And even then there was a substantial minority within the Council that opposed the idea. In addition, there was also opposition from the Metropolitan Council and from Provincial Government. This level of antagonism towards the concept had not been expected when the project was initiated. However, once the extent of the opposition to informal settlements was fully recognised, a new strategy was adopted. The research project was extended to a metropolitan wide study of informal settlements. The results of this study (described in Abbott and Douglas 1999, and Abbott and Douglas, submitted paper) proved conclusively that informal settlements were growing faster than housing was being supplied, and would continue to do so into the foreseeable future. The results of this research were presented to the Provincial Cabinet and to the various local authorities. Finally, in late 1999, there was broad consensus among politicians at all levels of government that they should support the principle of upgrading informal settlements in the Metropolitan Area in-situ. Not everyone liked the idea, but the large majority of them had finally recognised it as a necessity. The second phase was to change this view from seeing upgrading as a "necessary evil" to seeing it as a major development opportunity. Here the focus lay with professionals within local government, since they too tended to oppose upgrading and needed to be convinced and, more importantly, they had the power to change perceptions among politicians far more than did the University.

7.2.2 Changing the attitude and perceptions of technical professionals

The project was fortunate in that the attitude of the technical professionals was sceptical rather than hostile. It also helped that the University was involved, as there was already a working relationship and a degree of trust established between the relevant professionals. There is very little information and experience of informal settlement upgrading available to officials in local government in South Africa. There are also no design standards, as there are for conventional developments. All of this makes informal settlements very threatening at a professional level. A constant theme of the literature of low-income areas of the past 15 years has been the need to reduce standards, in planning, engineering and housing, with the emphasis being placed on the intransigence of authorities as being the core of the problem. At the same time the literature of projects such as Orangi in Karachi emphasise the concept of community-driven processes, taking this to the point where local authorities are excluded from the process.

The experience in Cape Town has been that neither of these approaches is appropriate, if the objective is the creation of a sustainable interface between the formal and informal cities. From the beginning the project has aimed at building a partnership between the community and the local authority. The concerns of engineers and planners were taken into account. At the same time, though, the needs of the community and the constraints imposed by a minimum relocation policy were also placed firmly on the table. The result was a compromise position and a change to, rather than a complete abandonment of, technical standards. As with the politicians this was not an easy process. But it did succeed, in that these same professionals became committed to the upgrading process. They may still want standards, but they are now flexible and willing to adapt.

This success in changing attitudes was built upon three key elements. The first was that the upgrading had a methodology, and inherent within this was a long-term vision. This is something that will be returned to later in the discussion about relations with the adjacent communities. The second element was that the process was carried out in a structured and professional way. It was not an ad-hoc process, although it was still extremely flexible. The third was that it used technical professionals on the side of the community. These were people who supported the underlying principles behind the upgrading, yet also shared a technical base with the City's professionals. These underlying elements provided a degree of 'comfort' to the technical team in the City, and moved the project from a confrontational stance to a collaborative one. If there is going to be a successful project, then it is crucial that everyone has the opportunity to share in that success.

7.2.3 Changing the attitude and perceptions of neighbouring communities

As mentioned previously, the settlements chosen to pilot the upgrading methodology were Kanana and New Rest. However, the two are being developed sequentially, with New Rest leading the process. Hence this report focuses primarily on New Rest.

The informal settlement of New Rest is situated on the edge of Gugulethu, a suburb that is situated approximately 12km from the centre of Cape Town close to the airport. This entire area was part of the Black Local Authority of Ikapa under the apartheid regime. New Rest itself was originally a buffer zone at the edge of the 'black' township, and is bounded on its other three sides by an urban freeway, a railway line and a suburban road. It was planned with part of it as a school site and part for business development. Hence its occupation in a land invasion was a contentious issue with many residents in Gugulethu, who would have preferred to see economic and social development opportunities taking place there, and who are extremely wary of the informal settlement that has arisen. On the other hand the area is now well established, having been settled first around 1990-91, and the average length of stay of the current occupants is 7 years. So the people living there represent a settled, and relatively stable, community.

From the time the pilot area was first identified, the project targeted key people in the surrounding areas (local civic movement, development forums, business people). The first step was to explain the nature of in-situ upgrading. An important element was the concept of the vision described earlier. It was the concept of an informal settlement that people had difficulty with. It is clear from the discussions that were held during this project that it is not just that such settlements are seen to be the base for criminal activity, although this is certainly the perception (although not necessarily the truth), there is a much deeper underlying fear, which stems from the randomness of the settlement. It is suggested here that it is the lack of physical order that many people find threatening. Thus the most influential factor in changing local perceptions was the fact that there was a plan to formalise the settlement. The fact that this was being driven by people inside the settlement was equally important. It appeared to change the attitudes of those outside from opposition to one in which they took collective pride in what was happening. The settlement is no longer an excluded and exclusive area, but is now being seen as part of Gugulethu. A crucial and very important attitude shift has occurred among all of the key external stakeholders. By creating a shared vision, one that can obtain buy-in from all stakeholders, the focus is turned from the informal settlement as a problem area competing unfairly for scarce local resources to one of seeing the informal settlement as a development opportunity that could provide a much wider benefit. The focus has shifted from exclusion to integration.

7.3 Gender equity

There is then the issue of gender bias. All projects are biased towards the men, in terms of preference and choice. The professionals employed are generally men, and this exaggerates the bias. The first step, therefore, is to gain a quantitative understanding of the gender balance. The social survey found that there is a relatively even demographic balance between the genders in New Rest. Of the total population (adults and children) there are 51% males and 49% females (all figures are rounded to the nearest 1%). 57% of the male population are adults while 57% of the female population are also adults. However, a more detailed breakdown of these divisions highlights some significant differences. Of all the households in the community 39% are female-headed. Of these, 78% are single households (ie. the head has children but does not have a spouse). Of the 61% male-headed households, 58% define their status as unmarried, with only 29% of these claiming dependents.

Despite the fact that, on average, households headed by males are less poor (see Figure 6.16), they tend to have a smaller number of total occupants. For instance, 54% of male-headed households have between 1 and 3 occupants, while only 45% of female-headed, single parent households have the same number of occupants.

Of all households headed by males 22% of them have no children. By comparison, there are no children in only 12% of all female-headed households. 47% of all male-headed households have only 1 or 2 children, as opposed to 51% of all female-headed households. Finally, 31% of all male-headed households have between 3 and 8 children, while the same is true for 37% of all female-headed households. This data implies that female-headed households are financially responsible for a greater number of household occupants, including children, and they have to manage this task with lower average incomes.

In addressing the issue of gender equity within an in-situ upgrading project, there are four key areas that appear to require specific attention. Each of these is discussed briefly below.

7.3.1 Addressing the needs of women

The first area of decision-making seeks to address the specific needs of women. The role of women in the project is crucial to project success, to equity in accessing project benefits, and to counter the historical imbalance that currently favours men. Thus it is crucial that women be given full recognition and the maximum opportunities, and that their involvement is seen holistically and incorporated into every facet of the project. This means addressing the issue in a number of different ways, which encapsulate the full extent of the decision-making opportunities opened up by the project. The social support system described in section 7.6 below should have a specific section devoted to quantifying these needs, and in particular the following. What are the priorities expressed by women? How do they perceive that their needs can be met? What are the particular economic activities that they are involved in?

7.3.2 Access and integration

In poor urban societies, it is, again, most often the women and the elderly who are marginalised. Many women, due to the roles and responsibilities they generally tend to carry in low-income households, bear the brunt of social dislocation and are often not well represented in formal decision-making structures. The use of community workers to access each and every household and involve them in the basic level of decision-making is intended to ensure that those who would normally be excluded are involved. One thinks specifically here of single parent families, whose time pressures and level of poverty preclude their involvement.

7.3.3 Urban design

The third area links to planning and infrastructure provision. A central facet of the project is community choice of site boundaries and of infrastructure. The needs of women should be central to these decisions. A good example here is access. Currently, access is designed for those with motor vehicles. Yet the largest number of trips to and from an area involves women and children. A second example is that of space. In conventional developments there is little or no thought given to the use of space. The result is that women are not only marginalised but also spatially isolated. The needs of women will be paramount when decisions are taken around the issue of space.

7.3.4 Community management structures

Upgrading is a partnership and the community, collectively, one of the partners. Thus external professionals or NGOs can (and should) draw the attention of the community to the above issues, and include appropriate sections in the survey. But ultimately the decisions will be those of the community. If women's needs are to be met, then women must be fully represented on the decision-making committees. The training programmes for the committees should, therefore, pay special attention to the needs of women, to ensure that they are not excluded by default. Their involvement at this level will be actively encouraged and supported.

The New Rest project attempted to address the issue of gender equity in a comprehensive way. However, it was not always particularly effective in addressing this issue, particularly in the early stages of the project. A study of gender and poverty in New Rest (Friedman, 2000), commissioned as part of the project found that, as in many other similar situations, the women in New Rest were not represented in any of the formal decision-making structures of the project at anywhere close to the demographic reality (as indicated in the earlier bar charts). This meant that the attempt to reach individual households via the social work/community development team is a highly significant project mechanism. However, despite their crucial conceptual significance to the project's long-term success, at the level of institutional support, the social work and community development side of the project had de facto been (unconsciously) inadequately supported.

Furthermore, at a community level, people's attitudes in the community were seen as being extremely traditional, with women automatically accepting men's authority. Thus they accepted, and were comfortable with, traditional beliefs about the roles of women and men in society (Friedman, 2000:8). Thus, even though there were many female-headed households and many women were involved in informal trading/business, acceptance of traditional relations with respect to 'authority' and 'leadership' is common.

Finally, despite its innovations, at the level of project implementation (as opposed to project research), the project appeared to reflect a fairly traditional gender division of labour, which is common to many projects of this type. Thus the managerial, technical and labour components are being done by men primarily, and the 'social work' by women. Following on from this, at a practical level, the social worker had little formal external support with no supervision or monitoring mechanisms in place (due to the loss of the intended project manager). Once again, given the pilot nature of the project and the nascent growth of 'developmental social work' in South Africa, it was accepted that there were not many role models for the social worker to learn from. However, the lack of support, if continued, could be seen to contribute to maintaining a 'weaker' social side in the project, which, as alluded to above, would simultaneously express a biased gender dynamic.

The failings of the project in respect of gender equity only serve to highlight the crucial importance of this issue. In addition, though, it is important to note that the commissioning and circulation of this report on gender equity has itself served as an important catalyst in raising the profile of gender and resulted in changed attitudes on all sides. It has also increased the commitment to achieving meaningful gender equity in the project.

7.4 The partnership between the community and the local authority

What the wider study of informal settlements, described in the first report (Abbott et al, 2001), would seem to indicate, is that the first point of contact between the formal and the informal cities is defined by contrast and confrontation. The primary issue then becomes one of moving beyond that condition and finding common ground. While section 7.2 described the broad strategy for dealing with this issue, it is equally important for there to be a clearly defined working relationship, particularly between the local authority and the community. For the answer does not lie in providing unconditional support (and resources) to the community (with the important word here being unconditional). Yes, the point of commonality should be support for the principle of in-situ upgrading. But there needs to be a more critical appraisal of what this entails, and a willingness to give and take on both sides. This means some form of agreement. This section will look first at the way that this was done for New Rest, and then show that this is insufficient, although it was an important first step. It is suggested that the answer can be found in the experiences, and current approaches, to partnerships that are being forged between the public and the private sectors.

The local authority has two distinct roles that place it in a difficult situation when dealing with informal settlements. The first role is a developmental one, where its objective is to encourage, support and enable development that results in improvements to the quality of life of residents. The second function is regulatory, where the local authority is obliged to enforce a multitude of, primarily, planning related regulations, many of which are not necessarily appropriate.

In Cape Town the decision was taken that no pre-determined standards would be imposed. New Rest would be treated as a pilot project and the results and proposals arising from the rigorous study would be considered on their merits and used, if necessary, to modify existing legislation.

To this end a steering committee was set up that included all the key directorates of the city on the one side, and community representatives and their advisors on the other. The Ward Councillor chaired the steering committee.

This situation worked well. The committee was party to all major decisions and kept up to date with current progress and thinking. All went well until the decision to appoint a planner was made. This aspect is covered in more detail in Chapter 8. What is important here is that there was a strong division of opinion between the Council officials and the Community Trust representatives. By agreement it was the Trust that would actually appoint the planner. But there were quite serious issues of principle underlying the difference of opinion. This revealed a major flaw in the structure, where there was no clear division of responsibility.

In addition, the flexible approach adopted by the City for New Rest is a "one-off" approach, which is not sustainable across all projects. It is too loose and takes too long. At some point there needs to be a framework.

Internationally, the closest that governments have come to this is the concept of community enablement. Helmsing and de Bos (1998: 74) state that "community enablement seeks to strengthen communities and their organisations and to make communities, via collective actions, either wholly or partially, responsible for particular services". Looking at what this means, government is creating an enabling legislative environment, and communities operate within this. This may sound reasonable, but in reality it is avoiding the real issue touched on above, which is what happens in reality at the point of interface between local government and community.

Some insight can be gained into this dilemma by looking at the experiences of public private partnerships. There a similar view was expressed initially, namely that the key to greater private sector involvement lay in the creation of an enabling framework. This does appear to be necessary, but increasingly it is being seen as merely a pre-requisite. The real progress stems from the creation of public-private sector partnerships.

It is not the intent to explore public-private partnerships in this paper. Valuable descriptions of what constitutes the important elements of these partnerships can be found in a number of practical and academic works. These include Heigers (2000), Domburger et al (1997), Borja and Castells (1996) and British Columbia Best Practice Guide (1997).

What emerges from these documents is the importance of the relationship between the public and private sectors, and the expression of that relationship, which is always contractual. It is suggested here that the partnership between the local authority and the community in the upgrading of informal settlements in-situ should follow a similar approach.

7.5 Internal organisational relationships

This component involves community building and development. It includes, but is not limited to, the establishment of community-based institutions and organisations to manage the process. The primary purpose is to create a vibrant and viable community that is able to respond appropriately to, and participate in, issues that affect the community. This component is designed to facilitate the meaningful involvement of the community in the participatory physical planning and the construction phases of this development process. The community development process would prepare and provide support to the community to engage in negotiations in relation to development of the site and infrastructure layout plan and the housing planning phase. It would also prepare and support the community to engage in the infrastructure and housing construction phase of the project.

There is very little written about organisational structures and organisational models. But there are some examples available. The first of these is the single community organisation. This is the basis of the People's Housing Process described in the introduction, and a working example is the Homeless Peoples' Federation. In this model a community group is formed that takes responsibility for all development. In the Federation this is generally based upon a savings club. This model has been shown to work well in a number of projects, a good example of which is the Victoria Mxenge Housing Project in Cape Town. There the women's savings group took responsibility for a house-building project. This is now successful and has become a successful case study. However, the limits of this type of organisation need to be recognised. This type of organisation works in situations where there is a clear separation of sector-based activities. This means that an activity can take place in one area or sector at a time. This type of structure is unlikely to succeed in complex, multi-faceted tasks. The reason for this is simple. The management of such tasks requires either a high degree of continuity among personnel or a sophisticated level of organisation. In communities it is more likely to be the first. But such a condition tends to result in serious accountability problems. Community organisations need to be highly accountable, but this inevitably means that they lack stability. Hence there is a condition of mutual exclusivity between an accountable structure and one which is set up to provide continuity to a project.

The issues involved with a development project operating at the level of the community are relatively easy to define. There needs to be agreement on the key principles that must guide the project, and established mechanisms for the settlement planning, on-going project decision-making and management

process. The methodology requires that the technical professionals responsible for the professional town planning, infrastructure design and technical project management be part of this participatory planning process that negotiates the development plan for the area. The site and infrastructure layout and overall development plans that are submitted to the relevant authorities for approval must be a result of consensus reached in the participatory planning process.

The second model is one that builds on this by establishing a community-based vehicle (eg. a development trust) to manage the project, but retaining the more accountable community structure (eg. the Resident's Committee or Civic Association) to take responsibility for community input and for community representation. This is the duality model. Unfortunately, this is the most unstable model of all, at least in a South African context. The reason for this is the housing subsidy. The Trust (to use this example) eventually takes control of the financial resources of the project, which gives it immense power in the community. Coupled with that, its key full-time members are often paid. The civic structure on the other hand will be comprised of voluntary members and have few external resources. Thus a power struggle ensues in which the Trust begins to dominate and the civic body becomes increasingly marginalised, until the situation reverts back to the single entity condition described previously.

So what is so wrong with a Trust being the primary vehicle for community development? The answer is a conflict of interest. This is not necessarily personal interest, although clearly this is a risk, but rather community interest. Upgrading requires a great deal of change to take place in the community. There are relocations. There are high levels of tension. There are marginalised groups within the community whose voice is not heard at the level of the Trust. Nor can the Trust necessarily deal with them even if it knows of them. For its primary concern is with project efficiency and effectiveness. It is the old debate about means and ends (Moser, 1983; 1989; Abbott, 1996:25-43). There has to be the incorporation of a group whose primary concern is with the social needs of the community.

The third model is one which moves to three groups. This may appear to be frighteningly complex and unmanageable to professionals, but there are strong arguments in favour of it. It is also the model that is recommended here, although this project does not profess to have evolved an ideal model. A full discussion of the benefits of the three-group model is to be found in Abbott (1996:173-93). This is derived from experience built up on a number of projects, and uses the experience of Luganda in Durban as an example of a successful three-group model. There the three groups comprised a development trust, responsible for development activities; a civic association, responsible for political issues and for community actions; and a collective of community groups that could voice the concerns and protect the interests of those groups. This third group also prevented the loss of status being inflicted on the civic by the balance of power described above. This latter group was vociferous in arguing for individual groups of people on the ground, and ensured that there was a process of continuous discussion and feedback that fed the decision-making process around physical development.

New Rest has a Trust and a Resident's Committee. It also has a social worker whose role is described in the next section. In respect of the participatory process, the social worker and her group worked with the poorer sector of the community and sought ways to ensure their involvement in decision-making. This has not been particularly effective during the phase of work described in this report. However, it is likely to have a much greater impact during the implementation phase, when the area is divided into a number of local zones, each making decisions about the physical and spatial structure of their zone.

In the current phase the project was delayed for six months by a serious dispute between the Trust and the Resident's Committee. In this case a solution was brokered by the Ward Councillor, who has played an active, and effective, role in this development. This experience has highlighted the importance of organisation and management (O&M) issues within the project and led to the appointment of a specialist O&M NGO to support the evolution of a comprehensive organisational framework for the area.

The internal organisational structure is a crucial element of settlement upgrading, a point which was strongly made at the beginning. The experience of this project is that there is a need for varied representation, which can be coalesced into three organisational structures. However, the exact nature of these structures will depend upon a number of factors that are area specific. These include the quality of the relationship between community and local government, the nature and extent of the external social support system, and the strength of existing interest groups within the community. What is important is to ensure that the organisational structure is given a central role in the development.

7.6 The social support system

If an in-situ upgrading project is to achieve its social development objectives, then it has to be able to interact with every single family in the settlement. There are many people in the settlement whose personal situation makes it very difficult to participate, and an important aspect of the programme revolves around ensuring that everyone has the opportunity to participate in decision-making. This is a complex process. Almost by definition, the primary characteristic of informal settlements is social exclusion. But this is a relative term, and in informal settlements there are degrees of social exclusion. Thus an objective of this process is to identify those that are marginalised even within the settlement, and to support them and integrate them into the wider upgrading process. Here two elements are important, the structure adopted to achieve this goal and the approach that is used.

The fundamental element of this component is the concept and introduction of Community Development Workers (CDWs), as opposed to Community Liaison Officers (CLOs). The latter are used in South Africa for new housing development, and are often employed by developers and development professionals. However, their role is generally limited to information transmission and to gaining support for the developer in the wider community or among the beneficiaries of the housing project. The development workers in an in-situ upgrade play a much more important role, which is discussed below.

The way in which this is organised is as follows. Firstly, the CDWs are recruited from within the community, and trained to facilitate the community development process. These CDWs, led by an experienced social worker, then facilitate and conduct, together with the community, household socio-economic and community needs analysis. Using the existing social networks, they would negotiate, organise, establish, train and service block-based Housing and Savings Associations, and ensure the dissemination and distribution of information. They would facilitate discussions and negotiation between the community leadership, households, Municipality, technical professionals and the Trust in relation to the development plan and the implementation of that plan in the area. In addition, the New Rest experience shows that they have an important personal role, as the first point of contact for many families in the settlement who experience a wide range of personal problems that inhibit their ability to participate in the project.

Throughout the programme, from analysis to post-occupation, the approach incorporates interaction with the local residents at varying levels. Under ideal circumstances, a site office ensures the permanent access of the residents to project staff, in particular a resident social worker. This element is seen as crucial to the success of in-situ upgrading, and represents a cost that should be covered by government if it is to accept this upgrading methodology. However, it is also important to recognise that this role is non-political, and should not be seen as being controlled by government. For, as experience in Belo Horizonte showed, it is important to recognise that the role of the social work team:

> "is neither to convince the people about the benefits of the project, nor to carry out exactly what each individual wants. Much rather, it has the role of discussing and developing a solution with the residents. The activity of developing the community, so that it is able to eliminate its problems, is complemented by activities directed at assisting in crises. This involves alleviating problems of malnutrition and abuse among young children, the development of crèches and the integration of adolescents into the job market. This aspect of social work is considered fundamental in the context of the severe poverty" Novara (pers. comm.).

Thus the social work component, which combines community development, resident participation and social upliftment draws on a range of community interaction techniques. In order to gain entry into the community for the social work, key informants are identified among the residents. These may be formal leaders of community associations or experienced and respected individuals whom residents would approach with problems. Together they form the reference group for the project. (Novara, pers. comm.)

Contact between residents and the project staff throughout the duration of the project ranges from interaction with individuals to interaction with the entire local population. This is done using the following techniques:

- Home visits.
- Individual consultation in the project office inside the settlement.
- Meetings with specific groups according to demand.
- Sectoral meetings with a group of streets or block of shacks.
- Meetings specifically for capacity building and decision-making with the reference group (key informants).
- Larger meetings and seminars with all residents.
- Meetings of the interdisciplinary team and involved organisations to plan activities.

As the project moves into the second phase, it is anticipated that the role of this group will grow. At this point, the CDWs would ensure and facilitate the involvement of households in the project decision-making regarding infrastructure and plots, layout plans and the people's housing delivery process. Each CDW would be responsible for one block (ie. about 400 households). They would also organise and ensure that all the training and decision-making workshops are well advertised and scheduled appropriately. Training would be provided to them to handle the resolution of disputes caused by the need to relocate some households due to safety and infrastructure planning and construction needs, and disputes about plot sizes, inter-organisational conflicts and allocation of job opportunities. Their main responsibility would be to build trust between them and the weaker sectors of the community, so that these sectors, households or individuals are provided with a vehicle through which they can raise any issues, particularly grievances pertaining to the project. Clearly, the appropriate fulfilment of these responsibilities would require CDWs to be trained to handle their duties professionally at all times and to be monitored by a competent person.

The CD workers are managed by an experienced and qualified social worker. This should be the key person in the community development process. S/he should be stationed full-time in the community and would be available to the community everyday, at least during office hours. S/he is responsible for the professional management and training of the CDWs and for ensuring that the community surveys and social research process meet professional standards. S/he trains and supervises the CDWs in this process. The social worker should also prepare and conduct qualitative social research, looking at issues such as violence, power relations, social hierarchies, cultural sensitivities, perceptions and attitudes in relation to levels of services, payment, working with external parties, including fears and concerns related to the project. Finally, s/he would bridge the gap between technical professionals and the people.

It is essential that the employment of the CDWs is seen and is indeed more than just a job creation exercise. There would have to be clear job descriptions, expected products, code of conduct, including a clear monitoring and performance appraisal mechanism. They have to work very closely with the technical professional on the planning and design criteria. Their employment should be on a twelve months renewable contract, with the review being based upon the progress of the project and resource availability. The community participation support component would last for the duration of the project. However, much of the work would have to be done in the first year of the project. Subsequent years would be used for supporting and consolidating the structures, processes and mechanisms established in the first year.

The New Rest project attempted to put such a process in place. It was partially, but not totally successful. The primary reason for this was lack of funding. Although basic funding was raised for the first year of operation from an external aid organisation, this was not followed through. In Brazil this funding is provided by local government and is slowly coming to be seen as the most important element of upgrading. This is not the case in South Africa.

This entire area, which is described collectively here as the institutional framework, is one which receives little, if any attention, in South Africa. Part of the reason lies in the over emphasis on physical development, and in the excessive influence of "hard" development professionals in this area. At the same time, however, there has been a reluctance on the part of social professionals, and particularly social workers, to embrace this "developmental social work". What is needed is firm support from government for this work and a much greater partnership between social and technical professionals who work in this area.

8. THE URBAN DESIGN PROCESS

8.1 Introduction

The information gathered about a settlement, up to this point in the upgrading process, provides a detailed knowledge of the status across a wide spectrum of activity areas, from the physical to the social and institutional. The next step is to begin to translate this information into a process of settlement improvement and development. At the same time, there remains one major outstanding issue that will have an impact on relocations, and which also needs to be taken before implementation can begin. That is the provision of movement corridors.

However, in order to plan the movement corridors effectively, it is necessary to situate them within the wider context of spatial relationships, as these affect the settlement as a whole. This chapter will argue that functioning and effective spatial relationships are essential for sustainable urban settlements. This does not, however, imply support for, or acceptance of, the current planning approach, which is based upon rigid standards. This approach was developed for a greenfield site. It is an approach that used spatial relationships to mould the future social and economic relationships of a settlement. This may be appropriate when there is no identifiable beneficiary community. In that case a settlement is usually targeted towards a specific income group, and it is the broad knowledge of the needs and preferences of a specific socio-economic group that guides the planning layout.

An informal settlement is different. The importance of prior occupation in this regard was made strongly in the first chapter. But it is more than simply prior occupation. People occupying informal settlements are, on the whole, extremely poor. The first chapter discussed the huge negative impact of social and economic shocks and trends, and the precarious nature of life in these settlements. This brings out the importance of social networks, of social capital, and of informal activity. The creation of a sustainable spatial structure for the settlement has, therefore, to be built around these elements, and constructed in such a way as to support the growth and development of these key elements of life.

The chapter is divided into four main sections. The first section looks at the issue of movement corridors from the perspective of the settlement as it currently exists. The second section then takes this and explores how it can be integrated into a spatial structure that is designed to enhance and develop the social and economic strengths of the community. The third section returns to the issue of internal relocation and how this can be effected. Finall,y the fourth part explores the wider issue of physical service provision. As with previous chapters, the information provided here, and the subsequent conclusions, are based upon the experience of the New Rest informal settlement upgrading project, integrated with the findings of the international literature review described in the earlier desk study associated with this project (Abbott et al 2001).

8.2 Developing an access framework

8.2.1 The purpose of movement corridors

Road layouts that have been designed according to the conventional approach are often criticised for causing an increase in car ownership and automobile dependency in communities (Behrens, 1998). At the same time, such an approach fails to meet the needs of the communities with low private car usage adequately. The situation becomes worse if the community to be developed is a low-income informal settlement because the numbers (of local vehicles) involved are so much lower. The result is an increased level of external vehicle usage that causes a disturbance to people inside their homes, deriving from car engine noise, hooting, car radio music, and so on. It also results in a more dangerous external environment for children and the elderly. Thus the benefit gained for a few, from time saved in travelling on newly constructed roads, is achieved only at a sacrificial cost to the majority, by denying them the right to enjoy peace and quiet in their own homes and the security of free movement outdoors.

Conventional road design makes the lives of non-motorised users difficult and effectively converts a multi-functional environment into a vehicle-dominated monoculture. The impact of this change can best be imagined by using an analogy from the natural environment. There, the current trend in agriculture towards large-scale monoculture, argued on economic grounds, has been shown to lead to a loss of bio-

diversity, and a continually degrading soil profile. And so it is with communities. The dominance of vehicular traffic reduces social and economic diversity within the settlement and leads ultimately to a sterile physical environment.

This section began by using the term 'movement corridors'. This wording is intentional. They are not roads (a term that reflects a preference for vehicular traffic). Movement corridors have to reflect the needs of all residents in proportion to use, and to cater for multi-functional use. To illustrate the importance of this point, the section begins by reviewing a survey of movement and vehicular traffic use in New Rest. It then uses this data to develop the policy for the creation of movement corridors.

8.2.2 Movement patterns and traffic use in New Rest

In September 1999 a student from the Department of Civil Engineering carried out a study of movement patterns and traffic use in New Rest (Kunene, 1999). This section summarises the key findings of that study as they pertain to this wider report.

A variety of data collection methods was used in this study. These included:

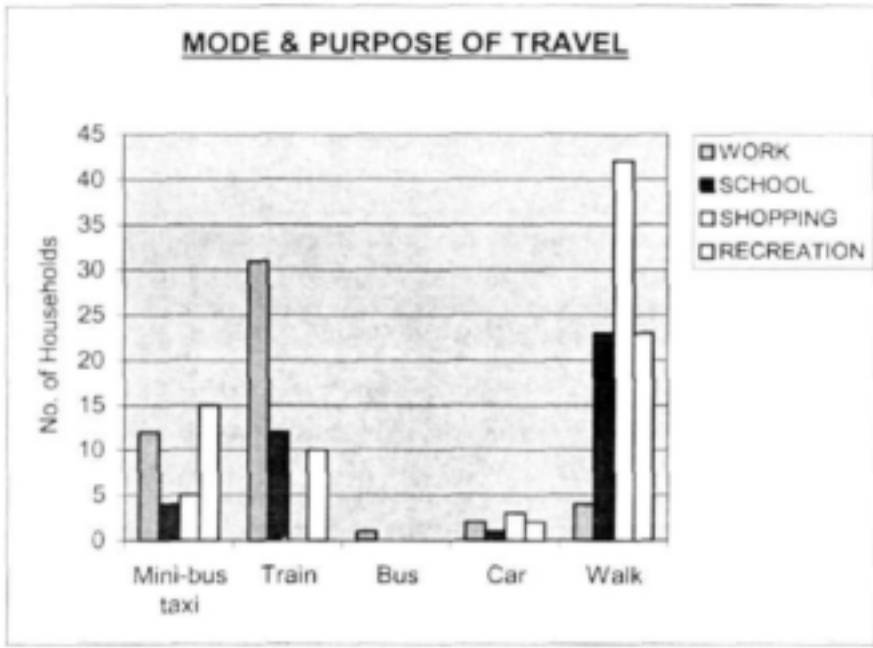
- Interviews with project committee members, the social worker, and car owners;
- Establishing level of car ownership in the settlement;
- Carrying out traffic counts in and out of the settlement for a week;
- Identifying house travel patterns;
- Community discussion meetings.

In terms of travel patterns, the aim of the survey was to determine, in particular, the nature of trips that people made and the transport mode they used for those trips. In order to get information, approximately 5% of households were visited in their shacks for questioning. To ensure that the sampling was representative of the entire community, the households that were chosen included:

- Male-headed households
- Female-headed households
- Households with at least seven members
- Household heads employed outside of the settlement
- Household heads employed inside the settlement
- Household head not employed.

Looking first at broad household travel patterns, the typical daily travel pattern for the fifty households interviewed is presented in Figure 8.1 below. This is taken from a weekly travel diary. The table shows the number of households for each purpose of travel and the mode of transport used.

Figure 8.1: Daily travel pattern of New Rest residents based upon a sample survey



Major outside trips that households were found to make included going to school (children), work, shopping, visiting friends and relatives, and recreation. It was found that people who used other modes of transport such as buses, taxis, and trains, had first to walk out of the settlement to suitable boarding points. Short-cut walking routes were being used to boarding points. People used both footpaths and roads for walking. Some of these pedestrian routes crossed roads. So this then becomes an important element that has to be considered in the design of future roads, to ensure safety for pedestrians. Overall, perhaps the most interesting finding was that the direction of walking routes that people use has been found to be different to that of cars. Thus to enter and leave the settlement, he predominant direction of pedestrian traffic people is along the settlement (broadly east-west in the long direction) while the direction of vehicular traffic is exclusive across the settlement (broadly north-south in the short direction).

There is, of course, a degree to which all families wish to have some formal roads, independent of their primary travel mode. Based upon the use of a structured questionnaire using open questions in a group discussion environment, the first finding was that access routes were understood by most people to mean roads and roadside walks. The idea of having footpaths that were not sited along the roads was to a certain extent foreign and needed to be discussed extensively. Equally, though, it was clear that people used the roads that currently existed simply as extra-wide footpaths. Thus an important point that emerges from this discussion on the difference between roads and footpaths is the negative impact that roads have in restricting pedestrian movement once they are formalised (i.e. provided with an impermeable pavement) and designed primarily for vehicular traffic flow. In the group discussion, much of the time was spent exploring the nature of access routes; how these routes will help the participants; the type of routes that they actually want; and how wide should they be. Deriving from this discussion, it was found that the community's primary need for formal roads derives from a desire to provide easy access for:

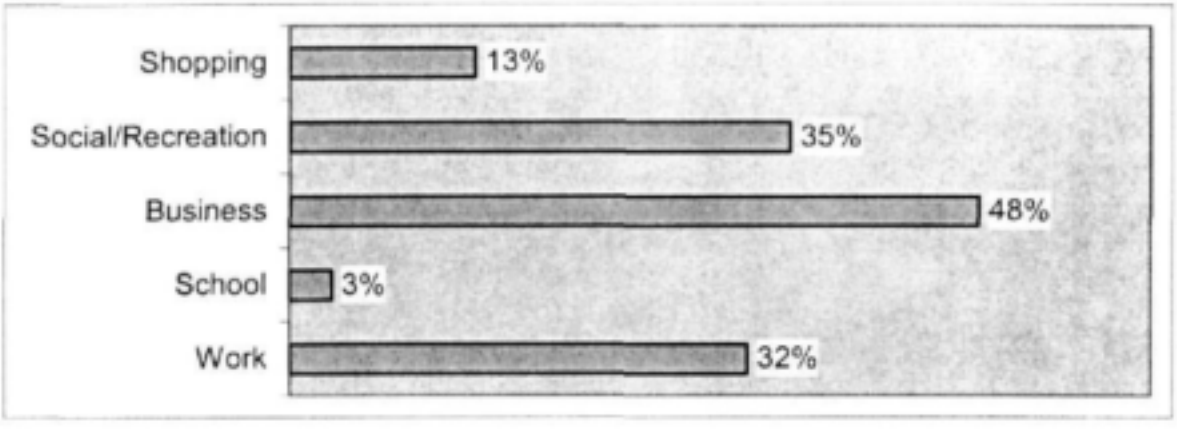
- Solid waste trucks that collect refuse from the settlement.
- Delivery trucks such as soft-drinks and bakery trucks that come to deliver to business owners.
- Public transport. Here, emphasis was given to buses.
- Emergency services such as ambulances that can then reach those in need more quickly and easily.

The community felt that footpaths should be provided as short-cut routes to roads and to facilities and services either within or outside the settlement and should have a width of not more than 1.5m. The roads should consist of a single major road (bigger road) that should run almost midway through the settlement and secondary roads (smaller roads) that should provide access to the rest of the settlement. The main road should be a two-way, with a width not more than 6.0m (with the width estimated from a

discussion of comparative roads in the surrounding areas) but wide enough such that a truck can pass a small car at crawl speed. The secondary roads should be smaller but small cars can pass each other at crawl speed (there was no proposed width). This is consistent with the point made earlier about the impact of formalising roads and the need to maintain multi-functional use of movement corridors wherever possible.

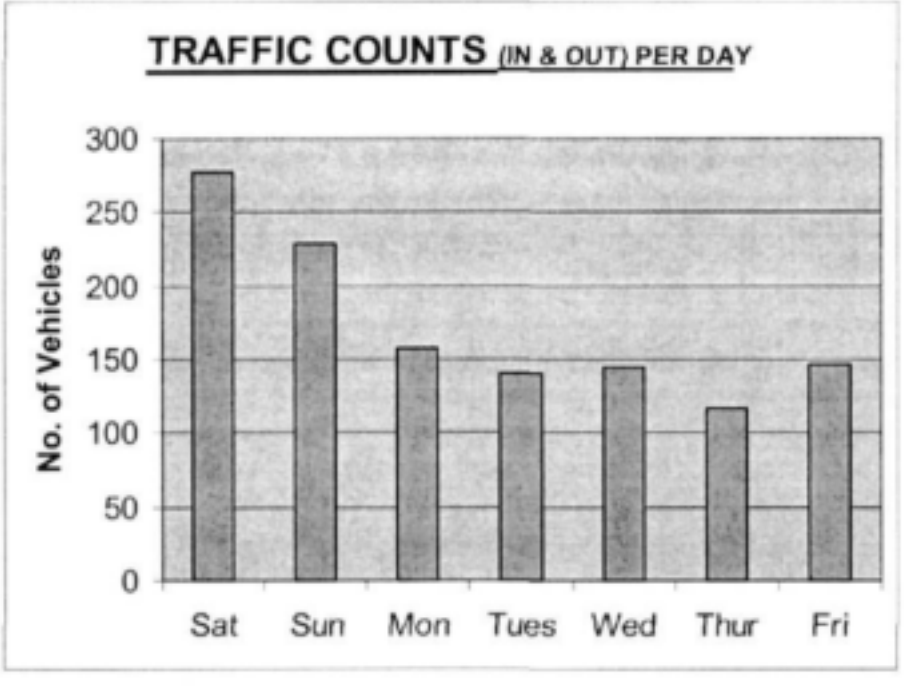
Turning next to the use of cars within the settlement, the survey found that car ownership was extremely low, with only 31 car owners out of 1130 shacks in the settlement. From the survey it was found that about 15 car owners have businesses and they use their cars to run them, the other owners use their cars for private use. Figure 8.2 below shows the nature of trips the 31 car owners make. The objectives given in the figure represent the primary objectives of the trip. This does not take account of secondary use.

Figure 8.2: Primary use of private vehicles



The third and final aspect of the survey relates to traffic counts. This data was obtained from conducting traffic counts over a week and covers all entrances to the site. Figure 8.3 shows the total traffic count into and out of the settlement. This indicates that the overall usage of roads by vehicular traffic is extremely small, with the highest usage occurring over the weekends.

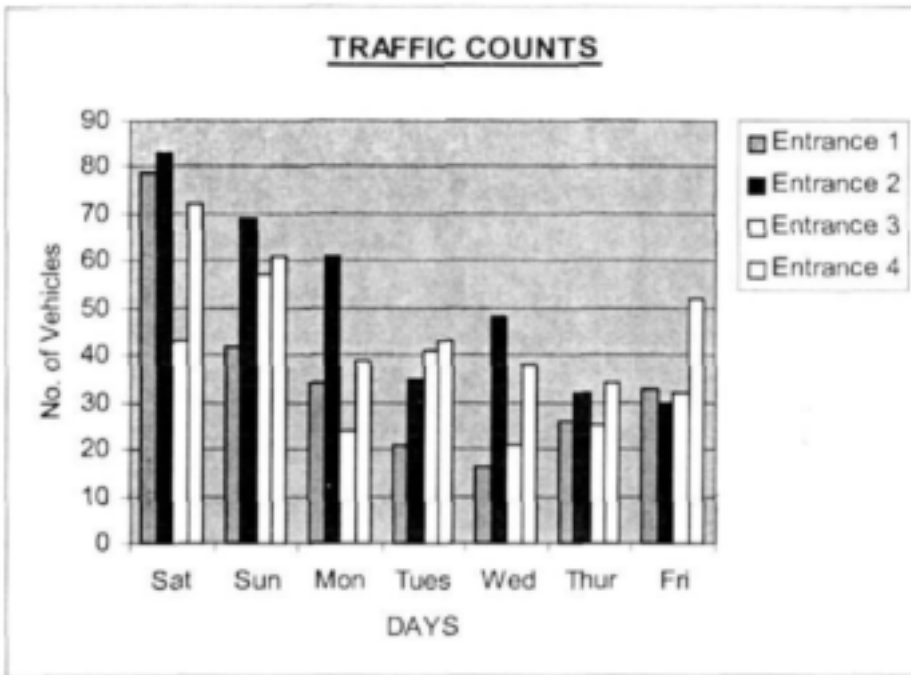
Figure 8.3: Traffic entering and leaving New Rest



In terms of distribution, there are four access points into New Rest, three from the South and one from the main road to the East (which is seen by the authorities to be an illegal access). Two entrances (named 2 and 4) recorded the highest number of vehicles, making these the busiest entrances (see Figure 8.4). The reason for this is because entrance 4 is the only entrance that serves the lower (ie. southernmost) part of the settlement. Entrance 2, on the other hand, is the illegal entrance directly onto the main road. One problem that encourages the use of entrance 4 is the state of the formal township road that runs to the South of the settlement, and which is used for entrances 1 and 3. This road was found to be in very bad condition. It is surfaced with concrete and there are large cracks in the road, as well as major potholes, while its stormwater drainage system also needs attention. Improving this road would improve the convenience of using entrance 1 significantly (this is the entrance situated furthest from the main suburban road. From observation and discussion, entrance 2 appears to have been used for a long time in order to get into the settlement and it is also the safest entrance.

Overall, the traffic counts indicate that there are too many entrance points to the settlement taking into account its size. It is too open for cars coming from outside, and the number could easily be reduced to two (entrances 1 and 2). Overall, the traffic counts data shows that there are approximately 150 cars use the entrance/exit points per day during the week and 250 per day at weekends (see Figure 8.3 above).

Figure 8.4: Traffic count by entrance



Vehicles from outside that were entering the settlement included small cars and heavy vehicles such as solid waste trucks. Some who were driving into the settlement were selling vegetables and those had to move around the whole settlement. In order to reach almost every part of the settlement they had to drive in and out of different entrance points because the roads within the settlement were in such bad condition. Some roads have trenches dug across them, which was done to drain flooded shacks. Other vehicles from outside were taxis that were bringing people into the settlement. Overall, the majority of the vehicles that were counted came from outside the settlement.

In reviewing these findings with the community the most important point to emerge was the extent to which the community wished to retain their existing route network. There was also major resistance to the idea of driving major roads through other areas of New Rest that were already settled. At this point a civil engineer was retained and his first task was to spend two days with the community, walking every route and holding a series of meetings. This took place in the first quarter of 2000. From this interaction the engineer prepared a rough plan showing how the existing road network might be modified to make it more effective, but without causing major disruption or imposing major change.

There are two major conclusions that emerge from this study. The first is that roads per se should not be the basis of a planning and engineering design process. That is to say that road hierarchy in the

classical sense should not be a determinant of spatial layout and spatial relationships. The real issue is access and the basis for planning and design flows from an understanding and quantifying of the multi-modal use of movement routes. Secondly, it is clear that there is definitely a two-tier hierarchical structure to movement networks in informal settlements. There are a series of major routes that can be accessed by vehicular traffic. These can be described as roads because they service vehicular traffic. However they arise out of what exists; they do not drive the process of design. Coupled with these, there are also informal paths that are used for walking and for bicycles and which cannot be easily accessed by cars (although some are). On this basis, it is recommended that this two-level hierarchy should form the basis for the long-term planning of movement networks in informal settlements. However, in order to determine the final position, extent and layout of the primary access network, it is necessary first to look at other aspects of urban design.

8.3 Urban design

The central issue here is the use of communal space, which is defined quite broadly to include a piece of land that is used by more than one family in their own capacity. Due to the pressure on land, and the absence of formal open spaces, as defined in the classical urban planning sense, movement networks play a central role in this area. There are only two examples that can be drawn upon in international experience of upgrading that deal with this issue of communal space. The first is Belo Horizonte in Brazil. Here the approach to urban space was part of an holistic upgrading plan (termed the 'Plano Global' in Portuguese). This holistic approach seeks to identify all of the important sets of relationships that exist within the social, economic and physical spheres of life in the settlement, and then create a physical redevelopment plan that embraces and enhances all of these. Thus spatial relationships form part of this wider, all-embracing process. The major difficulty with this approach lies in the need to create and maintain a physically static situation within the settlement while all the identified factors are dealt with. In Brazil this is aided to a large extent by the nature of house construction. Thus the majority of the dwellings are constructed using reinforced concrete frame structures, with dwellings often being inter-connected physically. Where some physical relocation is required, this necessitates a multi-pronged approach to upgrading. However the same condition does not apply in South Africa, where informal settlement dwellings tend to be discrete units of poor quality. In addition the Brazilian approach requires a high level of financial resources to implement. All of this makes the holistic planning approach difficult to adapt. But from a spatial perspective perhaps the most valuable lesson relates to the multi-functional use of movement routes.

The second relevant experience is that of the million houses programme in Sri Lanka, and in particular the community action planning process of decision-making, which revolves around the use of space. Here the important element is community decision-making and the capacity of communities to make decisions around spatial issues. In terms of its approach to community decision-making, community action planning can be described as a project-linked methodology. Hence the framework for community involvement is the project cycle, where a project is broken down into distinct stages comprising initiation, planning, design, implementation, and maintenance. Within this project framework, Hamdi and Goethert argue that "the plan stage is seen as the most crucial for the community and the city to be jointly involved, [on the grounds that] this is the stage at which key decisions are taken and the full programme is defined" (Hamdi and Goethert, 1996:78). The weakness of this approach is that it follows the conventional project cycle approach to development, and this makes it difficult to deal with more complex situations where there are different levels of decision-making. With community action planning the community and their needs are central. In respect of the use of space, this meant that the process worked well at a micro level, where the issue was that of the use and allocation of space between individual families. It did not deal with wider issues of space in the context of multi-functional use, primarily because that was not a major issue there.

What emerges from this discussion is the need to explore the use of space in an informal settlement at two distinct levels. The macro level relates to space that has widespread community use and also which links the settlement with the surrounding areas. The micro level is that which deals with the use of space closer to the individual families, where there is a need to quantify the crossover between individual and shared use of space locally.

This duality reinforces the broad thrust of the wider upgrading process described in the wider report, which is built around the two-tier approach. This will be returned to again in the next section for a discussion of the practicalities in respect of the wider settlement planning and design process. For now this section will deal with the use of space at the macro level.

This aspect of upgrading (ie. the detailed urban design process) represented the point at which the project moved out of the bounds of written international experience and a return to basic principles. With the approval of all parties, the Planning Department of the City of Cape Town and the Research group at UCT developed a planning brief that sought to describe the spatial principles that underpinned the project, both conceptually and practically. This was situated within the wider set of principles that governed and defined the upgrading project.

From a spatial perspective, the key aims were thus seen as follows:

- To create a continuum or hierarchy of public spaces and movement systems, which attract and give order to activities, events and elements according to their need for public use and privacy. This collective public social space network hierarchy and set of elements, need to act as containers for providing places where people can interact around social, economic, cultural, spiritual, recreation and learning activities;
- To create opportunities within the collective public social space network, where small scale economic activities and street trading can locate and be formally sustained over time;
- To create spatial opportunities in the landscape, where a network of public social facilities can locate and be consolidated into a public 'capital web', which offers optimal sustainable benefit to the community and meets their immediate basic needs.

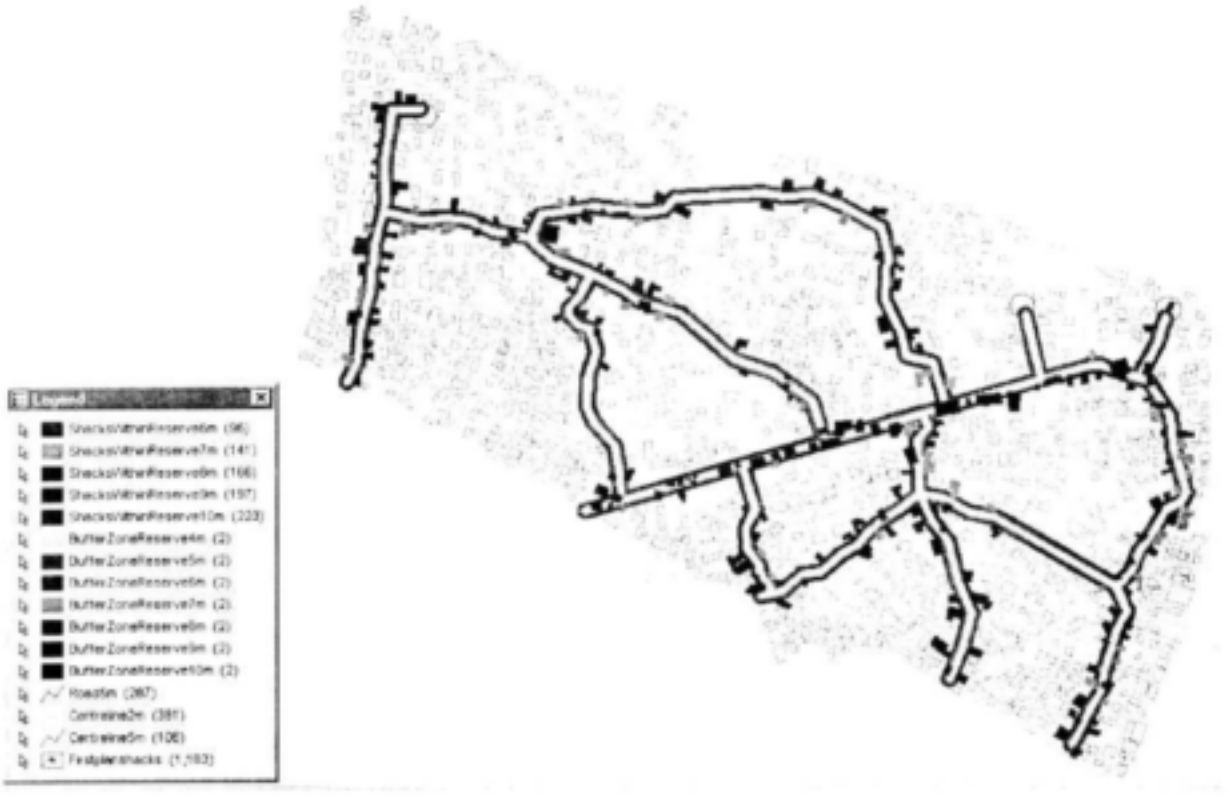
Having developed the brief this was then sent to selected consultants who submitted proposals and made presentations to a cross section of representatives from both the community and the city. Based upon a transparent points-based system of adjudication, a spatial planning/urban design consultant was appointed to carry out the initial planning process.

At the time of submission of this report the initial plan was nearing completion but had not been submitted. However, the work had proceeded far enough to define the way forward. Specifically the planning evaluation supported the feasibility of the two stage process and the civil engineering design also confirmed this, although there are obviously cost trade-offs that will be discussed later. It demonstrates, however, that it is possible to create sustainable, long-term development within the context of a minimum relocation policy.

The second important issue to emerge was the critical importance of movement networks within a framework of social and economic sustainability. These routes are far more than rights of way for vehicular traffic. In settlements with limited public space, where the majority of people conduct their activities close to their homes, these routes are important multi-functional spaces. In addition they play a vital role in integrating the community, physically, socially and economically with the surrounding formal areas. Their primary function is, therefore, one of providing social space.

Finally, based upon this analysis, it is clearly feasible to use the community's own network of access routes as the basis for permanent movement routes within the settlement. In New Rest this broadly takes the form that is shown in Figure 8.5 below.

Figure 8.5: The planned movement network for New Rest



8.4 Implementing the minimum relocation policy

The spatial definition of the major movement routes completes the assessment of the impact of physical and spatial features associated with the settlement that impinge on existing dwellings and are, therefore, likely to require internal relocation of families. By integrating the major servitude into movement networks this has reduced the overall impact. The stormwater analysis has determined the need to intercept stormwater generated upstream of the settlement and by-pass this to the stormwater system via a different route. This reduces the impact of flooding on the settlement. The geotechnical report indicated that, while much of the settlement is founded upon fill material of variable quality, this has a greater impact on public services and movement networks than on individual homes. Low-lying ground remains a problem in terms of potential flooding, but the number of families affected has been significantly reduced by the stormwater proposal. In other cases the sites occupied by the dwellings can be raised using fill material, thereby allowing the families to stay.

The net result is that a total of approximately 200 families will have to be relocated within the site to accommodate this redevelopment programme. This represents less than 20% of the total number of dwellings currently on the site. Based upon the experience of Belo Horizonte, this figure is quite acceptable. This is particularly so given the professional and institutional perceptions that existed four years previously. Then the consensus view was that New Rest was unsuitable for any housing development and it was anticipated that all the families would have to be relocated.

The families to be relocated will be moving to one of the existing blocks defined by the intersection of the movement network and the site boundary. The description of how this will be done does not form part of this report, which has focussed on the macro design. However, there is far more known about decision-making and the nature of decision-making processes at this micro level. The key elements of this process of micro planning will be discussed briefly here as an illustration of the way forward.

The creation of clearly defined spatial blocks creates zones of local interest and defines the residents that have a direct interest in their particular block or zonal area. The size of the blocks is relatively small, with an average of approximately 150 dwellings. This places it within a scale and scope suited to both community development management and effective community planning methodologies for decision-making. So whereas the macro planning process dealt with the needs of the settlement as a whole, the

micro process focuses on the specific needs of the group occupying a particular block, albeit taking into account the integration of these needs into the wider communal needs of the settlement as awhole.

Central to this process is again the issue of space and the use of space. The community accepted the existing cadastral boundary because it was, on balance, beneficial to do so. However it was not a pre-determining factor. At no time in this upgrading process has the issue of land boundaries and demarcation been a point of discussion. This is extremely important, since it is this policy approach that has created a framework that allows families to continue to move relatively freely within the settlement. Shack owners living in the different blocks have the opportunity therefore to explore different options with respect to the allocation of land between shared and private use. Using a social work and a community development team it is anticipated that a further planning process will be initiated at a local level to determine the use of space within the blocks. Here though the methodology will be significantly different. The only way to operate at this level effectively is through the use of one of the community planning methodologies that exist and have proven effectiveness. Thus it is anticipated that an urban designer will also be appointed at this stage, and hopefully also an architect. The brief, however, will be significantly different to that described earlier for the macro scale design. Here, the professional action is primarily in the role of facilitator, guiding a community-based planning process.

8.5 The provision of infrastructure services

The discussion to date has focused heavily on the issue of spatial relationships, and significantly less on the provision of physical infrastructure. It was mentioned in Chapter 2 that there are a number of development professionals involved in upgrading, and that all of them need to redefine their role in the process. They all need to move away from the role definition that was based upon greenfield site development, to create new roles that are appropriate to informal settlement upgrading. The role of the spatial planner (or more correctly the urban designer) has been defined most clearly in this report. The role of the land surveyor is also clear. The early work required here is that of identifying existing cadastral boundaries and working with the three-dimensional spatial analysis of the settlement as it exists. But there is no pre-definition of internal cadastral boundaries. This would seriously inhibit the upgrading process and reduce choice.

At present communities in informal settlements can choose one of three forms of land ownership. The first is where the entire settlement has a shared and common legal right to all of the land, whether vested in a Trust or through a legally binding agreement with the local authority. This would then include all public space and movement networks and could also incorporate physical infrastructure services. The second situation is where the residents of individual blocks bounded by the movement network and the external boundary choose a form of common ownership of land within that block. In that case, the movement network and major services would be the responsibility of the local authority or other utilities. This allows a high level of flexibility in terms of house design. The third option is for families to decide on individual ownership, where each family owns an individual piece of land. The second and third options can, of course, operate in parallel in a settlement, with different blocks choosing different tenure options.

From this discussion it can be seen that the legal demarcation of a cadastre for the settlement is something that can only occur as the final step in the upgrading process, once all of the other issues relating to space, housing and services have been agreed. This does not mean that they all have to be implemented, merely agreed. Therein lies the flexibility of the system.

Similarly the role of the architect and the whole housing debate is something that can only take place once the macro design process is complete and all families have been allocated to specific blocks. Housing then becomes a matter for discussion in each individual block. However, like land regularisation, it should not drive or predetermine a process, but should rather derive from and be an outcome of the upgrading process.

And what of the civil engineer and the infrastructure services? This role changes radically from the one defined in greenfield site development, although not that significantly when compared to that professional's role in the days before the introduction of township design standards.

The main impact that a standards approach to township design had on civil engineering was to cause a grouping of services into a collective function. Prior to that the different services had operated often

quite independently of one another. This grouping exercise made sense. It was the logical route to take in a situation where roads played such a major role in the physical layout to the extent that they become a major determinant influencing runoff generation and flow. Since road and stormwater design was most effective when matched to the topography, and since sewerage followed topography also, it was then equally logical to integrate sewer design. From there is was a small step to include water, and thereby bring all underground services together in a cost-effective way.

In informal settlement upgrading, however, there is no need to retain that linkage. On the contrary, retaining the linkage leads to pre-deterministic planning and has a similar impact to that of pre-deterministic land regularisation. In informal settlements the road surface area is greatly reduced, and the contribution of roads to stormwater runoff generation reduced proportionately. Hence there is no reason to link the two. In addition the design of sanitation systems is becoming increasingly flexible and the dependence on topography less important (albeit not totally separated). All of this makes it possible to explore the different elements of infrastructure and their relationship to the upgrading process on an individual basis, with the relationship between the different services now becoming a secondary consideration.

This is fortuitous, since the different services actually integrate into the upgrading process at different points. An analysis of the impact of rainfall and runoff is the most crucial, and takes place in the early stages of analysis, being one of the potential causes of risk. The major impact of stormwater runoff therefore is on relocation.

The second aspect to be considered is that of movement networks. These are not determined in terms of a road hierarchy, but rather in terms of social space, with the recognition that there has to be a basic skeletal core of the network that can accommodate vehicular traffic. This definition of use of the movement network based upon internal, rather than external, need has a significant impact upon pavement design, requiring it to be more accommodating of multi-functional usage and derived from a usage hierarchy that derives internally. Its direct impact on stormwater generation is therefore greatly reduced, as mentioned earlier, and this allows the two engineering elements to be de-coupled to a large degree.

The sanitation system then also becomes a product of the broader upgrading process, although it continues to have a degree of rigidity attached that needs to be taken into account. The dominant issue in the design of the sanitation system derives, however, from the two-tier upgrading concept described previously.

Stepping back from this issue briefly, it is worthwhile to explore sanitation in a wider context. The failure of conventional sewerage systems in many developing cities led to an exploration of different options for the provision of sanitation. This coincided with a period of intense research into rural sanitation needs that led to the development of the ventilated improved pit latrine or VIP. The net result was a range of options for sanitation, which were then assembled by the World Bank and built around the distinction between off-site and on-site sanitation systems (Kalbermatten et al, 1982). Slowly this concept evolved and widened to cover other elements of infrastructure, to a generic classification system described initially as the matrix of levels of service (South African Housing Advisory Council et al, 1988). This then became, later, a three-tier classification of services known as basic, intermediate and full services. What is interesting about this is the influence and role played by the integration of service design for townships that was described above. It also creates a mutually reinforcing situation, since the three tier hierarchy then further encourages services to be seen collectively and grouped together in one of the three categories. The reality of informal settlement upgrading, however, is that they can (and should) be viewed completely independently.

Returning then to sanitation, there are indeed three options available for sanitation in informal settlements, at least in a South African context (although there are certainly more than three for the construction of the movement network). However, it is not appropriate to describe them as different levels. The first option is that of VIPs. However, these are unlikely to be suited to dense settlements where the dwelling density is upward of 80 dwellings per hectare (gross density). Nonetheless they should not be excluded from the debate. For the reality is that they form the basis for a pyramid of on-site treatment options, the research into which is still in its early stages, but which is likely to provide the primary waste disposal mechanism of the future. Hence while this system be inappropriate for projects being designed presently, developments in this area need to be kept under constant review.

What remain are two options for water borne sewerage. The first is conventional sewerage and the second what is known as shallow sewerage (Pegram and Palmer, 1999). These are not, however, mutually exclusive options. On the contrary, together they provide the technical solution that makes the two stage upgrading process described here financially feasible. For the reality is that, in order to design the infrastructure to support the two-stage process in a financially viable manner, it may be necessary to separate the design of the sewerage system in the main network from that in the blocks. With conventional sewerage this would not be possible, since sewer design runs in a continuous line from the point of discharge from the settlement back to the highest point of household discharge into the sewer. By designing the system in two parts, with two different design methodologies, this provides the flexibility required to separate them in time. Hence a main network can be designed with conventional sewerage, and the blocks using a shallow sewer system. It is suggested that this hybrid sewerage system form the basis for the sanitation of informal settlements in an upgrading situation. It also has the added advantage of aligning the management of the block sewerage system with the wider issues of the block, thereby enhancing the responsibilities of the occupants within a block in taking charge of decisions that directly affect their lives.

The remaining service is water. From an engineering perspective this is the most flexible service. It is also one that is easily accommodated to a two-stage design process. The critical issue is to determine when it should be installed, given its crucial importance in community health. It is proposed here that the water reticulation only be installed once the primary movement network has been finalised. If it is necessary to provide water before this date then it is proposed that this be done in the form of an emergency supply, which can be removed at relatively low cost later and replaced by a permanent reticulation network. Thus a distinction needs to be drawn between an emergency supply (which could also apply to the sanitation system) and a permanent supply.

The section has shown how physical infrastructure services need to be treated independently of one another in the upgrading of informal settlements. Each one is, however, of vital importance in its own right. To ensure the successful provision of these individual physical infrastructure services, it is important to see the linkages that the designers of each of them will have. These linkages are no longer to other physical infrastructure services. Instead they are to the multi-disciplinary and community groups that are involved in the different stages of the process that integrate each particular service. This represents a significant change in thinking on the part of civil engineers. The traditional line of thought was one that viewed services collectively as an element of upgrading. In informal settlement upgrading, the issues, and even the terminology is changed. It is no longer roads, stormwater, sewerage and water supply. There are new activity areas and activity centres. And these centres can be defined as risk assessment and management, community movement networks, and environmental health. These are not just buzzwords; they are representative of a new development paradigm. It is likely that they require three different sets of skills. Informal settlement upgrading challenges all development professionals, not only to change their thinking but also to change the development paradigm within which they operate. That is the challenge. The reward is a sustainable future for the 15% of South Africa's urban population and, ultimately, for the much greater percentage of the population of developing cities that live in informal settlements.

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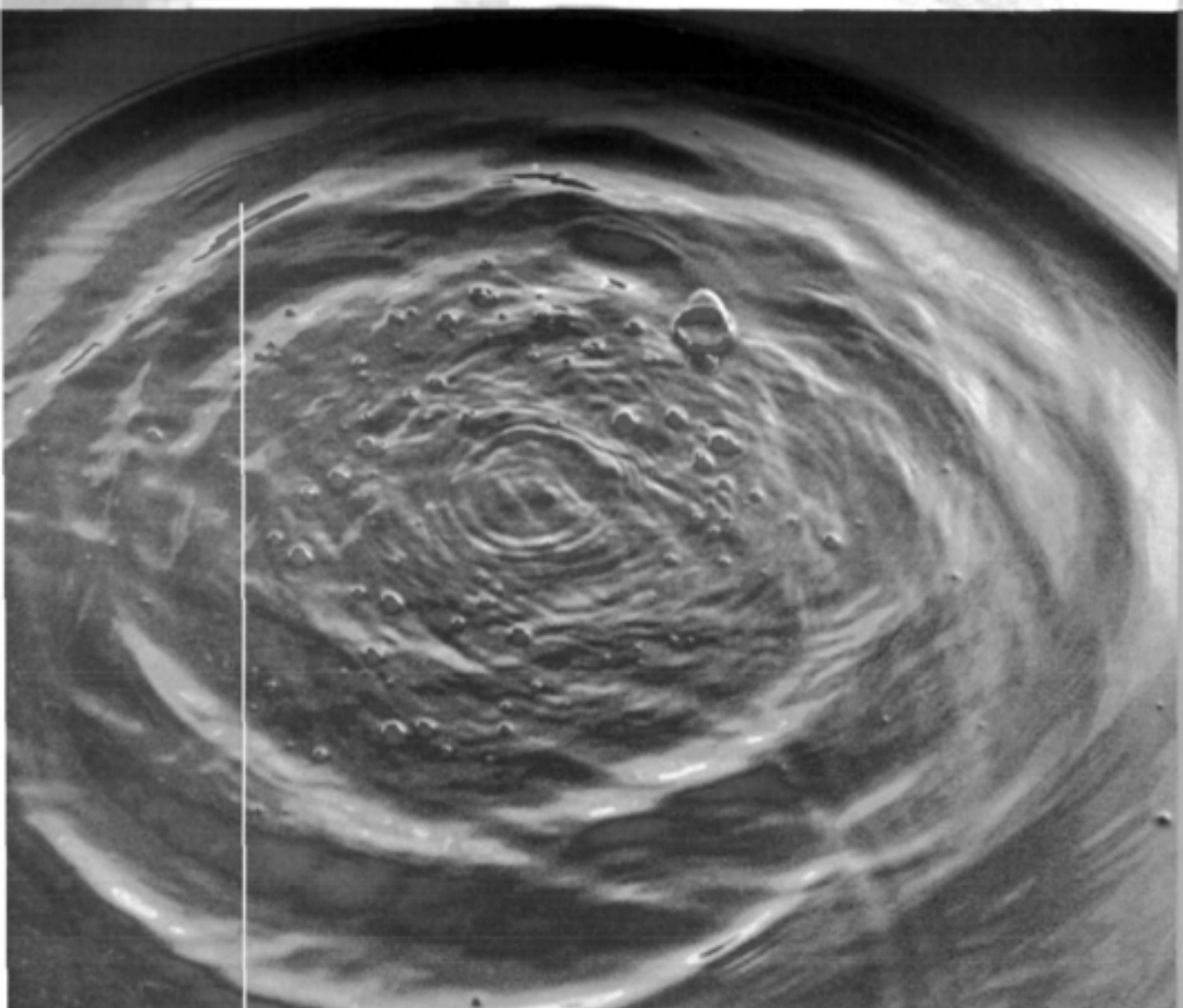

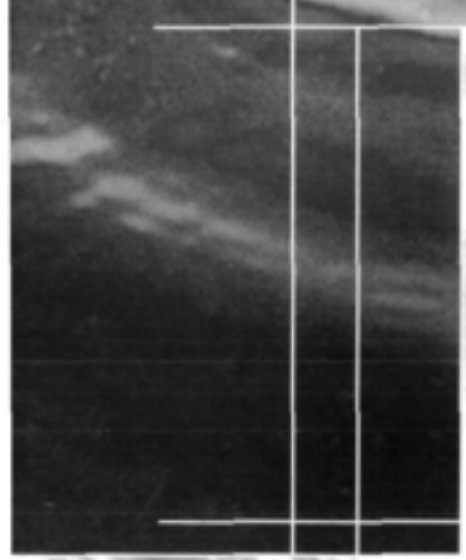

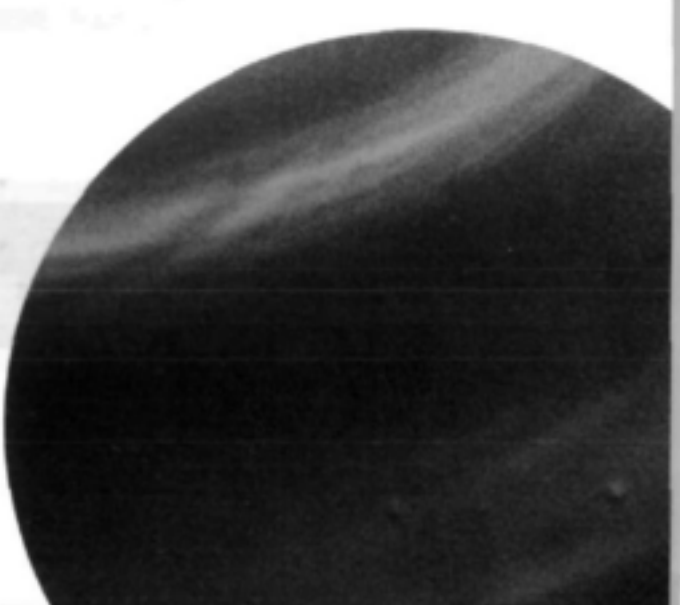

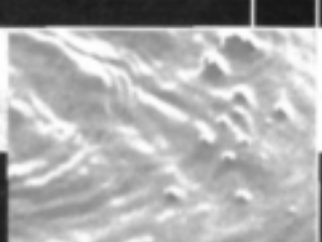

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