Financial Planning for Infrastructure Services at District Level:

A User Guide to the DISTRICT SERVICES MODEL

Version 1.1

Report to the
Water Research Commission

and

Development Bank of Southern Africa

by

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The publication of this report emanates from a project entitled *Preparation of Guidelines and a Model for the Financing of District Council's Water Supply Functions* (WRC Project No K5/994). The report is intended to be used with Version 1.1 of the District Services Model (DSM).

Disclaimer

This report has been reviewed by the Water Research Commission (WRC) and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the WRC, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

The District Services Model is provided as a public resource to assist with planning of infrastructure services at district level. The model is intended for strategic use only and should not be used for detailed budget preparation or project assessments. Model results are dependant on many inputs, including default costs, which may be inaccurate.

The developers and funders of the model hereby disclaim any responsibility for decisions taken on the basis of model results.

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EXECUTIVE SUMMARY

Introduction

This manual outlines the philosophy behind the model, its aims, limitations and key assumptions. The structure and operation of the model is described in detail, covering the required data inputs and the meaning and presentation of the various outputs.

Purpose of the District Services Model

The District Services Model (DSM) has been designed to assist district municipalities to undertake financial analysis of infrastructure investment plans. The model performs this analysis at two levels.

Level 1: District-wide infrastructure planning

Firstly, the model assists district municipalities in examining how *household affordability levels* and *available subsidies* place *constraints* on sustainable *service levels*. Improved understanding of these dynamics should promote realistic decisions about district-wide infrastructure programmes from the point of view of capital and operating expenditures. In order to provide these insights the model takes a district-wide perspective on infrastructure services.

Level 2: Medium-term Council budgeting

Secondly, the model has been designed to assist district municipalities to review the impact of service provision policies on the Council's own budget, over a medium-term (10 year) time horizon. These budget projections are based on a subset of the district-level outputs, together with projections for additional activities which are not related to household services. Financial viability can thus be assessed in terms of predicted cash flows, taking ability and willingness to pay into account.

Financial planning in district municipalities

District municipalities are currently required to undertake a number of planning exercises. In particular the Local Government Transition Act, as amended, compels all municipalities to develop negotiated integrated development plans for their respective areas of authority. According to the Act, integrated development plans must aim at integrated development and management of municipal areas in terms of the municipality's powers and duties.

The powers and duties of district municipalities have recently been spelt out in detail in the Municipal Structures Act, and require district municipalities to ensure the provision of various infrastructure services within their areas. Furthermore, the Act requires district municipalities to take up the responsibilities of other local government structures where these structures are unable to perform their functions. For this reason alone it is clear that district municipalities need to undertake financial planning as a key part of performing their mandates. Over and above this rationale, a number of other factors indicate a need for financial planning.

- Although inter-governmental transfers have simplified and their predictability and reliability increased, district municipalities still face funding uncertainties and need to plan for these.
- New budgeting standards will require local government to undertake multi-year budgeting, in similar fashion to national government's medium term expenditure framework.

Given these statutory requirements for financial planning, albeit in a context of significant uncertainty, the District Services Model has been designed to be as flexible as possible.

The scope of the model

The primary focus of the model are the five main infrastructure services:

- Water services;
- Sanitation services;
- Electricity;

- Solid waste removal; and
- District roads.

In addition, the model provides for limited modelling of:

- Fire and emergency services;
- Health services; and
- A user-defined category of 'Other' services.

Applying the model

The model has been designed to assist with a wide range of decisions. For instance, it can be used to examine the financial implications of the infrastructure service component of a district-wide regional development plan. Or it could be used to project the budgetary implications of a specific decision, such as what role the district municipality should play in the provision of sanitation services in dense settlements.

In general, the more care given to defining decisions and planning the process at the outset, the more effective the model will be in supporting decision-makers. Whilst there is no one best way to conduct a modelling process, users should consider including at least those steps described within the manual.

Settlement definitions

The most fundamental convention within the model is the use of five settlement categories.

DSM Settlement Types	Short Description
Urban	Proclaimed TLCs and Metros
Dense Settlements	Dense, unproclaimed settlements. Formal and informal
Villages	Less dense, informal unproclaimed settlements
Scattered settlements	Low density, scattered informal settlements
Farmland	Farmland and privately held land

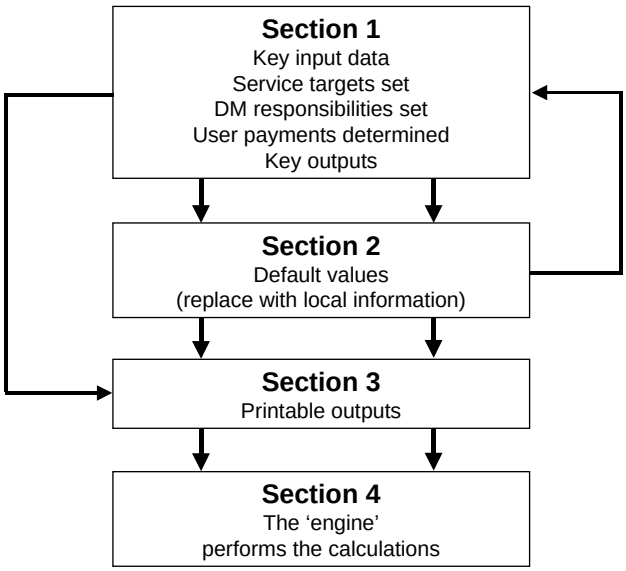
The starting point in applying the DSM is to allocate all households within the district to these settlement types. Generally, the most accurate source of demographic data will be the '96 household census.

Service levels

The model provides for a range of service options for each infrastructure service. These options are described, along with an indication of typical capital and operating costs for urban and rural areas respectively.

The model structure

The model consists of four sections:



Section 1 This is the interactive section of the model. Essential demographic, economic, services and financial information is entered here. An investment programme for the district is designed. The user then determines which services the District Municipality will take direct responsibility for. Payments for services are determined. Key outputs on the capital and operating accounts are shown for both the District Municipality and the district as a whole.

Section 2 Information is entered to replace default values which are used in the absence of local information. Once default values are over-ridden users should review decisions made in section 1 since outputs will change.

Section 3 Output information is presented in greater detail in a format which is suitable for printing.

Section 4 This is the "engine" where most of the calculations are conducted. Users would not ordinarily access this section, unless particular calculations had to be traced.

Model description

The general conventions employed in the District Service Model (DSM) are described.

The functions of each individual screen are described, highlighting assumptions, error conditions, and the meaning of calculated outputs.

Annexure 1 : Census data conversion

Financial models are highly sensitive to assumptions made about the status quo. In many cases though, existing district municipality data will be patchy, dated and unreliable - particularly when considered at the level of the district as a whole.

Whilst the '96 Household Census data has some failings, it does at least provide district municipalities with consistent data at a district-wide level. In order for Census '96 data to be useful, it must be translated from Census conventions into DSM conventions. A spreadsheet *census-dsm.xls* has been created to perform this translation.

Even if district municipalities are confident of their demographic and services data, it is essential that model users undertake this exercise before applying the model. Users will require the full Census '96 data set for their district, and a suitable GIS or database with which to manipulate the data.

The basic steps of the exercise are described in the annexure, together with a detailed explanation of the various census conventions.

THE ORIGINS OF THE DISTRICT SERVICES MODEL

The early stages

In 1994 the Water Research Commission (WRC) appointed Palmer Development Group (PDG) to undertake an institutional and financial review of water supply and sanitation services in the urban areas of South Africa (PDG). The overall objective of this project was to present information and analysis that could help relevant community leaders and decision-makers to guide and promote the extension of services to all people living in the (urban) areas of South Africa. The project also examined financial, institutional and policy issues relating to implementation strategies.

During this project, an investment-tariff model was developed to assist agencies responsible for urban water supply with the development and evaluation of investment scenarios and tariff policies. The model assumed a policy goal of eradicating service backlogs as rapidly as possible, whilst maintaining the financial viability of the service.

Model testing and extension

Subsequent to the model's initial development, Durban Water and Waste expressed interest in using the model and became involved in its further development and extension to include sanitation services. The revised model was used by a number of water service providers including Durban Water and Waste, Rand Water, Port Elizabeth, Pietermaritzburg and Estcourt.

The water and sanitation model was then applied to twenty towns in South Africa, during a study commissioned by the Development Bank of Southern Africa (DBSA) to assess the national financial viability of alternative residential infrastructure investment programmes (DBSA, 1995a). Similar models for electricity, roads and storm-water and solid waste were also developed and applied. A consolidated model of all these services was also developed for application on a national scale (DBSA, 1995b). These studies informed the first draft of the Municipal Infrastructure Investment Framework (Department of Constitutional Development, 1997).

The Combined Services Model

In early 1996 Palmer Development Group was commissioned by the DBSA to develop more "user-friendly" models for the major urban infrastructural services, namely water, sanitation, electricity, solid waste, roads and storm-water. The outcome of this project was the Combined Services Model (CSM) which is a single model designed for local authorities to assess the financial viability of alternative residential infrastructure investment programmes, in any or all of these services.

The CSM has been applied to a large number of local authorities in South Africa by DBSA, Palmer Development Group, BC Gildenhuys & Associates and the Western Cape Provincial Government. The model was used in the subsequent refinement and extension of the Municipal Infrastructure Investment Framework (Department of Constitutional Development, 1997). The CSM is a useful tool in the development of urban Integrated Development Plans, which are now a statutory requirement for local governments.

The Water Supply Services Model and the Sanitation Services Model

In 1997 the WRC funded the development of a Water Supply Services Model (WSSM), as an updated and extended version of the original investment-tariff water model. The WSSM incorporated additional variables, allowed for inflation, and made full use of the experience gained in the development and application of the Combined Services Model. The model was developed by Palmer Development Group and subsequently applied in the Winterveld, King William's Town, Harrismith, the Khayalami Metroplitan Council, Western Cape Metroplitan area and the (Johannesburg) Southern Metropolitan Substructure.

In addition, a Sanitation Services Model (SSM) was developed, to be used either in conjunction with the WSSM, or as a stand-alone model. The SSM has been applied in Harrismith, the (Johannesburg) Southern Metropolitan Substructure, and the Johannesburg Metro.

The District Services Model

As the various financial models matured, attention turned to the challenges facing district councils in planning services for rural areas. In 1998 the Palmer Development Group was commissioned by the WRC to develop a model suited to the circumstances facing district municipalities. The DBSA subsequently extended this project to include services other then water and sanitation.

The resulting District Services Model (DSM) has been specifically designed to assist district councils to develop financial plans associated with the provision of infrastructure services. To date the model has been applied in the iNdlovu Regional Council (Southern, inland KwaZulu-Natal).

ACKNOWLEDGMENTS

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The *Water Research Commission* (WRC) and The *Development Bank of Southern Africa* (DBSA) provided funding for the development of the model.

iNdlovu Regional Council funded the case study application of the model.

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Model development and case study

The following people contributed towards the development of the model:

- Jay Bhagwan (WRC) and Barry Jackson (DBSA) facilitated the establishment of the joint project between the two funders and provided inspiration and direction.
- Alwyn Coetzee and Richard Marwood of the DBSA brought various people together at key points and planned the distribution of the model.
- Andre Els offered iNdlovu Regional Council as a case study and chaired the case study Steering Committee.
- Les Howard, Anil Singh, Khaveen Sivenandan, Buhle Ally, Ambrose Ngcobo and various other iNdlovu Regional Council staff members assisted with the collection of data and the establishment of investment scenarios.
- Graham Smith and Margaret Futter of Scott Wilson provided conceptual advice from the perspective of iNdlovu's regional development plan and related projects.
- Ian Palmer of the Palmer Development Group assisted with the conceptualisation of the model and the establishment of default values.
- Mark Pickering lead the project.
- Bee Thompson programmed the model spreadsheets and contributed extensively to its functionality.
- Lindelwa Mabuntana researched roads policy, interpreted census data and assisted with the case study.

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CMIP	Consolidated Municipal Infrastructure Programme
CSM	Combined Services Model
DBSA	Development Bank of Southern Africa
DC	District Council
DCD	Department of Constitutional Development
DSM	District Services Model
EA	Enumerator Area
ECU	Energy Control Unit
ES	Equitable Share
GIS	Geographical Information Systems
IDP	Integrated Development Plan
KZN	KwaZulu-Natal
LOFLOS	Low Flow On Site Sanitation
LPG	Coal, Paraffin or Gas
MEC	Member of Executive Committee
NCWSTI	National Community Water and Sanitation Training Institute
NI	National 1 road
PDG	Palmer Development Group
RDP	Reconstruction and Development Programme
RSA	Republic of South Africa
SA	South Africa
SSM	Sanitation Services Model
STED	Septic Tank Effluent Drainage
TLC	Transitional Local Council
TRC	Transitional Rural Council
TRepCs	Transitional Representative Councils
UAW	Unaccounted for Water
VIP	Ventilated Improved Pit
WRC	Water Research Commission
WSSM	Water Supply Services Model

INTRODUCTION

This user guide outlines the philosophy behind the district services model, its aims, limitations and key assumptions. The structure and operation of the model is described in detail, including the required data inputs, and the meaning and presentation of the various outputs.

Purpose of the District Services Model

The DSM has been designed to assist district councils to undertake financial analysis of infrastructure investment plans. The model performs this analysis from two perspectives.

Perspective 1: District-wide infrastructure services

Firstly, the model enables a district-wide examination of infrastructure services, independent of any consideration as to which party will provide these services. In particular, the model focuses on the interactions between *household affordability levels, available subsidy levels* and *service levels.* Improved understanding of these dynamics should promote realistic decisions about district-wide infrastructure programmes, from the point of view of capital and operating expenditures.

Perspective 2: Medium-term district council budgeting

Secondly, the model enables district councils to examine the impact of becoming a service provider on the Council's own budget, over a medium-term (10 year) time horizon. These projections are based on a subset of the first perspective, together with an projections for non-service infrastructure activities. Financial viability is assessed in terms of predicted cash flows, taking ability and willingness to pay into account.

In essence then, the DSM has been designed to help district councils answer five key questions:

Q1. What is the current situation with regard to service provision within the district?

Q2. What levels of service are affordable and sustainable?

Q3. At what rate can infrastructure service backlogs be addressed?

Q4. What role should the district council play with regard to providing services themselves?

Q5. How should infrastructure services be financed?

Financial planning in district councils

District councils are currently required to undertake a number of planning exercises. In particular the Local Government Transition Act (Act 209 of 1993) as amended (Act 97 of 1996) compels all councils to develop negotiated integrated development plans for their respective areas of authority, in accordance with national regulations published by the Minister of Constitutional Development. According to this act, integrated development plans must aim at integrated development and management of municipal areas in terms of the municipality's powers and duties and, where applicable, having regard to the subject matter of a land development objective contemplated in Chapter 4 of the act.

The planning provisions of the above Act are to be replaced by those in the current Municipal Systems Bill.

The functions and powers of district councils have recently been spelt out in detail in the Municipal Structures Act (DCD, 1999), as per the following extract.

Municipal Structures Act

Chapter 5: Functions and powers of municipalities

General

80 (1) A municipality has the functions and powers assigned to it in terms of sections 156 and 229 of the Constitution.

(2) The functions and powers referred to in subsection (1) must be divided in the case of local and district municipalities as set out in this Chapter.

Division of functions and powers between local and district municipalities

81. (1) A district municipality has the following functions and powers:

(a) Integrated development planning for the district municipality as a whole, including a framework for integrated development plans for the local municipalities within the area of the district municipality.

(b) Bulk supply of water that affects more than one municipality.

(c) Bulk supply of electricity that affects more than one municipality.

(d) Bulk sewerage purification works and main sewerage disposal that affects more than one municipality.

(e) Solid waste disposal sites serving the area of the district municipality as a whole.

(f) Municipal roads which form an integral part of a road transport system for the area of the district municipality as a whole.

(g) Regulation of passenger transport services.

(h) Municipal airports.

(i) Municipal health services serving the area of the district municipality as a whole.

(j) Fire fighting services serving the area of the district municipality as a whole.

(k) The establishment, conduct and control of fresh produce markets and abattoirs serving the area of the district municipality as a whole.

(l) The establishment, conduct and control of cemeteries and crematoria utilised by more than one municipality.

(m) Promotion of local tourism for the area of the district municipality.

(n) Municipal public works relating to any of the above functions or any other functions assigned to the district municipality.

(o) The receipt, allocation and, if applicable, the distribution of grants made to the district municipality.

(p) The imposition and collection of taxes, levies and duties as related to the above functions or as may be assigned to the district municipality in terms of national legislation.

(q) Any other functions and powers allocated to a district municipality in terms of section 80.

(2) A local municipality has the functions and powers referred to in section 78, excluding those of such functions and powers allocated to the district municipality in whose area it falls.

(3) Subsection (2) does not prevent a local municipality from performing functions and exercising powers of the nature described in subsection (1) in its area.

Allocation of additional functions and powers and conflict resolution

82. (1) The MEC for local government in a province, with the concurrence of a district municipality and a local municipality within the area of that district municipality, or in the absence of such concurrence, with the approval of the Minister, may, by notice in the Provincial Gazette, assign any of the functions and powers of –

(a) the local municipality to the district municipality; or

(b) the district municipality to the local municipality.

(2) In the event of a dispute between those municipalities concerning the performance of any function or the exercise of any power, the MEC for local government, by notice in the Provincial Gazette, may resolve the dispute by defining the district or the local municipality's role in the performance of that function or in the exercise of that power.

Co-operation between district and local municipalities

83. (1) A district municipality and the local municipalities within the area of that district municipality must co-operate with one another by assisting and supporting each other.

(2) (a) A district municipality on request by a local municipality within its area may provide financial, technical and administrative support services to that local municipality to the extent that that district municipality has the capacity to provide those support services.

(b) A local municipality on request of a district municipality in whose area that local municipality falls may provide financial, technical and administrative support services to that district municipality to the extent that that local municipality has the capacity to provide those support services.

(3) The MEC for local government in a province must assist a district municipality to provide support services to a local municipality.

Local municipalities of developing types

84. (1) Despite section 79 (2) –

(a) a local municipality of a developing type has only those functions and powers assigned to it by the MEC for local government in the province concerned by notice in the Provincial Gazette; and

(b) the district municipality in whose area that local municipality falls has all the municipal functions and powers in the area of that local municipality not assigned to the local municipality in terms of paragraph (a).

(2) The district municipality must –

(a) in co-operation with the MEC for local government in the province, support and progressively strengthen the local municipality's capacity; and

(b) report every six months to the MEC for local government on progress with its efforts.

(3) The MEC must regularly review the capacity and tax base of that local municipality and assign those powers and functions to the municipality that it has the capacity and tax base to fulfil.

Sparsely populated areas

85. In sparsely populated areas the district municipality has all the municipal functions and powers.

(DCD, 1999)

The Structures Act thus requires district councils to ensure the provision of various infrastructure services within their areas. Furthermore, the Act requires district councils to take up the responsibilities of other local government structures where these structures are unable to perform their functions. For this reason alone it is clear that district councils need to undertake financial planning as a key part of performing their mandates.

The Municipal Systems Act requires that, as part of the IDP, a financial plan must be prepared which includes a budget projection for at least the next three years.

Over and above this rationale, financial planning will assist a district council to determine:

- What service levels are affordable and sustainable?

- At what rate can infrastructure service backlogs be addressed, within the financial constraints?
- How infrastructure should be financed, both from a capital and operating finance view point.

Financial planning provides assurance to potential public and private lending institutions that proposed infrastructure investment programme are viable. Without this assurance, envisaged service levels and service coverage plans tend to be "wish lists.

Local sources of finance

District municipalities have access to two key sources of finance from within their areas:

- The district council (former RSC) levies on businesses.
- Payments for particular services provided directly by the municipality.

The levy income is used for financing operating costs of the district municipality, capital works within the district and, in some cases, operating costs of local municipalities.

Recurrent intergovernmental transfers

District municipalities also have access to finance from outside their areas. In the case of recurrent income this is largely in the form of inter-governmental transfers from national government and agency payments from the province.

The system of inter-governmental transfers is being rationalised, with the Equitable Share grant being phased in to replace a range of other agency payments, subsidies and transfers for operating expenditure. A transitional phase will be in place while the "historic" grants are phased out and the Equitable Share phased in. The following are being phased out:

- Intergovernmental Grants (IGGs) formally paid to former Black Local Authorities to assist them in rendering services.
- Subsidies to R293 towns, which have historically been paid to cover substantial operating deficits incurred by the organisation running them. (These towns were typically established in former homeland areas with high service levels and little cost recovery. They were initially run by homeland governments but were typically handed over to new local governments in 1995). While these will be phased into the Equitable Share (after the 2000/01 financial year), they are currently conditional grants paid by central government to the relevant provincial governments who then allocate them to local government.
- DWAF subsidies to cover the operation and maintenance costs of some water schemes. It is anticipated that these will be integrated into the Equitable Share progressively from the 2000/01 financial year.
- Consumer bus service.

The way in which the Equitable Share will be phased in is somewhat complex, which makes local government financial planning rather difficult. The policy is for the amount to be allocated to the local municipality. If this municipality does not have the capacity to manage the funds then district municipality is required to do this for them.

Another source of income to districts from outside their area is agency payments received from province for services provided on behalf of the province. This relates primarily to primary health and roads services.

Capital finance

Capital grants have largely been included in the Consolidated Municipal Infrastructure Programme (CMIP). Totalling some R701 million in 1999/2000, this grant is bolstered by allocations for community water services by DWAF and various special Presidential projects. In addition to these sources, funding for capital infrastructure includes the housing subsidy scheme and other national grants (e.g. Department of Public Works and Department of Land Affairs).

At present it is difficult for districts to have a clear idea of what capital funding will be received and this makes planning difficult. However, there is an initiative to rationalise these grants and give districts greater certainty as to what grant finance they will receive.

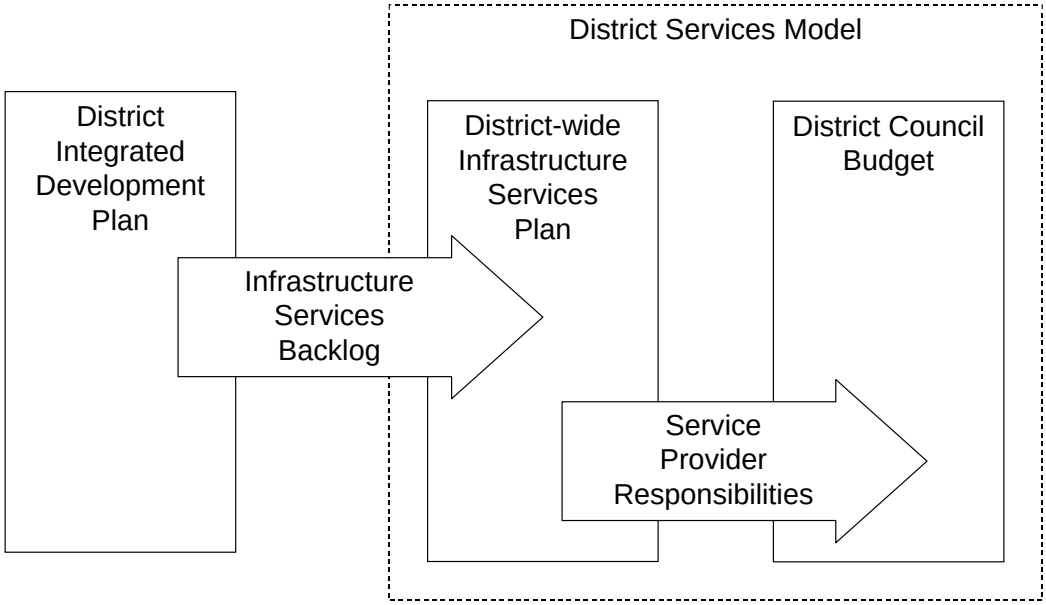
With regard to borrowing to fund capital expenditure, this is taking place to an increasing extent, with funding from the DBSA and private lending institutions.

Standard budgeting

The Department of Finance has initiated a project to develop uniform standards, formats and classifications for local government budgets. At present the lack of standards makes comparisons difficult. The new standards will require local government to undertake multi-year budgeting, in similar fashion to national government's Medium Term Expenditure Framework (Ministry of Finance, 1998).

Given these clear requirements for financial planning, the District Services Model has been designed to be as flexible as possible. The central emphasis then is to provide a tool to assist district councils with the task of linking their integrated development planning processes (also known as regional development plans) to their medium-term budget frameworks.

Figure 1 Linking Integrated Development Plans to district council budget frameworks.



The scope of the model

Purpose of the model

The model is intended as a strategic planning tool, to assist with long-range decisions regarding the way in which services are to be provided and the way they are to be financed. While it deals with the scale of payments which consumers need to make for the services they receive, and whether such payments are affordable to them, it is not a tariff setting tool. The model is also not intended to deal with specific projects and the way these are selected. (The DBSA has other models to do this). Rather, the DSM should be seen as setting an envelope for capital expenditure over a 10-year period. Allocations of funds to specific projects, which is generally a shorter term decision, should fit within this envelope.

Services included

The primary focus of the model are the five main infrastructure services, each of which are modelled in detail:

- Water services;
- Sanitation services;
- Electricity;
- Solid waste removal; and
- District roads.

In addition, the model provides for limited modelling of:

- Fire and emergency services;
- Health services; and
- A user-defined category of 'Other' services.

Services excluded

Although the model's primary focus is on infrastructure services for households, no provision is made for actual housing delivery, on the assumption that district councils have no responsibility for 'top structure'. Any housing grants are therefore assigned to infrastructure first, leaving the remainder for 'top-structure'.

The model does not consider economic infrastructure investments or the provision of social services. Nonetheless, provision is made for the direct entry of capital and operating budgets to support such programmes, in order to be able to generate a complete budget for district municipalities.

The model deals explicitly with the allocation of the Equitable Share funds available within the district, along with other infrastructure-related grants from central government.

Key assumptions

The DSM has been developed on the basis of the current policy context for district councils. As time goes by, this policy context will change and the model will require upgrades.

Version 1.1 of the model makes the following key assumptions:

- That finance required for investment in infrastructure may be obtained from consumer contributions, current revenue and/or subsidies. The balance is borrowed under conditions set by the user of the model. Only one set of borrowing conditions apply though. No provision is made for borrowing from internal and external sources at different rates.
- That high-income households provide the finance for their own internal infrastructure. High-income households are defined as those with incomes exceeding R3 500 per month who do not qualify for capital subsidies.
- All high-income households will receive high levels of service for water, sanitation and electricity. In urban areas all high-income households receive a curbside refuse removal service.
- The cash surplus/shortfall on the service provider's operating account is used as the indicator of financial viability, once all interest payments/earnings and contributions to funds have been included.
- The model covers a 11-year period with "Year 0" being the current planning year and "Year 1" being the first year of planned investment.

Extensions to the model

In common with other financial models, the DSM is likely to undergo future upgrades and extensions, to cope with changing user requirements and shifts in the policy environment.

Model users are encouraged to interact with the agencies responsible for the model (WRC and DBSA) and with the model developers (PDG). Users should always ensure that they are using the latest version of the model.

TECHNICAL SPECIFICATIONS

The model has been developed as an Excel spreadsheet, and may be run using Excel 5.0 or a later version under a Microsoft Windows operating system. It is recommended that users have a reasonably powerful PC with adequate memory. Whilst the model will run on a 100 MHz Pentium with 16 Mb memory it will take around 5 seconds to calculate the impact of small changes, and up to 2 minutes in unusual situations.

Users will need a basic knowledge of Excel, but need not be spreadsheet experts for normal modelling.

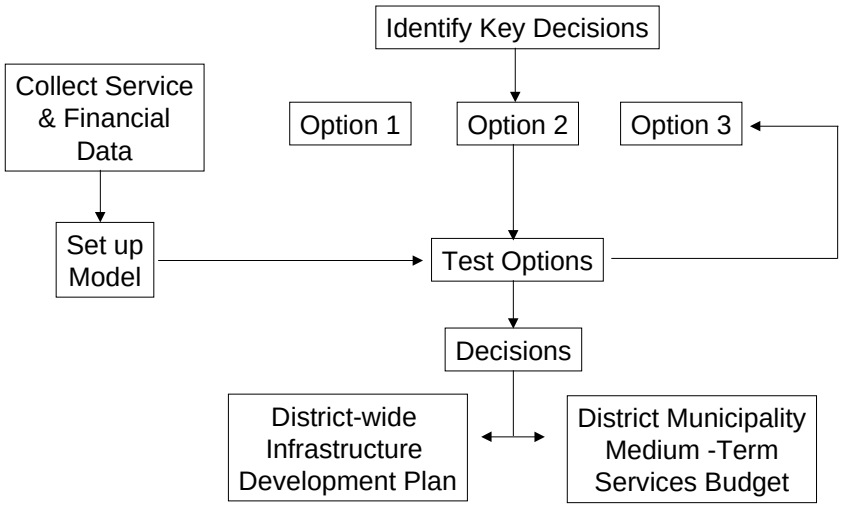
In order to establish the status quo (see Appendix 1) users will generally need to manipulate census data. This will require the use of a GIS or similar database system.

APPLYING THE MODEL

The model has been designed to assist with a wide range of decisions. For instance, it can be used to examine the financial implications of the infrastructure service component of a district-wide Regional Development Plan. Or it could be used to project the budgetary implications of a specific decision, such as what role the district council should play in the provision of sanitation services in dense settlements.

In general, the more care given to defining decisions and planning the process at the outset, the more effective the model will be in supporting decision-makers. Whilst there is no one best way to conduct a modelling process, users should consider including at least the steps described below[1].

Figure 2 Simplified process for applying the DSM.



Step 1. Identifying the key decisions

Where possible, model users should begin by identifying the decisions which require financial modelling support. Focusing investigations from an early stage will reduce unnecessary data gathering activities and save time. For instance:

- An investigation to establishing the parameters of a district-wide general infrastructure services plan. In this case all sections of the model should be used and all data fields should be filled in;
- An investigation into a district wide water services plan. In this case only the water sections of the model are relevant, and other services can be turned off and ignored.
- An investigation into the possibility of the district council becoming a water services provider within the district. In this case the focus should be on water, and the responsibilities of the council as a service provider.

Where possible, the ultimate decision-makers should be involved in defining and framing the key decisions to be taken.

Step 2. Identifying the options

Closely related to step 1 is the process of identifying the options to be considered. These could take the form of different institutional arrangements, or different levels of service provision, or different institutional responsibilities. It may not be possible to define the options clearly at the outset, but at some stage in the process it is important to define a limited number of choices to help focus decision-making.

Step 3. Understanding the current status quo

This step requires the collection of various service and financial data. Model users need to develop a thorough understanding of the current status of service provision in the area being modelled, including its

[1] See Gildenhuys, 1998 for an extensive overview of IDP processes.

demographic and economic profile, existing service coverage, operating and maintenance expenditure, income and payment profiles, water consumption patterns, etc. This information will typically be gathered from engineering, planning and treasury departments within the district council and other local authorities. A detailed description of each of these inputs is provided later in this guideline for each of the model screens.

This step will usually be the most time-consuming part of the process since district councils often have limited data on infrastructure services. Surveys may be required, which can be very expensive and time-consuming. A practical alternative to surveys is to use Census data. Appendix 1 of the guideline describes a spreadsheet which can be used to convert Household Census figures into the input formats required by the DSM. Even if the district council has a reasonably clear picture of income and service levels within the district, it may be worth comparing these with the results of the census exercise.

In order for the results of the model to be meaningful it is essential that these inputs are as accurate as possible. Data collection and interpretation should, therefore, be undertaken by experienced technical and financial personnel.

Step 4. Establishing service goals and time-frames

Once the status quo has been established, programmes can be designed to address infrastructure backlogs. It is at this stage that the selection of options becomes useful, as model users test alternative service levels and time-frames. Typically, three options would be chosen, for example:

- an ambitious option seeking to meet political aspirations for full household services in a short space of time;
- a financially conservative option seeking to minimise the need for subsidies and cross-subsidies; and
- a pragmatic "medium" option.

Ideally, these options should be developed through interaction between political representatives and the district council's technical and financial planners.

Step 5. Assessment of outputs

The key outputs provided by the model are:

- capital expenditure and sources of capital income;
- recurrent expenditure, income and cash flows;
- monthly household bills and subsidies; and
- consumption levels.

These outputs need to be assessed in terms of the delivery capacity of the institutions involved, the financial viability of the proposed programme, the affordability of projected household bills, and the political acceptability of the service goals.

Based on this assessment, it may be necessary to redefine the options under consideration, or even the nature of the problem itself.

Step 6. Undertake a sensitivity analysis

Model users may wish to adjust various inputs to determine the sensitivity of the outcome to various parameters. For instance, the extent of the council's responsibilities for service provision could be varied to assess the budgetary impacts.

Step 7. Select preferred option and refine analysis

Once the options are sufficiently clear they should be presented to the appropriate political representatives or financial and technical managers within the district council. These parties should provide guidance as to which options should be investigated further – or suggest alternative options.

Insights gained through steps 1-6 may well lead to a redefinition of the problem itself, leading to a need for new options, further data gathering, and more cycles of modelling. This interactive learning process is essential for sound financial planning, and requires ongoing communication.

Step 8. Updating the model

As new (or more accurate) data become available, the analysis can be further refined. In particular the 'status quo' picture should be constantly improved. The more accurate this data is, the more reliable the modelling results.

It is recommended that the model be updated at regular intervals, such as during annual regional planning exercises. The model predictions can then be used as a basis for ongoing monitoring and planning.

SETTLEMENT DEFINITIONS

The most fundamental convention within the model is the use of five settlement categories.

Table 1 DSM settlement categories

DSM Settlement Types	Short Description
Urban	Proclaimed TLCs and Metros
Dense Settlements	Dense, unproclaimed settlements. Formal and informal
Villages	Less dense, informal unproclaimed settlements
Scattered settlements	Low density, scattered informal settlements
Farmland	Farmland and privately held land

These settlement types are described in more detail below. Model users who intend to utilise the census data, as described in annexure 1, should ensure that they are familiar with these definitions.

Urban settlements

This category does not refer to Metros and TLCs, but rather to *settlements of urban character*.

This category includes formal residential areas where township establishment has taken place and informal settlements which are contiguous with these areas. Here the term 'informal' implies relatively recent settlement: people who have settled on land which they do not own in order to be closer to urban economies. The term 'contiguous' could be taken to mean that the edge of informal area is not further than 5km from the edge of established townships.

Settlement density

A density criterion could be applied here to deal with small holdings (with no squatters) and to help define a cut-off for those situations where there is a peri-urban fringe which expands continuously outwards from an urban core. This latter situation is often associated with towns adjacent to former homeland areas. In this case land ownership has not been a constraint for people in settling close to urban cores. A typical density limit would be of the order of 5 dwellings per hectare.

Settlement size

Urban settlements will generally be relatively large (greater than 5 000 people). However, there are some small towns which are below this limit. If a situation is found where an urban area accommodates less than 2 500 people, then this should be categorised as a village for modelling purposes.

Institutions

Within the urban category there will generally be an established local council, which has been delegated executive authority to provide services. The offices of this council will typically be within the settlement.

Enumerator area types

The urban category would include all the census categories called 'urban'. With regard to the 'semi-urban' census category the following guidelines are proposed:

- 'Semi-urban formal' should be treated as urban, with the size qualification mentioned above.
- 'Semi-urban informal' is likely to be the hardest to judge, as many areas in this census category may be away from urban cores and thus would fit more appropriately into the dense settlement category or, if they are smaller than 5 000 people, even into the villages category.
- 'Semi-urban hostels and institutions' would typically be regarded as urban.
- 'Rural formal and semi-formal' are unusually handled in the census as they refer to formal areas and are even given the name 'towns'. If these rural formal and informal settlements are larger than 5 000 people they belong with the DSM's urban category. If they are smaller than 2 500 people they belong to the village category. If they are of in-between size it becomes a judgement call.

Dense settlements

Typically, the term dense settlements has been used for large settlements associated with people who were forcibly removed under the apartheid government. These settlements are separated from urban areas by a substantial distance (generally greater than 50 km). They are typically located in former homeland areas and have not had townships proclaimed. They have little of their own urban economic activity and typically do not have central business districts.

From the point of view of the DSM there is merit in including large traditional settlements in this category. In fact it will often be difficult to differentiate between traditional settlements and dense settlements, in which case size and density criteria become important (see below).

Settlement density

When is a settlement a single settlement and when is it a group of individual settlements?

It is proposed here that if the density of settlement in an area is greater than 0.5 dwellings per hectare (dwellings an average of 150 m apart) it should be considered a single settlement. However, the nature of dense settlements is that they seldom have densities this low and will almost always have densities of greater than 5 dwellings per hectare and often have densities of greater than 15 dwellings per hectare.

Settlement size

For the DSM the dense settlement category is reserved for settlements of greater than 5 000 people.

Institutions

Dense settlements often do not have local councils with executive responsibility for providing services. Although some may be in this situation the council will seldom have an office within the settlement. From a service provider point of view dense settlements typically require more formal service provision arrangements, since community-based management is not well suited to settlements of this size. Their size generally warrants some formally employed service provider staff being based in the settlement.

Enumerator area types

The dense settlement category would include some of the following:

- 'Semi-urban informal (see discussion under urban above).
- 'Rural tribal villages and informal'. If these settlements are larger than 5 000 people they should be included under dense settlements.

Villages

This category is primarily used for traditional settlements in former homeland areas. However, small towns of less than 500 people and small informal settlements are also included. (The separation between 'traditional' and 'informal' settlement relates primarily to the history of the settlement, but also to the nature of the dwellings).

Settlement density

The density limit for a single settlement is similar to those for dense settlements. But villages will often have relatively low densities, in the range of 0.5 to 5 dwellings per hectare. However, higher densities do not preclude a settlement from being categorised as a 'village' for the DSM.

Settlement size

For the DSM the term 'village' is reserved for settlements of between 500 and 5 000 people.

Institutions

Villages typically do not have local councils with executive responsibility for service provision, although this is not necessarily always the case. Regardless of the local authority's situation, service provision is frequently best performed in such settlements through informal, community-based arrangements. The main reasons for this are the distance from formal service provider offices, and the low viability of having a formally employed person based in the village.

Enumerator area types

This category would include some of the following:

- 'Urban' settlements which are smaller than 2 500 people.
- 'Semi-urban formal' if it is has between 500 and 2 500 people in the settlement.
- 'Semi-urban informal, if they are between 500 and 5 000 people in size.
- 'Rural formal and semi-formal'. As mentioned under 'dense settlements', if these rural formal and informal settlements are larger than 5 000 people they belong with the 'urban' category of the DSM. If they are smaller than 2 500 people they belong with 'villages'. If they are of in-between size it becomes a judgement call.
- 'Rural tribal villages and informal', if these settlements are 500 to 5 000 people in size.

Scattered settlements

This term is reserved for all settlements which are less than 500 people in size, excluding commercial farms.

Settlement institutions

In scattered settlements the situation with service provider arrangements is similar to that with villages. However, the establishment of even community-based arrangements becomes difficult.

Farmland

This is a sub-category of 'scattered' to provide for people living on commercial farms or associated with other commercial activity. Settlement sizes are lower than 500 people and/or densities are lower than 0.5 dwellings per hectare. This category includes a mix of land owners and tenants, with the assumption that tenants are employed on the farm or by some other commercial entity.

Institutions

There is a specific institutional arrangement associated with this category, in that the owner of the commercial enterprise is responsible for service provision.

The use of census enumerator areas

The starting point in applying the DSM is to allocate all households within the district to these settlement types. Generally the most accurate source of demographic data will be the '96 household census. Each enumerator area (EA) in the census was allocated a settlement type description, as follows.

Table 2 Population Census '96 code list for Enumerator Area types

Census Settlement Type	Code	Description
Urban: *EAs within municipal or local authority boundaries.*		
Urban: formal	11	Ordinary town or city area as well as vacant areas. Various formal structures can be found, e.g. houses, blocks of flats and businesses.
Urban: informal	12	Area with mainly informal dwellings (so-called 'squatter areas').
Urban: hostels	13	Area with mainly hostels, e.g. mine, factory and municipal hostels.
Urban: institutions	14	Area with mainly institutions e.g. prisons and hospitals.
Semi-urban: *EAs with population concentrations adjacent to a municipal border (an EA must have one common boundary with the municipal border).*		
Semi-urban: formal	21	Semi-town (i.e. a town without a local authority) with predominantly formal dwellings.
Semi-urban: informal	22	Area with mainly informal dwellings.
Semi-urban: hostels	23	Area with mainly hostels.
Semi-urban: institutions	24	Area with mainly institutions.
Rural: *EAs situated in rural areas (not sharing a common boundary with a proclaimed urban municipal area).*		
Rural: formal	31	Semi-town (i.e. a town without a local authority) with predominantly formal dwellings such as mining, and industrial towns where housing for employees is provided by employers.
Rural: formal/semi-formal	32	Village/settlement without a local authority and which is not situated within a tribal area and with formal and semi-formal dwellings such as houses, huts and rondavels.
Rural: tribal villages	33	Tribal authority area with villages.
Rural: informal	34	Area with mainly informal dwellings.
Rural: hostels	35	Area with mainly hostels.
Rural: institutions	36	Area with mainly institutions.
Rural: farms	37	Area with farms, agricultural holdings, holiday resorts, agricultural schools and colleges.
Rural: tribal exc. Villages	38	Tribal authority area outside of villages.
Unknown or Dummy hhold[2]	99	

(Source: Statistics SA)

Enumerator areas have been grouped together in a hierarchy consisting of:

- Local authorities;
- Districts;
- Provinces; and
- National.

It is therefore possible to draw reports from the census at the district council level.

It should be noted that Census '96 took the approach of dividing urban EAs from rural EAs on the basis of proclaimed township boundaries. TLCs and Metros thus fall into the *urban* category, whilst TRC's TRepCs and Rural Council areas are regarded as rural settlements. This is a somewhat arbitrary distinction though, since proclaimed townships can include settlements that are rural in character, whilst unproclaimed areas can include urban settlements. This is just one of many weaknesses within the census data that modellers should be aware of.

[2] Category 99 'Unknown or Dummy household' should be ignored for DSM purposes.

In the likely event that the census settlement definitions are unreliable, model users will need to allocate individual EAs to the five DSM settlement types on the basis of the characteristics used to distinguish between the various categories.

The following table provides a guideline for the allocation of EAs, based on the census codes. However, it is very likely that the results from such an exercise will be flawed, due to variations in the definitions used by census enumerators. If this proves to be the case then district council planners should utilise local knowledge to allocate individual EAs to the various DSM settlement types.

Table 3 Household numbers by settlement category, based on enumerator area types

DSM Settlement Types	Mapped EA types	Notes
Urban	*Urban* 11 Urban: formal 12 Urban: informal	Planners may wish to include 21 in the Urban category.
Urban Institutions	13 Urban: hostels 14 Urban: institutions	Categorize separately in order to get household population numbers correct.
Dense Settlements	*Semi-urban* 21 Semi-urban: formal 22 Semi-urban: informal *Rural* 31 Rural: formal 32 Rural: formal/semi-formal	Planners may wish to reallocate some categories, depending on local knowledge.
Rural Institutions	23 Semi-urban: hostels 24 Semi-urban: institutions 35 Rural: hostels 36 Rural: institutions	Categorize separately in order to get household population numbers correct.
Villages	33 Rural: tribal villages	Some EAs could be Scattered Settlements.
Scattered Settlements	34 Rural: informal 38 Rural: tribal exc. Villages	Some EAs could be Villages.
Farms	37 Rural: farms	Some of these EAs may be more appropriately situated in Dense Settlement.

For further information on the use of census data see Annexure 1 : Use of census data.

SERVICE LEVELS

The model supports a range of service options for each infrastructure service.

These options are described in this section, along with an indication of typical capital and operating costs for urban and rural areas respectively. This section draws heavily on *Municipal service options: A guideline for local authorities* (Department of Constitutional Development, 1998).

Water reticulation

Communal standpipes

The communal standpipe option provides for a single standpipe, often with a single tap, to be shared by a number of households. The number of households per standpipe will depend on the density of dwellings in the settlement, but a ratio of 25 households per tap is typical for relatively dense settlements.

- Typical consumption range: 3-5 kℓ per household per month.
- Typical capital cost (total infrastructure) : R900 urban, R1 500 rural.
- Typical monthly operating cost: R10 per month urban, R14 per month rural.

Advantages

- Public standpipes are the least expensive water supply option for a reticulated water supply system, in terms of both capital and operating costs.
- Consumption is comparatively low and pipe sizes can be kept to a minimum, unless some form of upgrading is likely in the near future.

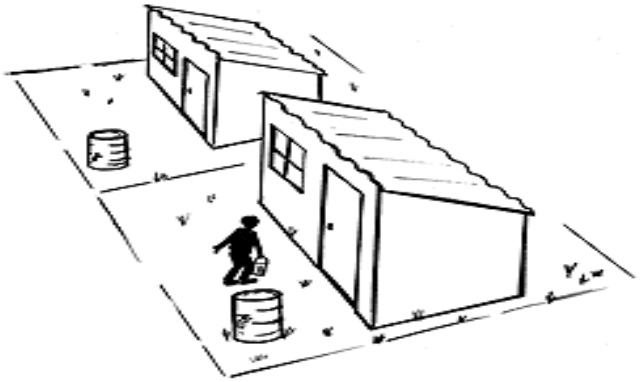
Disadvantages

- Customers have to carry water in containers to their houses which is inconvenient.
- Water is stored in the house, often in open buckets, where it could be contaminated unless proper care is taken.
- Poorly designed standpipes can create messy surroundings.
- Payment arrangements are difficult, leading to reduced cost recovery for the service.
- Free water or fixed-charge tariffs frequently lead to higher consumption and wastage.
- Inequitable access, in that some households are close to the tap and others far away.

The RDP stipulates that for a service to be adequate an amount of at least 25*l* of water per person per day must be delivered, within 200m of the homestead. Since reticulated services tend to be very costly in sparsely settled areas allowance has been made in the DSM for the provision of services below this level. The model therefore makes provision for two standpipe options:

- *Communal standpipes meeting the RDP standard* which meet RDP requirements, and
- *Communal standpipes below the RDP standard*, for cases where the service is below the minimum standard.

Yard tanks



The yard tank option provides for a tank to be installed in the yard. This tank is filled every day from a manifold serving a group of tanks. Customers generally pay a fixed sum up front on a monthly (or weekly) basis. Failure to pay results in isolation from the manifold. This system has been successfully pioneered by Durban Water and Waste.

- Typical consumption: 6 k/ per household per month.
- Typical capital cost: R1 600 urban, R2 500 rural.
- Typical monthly operating cost: R20 per month urban, R24 per month rural.

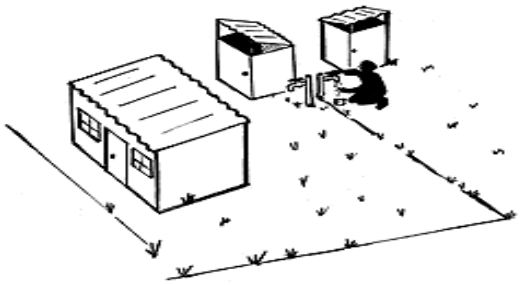
Advantages

- Up-front payments ensure that people pay for the service.
- People know how much water they are using.
- The fact that storage is provided "on-site" reduces the required capacity of the connector and internal reticulation pipelines and the distribution reservoirs.
- Low capital cost, particularly if people pay the capital cost of the tanks themselves.
- A good upgrade option, minimising requirements for new connector infrastructure.

Disadvantages

- Consumption is constrained and tanks can run dry during the course of the day.
- The operation of the system relies on the water bailiff to be present every day.

Yard taps



In this option a single tap is provided on each plot, either as part of a private standpipe or mounted on the wall of a toilet if a waterborne sanitation system is used. It is highly recommended that the supply is metered and consumers are billed according to the amount used.

Yard taps can be used with dry sanitation systems, low flow on-site sanitation (LOFLOS) or waterborne systems (see sanitation section). If no waterborne system is used, the drainage of the wastewater at the yard tap needs consideration. This could be a connection to the roadside drain in an urban area, or installation of a soakaway. If people are paying for water this becomes less of a problem as less water is wasted.

- Typical consumption range: 8-15 k/ per household per month, depending largely on sanitation.

- Typical capital cost: R1 600 urban, R2 500 rural.
- Typical monthly operating cost: R22 per month urban, R28 per month rural (variable).

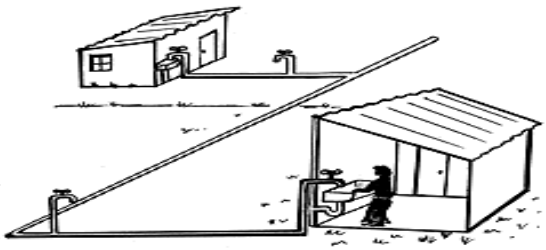
Advantages

- Water is available "on-site".

Disadvantages

- A meter reading and billing system is required for proper management.
- Pre-payment systems can be used, but the meters are expensive to install.

In-house water (house connections)



This option provides for a metered supply to the plot, a connection to the house and several taps inside the house. It requires a wastewater system such as a septic tank or waterborne system (see sanitation below). It is highly recommended that the supply is metered and consumers are billed according to the amount used.

- Typical consumption: 20-40 k/ per household per month.
- Typical capital cost: R1 900 urban, R2 800 rural.
- Typical monthly operating cost: R40 per month urban, R50 per month rural (variable).

Advantages

- Highest level of convenience.
- Provides the greatest health benefits.

Disadvantages

- High cost.
- High levels of water use.
- Difficult for consumers to control the amount used.
- Requires a complementary wastewater system.
- Requires a meter reading and billing system for proper management.
- Pre-payment systems can be used, but the meters are expensive to install.

Bulk water supplies

Non-reticulated improved source

This option includes spring protection, well, and boreholes with hand-pumps. Households would be expected to collect water at the source. This option is not available in urban areas.

Typical cost per kl of potable water provided: 130c/kl.

Bulk purchase of treated water

This option applies to the situation where a service provider purchases treated bulk water from an external agency, such as a water board, and model users wish to exclude the costs of bulk infrastructure. If bulk costs are to be included, the Regional Scheme option should be used (see below).

- Typical cost per kl of potable water provided: 80 c/kl - 300c/kl.

Regional scheme

A regional scheme serves many settlements or a few large settlements, typically supplying over 100 000 people. This type of scheme would almost always require a dam as the resource, and would have treatment works, a pumping system and a relatively large bulk reticulation.

- Typical cost per kl of potable water provided: 80 c/kl - 300c/kl.

Local scheme

This option refers to a small scheme serving more than one settlement, typically 10 000 to 100 000 people. It may be based on a dam, but boreholes or a run-of-river source are more likely. The network would probably not stretch for more then 20km.

- Typical cost per kl of potable water provided: 80 c/kl - 300c/kl.

Local bulk

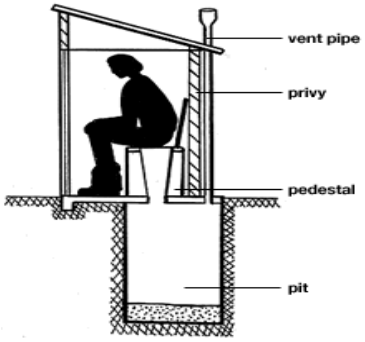
This option entails a bulk supply to a single settlement or cluster of settlements and would typically entail a borehole, spring or run-of-river source. Bulk lines would normally not be more than 5km long.

- Typical cost per kl of potable water provided: 80 c/kl - 300c/kl.

Sanitation

Sanitation services must be planned in conjunction with water supply. Where flush systems are selected sufficient water must be available. Where house connections are provided, a waterborne or septic tank system is required to drain off the wastewater. When either of these sanitation service options are considered the cost of the complementary water supply arrangements must also be taken into account.

VIP toilets or equivalent



A Ventilated Improved Pit (VIP) latrine is a partly or fully lined pit with a concrete slab over it. A sound and comfortable pedestal is positioned on the slab and a privy is built around it using locally available materials. The pit is fitted with a vent pipe and a fly screen, to allow odours to escape above the privy. The pit needs to be cleared when it is full, using a vacuum tanker. Generally it is best for pit emptying to take place on a regular basis, at between 5 and 10 year intervals. Alternatively, the VIP can be relocated and, if necessary, rebuilt in the new position. This is, however, an expensive option.

- Typical water consumption: Nil.
- Typical capital cost: R1 200 - R2 500 per household (depending on building materials and soil conditions).
- Typical monthly operating cost: R3 - 5 per month (repairs and provision for emptying).

Advantages

- Low capital and operating cost.
- System is robust with little day-to-day attention required, other than cleaning.

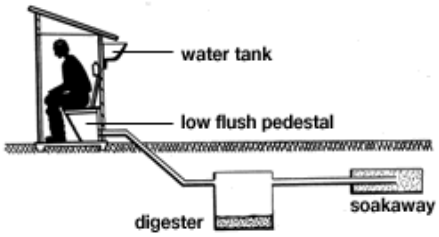
- Easy to build locally with commonly available materials.
- The option may not be possible where settlement densities are very high or if groundwater conditions do not allow.

Disadvantages

- The toilet must be outside.
- There can be problems where there is rocky ground or a high water table.
- De-sludging arrangements must be provided.

Other types of dry "on-site" sanitation systems may be used. Composting systems are one example and there are new developments in this area. Composting systems have the advantages of (a) not requiring deep excavations and (b) producing a usable product. However, they are typically more expensive than pit type systems and are more sensitive to operational problems.

Low-flow on-site systems



LOFLOS are not included as an option in the DSM, since they have yet to achieve sufficiently broad application to be a recommended system.

The term LOFLOS incorporates a number of sanitation options, including:

- The aqua-privy.
- Proprietary, factory-manufactured systems produced in South Africa, some of which are also referred to as aqua-privies.
- The pour flush system as used in India.

It is the proprietary systems which have been used most in South Africa, and are therefore discussed here. These systems have a pedestal, a digester (like a septic tank) and a soakaway. Several have a small tank for flushing water. The flush volume is generally below 1ℓ.

- Typical water consumption: 0,6 kℓ per household per month.
- Typical capital cost: R2 200 per household (depending on building materials. This cost is for similar materials to the VIP).
- Typical monthly operating cost: R10.

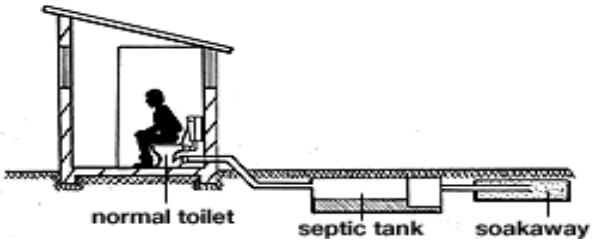
Advantages

- Fairly low capital and operating cost.
- Easy to install.

Disadvantages

- Water has to be carried to the flushing tank.
- Where small digesters are used they need to be emptied often.
- There has been a problem in the past with mechanical failures of the flushing mechanisms on some makes.
- Soakaways need to be carefully installed, as effluent may seep out onto the ground.

Septic tanks



A septic tank uses a conventional pedestal or flush toilet which can be located in a privy or in the house. The flow from the toilet goes into the septic tank (digester) and the effluent from the digester then flows into a soakaway and then into the ground. Flush volumes are in the range of 6 - 15ℓ. Other household water appliances can be connected, provided that the soakaway is big enough to deal with all the wastewater.

- Typical water consumption: five kℓ per household per month.
- Typical capital cost: R3 500 urban, R4 400 rural.
- Typical monthly operating cost: R5 urban, R8 rural, plus R6 for additional water.

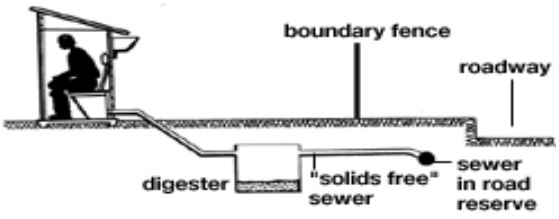
Advantages

- Does not require a sewer system.
- A possible upgrading option for individual households.
- A convenient system from the user's viewpoint.

Disadvantages

- Requires large plots.
- Most expensive on-site sanitation option.
- Uses more water in comparison to other on-site sanitation options.
- Tanks require de-sludging once every five to 10 years.
- Failure to de-sludge at the right time can lead to a blocked soakaway, needing total replacement.
- May not be suitable for certain groundwater conditions.

Intermediate sanitation systems



The term "intermediate sanitation" is used for waterborne systems where measures are taken to reduce the costs of the reticulation. These include:

- Backyard sewer systems.
- "Condominial" types.
- Settled sewage systems, also called small bore or septic tank effluent drainage (STED).

Backyard and "condominial" sewer systems are both methods of providing sewers at lower cost by lowering specifications (pipe size, depth, manhole design etc). In the case of settled sewage systems an on-site digester is required.

Both LOFLOS and septic tank systems can be used with a sewer which carries the effluent from the digester away from the plot. This means a soakaway is not required and sewers do not need to provide for large solids in the flow. Sewers can, therefore, have smaller diameters and are less expensive. However, in addition

to the sewers, an arrangement has to be in place for de-sludging the tanks, as in the septic tank and LOFLOS options.

- Typical water consumption: As for LOFLOS or septic tank.
- Typical cost: Capital: R2 800 per connection.
- Typical monthly operating cost: R17 per customer (fixed) plus additional water cost.

Advantages of settled sewage systems

- No soakaway required on the plot.
- Sometimes suits very hilly or very flat area as sewer gradients are not critical.
- A possible upgrading option for a neighborhood previously served with LOFLOS.

Disadvantages of settled sewage systems

- Requires sewers as well as digesters.
- Fairly expensive.
- Tanks require de-sludging.
- If de-sludging is not done properly the whole system could fail.

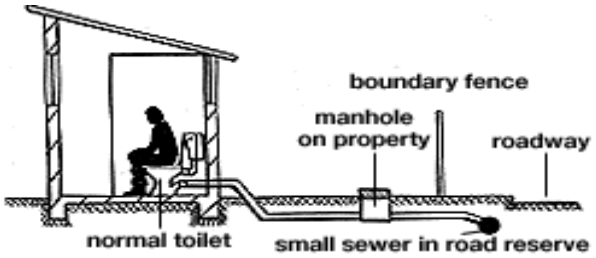
Advantages of backyard condominial systems

- Lower cost than full waterborne systems.

Disadvantages of backyard condominial systems

- Increased maintenance problems.

Full waterborne sanitation



A full waterborne sanitation system uses a conventional flush toilet in a privy or in the house. The flow from the toilet goes directly to sewers laid in the road reserve (or at the back of the plot in the case of "mid-block sewers"). Flushing volumes are typically in the range of 5 to 15 litters, with newer designs having lower flush volume requirements.

- Typical water consumption: 5 k/ per household per month.
- Typical capital cost: R4 200 urban, R6 700 rural.
- Typical operating cost: R15 urban, R20 rural plus R10 additional water cost.

Advantages

- The most convenient sanitation system from a user's point of view.

Disadvantages

- The most expensive system in terms of capital and operating costs. Too expensive to be a realistic option in sparsely settled areas and/or where plots are large.
- Uses the most water.
- Everyone in the neighbourhood needs to be connected, even those who may not be able to afford the service.

Electricity

Non-grid electricity – solar panels

The high costs of providing grid electricity to small scattered settlements in rural areas means that not everyone will be able to receive a grid supply. But there are other non-grid energy sources for providing small amounts of electricity cost-effectively, the most promising of which for SA is solar power. A typical solar installation would include a solar panel, a 12-volt battery, some 12-volt lights and a power outlet for radio or television. This option needs to be used in combination with other sources of energy for cooking and heating, such as biomass (wood), coal, paraffin or gas (LPG).

- Typical capital cost: R3 000.
- Typical operating cost: R16 per month urban, R17 rural (including provision for new battery every 3 to 4 years).

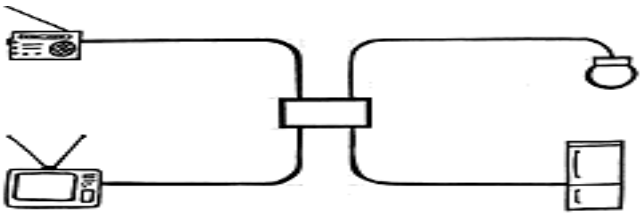
Advantages

- Cheaper to install than grid electricity in sparsely settled areas.
- Low operating costs.
- Fixed monthly payments.

Disadvantages

- Insufficient capacity for energy intensive uses such as cooking, space heating and water heating.
- Requires regular servicing and maintenance.
- Whilst the technology is proven, supply institutions have yet to prove their long term viability.

Grid electricity supply – 2.5 Amp Energy Control Unit supply



This option represents the first stage of a flexible capacity supply strategy, and reflects Eskom's most recent approach to rural electrification.

Under this option a household is supplied with electricity by means of an Energy Control Unit (ECU), which is a combination of a prepayment meter and a plug outlet. The ECU is installed in the customer's house at no cost and provides a maximum of 2.5A, sufficient to power a few light bulbs. Should the customer wish, the supply capacity can be upgraded to a 20A by simply purchasing a R100 token (either a magnetic strip card or an encrypted number). By entering the token number into the ECU the programmed capacity limit on the breaker is increased from 2.5A to 20A. Networks are therefore, designed, for 20A since it is anticipated that all customers will upgrade to 20A when they can afford the R100.

Since the 2.5A supply cannot be used for cooking or heating households must rely on other sources of energy (such as paraffin, wood or gas) for these purposes.

- Typical electricity consumption: 45 kWh per household per month.
- Typical capital cost[3]: R2 500 urban, R4 000 rural.
- Typical monthly operating cost: R20 per month urban, R25 per month rural (variable).

Advantages

- Low cost.

---

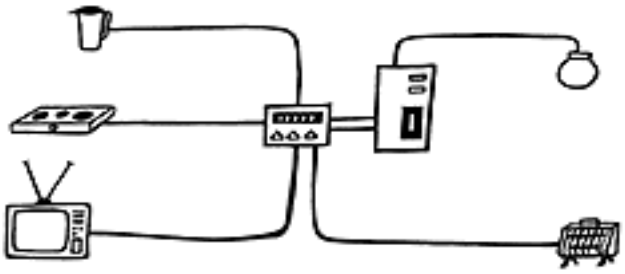
[3] Capital costs exclude generation and transmission costs.

- Grid connection is more reliable than solar panels.
- No monthly charge.
- Flexibility to allow customer to decide when to upgrade to 20A supply.

Disadvantages

- Low capacity supply.

Grid electricity supply – 20 Amp Energy Control Unit supply



The 20 Amp supply capacity is commonly used in lower to middle-income areas in South Africa. Once the household has upgraded to a 20 Amp supply it is possible to run energy intensive appliances such as stoves, heaters and kettles. In practice fuel-switching is a slow process and it generally takes households many years to acquire new appliances and new habits.

- Typical electricity consumption: 100 kWh per household per month.
- Typical capital cost[4]: R2 500 urban, R4 000 rural.
- Typical monthly operating cost: R40 per month urban, R55 per month rural (depending on consumption).

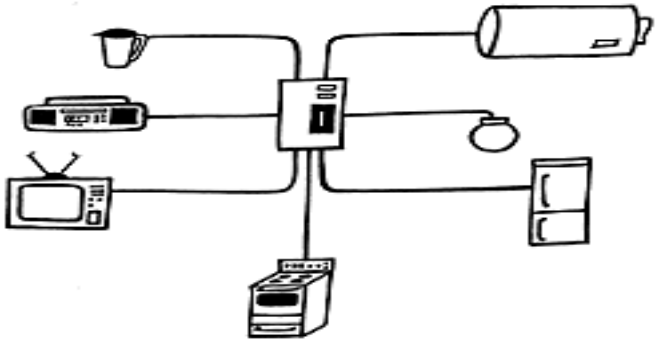
Advantages

- Sufficient capacity for most household purposes.
- Prepayment system allows consumers to control electricity consumption.
- Prepayment ensures that customers pay for the electricity they consume.

Disadvantages

- Insufficient capacity to run multiple energy intensive appliances simultaneously (such as a stove, heater and geyser).

Grid electricity supply – 60 Amp supply, internal wiring



[4] Capital costs exclude generation and transmission costs.

This option provides for a high-capacity household supply and would generally entail a full internal wiring system within the walls and roof of the house. Either a conventional credit meter or a prepayment meter may be utilised.

- Typical electricity consumption: 200-1 000 kWh per household per month depending on income level.
- Typical capital cost[5]: R4 200 urban R6 500 rural[6] (but R30 000 for 1km main farm line).
- Typical monthly operating cost: R40 – R150 (depending primarily on consumption).

Advantages

- Sufficient capacity to run all major household appliances simultaneously.

Disadvantages

- Expensive installation.
- Requires internal wiring.
- In the absence of effective credit control and cut-off procedures credit meters allow customers to run up large bills.

Solid waste

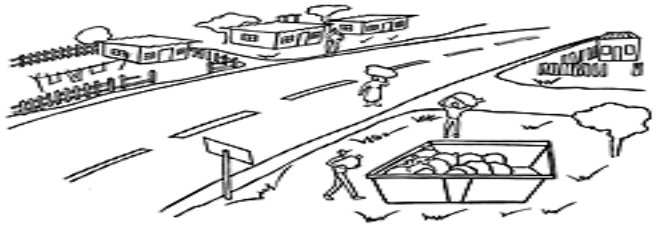
The RDP requires that "a refuse removal system" be provided. This can be interpreted to be some arrangement to take the solid waste out of an area on a regular (at least weekly) basis. However, it will be very costly for an external agency to provide this service to farms and sparsely settled areas. Viable alternatives for these areas are *communal dump sites* or, where plots are large, *on-site disposal* by households themselves (e.g. by burning and/or burying).

Communal dump sites

In this option households are required to transport their own waste to a dumping site outside the settlement area. The dumping site is provided and operated by the service provider or an appointed contractor, and is basically a small landfill site.

- Typical monthly operating cost: less than R1 per household.

Household transfer to communal bins (skips)



In this option households are required to carry their own solid waste to a communal point in the neighborhood where large bins (skips) are provided. The skips are then removed to the landfill site and emptied by the district council or an appointed contractor.

- Typical monthly operating cost: R6 per household urban, R15 rural (excluding sparsely settled areas).

Advantages

- Simple system.
- Low operating cost.

Disadvantages

- If distances are too great people dump their rubbish in the street.

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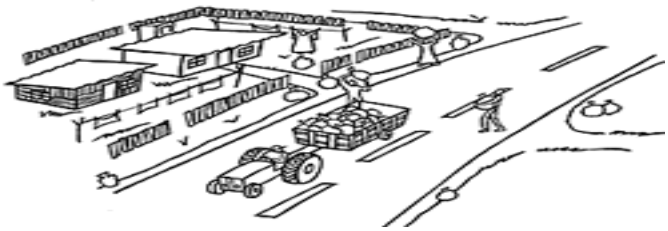
5 Capital costs exclude generation and transmission costs.

6 Cost assume underground cables in urban areas, overhead cable in rural areas.

- The collection point may become ugly and unhygienic.

Kerbside collection



This option requires households to put their rubbish out for collection once or twice a week. The municipality or its contractors collect the waste in trucks, or with tractors and trailers, and transport it to the landfill.

An alternative to this arrangement is organised transfer to communal skips, where contractors are appointed to collect the waste door-to-door. They transport it to a local collection point, perhaps using hand or bicycle-carts. The municipality, or another contractor, then transports the waste in skips to the landfill.

- Typical monthly operating cost[7]: R15 per household per month urban, R25 rural (excluding sparsely settled areas)

Advantages

- Convenient for households.
- No storage of waste at collection points.
- Contractor option creates local employment.

Disadvantages

- Fairly expensive option.
- May require substantial investment in specialised vehicles.

Note that this option is generally *not appropriate for sparsely settled areas* due to the high costs associated with distances.

Roads

Road level definitions

South African roads are generally classified into five levels, according to function. There is, however, no consistent approach between provinces as to terminology or criteria.

Table 4 Hierarchy of road levels

Level	Title and description	Alternative terminologies	
		Western Cape	*KZN*
1	***National Road*** (e.g. N1) Sometimes classified as a provincial road if the National Department of Transport is not responsible for maintenance	*Trunk Road*	
2	***Main Road*** Connects main centers within a district	*Main Road*	*Main Road*

[7] Including vehicle finance charges.

Level	Title and description	Alternative terminologies	
		Western Cape	*KZN*
3	***District Road*** Connects a community to a main road	*Divisional Road* Formerly under Divisional Council or Regional Service Council	*District Road*
4	***Local Road*** Connects communities, agricultural and tourist centers with each other	*Minor Roads* *Right of way*	*Local Road*
5	***Access Road*** Connects a household to the road network (generally a dirt road)	*Track*	

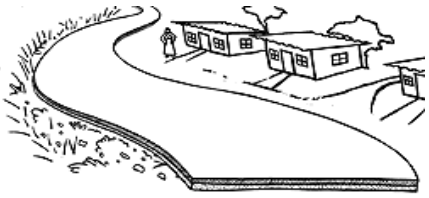
In addition to the classification problem, this is no consistent policy on the present and future responsibilities of district councils with respect to the provision and maintenance of road networks.

The DSM therefore only deals with *District Roads* (Level 3) and *Local Roads* (Level 4). Access roads, or roads leading to individual plots, are thus excluded[8].

Levels of service have been defined in terms of *road surfaces*. There are a wide range of options but, for the sake of simplicity, the DSM has made provision for the three main types only. These are *graded, gravel* and *paved* roads. Stormwater drainage has not been dealt with explicitly, but is included in the road costs.

Graded and gravel paved road

Roads: gravel



Roads: graded

In areas where road use is low it may be appropriate to have simple earth or gravel roads. Where local soils are of a good quality it may be possible to grade the existing material into a road formation. In other circumstances a gravel wearing layer may be needed.

Regular maintenance is essential to keep roads in good condition. Lack of regular maintenance can lead to the need for expensive rehabilitation or even complete re-building.

- Typical capital cost for graded roads: R35 per metre.
- Typical capital cost for gravel roads: R90 per metre.
- Maintenance cost for graded roads: 6% of construction cost per year.
- Maintenance cost for gravel roads: 4% of construction cost per year.

Advantages

- Low construction cost.

Disadvantages

- Dusty.
- Can be impassable during very rainy periods.
- Not suited to heavy traffic.
- Requires frequent maintenance (which can be labour intensive and locally managed).

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[8] For a discussion of access road options, see "Municipal service options: A guideline for local authorities" (Department of Constitutional Development, 1998).

Paved roads

Under this option the road would be of sufficient width for two lanes and would have the full width paved. Many different types of paving are available, including bitumen, a single layer bituminous "chip and spray" or pre-cast blocks. A paved road requires several layers of material below the paving to support it and give it sufficient strength. While maintenance intervals are longer than for other options, the cost of maintenance, when it is needed, is high and generally requires specialist attention.

- Typical capital cost: R900/m.
- Maintenance cost: 1.5% of construction cost per year (on average).

Advantages

- All-weather driving surface.
- Low maintenance intervals.

Disadvantages

- High cost.

A cheaper alternative to a fully paved road is a narrow paved option. The road would be paved but, in order to save costs, it would be built with a narrow width or only have a narrow width paved (about 3m). The paved surface would be less durable than the fully paved option.

Fire protection, health and other services

The DSM deals with fire protection, health and 'Other' services in a fairly simplistic manner. Costs are recorded on a Rands per household basis, with an additional amount allowed for non-residential purposes. Two levels of service are catered for, named *Basic* and *Full* services. The exact specification of these levels of service, and of the components of Other services, is left to the user, primarily in the form of the costs associated with each.

Examples of what these service levels may entail are provided below.

Fire protection

Settlement type	Full	Basic
All settlements	Full-time professional service	Partly or fully composed of volunteers. Appropriateness depends mainly on risk profile of the area concerned

Health services

Settlement type	Full	Basic
Urban TLCs	Fully-equipped permanent clinic, day hospital or hospital within 10 km radius	Mobile clinic in neighbourhood at least 1x per week
Dense settlements	As above within 15 km radius and mobile clinic within 3 km at least 1 x per week	As above
Villages Scattered settlements Farmland	As above within 20 km radius and mobile clinic within 3 km at least 1 x per week	As above

Other services

Settlement type	Full	Basic
Urban TLCs	All other urban services such as housing, traffic control, stormwater management, access roads, parks and gardens,	As for full but of a lower quality, and/or lower ratio of expenditure per household

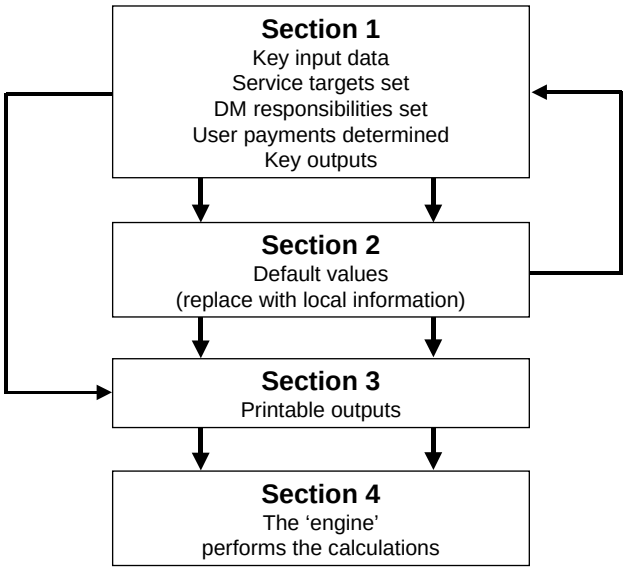
	community and sporting facilities, abattoirs, and fresh produce markets	
Dense settlements	Traffic control, stormwater management, access roads, community and sporting facilities	As above
Villages Scattered settlements Farmland	Community and sporting facilities	As above

INTRODUCTION TO THE MODEL

Model structure

The model comprises four sections:

Figure 3 The model structure.



Section 1 This is the interactive section of the model. Essential demographic, economic, services and financial information is entered here. An investment programme for the district is designed. The user then determines which services the district council will take direct responsibility for. Payments for services are determined. Key outputs on the capital and operating accounts are shown for both the district council and the district as a whole.

Section 2 Information is entered to replace default values which are used in the absence of local information. Once default values are over-ridden users should review decisions made in section 1 since outputs will change.

Section 3 Output information is presented in greater detail, in a format suitable for printing.

Section 4 This is the "engine" where most of the calculations are conducted. Users would not ordinarily access this section, other than to trace particular calculations.

The table of contents of the model is provided below. The title of each screen in sections 1 and 2 are shown, together with the major subdivisions of section 3 (output screens).

Model screens

SECTION 1 : ESSENTIAL INPUTS, PROGRAMME DECISIONS AND KEY OUTPUTS

ESSENTIAL INFORMATION INPUTS

1.0 DESCRIPTION
1.1 SERVICES MODELLED AND AGENCY RESPONSIBILITIES
1.2 RESIDENTIAL CONSUMERS – CURRENT AND FUTURE
1.3 INCOME DISTRIBUTION
1.4 ECONOMIC ENVIRONMENT
1.5a EXISTING RESIDENTIAL SERVICES – WATER RETICULATION
1.5b EXISTING SERVICES – BULK WATER
1.5c EXISTING RESIDENTIAL SERVICES – SANITATION
1.5d EXISTING RESIDENTIAL SERVICES – ELECTRICITY
1.5e EXISTING RESIDENTIAL SERVICES – SOLID WASTE
1.5f EXISTING SERVICES – ROADS
1.5g EXISTING RESIDENTIAL SERVICES – FIRE, HEALTH AND OTHER SERVICES
1.6 NON-RESIDENTIAL SERVICES

SERVICE LEVEL TARGETS

1.7a RESIDENTIAL SERVICE TARGETS – WATER
1.7b BULK SERVICES – WATER
1.7c RESIDENTIAL SERVICE TARGETS – SANITATION
1.7d RESIDENTIAL SERVICE TARGETS – ELECTRICITY
1.7e RESIDENTIAL SERVICE TARGETS – SOLID WASTE
1.7f SERVICE TARGETS – ROADS
1.7g RESIDENTIAL SERVICE TARGETS – FIRE, HEALTH AND OTHER SERVICES

DISTRICT COUNCIL RESPONSIBILITY

1.8a DC RESPONSIBILITY FOR SERVICE PROVISION – RETAIL
1.8b DC RESPONSIBILITY FOR SERVICE PROVISION – BULK
1.8c DC RESPONSIBILITY FOR SERVICE PROVISION – SUPPORT FUNCTIONS

PAYMENT FOR SERVICES

1.9a WILLINGESS TO PAY BY LOW-INCOME HOUSEHOLDS
1.9b SURPLUS FROM SERVICES TO HIGH-INCOME AND NON-RESIDENTIAL CONSUMERS
1.9c EQUITABLE SHARE SUBSIDY ALLOCTION

DISTRICT COUNCIL INCOME AND EXPENDITURE

1.10 DISTRICT COUNCIL INCOME & DISTRICT ES SUBSIDY (R'000)
1.11 DISTRICT COUNCIL EXPENDITURE (R'000)
1.12 ALLOCATION OF DC INCOME

KEY MODEL OUTPUTS

1.13 DISTRICT COUNCIL INCOME & EXPENDITURE AND NET SERVICE INCOME
1.14 CAPITAL ACCOUNT, CASH FLOWS AND BILL

SECTION 2 : REPLACEMENT OF DEFAULT VALUES

UNIT COSTS

2.1 UNIT COSTS & CONSUMPTION – WATER RETICULATION
2.2 UNIT COSTS – BULK WATER
2.3 UNIT COSTS & WASTEWATER FLOWS – SANITATION
2.4 UNIT COSTS & CONSUMPTION – ELECTRICITY
2.5 UNIT COSTS – SOLID WASTE
2.6 CAPITAL AND MAINTENANCE COSTS – ROADS
2.7 COSTS OF FIRE PROTECTION, HEALTH AND OTHER SERVICES
2.8 SUPPORT FUNCTION COSTS; WATER AND ELECTRICITY LOSSES
2.9 OTHER CAPITAL EXPENDITURE BY THE DC

CAPITAL ACCOUNT

2.10 ASSET REPLACEMENT
2.11 CAPITAL SUBSIDIES : PER HOUSEHOLD SUBSIDIES FROM EXTERNAL SOURCES
2.12 CAPITAL SUBSIDIES : LUMP SUMS FROM EXTERNAL SOURCES

OPERATING ACCOUNT

2.13 INTEREST RATES AND LOAN REPAYMENT SCHEDULES
2.14 "EQUITABLE SHARE" INCOME
2.15 AGENCY FEES AND RECURRENT SUBSIDIES

SECTION 3 : DETAILED OUTPUTS

SUMMARY INFORMATION

3.1 – 3.7

CAPITAL ACCOUNT – DISTRICT TOTAL

3.8a – 3.8f

CAPITAL ACCOUNT – DISTRICT COUNCIL

3.9a – 3.9f

RECURRENT EXPENDITURE AND INCOME – DISTRICT TOTAL

3.10a – 2.10f

RECURRENT EXPENDITURE AND INCOME – DISTRICT COUNCIL

3.11a – 2.10f

Model conventions and user instructions

The general conventions employed in the District Service Model (DSM) are described in this section. It is recommended that the reader have the model on screen, or have a full printout of sections 1, 2 and 3 at hand when reading this section.

Model start-up

When the model is started, Excel will probably ask the user two questions, depending on user preferences.

Enable macros?

Firstly, Excel may ask whether or not to enable macros. This is a routine protection measure against infection by macro viruses. Users should have virus protection installed and should answer *yes* to enable macros. (See screen 1.12 for more information on the macro).

Read-only?

Secondly, Excel may ask whether to open the file in Read-only format. If you intend to make changes and save the file with the same name answer *no* to this question. If you only intend to look at the model and do not expect to have to save any changes then answer *yes*. If you have answered yes, and subsequently do wish to make changes, you will need to save the model with a new name.

Navigating around the model

On start-up Excel will automatically open four windows, each containing a different screen of the model. In general it is advisable to use window 1 to view screens in section 1, window 2 for section 2, and so on. This approach reduces the need for excessive scrolling between screens.

Saving the model

Routine work

It is advisable to save the model under a new file name each time input data is changed significantly. For instance, you may have three versions of the model running, each dealing with separate options.

Backups

It is advisable to keep a 'clean' version of the model in a safe place.

Cell protection

The model uses Excel's protection feature to prevent users from inadvertently altering formulae. Should a user attempt to enter data into a protected cell Excel will provide a warning beep and an error message.

If, for some legitimate reason, a user should need to amend the model (for instance it may be necessary to reformat a graph for clearer presentation of data) then the relevant sheet should be unprotected via the *tools - protection - unprotect sheet* command.

Model adaptations

Experienced spreadsheet users may wish to adapt the model for their particular needs. For instance, you may wish to pre-process some inputs, or establish new output presentations. In general, however, it is not advisable to intervene in the model's calculations since this may have unintended consequences and jeopardise the results.

Bugs

Although the model has been tested it is quite possible that some bugs have yet to show up. If you should detect a bug please contact either the model sponsors (WRC and DBSA) or the model developers (PDG), using the contact details provided in the front of this manual.

Screen numbering

Note that screens in section 1 are numbered 1.1, 1.2 ...; the screens in section 2 are numbered 2.1, 2.2 ...; and those in section 3 are numbered 3.1, 3.2....

Error messages

Situations under which the model will give error messages or be unable to calculate are *italicised and underlined* in this manual.

Default values and colour coding

The model is designed in such a way that an initial run requires minimal data. If no information is provided by the user, default values are used in calculations. Information entered into the relevant field overrides these default values.

Essential inputs

Essential inputs are entered in the yellow input blocks, and the model cannot run without these. If no information is entered the model will assign a value of zero.

Default values

Inputs that replace default values are entered in the white input blocks. The relevant default values are shown in blue below or next to the white input blocks.

Some defaults are displayed in bold blue type. These are simply numbers and not based on other inputs. Others defaults are displayed in normal blue type. These are calculated from model data.

Comment facility

Explanatory comments are included throughout the model by means of Excel's 'comment' feature. Excel indicates the presence of a comment by means of a small red triangle in the top right corner of a cell. To view a comment, simply hold the cursor over the relevant cell.

Input formats

Numerical inputs

All numerical inputs must be entered as numbers. Percentage inputs should be entered as a plain number. In other words do not use the % sign! The model automatically converts the input into a percentage.

Non-numerical inputs

Non-numerical inputs require the user to enter a word, such as 'yes' or 'no'. The inputs should be typed as per the question on the screen.

Real financial values

All financial outputs are in real terms, i.e. in base year Rands. The model does not calculate nominal values.

Default cost units

The units for each default cost are indicated in the model (e.g. R/km, R/household). Costs are generally expressed per household, and never per capita.

SECTION 1 : ESSENTIAL INFORMATION, INVESTMENT PROGRAMME AND DISTRICT COUNCIL RESPONSIBILITIES

Screen 1.0 Description

The purpose of this page is to record the area and model user, set the base year and note details unique to the particular run of the model. The user should enter:

District council

The name of the district being modelled.

Run

A unique run number for each scenario (usually starting at 1). This number is shown on every subsequent screen. This number is useful to distinguish between print-outs of different runs.

Scenario

A description of the scenario being modelled. For instance service level targets could be recorded. It is also useful to make notes of key estimates and assumptions. For example, if the number of households and service levels in certain areas are uncertain, this should be recorded.

Base year

The current planning year (Year 0). If Year 0 is 1997, then the first year of investment will be 1998 and the last year of analysis will be 2007.

Financial years and calendar years generally do not coincide, and the user must therefore record the financial year to which the planning year refers. The planning year may be recorded as the calendar year in which the financial year either begins or ends, as long as the definition is used consistently. For example, if a financial year runs from 1 July 1998 to 30 June 1999 the planning year may be entered as either 1998 or 1999.

It is important to enter a single year (as a number) as the base year, since this input is used to calculate all the "year" displays on subsequent screens.

Screen 1.1 Services modelled and District Council agency responsibilities

Services modelled

The model is designed in such a way that it is compulsory to model water and sanitation services, with other services being optional. To exclude services enter a "no" in the relevant input boxes. Messages then appear on later screens (current services 1.5a–1.5g and investment targets 1.7a–1.7g) to indicate that the service is excluded.

It is important that the screens of excluded services are left blank. *If data are entered on excluded screens the model will not provide sensible outputs*.

Agency roles for the district council

If the district council is to act as an agent for another tier of government in providing a service such as Roads, Fire Protection, Health and/or Other services, then the higher tier will generally be responsible for providing a substantial proportion of the costs associated with the service. The user is asked to state whether the district council acts as an agent for each of these services.

If the answer is "yes" for roads, the model defaults assume that 100% of capital expenditure and 50% of the recurrent expenditure are covered by provincial/national government (see screens 2.12 and 2.15 where these default values may be over-ridden). If the answer is "no", the defaults assume that the district council receives no subsidies.

If the answer is "yes" for Fire Protection, Health and/or Other services, the model defaults assume that 90% of capital expenditure and 50% of the recurrent expenditure is covered by Province/National (see screens 2.12 and 2.15 for default over-rides). If "no", the defaults assume that the district council receives no subsidies.

Screen 1.2 Residential consumers – current and future

The recommended source of information for this screen is the Population Census. See *Annexure 1 Census Data Conversion* for a methodology for establishing this data.

Base year population and households

The model requires the user to enter the district population and the number of households. The number of people per household (i.e. average household size) is calculated to ensure that the data are consistent. An average household size of less than 2.5 or greater than 7 indicates that the estimates of households and/or population may be incorrect.

The population in institutions (e.g. hospitals, schools, prisons) is entered per settlement type for completeness. The model does not make use of this data in its calculations, since institutions are treated as "non-residential" consumers. This is, therefore, a non-essential input.

Household growth

For each settlement type, the user is asked to enter household growth rates for the base year, year 5 and year 10. Separate rates are entered for high- and low-income households respectively, which are defined as households with incomes exceeding and below R3 500 per month respectively. The model extrapolates rates for the intervening years.

The defaults assume that low-income households will grow more rapidly than high-income households, and that growth will be progressively slower as the size of settlements decreases.

Screen 1.3 Income distribution

The recommended source of information for this screen is the Population Census. See *Annexure 1 Census Data Conversion* for a methodology for establishing this data.

Income distribution is critical for assessing the viability of an investment programme, since it determines to a large extent the amount that people are able and willing to pay for services (see screens 1.9a and 1.9b).

Five income categories are provided, the first four of which are for low-income households who qualify for government's capital subsidies. The first category is used to calculate the amount of Equitable Share subsidy that will be allocated to each settlement type (see screen 2.14). The user may define the middle low-income categories in terms of monthly household income (Rands per month).

The percentage of households which fall into each category in the base year must be entered for each settlement type, except for the highest level which is treated as a residual.

Finally, the expected distribution in year 10 is determined. The percentage falling into the high-income category is calculated from the growth rates entered on the previous screen, while the percentage falling into the top low-income category is calculated as a residual.

The defaults assume that the percentages in the lowest three income categories will remain unchanged.

Screen 1.4 Economic environment

Turnover and payroll taxes

The main source of income for most district councils are the turnover and payroll levies.

The taxable turnover and payroll within the district in the base year are entered here (R millions) along with their current and expected growth rates. These growth rates could include provision for improved collection ratios. Rates for intervening years are extrapolated.

This information is used to calculate the district council's current and future levy income. Users should ensure that the resulting base year levy income shown in screen *1.10 District council income* is correct. In other words, start with the known figure for current/budgeted levy income and divide this by the applicable tax rate (c/R) to get the turnover and payroll amounts in the district.

Economic growth

Enter the expected economic growth rates for each settlement type. These rates are effectively used as estimates of growth in the consumption of services by non-residential consumers (i.e. excluding increases due to making up service backlogs - see screen 1.6).

Inflation

Enter the expected rate of inflation in the base year, year 5 and year 10. This figure is used to calculate interest and redemption charges more accurately, and also to determine the real value of capital subsidies in the future (see screens 2.11 to 2.13) . Note that all model outputs are expressed in real terms.

Screen 1.5a Existing residential services – Water reticulation

The recommended source of information for this screen is the Population Census. See *Annexure 1 Census Data Conversion* for a methodology for establishing this data.

The user is asked to enter the number of households in each of the settlement types with the different water supply options described earlier in the guidelines.

Note that the number without reticulated services is calculated as a residual.

This service is compulsory. If no data are entered the model will proceed as if no households have adequate services in the base year.

If the sum of the entries exceeds the total number of households entered on screen 1.2, a message "check inputs" will appear and the model will not calculate all the outputs.

The model requires that sufficient in-house connections be recorded to provide for all households in the high-income category. If insufficient connections are provided, a message to this effect appears on the screen. The number of high-income households is displayed for guidance.

In-house connections are allocated to high-income households first, then to households in the low-income categories.

Screen 1.5b Existing services – Bulk water

This service is compulsory. If no data are entered, the model will proceed as if no households have adequate services.

The recommended source of information for this screen is the Population Census. See *Annexure 1 Census Data Conversion* for a methodology for establishing this data.

The user is requested to indicate the number of households in each of the settlement types served by the various bulk water supply options.

The number of households without reticulated water supplies, entered on the previous screen, is displayed on this screen as a guide to the user.

If the number of households with a "Non-reticulated improved source" (input column 1) is greater than the number without reticulated water (from screen 1.5a) an error message will appear and the model will not calculate all the outputs.

The number of households with no or inadequate bulk water is calculated as a residual.

If the sum of the entries exceeds the total number of households entered on screen 1.2, a message "check inputs" will appear and the model will not calculate all the outputs.

Screen 1.5c Existing residential services – Sanitation

This service is compulsory. If no data are entered, the model will proceed as if no households have adequate services.

The recommended source of information for this screen is the Population Census. See *Annexure 1: Census Data Conversion* for a methodology for establishing this data.

The user is asked to enter the number of households in each of the settlement types served by the various sanitation options.

As discussed earlier in these guidelines in the section describing service levels, sanitation services must be provided in conjunction with water supply. The table at the bottom of the screen assists the user to enter existing services sensibly, by indicating the minimum and maximum permissible number of waterborne connections and/or septic tanks. Any surplus or shortage is displayed in red in the last column of this table. If the data indicate a surplus or shortage, the user must use his/her judgement and adjust the numbers accordingly. A surplus or shortage will not cause the model to cease calculations, and serves only to draw attention to possible discrepancies in the data.

Bucket sanitation is a relatively common service in South Africa. However, it has high operating costs and is also not regarded as an adequate level of service. Since discontinuation can lead to substantial cost savings, this option is treated separately on this screen.

The number of households with no service, or with an inadequate service other than bucket sanitation, is calculated as a residual.

If the sum of the entries exceeds the total number of households entered on screen 1.2, a message "check inputs" will appear and the model will not calculate all the outputs.

The model requires that sufficient numbers of waterborne connections and/or septic tanks are entered to provide for all households in the high-income category. *If insufficient connections are provided, a message to this effect appears on the screen*. The number of high-income households is displayed for guidance.

The user specifies the number of septic tanks that serve high-income households. This number cannot be greater than the total number of septic tanks provided.

The default allocates septic tanks to high-income households first. The number of high-income households with waterborne sanitation is reduced accordingly.

Screen 1.5d Existing residential services – Electricity

If the electricity has been excluded on screen 1.1, this screen must be left blank.

The recommended source of information for this screen is the Population Census. See *Annexure 1 Census Data Conversion* for a methodology for establishing this data.

Information is entered as for water reticulation on screen 1.5a.

The model requires that a sufficient number of 60 Amp connections is entered to provide for all households in the high-income category. *If insufficient connections are entered, a message to this effect appears on the screen*. The number of high-income households is displayed for guidance.

Screen 1.5e Existing residential services – Solid waste

If the solid waste has been excluded on screen 1.1, this screen must be left blank.

Information is entered as for electricity on screen 1.5c.

The model requires that sufficient kerbside services be recorded in *urban* areas to provide for all households in the high-income category. *If insufficient services are provided, a message to this effect appears on the screen*. The number of high-income households is displayed for guidance.

Screen 1.5f Existing services – Roads

If the roads have been excluded on screen 1.1, this screen must be left blank.

The model deals with only *district roads* (level 3) and *local roads* (level 4). District roads are connector roads between district centres, and local roads are roads connecting settlements to district roads.

The user is required to record the number of km of existing graded, gravel and paved road respectively for each level of road. Then the condition of the roads must be entered, specifying the percentage that can be described as good, adequate or poor respectively. The precise definition of these conditions is left to the user.

The model displays the number of metres of road per household for information.

Screen 1.5g Existing services – Fire protection, health and other services

If any of these services has been excluded on screen 1.1, the relevant section(s) on this screen must be left blank.

The number of households receiving services at the 'basic' and 'full' levels must be entered for each of the services. The model calculates households with inadequate services as a residual. The definition of what constitutes a basic and a full service respectively is left to the user. Associated default costs appear in screen 2.7.

If the sum of the entries exceeds the total number of households entered on screen 1.2, a message "check inputs" will appear and the model will not calculate all the outputs.

Screen 1.6 Non-residential services

If any of these services has been excluded on screen 1.1, the relevant section(s) on this screen must be left blank. Messages on the screen indicate which services are to be included.

All the information required for non-residential users is recorded on this screen. The investment programme to make up the backlog of services is also entered here.

For the retail services (water, sanitation, electricity and solid waste), the user is requested to enter the number of consumers with services and the number without services. The latter constitutes the backlog. *Annexure 1 Census Data Conversion* provides a methodology for estimating the number of non-residential consumers in the absence of better information.

The next step is to estimate consumption per consumer, so as to estimate total consumption. This is then shown as a percentage of total consumption, which serves as a rough guide to the accuracy of the number of non-residential units and their consumption. Ranges of acceptable values are provided in notes on the screen. Note that water and electricity losses are entered on screen 2.8.

The final step for each service is to specify the time to make up the backlog. In the case of sanitation and electricity the nature of the provided services is also specified. The number of consumers within the backlog is important, and should be specified as accurately as possible. In the absence of certain information, however, an informed guess is better than nothing.

The model assumes that the consumption per new connection will be the same as that of existing connections. It is important that consumption levels for existing connections are sensible.

Non-residential fire protection, health and other services are specified in screen 2. 7.

Residential service targets – Overview

The residential infrastructure investment programme is specified on screens 1.7a - 1.7g.

To set the investment programme, the user specifies the percentage of households to receive each service type by year 5 and year 10 respectively. The model assumes that services will be provided on a straight-line basis in the intervening years. In reality, provision is more likely to follow some sort of 'S-curve' (a slow start-up, followed by rapid delivery, tailing off towards the end) so users should make allowances for discrepancies between predictions and actuals in the first few years.

The percentage distribution in the base year is displayed on each screen to guide investment decisions.

Screen 1.7a Residential service targets – Water

All new households in the high-income category are automatically assigned in-house connections.

The percentage of low-income households with in-house connections is calculated as the residual.

The default investment programme provides in-house connections to all households.

If the sum of the entries exceeds the percentage of households that is classified as low-income, a message ">0" will appear and the model will not calculate all the outputs.

If the investment programme is such that the number of in-house connections for low-income consumers decreases, a message "***Programme not legitimate***" will appear. The model will calculate all the outputs, but these will not be sensible.

The screen provides a number of guides to the design of an investment programme:

1. The percentage of households with incomes in the lowest category is displayed for each settlement type. For the programme to be financially viable this percentage (or more) will probably need to be provided with standpipes, tanks or yard taps, rather than in-house connections.
2. The average bills paid by low-income households are shown for year 1 and year 10. These amounts reflect the predicted payments, such that the model assumes that households are not billed more than they are willing to pay (see screen 1.9a). The bills will be lower if the Equitable share subsidy is used to subsidize services to low-income households (see screen 1.9c).
3. The annual cash flow for all service providers in the district is displayed on the graph for each settlement type. If the annual cash flow is negative, then lower levels of service need to be provided. Alternatively, or in addition, the user may review the assumed maximum amounts that low-income households are willing to pay for water (screen 1.9a) and/or the surplus that can be made on sales to high-income and non-residential users (screen 1.9b) and/or the use to which the Equitable Share subsidy is put (screen 1.10).
4. The shortfall on services provided to low-income households is also expressed as a percentage of the total cost of service provision to all consumers. The shortfall is calculated as:

   user charges + allocated ES subsidy - total expenditure on low-income, including allocated finance charges

5. The change in the number of households with each service type is displayed at the bottom of the screen for each year of the investment programme.

Screen 1.7b Bulk services – Water

The investment programme for bulk water is similar to that for internal services. The user specifies the percentage of households to be provided with water from each source by years 5 and 10 respectively, for each settlement type. The base year percentages are shown for information, from data entered on screen 1.5b.

The percentage of households without reticulated water is shown in the second column of the table, for information. The percentage with no or inadequate bulk services, shown in the next column, is calculated as

percentage with no reticulated water - percentage with a non-reticulated improved source [last column]

For example, if 15% of households have no reticulated water and 5% are provided with a non-reticulated improved source, then 10% will have no/inadequate bulk supply. Should the percentage with a non-reticulated improved source be recorded as 20%, the model will calculate the percentage with no bulk supply as –5%. This is obviously incorrect and the inputs must be adjusted accordingly.

The percentage of households provided with treated bulk water purchased from an external source is calculated as the residual.

The default programme provides all reticulated water connections with purchased treated water from an external agency by year 5 (i.e. bulk purchase of treated water).

If the sum of the entries exceeds 100, a message ">0" will appear and the model will not calculate all the outputs.

The next table on the screen (below the input table) provides an estimate of the quantity of water provided from the different sources. This is calculated simply by excluding households with no/inadequate bulk water.

This estimate makes the implicit assumption that, within each settlement type, average consumption per household is the same regardless of the source. A further assumption is that bulk water for non-residential use is obtained from the different sources in the same proportions as water for household use. These are both over-simplifications that will inevitably lead to inaccuracies, but are regarded as adequate for the purpose of strategic financial planning.

The last table on the screen shows the changes in bulk water supplied from the different sources for each year of the investment programme, in Mℓ per year. Users should check this to ensure that the investment programme is sensible.

Screen 1.7c Residential service targets – Sanitation

The investment programme for sanitation is entered in the same manner as that for water, with a few qualifications.

Firstly, high-income households can be provided with either waterborne sanitation or septic tanks. The model allows for the replacement of septic tanks by waterborne sanitation, and *vice versa* (although the latter is unlikely).

The defaults for *urban* settlements assume that all new high-income households are provided with waterborne systems, while the number of septic tanks remains unchanged. The defaults for the *non-urban* settlements assume that septic tanks are provided, rather than waterborne systems.

Secondly, sanitation services need to be provided in conjunction with water supply. The number of waterborne connections and septic tanks in excess of the number permitted is displayed in red in the last column of the first table. If there are too few of these services, the shortage is displayed as a negative number. A surplus or shortage will not cause the model to cease calculations, but the discrepancy should be minimised. If there is a discrepancy in the base year data, the investment programme should be such that this is reduced and not increased.

The default investment programme for urban areas provides waterborne sanitation. The default programme for the other areas provides septic tanks.

Screen 1.7d Residential service targets – Electricity

If electricity has been excluded on screen 1.1, this screen must be left blank.

The investment programme for electricity is entered in the same manner as that for water.

The default investment programme provides 60 Amp grid connections to all households.

Note that a non-grid solar option is provided. This is a new technology for South Africa, and the institutional infrastructure necessary to provide and maintain the service is not yet stable. The costs associated with solar electricity (screen 2.4) are therefore provisional, and may underestimate the initial costs (see the Electricity service level description for further information).

Screen 1.7e Residential service targets – Solid waste

If the solid waste has been excluded on screen 1.1, this screen must be left blank.

The investment programme for solid waste is entered in the same manner as water and electricity, with the following exceptions.

Only in urban areas does the model assume that high-income households receive the highest level of service (i.e. kerbside).

Kerbside services in dense settlements are allocated to high-income households first, with any surplus allocated to low-income households.

The default investment programme for urban and dense settlements provides kerbside services.

The default programme for the other settlement types (villages, scattered settlements and farmland) provides communal dump sites.

Screen 1.7f Service targets – Roads

If the roads have been excluded on screen 1.1, this screen must be left blank.

The investment programme for roads has three components.

1. Existing roads can be *upgraded* from one type to another, e.g. from gravel to paved. To do this the user specifies the percentages of road that are graded and gravel surfaced in year 5 and year 10 respectively. The model then calculates the percentage that is paved in each year. This is done in the third column of the table (i.e. the first input column). The default programme provides for all roads to be paved by year 5.
2. Exiting roads can be *rehabilitated*, i.e. their condition can be improved without changing the type of surface. For example, gravel roads in poor condition can be rehabilitated to gravel roads in a good condition. This is done horizontally in the fourth, fifth and sixth columns of the table by specifying the percentages of road surface that can be classified as "adequate" and "poor" in year 5 and year 10 respectively. The percentage classified as "good" is calculated as the residual. The default programme improves the condition of all roads to "good" by year 5.
3. *New* roads can be provided in any combination of the surface types included in the model. The number of additional kilometres provided in each five-year period is entered into the relevant block in the last input column. The total km of road by year 5 and year 10, and the distance per household, are displayed as information.

The procedure is identical for District (Level 3) and Local (Level 4) roads.

It is assumed that new roads will remain in good condition because adequate provision is made for maintenance.

Screen 1.7g Residential service targets – Fire, health and other services

If any of the services has been excluded on screen 1.1, the relevant section(s) on this screen must be left blank.

The investment programme for solid waste is entered in the same manner as for water and electricity, except that no assumptions are made regarding the level of service provided to high-income households.

The default investment programme provides full services to all households.

The graph on this screen shows the shortfall that needs to be financed out of district council income. This amount is the deficit after user payments and external subsidies, including Equitable Share income allocated to Other services (see screen 1.9c).

Screen 1.7h Levels of service – Summary

The impact of the various infrastructure investment programmes is summarised on this screen in graph form.

In the case of water, an 'adequate service' is defined as including non-reticulated improved sources and all reticulated supplies.

In the case of solid waste, an adequate service is defined as including on-site disposal in villages, scattered settlements and farmland, whilst on-site disposal is regarded as being inadequate in urban and dense settlements.

Screen 1.8a District council responsibility for service provision – Retail

On screens 1.8a – 1.8c, the user determines

- the extent to which the district council will provide retail and bulk services; and
- the extent to which the district council will extend support services to other service providers.

These decisions have a direct impact on the finances of the district council.

Screen 1.8a is used to specify the extent to which the district council provides *retail services* in each of the settlement types. The percentage of households directly provided with retail services in years 0 (base year), 5 and 10 is entered. Percentages for the intervening years are extrapolated.

The model assumes that the same percentages will apply to non-residential consumers. It also assumes that the percentage of households provided with services translates into the percentage of district expenditure and income for the settlement type in question.

For example, assume that the district council provides retail water services to 10% of households in dense settlements in year 10. Assume further that the full cost of providing this service in these areas, including bulk purchases of treated water and capital charges, is R100 million, while revenue amounts to R110 million. The district council will then spend R10 million on providing the service, and receive R11 million in revenue.

Note the implicit assumption that the district council is no more and no less efficient than any other service provider. This may not be the case in practice.

Also, note the assumption that the district council does not target specific groups of consumers (on an income basis) within a settlement type. Its consumer mix is assumed to be the same as that prevailing in the settlement type as a whole.

Screen 1.8b District council responsibility for service provision – Bulk

Screen 1.8b is used to specify the extent to which the district council provides *bulk services* in each of the settlement types. As on the previous screen, the percentage of households to be provided with bulk services by the district council is estimated for years 0 (base year), 5 and 10.

No bulk supply option is provided for electricity. It is assumed that electricity is purchased in bulk from an external agency.

The assumptions regarding non-residential supply, finance and efficiency for retail services apply equally to bulk services.

The district council's responsibilities for *roads* are also specified on this screen. The percentage of total km of road that the district council is responsible for is specified, for District and Local roads respectively. This is done for years 0, 5 and 10.

DC responsibility means responsibility for both capital expenditure and maintenance costs, and refers to institutional responsibility rather than merely sources of finance. If the district council acts as an agent for provincial or national government, or takes full institutional responsibility, then it must be recorded as being the responsible agent. If, on the other hand, the district council simply provides funds for roads to another responsible agent (e.g. a municipality) the district council is not the responsible agent.

Screen 1.8c District council responsibility for service provision – Support functions

A number of households are provided with *retail* services by institutions other than the district council. The user is asked to specify on this screen the percentage of these households provided with support by the district council in years 0, 5 and 10. The percentages for the intervening years are extrapolated.

Support for road building and maintenance is specified in terms of the percentage of kilometres of road for which support is provided.

Support is generally provided for community-based service providers, such as water committees, but small or new TLCs may be included. No provision is made for support to be provided for electricity, fire protection or health services, since these are likely to be provided by an outside agency rather than a local institution requiring support.

Screen 1.9a Willingness to pay by low-income households

Screens 1.9a and 1.9b determine the amount of income that service providers receive for the provision of services.

The user is requested to enter the maximum amounts that low-income households (that is with incomes of less than R3 500 per month) are willing to pay for each service, expressed in Rands per household per month. Note that fire, health and other services can be paid for by means of user charges and/or property rates.

If the Equitable Share (ES) subsidy is to be used to subsidise services provided to low-income households, these households pay the full cost of service provision (including allocated finance charges) less the ES subsidy allocation, to the maximum that they are willing to pay. If the ES subsidy is not to be used in this manner, low-income households pay the full costs of service provision to the maximum that they are willing to pay. The manner in which the ES subsidy is to be used is set on screen 1.9c.

The default amounts are calculated as percentages of the *average income* in each household income bracket. For example, the average income in the R0-800 per month bracket is R400.

The total amounts that households are willing to pay is expressed as a percentage of average income. These serve as guides to the individual monthly amounts indicated.

Screen 1.9b Surplus from services to high-income and non-residential consumers

Financial surpluses can be generated from services to high-income households and non-residential consumers, particularly in the case of water and electricity services. The surpluses may be used to cross-subsidise low-income households and/or other services.

On this screen the user enters the *percentage of surplus* that service providers can obtain from services to non-residential and high-income consumers respectively. This income may be in the form of user charges or property rates.

For fire, health and other services, the model calculates surpluses on expenditure net of external subsidies. No surpluses will be generated on services when the district council provides these as an agent of another government agency, and this agency is paying for all or part of the service.

Screen 1.9c Equitable Share subsidy allocation

The first table on this screen requests the "Equitable Share" (ES) subsidy income provided directly to the district council, to urban TLCs and to non-TLC local government in the base year.

The model assumes that the TLC allocation is spent in urban areas, while the district council and non-TLC allocations are spent in the other settlement types.

The user must select one of two options for the use of the subsidy:

- The "Equitable Share" subsidy may be added to the general income of the municipality as a lump sum. It then becomes unclear what the subsidy is spent on.
- The ES subsidy may be specifically allocated to services and used to subsidize services provided to low-income households where this is possible. In practice, this means that the ES income would be used to reduce the bills of these households (or at least the part that they are expected to pay).

If the second option is selected (i.e. "yes" is entered or the default is used), the user is asked to specify whether ES income is to be allocated to water, sanitation, electricity and/or solid waste (yes/no). The user must also indicate the percentages to be retained for roads, fire, health and other services, and other district council activities.

The model displays the amounts allocated to each service for each settlement type and the ES allocation as a percentage of total cost of service provision to low-income households.

The model calculates the amounts allocated to services in proportion to the costs of services to low-income households.

The defaults assume that ES income is used to subsidise services to low-income households, while a certain percentage is retained for roads and other services, as indicated.

Note that if ES income is to be allocated as service subsidies to low-income households, households will be required to pay less for services. The overall financial position of the district and district council may

therefore be worse than if households are required to fully cover their costs or pay as much as they are willing to (see screen 1.9a), since the ES income will then be added to these maximum payments.

Screen 1.10 District council income

The main source of income for district councils are the turnover and payroll levies. The table entitled *LEVIES (c/R)* is necessary for the calculation of this income, and the user is required to enter the turnover and payroll levy rates (in c/R). Note that income is projected in real terms (i.e. base year Rands) so that increases in levies must exclude the effects of inflation.

The table entitled *DC INCOME* records the district council's income in the base year, and projects it into the future.

Base year income

Income in the base year in entered in the first input column for all items. The next columns shows the amounts calculated, and used, by the model. The items in which differences may arise are:

1 *Levy income*. This is calculated by the model from total turnover and payroll information (screen 1.4) and the rates entered on this screen. The amounts should correspond exactly.

2 *Equitable Share subsidy income*. If the ES is allocated to services (screen 1.9c), the amount shown as district council income may differ from the amount allocated directly. This is because the amount allocated by the model will reflect the amount of ES income used to subsidise the services actually provided by the district council. For example, the ES income used by other service providers to pay the district council for bulk services will be included in the income amount. Similarly, ES income allocated to the district council, but which is used to pay other service providers, will not be reflected as district council income.

3 *Service charges & rates*. The model calculates income from service charges on the basis of the district council's responsibilities (screens 1.8a to 1.8b), costs (section 2) and maximum payments (see screens 1.9a and 1.9b). The purpose of using a calculated amount, rather than the inputs, is to provide a rough cross-check of information on district council responsibilities. Also this convention should ensure consistency in the approach used to calculate income between the base year and subsequent years. A certain margin of error is, however, likely, and may be ignored.

The item Extraordinary Income may be used to capture unspent funds brought forward from the previous year if the district council uses this accounting convention. *However, the model works on the assumption that, from year 1, all income is spent,* so that this item falls away.

Total income

The amount calculated by the model in the base year should reflect the actual total income of the district council, after making allowance for errors in the income from "Equitable Share" subsidy income and service charges.

Projected income

Income is projected for the 10-year period, from information contained in the model. The exception to this is *Interest*, *Sundry* and *Extraordinary income*, which the user is requested to enter.

The defaults assume base year income in real terms for Interest and Sundry, and R0 for Extraordinary.

Fire, health, road maintenance and other subsidy income

This income is calculated from information on district council responsibility (screens 1.1, 1.8a and 1.8b), the costs of service provision (screens 2.6 and 2.7) and recurrent subsidies provided for these services (screen 2.15). The primary determinants are the extent of district council responsibility and the proportions of district council expenditure funded by external subsidies, but the amounts will also change following changes in the investment programme, and units costs.

Capital grant income

Income from capital grants depends primarily on district council responsibilities (screens 1.1, 1.8a and 1.8b). The investment programme (screens 1.7a – 1.7g), unit costs (screens 2.1 – 2.7), other district council capital expenditure (screen 2.9) and unit subsidies (screens 2.11 and 2.12) will also influence this amount.

Service charges and rates

The figure includes property rates, where applicable. The income is calculated on the basis of district council service responsibility and calculated user payments (see screens 1.9a, 1.9b and 3.5). The amounts paid may be adjusted by changing the amounts that households are assumed to be willing to pay and/or the surplus on services to high-income and residential consumers.

Screen 1.11 District council expenditure

Base year expenditure

Expenditure in the base year is entered for all items. The next column (column D) shows the amounts used or calculated by the model. Only the items of *operating expenditure* and *support costs* are calculated (rows 12–15). These serve as further cross-checks of other inputs. Where large discrepancies occur, the input data on district council responsibilities (screens 1.8a and 1.8c), existing services (screens 1.5a–1.5g and 1.6) and/or unit costs (screens 2.1–2.8) should be adjusted. A certain margin of error is to be expected, however, and may be ignored.

Projected expenditure

The model calculates projected expenditure on all items, with the exception of overhead expenditure and district council expenditure on other activities. The user enters values for the last two, although the model provides default expenditure amounts for overheads. The item "other activities" is intended to capture district council operating expenditure on activities such as institutional and enterprise support, demonstration projects, community development projects, emergency services and social development programmes. This is not the same as Other services, which includes services such as traffic control, abattoirs and markets within a local authority area.

Overheads

The default overhead expenditure amounts are calculated to increase at 50% of the rate of district council operating and support expenditure. A maximum total increase of 50% per year is permitted. This formula allows for an increase in the size of the head office etc. as responsibility increases, while recognising some efficiencies due to economies of scale.

Expenditure deficits

An expenditure deficit in years 1 to 10 means that the district council does not have sufficient income to cover its direct responsibilities, and does not provide any financial assistance to other service providers. A *surplus* will be reflected only once the income received exceeds the amount required to cover both capital and operating account deficits for all service providers in the district. District council income in excess of its own expenditure is reflected in the items "Capital Expenditure on other projects" and "Grants for recurrent expenditure".

The allocation of district council income in excess of operating costs is set on screen 1.12.

Screen 1.12 Allocation of district council income

Allocation priorities

The model assumes that the district council's first priority is to cover its recurrent expenditure. This includes, in order of preference:

1. overhead expenditure
2. service deficits
3. operating costs
4. finance charges
5. support costs and
6. bank overdrafts.

Any surplus is then allocated between:

1. capital expenditure on district council projects
2. grants to other service providers for capital expenditure, and
3. recurrent subsidies to other service providers.

User entries and the use of the macro

Net recurrent income is displayed as the first row of data. The calculation of this amount is shown in the last table on the screen, and includes the repayment of bank overdrafts. This is the amount that is to be distributed between district council capital expenditure, other capital expenditure and recurrent subsidies to other service providers. The amounts required for each of these expenditure items after subsidies are displayed on the screen, and the user is asked to enter the amounts used for capital expenditure.

Note that the amounts shown in blue are suggested amounts only, and not default values.

If the suggested amounts are entered into the inputs blocks by means of a formula (= suggested amount), a circular referencing error will occur.

Amounts must be entered into the blocks manually, or by making use of the *macro* (to run the macro hold down the Ctrl key and press the c key, i.e. ctrl-c). The macro will enter the suggested amounts, which may change during the process. It may be necessary to run the macro more than once in order for the amounts entered to be the same as the suggested amounts.

Borrowing requirements

The difference between the amount of finance required for capital expenditure and that provided by the district council is the *borrowing* requirement.

If there is any income remaining, it is used to cover any operating deficits by other service providers (see screen 1.10, row 20).

The graph at the top of the screen shows the different categories of expenditure to which district council funds are committed. The higher the share of the *yellow* sections, the larger the proportion of expenditure on district council overheads and operating costs. The larger the *green* sections, the larger the proportion of income devoted to capital expenditure. *Purple* sections show the bank overdrafts that need to be repaid. *Red* sections mean that the district council has insufficient income to cover its operating and capital expenditure commitments, and will need to borrow to cover the deficit. If a red section on the graph is accompanied by a net recurrent surplus (first row of data), the borrowing is for capital expenditure.

IF THE DISTRICT COUNCIL EXPERIENCES A NET RECURRENT DEFICIT, BORROWING WILL BE REQUIRED FOR RECURRENT EXPENDITURE AND THIS SITUATION IS NOT SUSTAINABLE!

The shortage of income over expenditure can be eliminated in a number of ways, such as designing a less ambitious investment programme (screens 1.7a–1.7g), decreasing district council responsibility for service provision (screens 1.8a–1.8c), increasing levy income (screen 1.10), or increasing surplus transfers from non-residential customers and high-income households (screen 1.9b).

Screen 1.13 District council income and expenditure and net service income

This is an output screen for display purposes only. The first graph shows total district council income and expenditure, and the surplus left for distribution to other service providers. District council expenditure includes the repayment of bank overdrafts (with interest), so that the a cash deficit is in fact an accumulated deficit. Note that no accumulated surplus is shown, since the model assumes that all surplus income is distributed to service providers in the district.

The same information is displayed in the tables below the graphs, in greater detail.

The second graphs shows, firstly, the net annual income from services provided by the district council (R millions per year). Secondly, it shows the net income from services for the district as a whole. The net service income includes all recurrent subsidy income, and excludes expenditure on district council overheads, other district council activities (entered on screen 1.10) and the repayment of bank overdrafts.

Note that in this instance ES subsidy income is included in the net income, whether it is directly allocated to services or not.

Screen 1.14 Capital account, cash flows and bills

This is an output screen for display purposes, showing capital expenditure, sources of finance, total district recurrent expenditure by service and average household bills.

The first graph shows capital expenditure by service, and the second shows the sources of finance for this expenditure. These may be viewed for the district council or the district as a whole, by indicating the selected option in the box on the right hand side of the screen. If no selection is made, the graphs will display information for the district council.

The third graph shows the annual cash flow for each service for the district as a whole, before district council financing of recurrent expenditure. This graph thus shows which services are financially self-sufficient and which require district council support.

Note that recurrent subsidies from external sources that are specifically allocated to services are included as income. This means that the ES subsidy will be excluded, unless it has been deliberately allocated to subsidise the services provided to low-income households (screen 1.9c).

The table shows the average monthly bills paid by low-income and high-income households respectively in year 10 for all the services included in the model.

SECTION 2: REPLACING DEFAULTS

Introduction

The outputs shown in section 1 are generated on the basis of the essential data entered in section 1, and the default values contained in section 2. All inputs in section 2 have default values, which are used by the model in the absence of other information. Defaults that are numbers (**bold** type) should be replaced for greater accuracy wherever local information is available. Defaults that are calculated (regular type) should be treated more cautiously.

Screen 2.1 Unit costs and consumption – Water reticulation

Source of cost information

The cost information provided as defaults in the model is taken from a range of sources available to the model authors, with judgement applied in interpreting information from a variety of origins. It is not possible to identify all sources. However, the major one is the Municipal Infrastructure Investment Framework which was prepared for the Department of Constitutional Development in 1997.

Disclaimer

While the best efforts have been made to enter reasonably accurate default costs, it is not possible for this information to be accurate for all situations and the authors and funders of the model development do not take any responsibility for results which are produced from the model using the default values.

Capital costs for new internal services for households

The capital costs for reticulated services are entered as on the basis of *cost per household* (Rands per household).

Costs for non-residential services are entered as an average cost per consumer (Rands per consumer).

The model uses these costs for the full ten-year period. Costs should therefore be estimated as the likely average cost of developments over the period.

Costs for communal standpipes, yard tanks and yard taps should include the cost of meters and terminals. Costs for in-house connections should include the costs of the meter and isolating valve, but exclude the costs of on-site plumbing. These latter costs will be included in the cost of the house itself (i.e. the top structure). All costs must be comprehensive, including VAT, overheads, contingency fees etc.

The default costs for new services in urban areas are in 1998 prices. The default costs for the other settlement types are calculated as multiples of the appropriate urban cost.

Operating costs

These exclude bulk water purchase and treatment costs, and are entered as a *monthly cost per household/consumer* (Rands per household per month). They cover costs such as administration, meter reading, billing and maintenance of the infrastructure. Bulk water costs are dealt with on screen 2.2.

Consumption

Consumption is entered in k/ per household per month for the different service types.

Note that non-residential consumption is entered in screen 1.6.

Upgrading of distribution infrastructure

Some of the existing infrastructure can usually be re-used when a service is upgraded. This table allows the user to put a value to this infrastructure. The cost of each upgraded connection is then the cost of a new connection less the re-usable portion of the original infrastructure. For example, assume that communal standpipes in an area are to be upgraded to yard taps. Take the cost of a new yard tap as R1 400 per

household. If the re-usable portion of the communal standpipe infrastructure is valued at R600 per household, the cost of the upgrade will amount to R800 per household (R1 400–R600).

The default values are calculated as percentages of the cost of new connections, entered in Table 1.

Contribution by consumers towards capital costs of services

Household contributions are entered in Rands per household for low-income consumers. Recall that high-income consumers are assumed to pay the full costs.

Payments by non-residential consumers are entered as a percentage of internal service costs.

Screen 2.2 Unit costs – Bulk water

Cost of bulk and connector infrastructure

The total cost of new infrastructure is calculated on the basis of the additional capacity required, and the cost per unit of new capacity (in Rm/M*ℓ*/day new capacity). The costs should include provision for capacity requirements in excess of average daily flows.

The capital costs should include the following:

- *Bulk purchase of treated water*: connector infrastructure only (i.e. reservoirs and major pipelines)
- *Regional schemes*: treatment facilities and connector infrastructure. Dams and bulk pipelines are included if they are the responsibility of local service providers, but excluded if they are owned and managed by DWAF. In the latter case, the costs of the dams are incorporated into the purchase price of raw water.
- *Local schemes*: Dams, boreholes and weirs that are the responsibility of local service providers; treatment facilities and connector infrastructure.
- *Local bulk*: all bulk and connector infrastructure.

Operating costs

These are entered in c/*ℓ* for each source and settlement type and must include the purchase price of treated or raw water, as appropriate.

Change in bulk supply arrangements

This input is expressed in Rm/M*ℓ*/day of the original service that is re-usable, and is based on the premise that, should the bulk supply arrangements change, some of the infrastructure will be re-usable.

The default values are calculated as percentages of the cost of new infrastructure, entered in Table 1.

Screen 2.3 Unit costs and wastewater flows – Sanitation

This screen is self-explanatory, and follows the logic of the cost data for water supply.

Wastewater as a percentage of water consumed by consumers with waterborne sanitation

A large proportion of the water used by consumers with waterborne sanitation finds its way into the wastewater stream. In this table, the percentages of water disposed of in this manner are specified for the various user categories. Consumers with on-site sanitation generally dispose of their wastewater on site, and are therefore not included[9].

Screen 2.4 Unit costs and consumption – Electricity

This screen is self-explanatory, and follows the logic of the cost data for water supply.

Note that solar energy is a relatively new technology and that service providers do not exist throughout South Africa. The default costs are therefore provisional and may under-estimate costs in the early phases while appropriate organisational arrangements are being established.

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[9] Households with yard taps and on-site sanitation may be connected to a wastewater system in urban and larger rural centers. The quantities involved are however likely to be small.

Screen 2.5 Unit costs – Solid waste

This screen is largely self-explanatory.

Note that the only capital costs requested are for disposal facilities. Removal equipment (mainly vehicles) is dealt with as an operating cost on the assumption that service providers enter into lease agreements.

Waste production is recorded according to household income rather than service type, since the latter has little effect on the volume produced. The model implicitly assumes that all refuse will eventually find its way to landfill sites, where these exist, whether it is formally collected or not.

Screen 2.6 Capital and maintenance costs – Roads

Cost for new roads, road rehabilitation (Table 1) and upgrading (Table 2) are entered in Rands per metre (or R'000/km).

The default rehabilitation costs are calculated as a percentage of the cost of a new road. The same convention applies to upgrading costs.

Maintenance costs are entered as a percentage of the cost of a new road. This percentage may include provision for both routine maintenance and resealing/resurfacing, which is, in effect, asset replacement. If no provision is made for resealing/resurfacing, then asset replacement must be provided for separately on the appropriate screen (screen 2.10 "as rep" in section 2).

The default percentages include provision for both routine maintenance and resealing/resurfacing.

Screen 2.7 Costs of fire protection, health and other services

These costs are dealt with in a very simple manner. For residential services, a cost is entered per household for capital expenditure in terms of 'Rands per household', while for operating expenditure the cost is entered in terms of 'Rands per household per month'.

Non-residential costs are simply entered as a percentage of total residential costs. For example, should the costs of a fire protection service amount to R100 000 per month, this amount must be split between residential and non-residential customers. If R20 000 per month is allocated to non-residential customers, then the percentage to be entered is 25 (R20 000/R80 000).

These services generally involve high operating costs relative to capital costs. The costs entered in Table 2 are, therefore, more important than those entered in Table 1.

Note that these default costs are only rough estimates and should not be relied on to provide accurate financial outputs.

Screen 2.8 Support function costs – Water and electricity losses

Support function costs

The extent of district council responsibility for support functions is entered on screen 1.8c (section 1). The cost of these activities is entered here, in terms of Rands per household per month for the various services. In the case of roads, an amount is entered per kilometre of road for which the district council provides support.

The actual costs of support functions are highly variable and depend on local circumstances. The defaults should be seen as a provision for this expenditure rather than an estimate of actual costs.

Water and electricity losses

This information is requested in order to calculate total water and electricity purchases.

Note that water losses refer only to actual physical losses, and not to the broader definition of unaccounted for water (UAW) which includes water use by unmetered consumers and errors due to faulty meters and meter readings. On-site losses in unmetered areas, due to leaking toilets for example, should, however, be included in losses.

Electricity losses should include transmission losses and theft, due to "illegal" connections or meter tampering.

Screen 2.9 Other capital expenditure by the district council

Capital expenditure to be financed by the district council, but not relating to infrastructure services, may be entered here. For example, capital expenditure on economic infrastructure, community reconstruction and social services may be entered here.

The amount of external grant finance which the district council expects to receive in relation to these expenditures should also be entered here. External grant finance refers to finance from sources such as national and provincial government, businesses and donor agencies.

Note that the model does not associate any operating costs with the capital expenditure entered on this screen. Associated operating costs must be entered in screen 1.11, under the item *DC operating exp. on other activities*.

Screen 2.10 Asset replacement

The model makes provision for annual expenditure on asset replacements, linked to the replacement cost of infrastructure in the base year. Note that this is *actual expenditure, and not an accounting provision for depreciation*.

It is assumed that expenditure on asset replacement applies to existing infrastructure only, and not to new infrastructure provided as part of the investment programme.

The user is asked to enter the *replacement value* of the various components of existing infrastructure in the first input column, and annual expenditure on replacement, expressed as a percentage of the replacement value, in the second input column. The resulting expenditure per annum (R'000) is shown in the last column in base-year Rands.

The default replacement values are calculated on the basis of information provided on the number of customer units, the services provided and the costs. The percentage inputs are estimates only.

It is recommended that the user adjust the percentage inputs rather than the asset replacement values to achieve acceptable annual estimates - unless recent and reliable estimates are available of the actual replacement value of existing assets.

Screen 2.11 Capital subsidies – Per household subsidies from external sources

There are five sources of finance for capital expenditure:

- consumer contributions;
- capital subsidies;
- net income from service provision;
- other district council income (mainly levy income); and
- borrowing.

On this screen the user is asked to enter subsidies from external sources that are made available on a per household basis. "External sources" include national and provincial government, the private sector and donor agencies. Capital grants made available to service providers by the district council are thus excluded.

The national subsidy policy for urban areas is well established, and consists of:

- *Housing subsidies* of up to R15 000[10] for internal infrastructure, land and top structure;
- *Consolidated Municipal Infrastructure Programme* (CMIP) subsidies of up to R3 000 per household for bulk and connector infrastructure; and

[10] The subsidy may be increased to R17 500 if environmental factors result in higher than normal construction costs.

- Subsidies made available by the *electricity industry* for the electrification programme (see DCD, 1997).

Theoretically, the housing and CMIP subsidies are available in rural areas, but there are practical and conceptual problems with this approach. An alternative suggestion has been to make available an infrastructure grant of R6 000 per household in lieu of the housing and CMIP subsidies (DCD, 1997). Finance is currently available for grid supplies from the electricity industry, and there is a possibility that subsidies may become available for non-grid supplies.

Per household subsidies are entered in two steps, with the same logic applying to subsidies for internal and B&C infrastructure:

Step 1

The user is requested to enter the total subsidy amount available for infrastructure from external sources, excluding electricity subsidies.

Step 2

The user must allocate the subsidy to water supply and sanitation services by specifying the *maximum* amount that can be used for each service (R per household). The model will make use of the amount required per service up to the specified maximum.

If any subsidy remains after the provision of water and sanitation, this is allocated to "other" services not included in the model (e.g. land, access roads) or top structure.

If the sum of the amounts allocated to water and sanitation exceeds the total amount available, the amount available for other purposes will be "<0". An error message *total available exceeded* will appear.

Step 3

The maximum subsidy available for electricity must be entered.

The default total subsidy for internal infrastructure in urban and dense rural areas assumes that up to R10 000 of the housing subsidy can be used for infrastructure.

The default total subsidy for the remaining areas assumes that up to R3 000 of the infrastructure grant can be used for internal services.

The default total subsidy for B&C infrastructure in urban and dense rural areas is the full R3 000 CMIP subsidy.

The default total subsidy for the remaining areas for B&C infrastructure is the remaining R3 000 of the R6 000 rural infrastructure grant.

The default allocations to water supply and sanitation services are based on costs less consumer payments, and are explained in the notes on the screen.

The default maximum subsidy for electricity is R2 000 per household, regardless of the technology to be used.

Rate of increase in the nominal value of capital subsidies

The nominal value of the capital subsidies may not increase sufficiently to keep pace with inflation, in which case the real value will decline. The user is asked to specify the nominal rate at which these subsidies are to increase, in percentages per annum.

The default rate of increase for services is 50% of the inflation rate, which is displayed directly below the input boxes.

Screen 2.12 Capital subsidies – Lump sums from external sources

Additional capital subsidies or grants may be available for bulk and connector infrastructure, and/or internal services. This screen makes provision for subsidies/grants to be provided.

Service excluding roads

The first table refers to all services *except roads*. Some capital expenditure will not be funded by consumer payments or by the household grants entered on the previous screen. The user is asked to specify the

percentage of the remaining expenditure, *including asset replacement*, which will be funded by means of external grants/subsidies.

The default is 0% for all services except fire protection, health and Other services. For the latter, the default is 90% if the district council acts as an agent for another tier of government and 0% if this is not the case.

Note the implicit assumption that the same funding arrangements for fire protection, health and Other services apply to the district council as to other service providers.

District (Level 3) and Local (Level 4) roads

Roads are dealt with in the second table. The user is asked to enter the percentage of capital expenditure funded from external sources for each type of road. Roads that are the district council's responsibility are dealt with separately from roads that are the responsibility of other agencies. Again, the user is asked to specify the percentage of total capital expenditure that will be funded from external sources.

Where the district council acts as an agent for another tier of government the default for roads for which the district council takes responsibility is based on the assumption that capital expenditure will be fully financed from external sources (usually Provincial government). If the district council does not function as an agent it becomes fully responsible for financing capital expenditure.

The default for roads that are not the district council's responsibility is 100%. Generally, these roads will be funded by Provincial government.

Screen 2.13 Loans

Interest payable on short-term loans

This is the interest rate on district council bank overdrafts or other short-term loans. It is specified in nominal terms, which is the applicable rate since interest is generally charged on a monthly basis.

The default rate is calculated for a rate net of inflation of 12%.

Cost of loans for capital expenditure

The terms on which long-term loans are raised are specified here. The user enters the borrowing rate for long-term loans (for capital expenditure) for the base year, year 5 and year 10. The model extrapolates the rates for the intervening years. These rates must be entered in nominal terms, and the model then calculates the real rates. The loan repayment period must also be entered.

The default interest rates are the nominal rates calculated for a real rate of 6% per annum. The default repayment period is 15 years. Note that the model assumes that these terms apply to loans for all services and all service providers included in the model.

Payments on past loans

The remainder of this screen is used to capture payments on loans raised prior to the planning period under consideration. These payments (capital charges) are important because (1) they affect the cost of providing services district-wide and (2) the district council is likely to take over some of these payments if it takes over the associated services.

Base year payments by the district council should have been entered on screen 1.11, and are reflected on this screen.

Capital charges paid by other (local) service providers are requested by service and settlement type. These are likely to be substantial for urban areas, and a rough estimate is better than no estimate. If there are a few large centres in the district, their repayments should be ascertained from financial statements. Capital charges are unlikely to be of much significance in rural areas, however, and can probably be ignored.

Screen 2.14 “Equitable Share” income

Total district Equitable Share allocation from national government (R'000, real)

The use to which the “Equitable share” subsidy is to be put is determined on screen 1.9c. In the first table on this screen the *total amount* allocated to the district in the future is determined by settlement type.

The default amount for urban areas is the amount allocated in the previous year.

The base year amounts for the other settlement types are the sum of the amounts provided to district council and non-urban local authorities, allocated out in proportion to the share of households with incomes of less than R800 per month.

The default amounts for a future year are the previous year's amounts.

District council Equitable Share allocation for services provided (R'000, real)

If ES income is to be added to total district and district council income ("no" selected on screen 1.9c), the user may enter the annual amounts that will be allocated directly to the district council. The default amount is the amount in the previous year.

If ES income is to be allocated as service subsidies to low-income households, the model automatically allocates this income between the different services on the basis of the district council's responsibility for service provision. This allocation includes ES income used to pay for district council services such as fire protection or bulk water.

Screen 2.15 Agency fees and other recurrent subsidies

District and Local roads, fire protection and health services are unlikely to be funded out of ES income. Provincial government currently provides funds for these services, and this situation is likely to continue. Nonetheless, the model provides for the possibility that the district council might be required to finance such services in the future.

The user should specify the percentage of the operating costs that will be funded from external sources (ES subsidy excluded). Each of the services mentioned above is dealt with separately, and provision is made for Other services to be funded in this manner. The percentages funded are entered separately for services that are the district council's responsibility.

The DSM defaults assume that if the district council acts as an agent for another tier of government, 50% of recurrent expenditure will be externally financed (e.g. by transfers from Provincial government). If the district council is not an agent no external funding is provided. This applies to all services except 'other', which the default assumes receives no subsidy from this source. The defaults for other service providers work on the assumption that the same funding arrangements apply as for the district council.

SECTION 3: MODEL OUTPUTS

Section 3 consists of 31 output screens in formats suitable for printing. The first seven screens provide summaries of the main financial results of the scenario. These are provided for the district council and, where applicable, for the district as a whole. The screens are:

3.1 CAPITAL ACCOUNT, ALL SERVICES (District Council, real)
3.2 RECURRENT INCOME AND EXPENDITURE (District Council, real)
3.3 CAPITAL ACCOUNT, ALL SERVICES (District total, real)
3.4 RECURRENT INCOME AND EXPENDITURE ON SERVICES (District total, real)
3.5 HOUSEHOLD BILLS
3.6 NET INCOME FROM SERVICES BY SERVICE AND AREA
3.7 RECURRENT INCOME AND EXPENDITURE ON SERVICES (District Council, real)

The remaining screens provide information of each service in greater detail, as follows:

- Capital expenditure and income for the total district (screens 3.8a – 3.8f)
- Capital expenditure and income for the district council (screens 3.9a – 3.9f)
- Recurrent expenditure and income for the total district (screens 3.10a – 3.10f)
- Recurrent expenditure and income for the district council (screens 3.11a – 3.11f)

The following methods have been adopted in representing the capital and recurrent accounts:

- On the capital account, no provision is made for equity finance from service providers, except the district council and the electricity industry. In the latter cases, equity finance takes the form of funding out of its own resources. The district council uses levy, net service and other income to finance capital expenditure, which is recorded as "DC finance" in the tables of capital expenditure. The electricity industry, in effect, provides equity finance by means of capital grants to households. This is reflected as subsidy income rather than equity finance on the capital account.
- The tables on current income and expenditure show the cash flows associated with service provision, rather than conventional profit and loss statements. No provision is made for depreciation as an expenditure. Asset replacement is included as an item of capital expenditure, and appears on the capital account, and capital redemption (i.e. repayment on principle) is included in the current account.

ANNEXURE 1:CENSUS DATA CONVERSION

Overview of Census-DSM conversion process

Financial models are highly sensitive to assumptions made about the status quo. In many cases though, existing data is patchy, dated and unreliable - particularly when considered at the level of the district as a whole.

Whilst the '96 Household Census data has some failings, it does at least provide district councils with consistent data at a district-wide level. These results can be tested against existing data sets and local knowledge. In order for Census '96 data to be useful, however, it must be translated from Census conventions into DSM conventions. A spreadsheet *census-dsm.xls* has been created to perform this translation.

Even if district councils are confident of their demographic and services data, it is essential that model users undertake this exercise before applying the model. Users will require the full Census '96 data set for their district, and a suitable GIS or database with which to manipulate the data.

The basic steps of the exercise are described below, followed by a more detailed explanation of the various census conventions.

Allocation of enumerator areas to settlement types

Each enumerator area within the district must be allocated to one of the five DSM settlement types on the basis of the settlement descriptions which appear in these guidelines. This should be undertaken by individuals with a good sense of local conditions, using a GIS or similar database.

Users should ensure that settlement types are used in a manner which complements the key decisions to be supported by the financial modelling. For instance, a 'quick and dirty' run could be undertaken by allocating all TLC enumerator areas to the Urban Settlement category and all other enumerator areas to the most suitable rural category.

Note that users should not use the settlement categories to model political boundaries, such as sub-regions within a district.

Demographic information

Once enumerator areas have been allocated to settlement types, it becomes a relatively simple matter to establish the total number of people and households living within each settlement type. This data should be entered into the 'Pop' sheet within the census-dsm.xls conversion sheet.

Similarly, the number of households within each income category should be established for each settlement type and entered into the 'Inc' sheet

Note that the data must apply to *household* incomes, rather than *individual* incomes.

Service information

The number of households with each service level should be established, as per the census categories, and this data should be entered into the 'Services' sheet.

Users should check each service to see whether the census has generated an adequate response rate. If response rates are too low to be reliable, then the alternative derivation sheets should be used.

Service conversion factors should be adjusted for each service to suit local conditions.

Dummy data

Depending on the level to which the census data has been manipulated by other authorities, users may encounter the following fields:

- *Other* - households in this field should generally be considered to have no service or an inadequate service.

- *Unspecified/Dummy* - households in this field should generally be disregarded ore treated as having no service. If a significant proportion of households appear in this field the census generated a low response rate, indicating that the data should not be relied upon. Alternative sources should then be sought.

Data transfer

Once the census data has been converted to DSM conventions, the results should be transferred into the DSM. It is strongly recommended that users do not link the two spreadsheets. Experience has shown that links are not reliable for such large spreadsheets. Either use the *copy*, *paste special*, *values* function, or simply print out the converted results and re-type the numbers (it should only take a few minutes).

Census conventions

Water services

Census 96 asked each household, hostel and institution about their main water supply. The options given varied slightly for households and hostels/institutions:

Table 5 Census options for water services

Households	Institutions
Piped (tap) water, in dwelling	Piped (tap) water, for each housing-unit in the hostel/institution
Piped (tap) water, on site or in yard	Piped (tap) water, on site or yard of hostel/institution
Public tap	Shared tap/s for residents
Water-carrier/tanker	Water-carrier/tanker
Borehole/rain-water tank/well	Borehole/rain-water tank/well
Dam/river/stream/spring	Dam/river/stream/spring
Other	Other

Since district councils are not responsible for the provision of water services within private institutions, the DSM only considers the *household* data. However, it may be useful to establish the number of people living in institutions, and the levels of service they are currently provided with, from a public health point of view.

The *census-dsm.xls* spreadsheet converts the census service options into DSM conventions.

Bulk water services

It is not generally reasonable to expect households to know the source of the water supplied to their house. Therefore, the census did not distinguish between bulk water sources.

Model users should utilise local knowledge to allocate households to bulk water supply system types.

Sanitation services

Census '96 asked households, hostels and institutions the same questions about available toilet facilities. The instructions on all questionnaires noted that only one option was to be circled.

Table 6 Census options for sanitation services

Census categories
1 Flush or chemical toilet
2 Pit latrine
3 Bucket latrine
4 None of the above
9 Unspecified/Dummy

Since district councils are not responsible for the provision of sanitation services within private institutions, the DSM only considers the *household* data. However, it may be useful to establish the number of people living in institutions, and the level of service they are currently provided with, from a public health point of view.

The *census-dsm.xls* spreadsheet converts the census service options into DSM conventions.

Electricity services

The census asked households which fuel they use for cooking, heating and lighting. The most reliable indicator of the availability of grid electricity is the answer to lighting, since many households with electricity still choose to cook and heat with other fuels.

Table 7 Census electricity service options for lighting

Census categories
1 Electricity direct from authority
2 Electricity from other source
3 Gas
4 Paraffin
7 Candles
0 Other
9 Unspecified/Dummy

Households with access to grid electricity must still be allocated to the various DSM service levels using the conversion factors in the *census-dsm.xls* spreadsheet.

Solid waste services

The census asked each household, hostel and institution how the refuse or rubbish of the household/hostel/institution was disposed of. Provision was made for the same responses in all questionnaires, with the exception of the category 'No rubbish disposal' which appeared as 'None of the above' on hostel and institution questionnaires. If the response was 'Other', provision was made for a response to be written in but, if it couldn't be related to one of the other response options, it was just coded as 'Other'.

Table 8 Census solid waste service options

Census categories
1 Removed by local authority at least weekly
2 Removed by local authority less often
3 Communal refuse dump
4 Own refuse dump
5 No rubbish disposal
6 Other
9 Unspecified/Dummy

Roads

Unfortunately, Census '96 does not provide any information about access to roads. This data must be obtained from other sources.

ANNEXURE 2: REFERENCES AND USEFUL RESOURCES

References

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Ministry of Finance (1998) *Medium term budget policy statement 1998*. Pretoria.

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Useful resources

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Idasa (1997) *A practical guide to local government in South Africa.* Kutlwanong Democracy Centre, Pretoria.

Palmer Development Group (1998) *Guidelines for district councils relating to the provision of water services. Guideline 1: Overall roles and responsibilities of district councils*. Prepared for the Department of Water Affairs and Forestry.

Useful web-sites

The African Water Page - Len Abrams. http://www.sn.apc.org/afwater

Department of Constitutional Development, Local Government. http://www.local.gov.za

Development Bank of South Africa. http://www.dbsa.org

Local governance learning network. http://www.logon.org.za

Municipal Demarcation Board. http://www.demarcation.org.za

Municipal Infrastructure Investment Unit. http://www.miiu.org.za

South Cape District Council Integrated Development Planning. http://ipros.csir.co.za/southcape

Statistics South Africa (1998) Census code books. Available at http://www.statssa.gov.za

Water Research Commission. http://www.wrc.org.za

ANNEXURE 3: MODEL CHECKLIST

SECTION 1 : ESSENTIAL INPUTS, PROGRAMME DECISIONS AND KEY OUTPUTS

No.	Screen	Chk
ESSENTIAL INFORMATION INPUTS		
1.0	DESCRIPTION	
1.1	SERVICES MODELLED AND AGENCY RESPONSIBILITIES	
1.2	RESIDENTIAL CONSUMERS – CURRENT AND FUTURE	
1.3	INCOME DISTRIBUTION	
1.4	ECONOMIC ENVIRONMENT	
1.5a	EXISTING RESIDENTIAL SERVICES – WATER RETICULATION	
1.5b	EXISTING SERVICES – BULK WATER	
1.5c	EXISTING RESIDENTIAL SERVICES – SANITATION	
1.5d	EXISTING RESIDENTIAL SERVICES – ELECTRICITY	
1.5e	EXISTING RESIDENTIAL SERVICES – SOLID WASTE	
1.5f	EXISTING SERVICES – ROADS	
1.5g	EXISTING RESIDENTIAL SERVICES – FIRE, HEALTH AND OTHER SERVICES	
1.6	NON-RESIDENTIAL SERVICES	
SERVICE LEVEL TARGETS		
1.7a	RESIDENTIAL SERVICE TARGETS – WATER	
1.7b	BULK SERVICES – WATER	
1.7c	RESIDENTIAL SERVICE TARGETS – SANITATION	
1.7d	RESIDENTIAL SERVICE TARGETS – ELECTRICITY	
1.7e	RESIDENTIAL SERVICE TARGETS – SOLID WASTE	
1.7f	SERVICE TARGETS – ROADS	
1.7g	RESIDENTIAL SERVICE TARGETS – FIRE, HEALTH AND OTHER SERVICES	
DISTRICT COUNCIL RESPONSIBILITY		
1.8a	DC RESPONSIBILITY FOR SERVICE PROVISION – RETAIL	
1.8b	DC RESPONSIBILITY FOR SERVICE PROVISION – BULK	
1.8c	DC RESPONSIBILITY FOR SERVICE PROVISION – SUPPORT FUNCTIONS	
PAYMENT FOR SERVICES		
1.9a	WILLINGESS TO PAY BY LOW-INCOME HOUSEHOLDS	
1.9b	SURPLUS FROM SERVICES TO HIGH-INCOME AND NON-RESIDENTIAL CONSUMERS	
1.9c	EQUITABLE SHARE SUBSIDY ALLOCTION	
DISTRICT COUNCIL INCOME AND EXPENDITURE		
1.10	DISTRICT COUNCIL INCOME & DISTRICT ES SUBSIDY (R'000)	
1.11	DISTRICT COUNCIL EXPENDITURE (R'000)	
1.12	ALLOCATION OF DC INCOME	
KEY MODEL OUTPUTS		
1.13	DISTRICT COUNCIL INCOME & EXPENDITURE AND NET SERVICE INCOME	
1.14	CAPITAL ACCOUNT, CASH FLOWS AND BILL	

SECTION 2 : REPLACEMENT OF DEFAULT VALUES

No.	Screen	Chk
UNIT COSTS		
2.1	UNIT COSTS & CONSUMPTION – WATER RETICULATION	
2.2	UNIT COSTS – BULK WATER	
2.3	UNIT COSTS & WASTEWATER FLOWS – SANITATION	
2.4	UNIT COSTS & CONSUMPTION – ELECTRICITY	
2.5	UNIT COSTS – SOLID WASTE	
2.6	CAPITAL AND MAINTENANCE COSTS – ROADS	
2.7	COSTS OF FIRE PROTECTION, HEALTH AND OTHER SERVICES	
2.8	SUPPORT FUNCTION COSTS; WATER AND ELECTRICITY LOSSES	
2.9	OTHER CAPITAL EXPENDITURE BY THE DC	
CAPITAL ACCOUNT		
2.10	ASSET REPLACEMENT	
2.11	CAPITAL SUBSIDIES: PER HOUSEHOLD SUBSIDIES FROM EXTERNAL SOURCES	
2.12	CAPITAL SUBSIDIES: LUMP SUMS FROM EXTERNAL SOURCES	
OPERATING ACCOUNT		
2.13	INTEREST RATES AND LOAN REPAYMENT SCHEDULES	
2.14	“EQUITABLE SHARE” INCOME	
2.15	AGENCY FEES AND RECURRENT SUBSIDIES	