STELLENBOSCH MUNICIPALITY

WATER MASTER PLAN

(Final Draft)

June 2019

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TABLE OF CONTENTS

Pp

LIST OF TABLES

Pp

LIST OF FIGURES

Pp

LIST OF ABBREVIATIONS & ACRONYMS

AADD	-	Annual average daily demand
BPT	-	Break pressure Tank
CEs	-	Community Engineering Services (Pty) Ltd
CoCT	-	City of Cape Town
d	-	Day
DWA	-	Department of Water Affairs
ECE	-	Element Consulting Engineers
EGL	-	Energy Grade Line (in m a.s.l.)
GIS	-	Geographic Information System
GLS	-	GLS Consulting Engineers (Pty) Ltd
h	-	Hour
ha	-	Hectare
IMQS	-	Infrastructure Management Query Station (software)
kℓ	-	Kilolitre
kℓ/d	-	Kilolitre/day
kℓ/y	-	Kilolitre/year
km	-	Kilometre
kW	-	Kilowatt
kWh	-	Kilowatt-hour
ℓ	-	Litre
ℓ/day/UE	-	Litre/day/unit erf
ℓ/h/connection	-	Litre/hour/connection
ℓ/min	-	Litre/minute
ℓ/s	-	Litre/second
m	-	Metre
m a.s.l.	-	Metres above mean sea level
m/s	-	Metres per second
Mℓ	-	Megalitre
mm	-	Millimetre
P & G	-	Preliminary and general
PDF	-	Peak day flow
PHF	-	Peak hour flow
PRV	-	Pressure Reducing Valve
PWF	-	Peak week flow

s	-	Second
SG	-	Surveyor General
SWIFT	-	Sewer Water Interface For Treasury systems (software)
TWD	-	Total annual water demand
TWL	-	Top Water Level (in m a.s.l.)
UAW	-	Unaccounted-for-water
uPVC	-	Plasticised polyvinylchloride
UWD	-	Unit Water Demand (e.g. ℓ/stand/d, or kℓ/ha/d)
VAT	-	Value Added Tax
WADISO	-	Water Distribution System Optimization program (software)
WTP	-	Water Treatment Plant (potable water)

1. INTRODUCTION

1.1 BRIEF

GLS consulting engineers (GLS) were appointed to update the master plan of the water distribution system for Stellenbosch Municipality.

The project entails the updating of computer models for the water distribution systems in Stellenbosch Municipality, the linking of these models to the stand and water meter databases of the treasury's financial system, evaluation and master planning of the networks, and the posting of all information to the Infrastructure Management Query Station (IMQS).

This master plan report lists the analyses and findings of the study on the water distribution systems of all the towns and rural areas within the Stellenbosch Municipality.

1.2 STUDY AREA

The location of Stellenbosch within the Western Cape is shown on Figure SW1.1. The urban areas within the boundary of the Stellenbosch Municipality are:

- Stellenbosch (including Jamestown & De Zalze)
- Dwars River (Pniel, Kylemore, Johannesdal and Lanquedoc)
- Greater Franschhoek (Franschhoek, La Motte and Wemmershoek)
- Klapmuts
- Raithby

The rural areas within the Stellenbosch Municipality boundary are:

- Faure system
- Polkadraai system
- Koelenhof system
- Muldersvlei system
- Meerlust
- Helderberg
- Croydon

Figures SW1.2 show the suburbs with suburb names entered during this investigation for all records in the GIS database. The total area of these suburbs indicates the study area of this investigation.

1.3 PREVIOUS MASTER PLANNING

GLS conducted a water master plan for Stellenbosch Municipality for the town of Stellenbosch in June 1993 and in 1999 the master plan was updated by GLS for various density scenarios.

In July 1995 V3 Consulting Engineers compiled a report for the Franschhoek Municipality regarding the analysis of the existing water system. In January 2003 V3 Consulting Engineers updated this report and performed master planning for the Franschhoek water system.

In 2000 Community Engineering Services (Pty) Ltd (CEs) compiled a water master plan for the Dwars River area.

In 2008 Element Consulting Engineers (ECE) in association with GLS conducted master planning for the water distribution systems of Stellenbosch town, the Dwars River area, the Greater Franschhoek area, Klapmuts and Raithby.

All these previous master plans where then updated in December 2011 by GLS. In June 2017 the previous master plans for the urban areas were updated and planning was also performed to include all the rural areas. These master plans were updated by GLS in 2018 and 2019.

1.4 DEFINITIONS

1.4.1 Water supply system

In this report the term *water supply system* is used to describe the reticulation system downstream of the clean water reservoir and upstream of individual consumer meters; it is also often termed the internal water reticulation system. Capital expenditure relating to this system is the responsibility of the Municipality.

In order to further distinguish between capital expenditure by the Municipality and by other role-players the following terms are defined:

- *Bulk water supply system* is used to describe the system upstream of the clean water reservoir, yet belonging to the Municipality, while the term,
- *External bulk water supply system* - is used to describe those parts of the water supply system that are owned by third parties.

1.4.2 Water management zones

Management zones are often termed bulk zones, distribution zones, or water pressure zones. Following the notation of the Water Demand Cookbook (McKenzie et al, Nov 2003) the following terms are used in this report. *A water management zone* can be either a district, a sub-district or a zone, where:

- a *district* is a unique area with individual bulk supply and boundaries usually fixed by topographical constraints. This would include various consumer categories (typically about 30 000 connections).
- a *sub-district* is a subdivision of a district and is identified by a reservoir, tower, pump, or PRV zone (typically 2000 to 10 000 connections). This would include various consumer categories.
- a *zone* is a subdivision of a district, identified by areas of similar characteristics (typically not larger than 2000 connections).

The set-up (identifying and installing, where necessary, zone valves) and maintenance of zones (training maintenance staff to understand why these zone valves should not be opened) is a particular challenge to many towns in South Africa.

1.4.3 Unaccounted-for-water (UAW)

The acronyms UAW and UFW are used in literature for the term *unaccounted-for-water*. In this report UAW is used. Generally speaking UAW is the difference between the volume of water purchased by a water service provider (or bulk supply to the town) and the volume of water sold to consumers (recorded by consumer meters and billed to consumers). However, the definition of UAW and the topic is much more involved - UAW is best described by a table and detailed report such as the one by McKenzie et al (2002), where a detailed table is provided to illustrate the different components of UAW.

In this report the term UAW is used to describe the non-revenue water, that is, all water use that is not recorded in the treasury system of the Municipality is considered to be “unaccounted-for”, whether it is metered or not. Unless metered unbilled water use is specifically pointed out it is not included in the analysis in this investigation.

1.4.4 Stand

In this report *stand* is used to denote a piece of ground identified in the database of the Surveyor General (SG) as a unique property. A stand could have one or more (or no) metered connections to the water supply system. The words property, site, erf (or erven), and lot are also sometimes used elsewhere to describe a stand.

1.4.5 Treasury record

A *treasury record* is a consumer's account that is recorded in the treasury database of the Municipality. Each treasury record normally represents a water meter forming a consumer's connection to the water supply system. Some treasury records might not pertain to a water connection (or customer meter).

1.5 STRUCTURE AND SCOPE OF REPORT

This report addresses the distribution of potable water within the Stellenbosch Municipal area. Water quality aspects and the analysis of the bulk water (raw water) pipelines upstream of the Water Treatment Plant's (WTP's) and reservoirs are beyond the scope of this report. Investigation of, and comments on the sufficiency of the existing water sources are beyond the scope of this study.

The contents of each chapter is arranged so that all of the text is grouped together, followed by the tables and then the figures if applicable to the chapter.

1.6 DISCLAIMER

The investigation has been performed and this report has been compiled based on the information made available to GLS. All efforts, within budget constraints, have been made during the gathering of information to ensure the highest degree of data integrity. The information supplied to GLS by the Stellenbosch Municipality and other consultants at the outset of this master planning process is assumed to be the most accurate representation of the existing system up to date hereof.

Subsequent to the completion of the data capturing, the layout plans including the relevant attributes, were handed back to the Municipality so that the information could be verified by the Client. GLS can therefore under no circumstances be held accountable by any party for any direct, indirect, special or consequential damages as a result of inaccurate information received pertaining to the components of the existing system.

The information in this report is intended for use by the Stellenbosch Municipality only.

Figure SW1.1: Locality plan - Stellenbosch Municipality

Figure SW1.2(a): Towns and suburbs per treasury - Stellenbosch

Figure SW1.2(b): Towns and suburbs per treasury - Dwars River & Meerlust3

Figure SW1.2(c): Towns and suburbs per treasury - Franschhoek4

Figure SW1.2(d): Towns and suburbs per treasury - Klapmuts5

Figure SW1.2(e): Towns and suburbs per treasury - Raithby, Faure, Helderberg & Croydon6

Figure SW1.2(f): Towns and suburbs per treasury - Polkadraai7

Figure SW1.2(g): Towns and suburbs per treasury - Koelenhof & Muldersvlei8

2. EXISTING SYSTEM

2.1 WATER SOURCES

2.1.1 Stellenbosch town

Stellenbosch is supplied with water from two sources, namely the Eerste River/Idas Valley dams and the Theewaterskloof scheme.

During the winter months the Eerste River in the Jonkershoek Valley supplies water directly to the Idas Valley WTP. Surplus water from the Eerste River is transferred to the Idas Valley dams (564 Mℓ and 1 818 Mℓ). In the dryer summer months there is a shortage from the Eerste River and water is supplemented from the Idas Valley dams. Water from the Idas Valley dams and the Eerste River is purified at the Idas Valley WTP from where it is supplied into the Stellenbosch network.

Stellenbosch Municipality also has an allocation of 3 million m^3/annum from the Theewaterskloof tunnel. Raw water from this source is purified at the Paradyskloof WTP from where it is supplied into the distribution network.

In 1998 a bulk water transfer scheme was commissioned where 12,5 Mℓ/d of purified water could be transferred between the two sources.

2.1.2 Dwars River

The Dwars River area purchases water in bulk from the City of Cape Town (CoCT). This water from the CoCT is purified water from the Wemmershoek scheme.

2.1.3 Franschhoek

Franschhoek is supplied with water from two sources. Its own source in the adjacent mountains, the so-called Perdekloof source and purchased water from the CoCT. La Motte and Wemmershoek are only supplied with water purchased from the CoCT. The water from the CoCT is purified water from the Wemmershoek scheme while the raw water from the Perdekloof is purified at a package plant next to the Fransche Hoek Estate Lower reservoir.

2.1.4 Klapmuts

Klapmuts purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

2.1.5 Raithby

Raithby purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Faure WTP.

2.1.6 Faure system

Faure purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Faure WTP.

2.1.7 Polkadraai system

Polkadraai purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Blackhealth WTP.

2.1.8 Koelenhof system

Koelenhof purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

2.1.9 Muldersvlei system

Muldersvlei purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

2.1.10 Meerlust

Meerlust purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

2.1.11 Helderberg and Croydon

Helderberg and Croydon purchases water from the CoCT. This water from the CoCT is purified water from the Steenbras WTP.

Note: Investigation of, and comments on the sufficiency of the existing water sources are beyond the scope of this study.

2.2 BULK SUPPLY SYSTEM

The analysis of the bulk supply system, viz. the system upstream of the storage reservoirs, CoCT bulk connection points or WTPs is beyond the scope of this study.

2.3 RETICULATION SYSTEM LAYOUT AND OPERATION

2.3.1 General Description

The existing Stellenbosch water supply system is discussed in this section.

The water distribution system layouts are shown on Figures SW2.1, with a separate Figure for each area as follows:

- a - Stellenbosch
- b - Dwars River & Meerlust
- c - Franschhoek
- d - Klapmuts
- e - Raithby, Faure, Helderberg & Croydon
- f - Polkadraai
- g - Koelenhof & Muldersvlei

This notation to distinguish between areas is used throughout this report for all Figures where appropriate.

The water distribution zones are shown in Figures SW2.2.

Table SW2.1 provides a summary of the pipes, reservoirs, pumps and control valves in the existing system.

Table SW2.2 provides a summary of the existing annual average daily demand (AADD) of each zone in the system.

2.3.2 Stellenbosch town

The system is operated in 26 zones. There are 22 reservoirs (of which the Jonkershoek, La Coline, Kayamandi Old 1, Kayamandi Old 2 and Onder-Papegaaiberg reservoirs are currently not in use), one break pressure tank (BPT), 12 pressure reducing valve (PRV) zones and one tower zone for a higher lying area.

The Central zone is the largest of the zones and supplies 36% of the total water demand. The zone is supplied by water from the Idas Valley 2 and Rozendal reservoirs. The Idas Valley 2 and Rozendal reservoirs are supplied directly from the filters at the Idas Valley WTP. From the Central zone water is also distributed through the network to the Idas Valley 1 reservoir and the Papegaaiberg reservoir. Water can also be supplied from the Central zone to the Welgelegen reservoir.

The Arbeidslus reservoir and Arbeidslus PRV 1 zones are supplied from the Arbeidslus reservoir, which is supplied with water through a rising main and pump station from the Rozendal reservoir.

The Uniepark 2 reservoir is supplied with a 375 mm diameter rising main and a pump station from the Idas Valley 2 reservoir, or via gravity from the Arbeidslus reservoir. The Uniepark 1 reservoir is supplied with water from the Uniepark 2 reservoir, or via a 200 mm diameter rising main and the pump station at the Idas Valley 2 reservoir. The Uniepark 1 zone is supplied from the Uniepark 1 reservoirs. The Cloetesville reservoir and tower, the La Coline PRV zone and the Uniepark 2 zone are supplied with water from the Uniepark 2 reservoir through a dedicated bulk pipe.

The Idas Valley zone is supplied from the Idas Valley 1 reservoir, which is supplied with water through the Central zone from the Idas Valley 2 reservoir.

Cloetesville reservoir supplies the Cloetesville zone and from here the Cloetesville tower is filled that supplies the higher lying areas.

Water is pumped from the Kleinvallei reservoir to the Kayamandi reservoir. From here the Kayamandi reservoir and Kayamandi PRV zones 1 to 4 are supplied. The Kayamandi reservoir can be supplied with water through a rising main from the Kayamandi pump station and sump which receives its water through the Central zone.

The Papegaaiberg reservoir is supplied from the Central zone or the Paradyskloof 1 zone. From here the Papegaaiberg zone is supplied and water is pumped to the Kleinvallei reservoir and to the Kayamandi reservoir through the Papegaaiberg old and new pump stations and accompanying rising mains.

The Kleinvallei reservoir supplies the Kleinvallei PRV 1 zone and from here water is distributed to the Kleinvallei BPT, which supplies the Kleinvallei PRV 2 zone. From the Kleinvallei reservoir water is also pumped to the Kayamandi reservoir.

From the Paradyskloof WTP the Paradyskloof 1 & 2 reservoirs are filled. The Paradyskloof 1 reservoir supplies the Paradyskloof 1 zone and the Paradyskloof 2 reservoir supplies the Paradyskloof 2 reservoir, PRV 1 and PRV 2 zones. The Brandwacht reservoir is also supplied from the Paradyskloof 2 reservoir through a dedicated pump station and rising main.

From Paradyskloof 1 reservoir a dedicated gravity pipe feeds the Welgelegen reservoir and the Papegaaiberg reservoir is also fed through the Paradyskloof 1 zone. Jamestown can also be supplied with water through the Paradyskloof 1 zone.

The Welgelegen reservoir supplies the Welgelegen reservoir and PRV zones and from the Welgelegen reservoir the water can also be pumped through the Brandwacht zone to the Brandwacht reservoir.

The Brandwacht reservoir supplies the Brandwacht reservoir and PRV zones

Jamestown zone is supplied from the Jamestown reservoir which receives its water from the Faure WTP via the supply scheme which supplies Spier and the De Zalze Golf Estate. The Jamestown reservoir can also be supplied with water through the Jamestown reservoir network with water supplied through the Paradyskloof 1 zone.

2.3.3 Dwars River

The system is operated in 10 zones supplied from 6 reservoirs. Some zones are supplied with water directly from the bulk system.

Dwars River purchases bulk water from the CoCT's Wemmershoek line from where the water gravitates to the Bulk pump station 1 and sump. From here it is pumped to the Bulk pump station 2 and sump.

The Deltacrest development along with a few other developments are supplied from the gravity line between the Wemmershoek line and Bulk pump station 1.

From the second bulk pump station the water is pumped with a dedicated rising main to Johannesdal and the Pniel lower reservoirs and with a second rising main to Kylemore Lower reservoir. The Lanquedoc zone is supplied directly from the rising main between Johannesdal and the second bulk pump station.

Johannesdal Lower zone is supplied from the Johannesdal Lower reservoir. The Johannesdal Upper zone is supplied by the Johannesdal Upper reservoir which receives its water from a pump station and rising main that is supplied through the Johannesdal Lower zone.

The Pniel Lower reservoir supplies the Pniel Lower zone and from here a pump station and rising main feeds the Pniel Upper reservoir which supplies the Pniel Upper zone.

The Kylemore Lower reservoir supplies the Kylemore Lower zone and from here a pump station and rising main feeds the Kylemore Upper reservoir which supplies the Kylemore Upper zone.

2.3.4 Franschhoek

Franschhoek is operated in 14 zones supplied from 12 reservoirs. The La Motte and Wemmershoek systems are each operated in 1 single zone, supplied from a single reservoir, respectively.

The western part of Franschhoek, La Motte and Wemmershoek receives bulk water from the CoCT's Wemmershoek pipeline. From the connection point the water gravitates to the Wemmershoek booster pump station 1. From here it gravitates or could be boosted to the Wemmershoek booster pump station 2 as well as the Wemmershoek reservoir. The Wemmershoek zone is supplied from the Wemmershoek reservoir.

From the second booster pump station the water gravitates or could be boosted via 2 dedicated bulk pipes to the La Motte reservoir and the Groendal reservoir respectively. The La Motte zone is supplied from the La Motte reservoir.

The Groendal reservoir supplies the Groendal zone and from here a rising main and pump station fills the Langrug reservoir which supplies the Langrug reservoir and Langrug PRV zones. From the Groendal reservoir water is also pumped to the Franschhoek reservoir.

The Franschhoek reservoir zone and Franschhoek PRV zone receives water from the Franschhoek reservoir.

The Southern booster zone is supplied with water through the Franschhoek PRV network and supplies the higher lying erven.

Fransche Hoek Estate receives water from the Perdekloof source, which is treated at a package plant next to the Fransche Hoek Estate Lower reservoir. Water from the package plant supplies the Fransche Hoek Lower reservoir (1 Mℓ of the reservoir capacity is allocated to Franschhoek town and 1 Mℓ for the Estate), which supplies the Fransche Hoek Lower reservoir zone, Fransche Hoek Lower PRV 1 zone, Fransche Hoek Lower PRV 2 zone and the Bo-Dorp PRV zone.

The Fransche Hoek Upper reservoir is fed with raw water from a borehole, which is disinfected at the reservoir, and from where the Fransche Hoek Upper reservoir zone is supplied. Water can also be supplied from the Fransche Hoek Upper reservoir zone through a PRV to the Fransche Hoek Lower reservoir zone.

The Bagatelle (Onder-Dorp) reservoir can be supplied with water either from the Franschhoek reservoir or from the Franschhoek Bo-Dorp PRV.

The La Avenue booster pump station next to the Bagatelle (Onder-Dorp) reservoir supplies a higher lying area adjacent to the reservoir.

2.3.5 Klapmuts

Klapmuts purchases bulk water from the CoCT's Wemmershoek scheme. From the connection point the water gravitates to the Klapmuts Old reservoir. From here it is pumped to the New Klapmuts reservoir. The Klapmuts zone is supplied from the New Klapmuts reservoir through a PRV next to the Klapmuts Old reservoir.

2.3.6 Raithby

The Raithby reservoir is supplied with water from the Raithby bulk pump station with a connection point on the CoCT's pipe next to the Faure reservoir. From the Raithby reservoir the Raithby zone is supplied while a booster pump station supplies a higher lying area adjacent to the reservoir.

2.3.7 Faure system

The Faure system is supplied with water from a connection point on the CoCT's pipe next to the Faure reservoir. From here water gravitates through the Faure network to the Faure pump station that supplies water to the Jamestown reservoirs and De Zalze.

2.3.8 Polkadraai system

The Skoonheid (Polkadraai) reservoir is supplied with water from the Blackhealth bulk pump station next to the Blackheath reservoirs. From the Skoonheid reservoir water gravitates to the Polkadraai network to 3 PRV zones. The Skoonheid reservoir also feeds the Longlands Estate reservoir as well as the Digteby Estate reservoir.

2.3.9 Koelenhof system

The Koelenhof zone consists of 3 reservoirs and a PRV zone. Water from the Koelenhof reservoir feeds all the zones in the Koelenhof area. Water gravitates to the Elsenberg pump station where it is boosted to the Elsenburg reservoir and to the Devon Valley and Sonop pump station where water is boosted to the Devon Valley tank and Sonop reservoir.

The Devon Valley tank feeds the Devon Valley zone and the Sonop reservoir feeds through a PRV to the Sonop reservoir zone.

2.3.10 Muldersvlei system

Muldersvlei is supplied with water from a connection point on the CoCT's pipe.

2.3.11 Meerlust

Meerlust is supplied with water from a connection point on the CoCTs Wemmershoek pipe.

2.3.12 Helderberg/Croydon

Helderberg and Croydon are supplied with water from a connection point on the CoCT's pipe. Helderberg also has a booster pump station that boosts the water from the CoCT connection point to the network.

2.4 EXISTING OPERATIONAL PROBLEMS

The operational staff indicated the following operational problems:

- Low residual water pressures in Kayamandi
- Low residual water pressures in Kylemore Lower zone
- Low static and residual water pressures in Raithby zone
- High pressures in Franschhoek

2.5 SPECIAL CONSIDERATIONS

2.5.1 General

Detailed drawings of the system are included in the plan book. The plan book should be used to indicate (by physical markings on the drawings) any additional information, or amendments, that would improve the quality of the final product.

2.5.2 Information to be clarified

Detail information regarding pump duty points and top water levels of reservoirs in Stellenbosch (pump information), Dwars River (reservoir information and pump information), Raithby (pump information) Koelenhof (pump information) and Polkadraai (reservoir information) should be clarified.

2.5.3 Data integrity

If this report is noted to have any discrepancies compared to alternative information, GLS should be contacted in this regard to ensure that the relevant sections of the system are verified in an attempt to continuously improve the data integrity.

Table SW2.1(a): Existing water system summary - Pipes

Table SW2.1(b): Existing water system summary - Reservoirs and Water Towers

Table SW2.1(c): Existing water system summary - Pumps3

Table SW2.1(d): **Existing water system summary - Pressure reducing valves4**

Table SW2.2: Existing water system zone AADD's5

Figure SW2.1(a): Existing water system layout - Stellenbosch9

Figure SW2.1(b): Existing water system layout - Dwars River & Meerlust10

Figure SW2.1(c): Existing water system layout - Franschhoek11

Figure SW2.1(d): Existing water system layout - Klapmuts12

Figure SW2.1(e): Existing water system layout - Raithby, Faure, Helderberg & Croydon13

Figure SW2.1(f): Existing water system layout - Polkadraai14

Figure SW2.1(g): Existing water system layout - Koelenhof & Muldersvlei15

Figure SW2.2(a): Existing distribution zones - Stellenbosch16

Figure SW2.2(b): **Existing distribution zones - Dwars River & Meerlust17**

Figure SW2.2(c): Existing distribution zones - Franschhoek18

Figure SW2.2(d): Existing distribution zones - Klapmuts19

Figure SW2.2(e): Existing distribution zones - Raithby, Faure, Helderberg & Croydon20

Figure SW2.2(f): Existing distribution zones - Polkadraai21

Figure SW2.2(g): Existing distribution zones - Koelenhof & Muldersvlei22

3. PRESENT LAND USE AND WATER DEMAND

3.1 METHODOLOGY

The SWIFT program is a link between treasury billing data, and water/sewer network models. (The name is derived from "***S****ewer* ***W****ater* ***I****nterface* ***F****or* ***T****reasury systems*"). The program was used to analyse the present land use and water demand situation in Stellenbosch, as well as the projected potential water demand for a fully occupied existing system.

3.2 SWIFT ANALYSIS

A SWIFT analysis was conducted as part of this investigation. The Stellenbosch Municipality has a SAMRAS treasury system, with a single treasury system for all the towns in the Municipal area. A data extraction routine for SWIFT was compiled as part of this investigation and will remain a standard part of the SAMRAS software suite in future.

The treasury records for the period July 2018 to June 2019 were used as the base information for the analysis.

3.3 LAND USE

With cognizance of the limited land use and zoning codes maintained in the treasury system being operated by the Stellenbosch Municipality, the following land use categories were identified for this study:

- BUS_COMM - Business/Commercial
- CLUSTER - Town houses
- EDU - Educational
- FARM_AH - Farm/Agricultural holding
- FLATS - Flats
- GOVT_INST - Government/Institutional/Municipal
- IND - Industrial
- OTHER - All other categories
- PARKS - Parks
- RES - Residential stands
- UNKNOWN - All stands where the category of the land use code is unclear

In order to account for the effect of stand size on residential water demand, the RES category is further subdivided into five sub-categories, based on stand size, as follows:

- RES 500 - smaller than 250 m²
- RES 500 - 250 m² to 500 m²
- RES 1 000 - 500 m² to 1 000 m²
- RES 1 500 - 1 000 m² to 1 500 m²
- RES 2 000 - 1 500 m² to 2 000 m²
- RES > 2 000 - larger than 2 000 m²

The LARGE category is required to remove these special water consumers from their regular land use category, so as to prevent them from skewing the statistics for the specific category and to detach them from any theoretical unit water demand's (UWD's) that might not be applicable to them. The large water users are discussed later in this Chapter.

3.4 DISTRIBUTION ZONES AND ZONAL METER READINGS

3.4.1 General Description

Distribution zones are defined in Section 1.4 of this report.

No zonal meter readings are available for Stellenbosch. Table SW3.1 lists the total bulk water meter readings as obtained from the Municipality which represents the water supplied to the entire Stellenbosch.

3.5 INFORMAL SETTLEMENTS

The treasury data does not contain any information on informal settlements in the study area.

The following informal settlements were reported to be present in the 2011/12 Water Services Development Plan (performed by WorleyParsons for the Stellenbosch Municipality) dated June 2011:

- 8 235 households in Stellenbosch (Kayamandi)
- 226 households in Jamestown
- 1 635 households in Franschhoek (Langrug and Mooiwater area)
- 30 households in Dwars River (Kylemore and rural area)
- 256 households in Klapmuts

These settlements receive water from a number of unmetered stand pipes.

3.6 SWIFT RESULTS AND RESULTING WATER DEMANDS

3.6.1 Suburb-by-suburb land use and water use statistics

All available treasury data in Stellenbosch was analysed with the SWIFT program, in order to determine (for each stand/meter record) the suburb, the land use, whether it is occupied or vacant, its AADD and total annual water demand (TWD) for the base year. This information was then totalised and summarised by SWIFT per suburb, and broken down into the various land use categories. Average unit water demands (ℓ/stand/d) were also determined for each land use category in each suburb. The results are summarised in Table SW3.2.

Figure SW3.1 shows all the stands coloured in accordance with their land use according to the SWIFT analysis.

3.6.2 Distribution zone land use and water use statistics

Each stand/record was linked or associated via GIS to its specific distribution zone(s) and the same totals and summaries as above were produced per distribution zone and were also broken down into the various land use categories. In this way the TWD per distribution zone was determined. The results are summarised in Table SW3.2.

3.6.3 Unaccounted-for-water

The total water inputs for each area were compared with the total water sales, which resulted in UAW figures of 30% for Stellenbosch town, 50% for the Dwars River area, 32% for the Greater Franschhoek area, 20% for Klapmuts, 32% for Faure, 28% for Polkadraai, 28% for Muldersvlei, 26% for Meerlust and 21% for Helderg and Croydon. The results are summarised in Table SW3.3.

The global UAW of 24 % should be able to be reduced by implementing a Water Demand Management Programme.

3.6.4 Rationalized ("theoretical") unit water demands

The UWD's per land use in each suburb were rationalised into rounded-up "theoretical" values. These values were calibrated by applying them to the total number of occupied stands in each land use category of each suburb, and comparing the resultant "theoretical" total water demand (excluding UAW) for each suburb with the actual water demand (excluding UAW) for the suburb. The results are summarised in Table SW3.4.

3.6.5 Rationalized ("theoretical") UAW

For planning and evaluation purposes, the UAW Figures were also rationalised on a regional (wider-area) basis, as allowed by the sensibility of the results. After allowance was made for unmetered informal areas in the area, an UAW figure of 34% for Stellenbosch town, 33% for the Dwars River area, 37% for the greater Franschhoek area, 27% Klapmuts, 20% for Raithby, 20% for Faure, 20% for Polkadraai, 20% for Koelenhof, 20% for Muldersvlei, 37% for Meerlust and 20% for Helderg and Croydon were applied for modelling purposes of the existing system.

For modelling purposes of the future system, an UAW figure of 30% for Stellenbosch town, 30% for the Dwars River area, 30% for the greater Franschhoek area, 20% Klapmuts, 20% for Raithby 20% for Faure, 20% for Polkadraai, 20% for Koelenhof, 20% for Muldersvlei, 30% for Meerlust and 20% for Helderg and Croydon were applied.

3.6.6 Theoretical present water demand

The rationalised UWD's and UAW's were applied to all the stands in each land use category of each suburb, as a "theoretical" model of the present water demand situation. For calibration, the resultant "theoretical" total water demand (inc. UAW) for each suburb was compared with the actual water demand (inc. UAW) for the suburb. The results for the formal areas are summarised in Table SW3.4.

3.6.7 Potential land use and AADD of existing developments

The SWIFT program determines the total number of vacant stands in each land use category for each suburb and each distribution zone. These vacant stands do not contribute to the present water demand calculations (actual or theoretical) as described above. However, the SWIFT program also determines from treasury data what the land use or zoning rights of vacant stands might be. The rationalised theoretical UWD's and UAW's can therefore also be applied to these vacant stands in order to determine their potential water demand, should they become developed/occupied.

The theoretical present water demand model was therefore extended in SWIFT to include all vacant stands and a potential fully occupied present water demand (inc. UAW) for each suburb and distribution zone in Stellenbosch was determined. The results are summarised per suburb in Table SW4.2.

3.7 LARGE WATER USERS

Table SW3.5 is a list of the stands defined as large users in SWIFT for Stellenbosch Municipality. The table shows the 50 largest users sorted per demand. The tabulated information for each user (e.g. owner, consumer, address) is unchanged as recorded in the treasury system.

The water demand for each of the large users recorded in the treasury database is interrogated by SWIFT. The AADD calculated by SWIFT for each large user is used to calculate the peak flow for the relevant consumer. The location of each large user is identified uniquely in view of its demand in the water system model. The 50 largest users in the Stellenbosch Municipality (including rural consumers supplied from the rural water schemes) have a total AADD of 6 902 kℓ/d (excluding UAW), representing ± 25% of all water sold in the Stellenbosch Municipality water system.

3.8 RURAL AREAS

In the SM rural areas each stand/farm has an assigned water use allocation. However some of this information was not available for this study.

Table SW3.6 is a list of all the water users in the urban areas, and where available their water use allocation.

Table SW3.1: Bulk water input6

Table SW3.2: Actual water use per suburb and land use (SWIFT result)7

Table SW3.3: UAW analysis summary8

Table SW3.4: Theoretical water use per suburb and land use (SWIFT result)9

Table SW3.5: Large water users (50 largest users)10

Table SW3.6: Rural water scheme allocations11

Figure SW3.1(a): Land use per stand - Stellenbosch23

Figure SW3.1(b): Land use per stand - Dwars River & Meerlust24

Figure SW3.1(c): Land use per stand - Franschhoek25

Figure SW3.1(d): Land use per stand - Klapmuts26

Figure SW3.1(e): Land use per stand - Raithby, Faure, Helderberg & Croydon27

Figure SW3.1(f): Land use per stand - Polkadraai28

Figure SW3.1(g): Land use per stand - Koelenhof & Muldersvlei29

Figure SW3.2(a): Location of large water users - Stellenbosch30

Figure SW3.2(b): Location of large water users - Dwars River & Meerlust31

Figure SW3.2(c): Location of large water users - Franschhoek32

Figure SW3.2(d): Location of large water users - Klapmuts33

Figure SW3.2(e): Location of large water users - Raithby, Faure, Helderbg & Croydon34

Figure SW3.2(f): Location of large water users - Polkadraai35

Figure SW3.2(g): Location of large water users - Koelenhof & Muldersvlei36

4. FUTURE LAND USE AND WATER DEMAND

4.1 FULL OCCUPATION OF EXISTING DEVELOPMENTS

For the future land use and water demand scenario the potential future developments for the area were taken into account (these areas are information supplied by the Planning Directorate of Stellenbosch Municipality).

It was thus not only assumed that all existing but vacant stands in the treasury data would become “occupied”, i.e. start using water (as for the existing system), but also that these potential future developments would materialise and start using water.

4.2 POTENTIAL FUTURE LAND DEVELOPMENTS AND WATER DEMAND

The potential areas for future developments were identified in consultation with the Planning Directorate of Stellenbosch Municipality. Each potential area was assigned an anticipated predominant land use, and will be phased in over a 20-year period.

The potential future land developments are shown on Figure SW4.1, coloured according to the land use.

Typical UWD’s (per ha or per stand/unit) were estimated for the potential future areas based on previous experience and statistics obtained from the SWIFT analysis of the present water demands.

4.3 FUTURE WATER DEMAND

The future AADD of the Stellenbosch system is summarised in Table SW4.2. The future AADD (modelled as the future system) represents an increase of ± 116% over the actual present AADD, and an increase of ± 73 % over the potential fully occupied present AADD.

Table SW4.1: Potential future land developments12

Table SW4.2: Present and future water demand summary13

Table SW4.3: Potential future developments for rural areas14

Figure SW4.1(a): Potential future developments - Stellenbosch37

Figure SW4.1(b): Potential future developments - Dwars River & Meerlust38

Figure SW4.1(c): Potential future developments - Franschhoek39

Figure SW4.1(d): Potential future developments - Klapmuts40

Figure SW4.1(e): Potential future developments - Raithby, Faure, Helderberg & Croydon41

Figure SW4.1(f): Potential future developments - Polkadraai42

Figure SW4.1(g): Potential future developments - Koelenhof & Muldersvlei43

5. EVALUATION AND PLANNING CRITERIA

5.1 WATER DEMANDS AND PEAK FACTORS

5.1.1 Planning

The major objectives pursued in the evaluation and planning of the water supply system as presented in this report can be summarised as follows:

- Establishing a model of the water network that accurately reflects the existing system.
- Detailed water demand analysis based on data in the treasury system.
- Conformity with operational requirements and criteria adopted for this study.
- Optimal use of existing facilities with excess capacity.
- Optimisation of the system with regards to capital -, maintenance - and operational cost.

The future system planning was done so as to satisfy the future water demands. The future AADD of the study area is anticipated to be 80 805 kℓ/d. This AADD will be realised in the year ± 2038 if the demand increases at a compound growth rate of ± 4,0 % per year.

5.1.2 Present and future AADD's

Existing systems were evaluated on the basis of the existing AADD as documented, including UAW.

For planning of future systems it was accepted that all existing vacant stands are occupied and are using water in accordance with the assumed UWD's, and AADD's of all potential future developments were added.

5.1.3 Peak factors

The peak factors used for this study are dependent on type of land use in the area under consideration, and the magnitude of water demand in the area, and are summarised in Table SW5.1.

These peak factors are based on factors measured and obtained from other previous studies in South Africa.

5.2 OPERATIONAL CRITERIA

5.2.1 Maximum and minimum pressures

The pressure criteria used for the evaluation and planning of the reticulation networks are listed in Table SW5.2.

5.2.2 Fire fighting flows

Fire fighting flow and pressure criteria are listed in Table SW5.2. The requirements are more or less in conformity with those prescribed by the so-called "Red Book" (Guidelines for Human Settlement Planning and Design - Dept. of Housing, August 2003).

5.2.3 Flow velocities

Flow velocities must be limited in order to protect pipeline coatings and reduce the effects of water hammer. The preferred maximum allowed is 1,8 m/s, but an absolute maximum of 2,2 m/s is acceptable where only intermittent peak flows occur.

5.2.4 Pump stations

Pump stations should always have one standby pump available. An electrically driven standby pump should suffice except in the case of high-risk areas, where the standby pump should be diesel-driven.

5.2.5 Redundancy

Within distribution networks to end-users, branched systems should be avoided as far as possible, i.e. there must be at least two directions of flow to a consumer. For bulk supply systems branched portions may be acceptable, due to the role of reservoirs, and redundancy refers more to the level of integration in the system.

5.3 RESERVOIR SUPPLY RATES AND STORAGE CAPACITIES

Reservoirs in the system serve two main functions:

- Emergency storage, including that required for fire fighting, to provide sufficient water when a supply failure occurs.
- Balancing storage, required to balance out peaks in the demand.

For initial assessment of reservoir size these two functions are viewed integrally. The criteria for total reservoir volume used in this study for evaluation and planning is 48 hours of the AADD (of the reservoir supply zone) for Stellenbosch town, the Greater Franschhoek area, Klapmuts, Raithby, Faure, Polkadraai, and Koelenhof for gravity and pumped supply to the reservoir. It is noted that this could represent as little as 20 to 25 hours’ storage of the peak day demand for high-peak consumers.

Reservoir storage criteria of 72 hours x AADD was, however, adopted for the Dwars River area. This was due to the fact that water supply to the area is from one source, annual routine maintenance on the Wemmershoek WTP causes water supply to be interrupted by as long as 48 hours and all the water is pumped at least twice and in certain areas even three times, which means the security of the water supply is highly dependent on the security of electricity supply. Sporadic power outages have caused the need for larger emergency storage volumes for this area.

It should, however, be noted that many of the abovementioned reasons for a higher storage criteria for the Dwars River area also applies to the water systems of Klapmuts the greater Franschhoek area and Koelenhof. It could therefore also be considered to increase the criteria for these areas in future planning.

The volume required for the balancing function is dependent on the supply rate to the reservoir and is therefore closely related to the capacity of the feeder main to the reservoir.

In some cases where capacity appears to be a problem the relationship between balancing storage in a reservoir and the supply to the reservoir is dealt with as follows in order to optimise the system by means of time simulation:

- For new reservoirs, the optimum combination of supply rate and balancing volume was determined.
- For existing reservoirs, any excess capacity was utilised as balancing storage, in order to minimise the required supply rate and thus also the load on the system supplying the reservoir.
- For existing reservoirs with limited capacity for balancing, an economic analysis was done in order to determine whether to increase the supply rate to the reservoir so that the balancing load is minimised, or whether to increase the storage capacity.

Balancing storage is an analytical exercise based on time simulation, but in contrast the emergency storage is a matter of perception and subjective assessment of the risk of non-supply of water. It is often not necessary to provide more than 30 h x AADD emergency storage in a reservoir (in addition to balancing storage), unless there are specific conditions or risks to justify a larger storage.

These criteria are summarized in Table SW 5.3.

The risk of interruption of bulk water supply to Dwars River, La Motte, Wemmershoek, Klapmuts, Raithby and Koelenhof is relatively high due to the fact that it is supplied mainly from one source and that it has a relatively long pipeline between that source and the town. The 30 h x AADD that was provided as emergency storage in the reservoirs for the greater Franschhoek area, Klapmuts and Raithby and the 54 h x AADD for the Dwars River area should, however, be sufficient.

5.4 WATER TOWER SUPPLY RATES AND STORAGE CAPACITIES

One water tower is present in the existing system of Stellenbosch viz. the Cloetesville water tower.

Water towers serve merely to sustain pressure in a network, and should not be regarded as facilities for balancing peaks and for emergency supply. Because of their relatively small volumes, the supply rates to towers must be such that they can be kept full at all times. On the other hand, volumes must be large enough to allow room for operation of pumps filling the tower (where applicable) such that the number of pump cycles per day is limited. The following guidelines as summarised in Table SW5.3 were used for evaluation and planning of water towers:

- Supply rate into tower - 1,0 to 1,1 x PHF x AADD
- Tower storage - 2 h to 6h x AADD

5.5 OPTIMAL USE OF EXCESS CAPACITIES IN EXISTING FACILITIES

Many existing facilities may have excess capacity when measured in terms of the operational criteria described above. In the planning done for this study it was strived to utilise the excess capacities in existing facilities to its economically viable maximum.

5.6 ECONOMIC OPTIMISATION AND COST FUNCTIONS

All the strategic and technical alternatives studied were compared on mainly economic grounds, with a view to establishing a "master plan" which will result in the lowest present value of capital works, operations and maintenance.

The cost functions for cost estimates, cost comparisons and economic optimisation in general, are presented in Table SW5.4.

It should be noted that the proposed pipeline routes are indicated schematically on the Master Plan and that no detail topographical or geotechnical surveys have been conducted to verify these routes. The detail assessment of the routes are thus beyond the scope of this report and should be performed in the preliminary design stage during implementation. A variance of the cost estimates could therefore be experience typically due to the presence of hard rock in the substrata along the pipeline route, existing services of which the crossings appear to be problematic or for which ever reason the pipeline route has to be lengthened.

Table SW5.1: Design and evaluation criteria - Peak factors for water demand15

Table SW5.2: Design and evaluation criteria - Flow and pressure16

Table SW5.3: Design and evaluation criteria - Reservoirs and bulk supply17

Table SW5.4: Cost Functions18

6. EVALUATION AND MASTER PLAN

6.1 EXISTING SYSTEM

6.1.1 Overview

The results of the existing system analysis are presented in the following figures:

- Figure SW6.1 shows the static pressures in each system, thus the maximum pressure that could be expected in the system at any time.
- Figure SW6.2 shows the residual pressures in each system under peak hour demand conditions.
- Figure SW6.3 shows the flow velocity in each system under peak hour demand conditions.

6.1.2 Discussion

Stellenbosch town

The static analysis indicates no areas in the network where pressures are below 24 m. Pressures in the lower lying area of the Brandwacht and Central zones, the supply pipelines from the Paradyskloof 1 reservoir network to Jamestown and to the Papegaaiberg reservoir and the supply pipeline from the Uniepark 2 reservoir to Cloetesville are however above 90 m. This is not a concern due to the fact that the pressures are only marginally above 90 m and it is a relatively small area where these high pressures are experienced.

The residual pressures in the existing system under peak hour demand conditions are mainly in the 24 m to 90 m range, except for the higher lying areas of the Mosterdsdrif suburb in the Central zone, the higher lying areas of the Idas Valley suburb in the Uniepark 1 and Idas Valley 2 reservoir zones, the higher lying areas in the Papegaaiberg and Jamestown reservoir zones and some areas in the Kayamandi suburb in the Kayamandi reservoir and Kayamandi PRV 1 to 4 zones, where the pressures are below 24 m.

There are a few pipes which have a velocity under peak hour demand conditions which exceeds 1,5 m/s. The most significant of these are the 300 mm Ø and 250 mm Ø supply from the Idas Valley reservoir to the Central zone, the 350 mm Ø main supply from the Rozendal reservoir to the Central zone, a 200 mm Ø pipe supplying the Mosterdsdrif suburb in the Central zone, the 450 mm Ø supply pipe from the Paradyskloof 1 reservoir to Papegaaiberg reservoir when flow is uncontrolled at the Papegaaiberg reservoir inlet, the 125 mm Ø supply from the Kleinvallei reservoir to the Kleinvallei PRV zones when flow is uncontrolled at Kleinvallei BPT, the 315 mm Ø supply to Cloetesville reservoir and some pipes in the Kayamandi reservoir and PRV zones. The 375 mm Ø rising main between the Idas Valley pump station and Uniepark reservoirs and the 200 mm Ø rising main between the Kleinvallei pump station and Kayamandi reservoir have flow velocities above 1,5 m/s when both pumps of the respective pump stations are running. The velocities in these pipes are all between 1,5 and 2,0 m/s except for a few pipes in the Kayamandi reservoir and PRV zones which exceeds 2,5 m/s. The relatively small diameters of the main supply pipelines in Kayamandi causes high velocities, low residual pressures and resulting water supply problems.

Dwars River

The static analysis indicates no areas in the network where pressures are below 24 m apart from the higher lying areas in the Pniel Upper zone. Pressures in the lower lying areas of the Pniel Lower and Lanquedoc zones are however above 90 m. This is not a concern due to the fact that the pressures are only marginally above 90 m and it is a relatively small area where these high pressures are experienced.

The residual pressures in the existing system under peak hour demand conditions are mainly in the 24 m to 90 m range, except for the Kylemore Lower and Upper zones and the higher lying areas of the Pniel Upper zone, where the pressures are below 24 m.

The only pipes with flow velocities exceeding 1,5 m/s in the system are the main 100 mm Ø supply pipes from the Kylemore Lower reservoir to the Kylemore Lower zone and from the Kylemore Upper reservoir to the Kylemore Upper zone. Due to the high velocities under peak hour water demands in these pipes, large pressure losses are experienced and therefore the low pressures in these zones. The relatively small diameter of these main supply pipelines therefore causes high velocities, low residual pressures and resulting water supply problems.

Franschhoek

The static analysis indicates no areas in the network where pressures are below 24 m apart from the higher lying areas in the Langrug zone and the La Avenue booster and Southern booster zones when the pumps are not operational, where the pressures are below 24 m. Pressures in the lower lying areas of the Fransche Hoek Estate Lower PRV zones are above 90 m as well as the lower lying areas in the Franschhoek reservoir zone.

The residual pressures in the existing system under peak hour demand conditions are mainly in the 24 m to 90 m range, except for the higher lying areas of the Langrug zone and the supply pipeline to the Southern booster zone where the pressures are below 24 m and the higher lying areas in the La Avenue booster zone.

The only pipes with flow velocities exceeding 1,5 m/s in the system are the 100 mm Ø supply pipe to the Bagatelle (Onder Dorp) reservoir, the 300 mm Ø pipe from the CoCT's Wemmershoek line draw off point to the Wemmershoek booster pump stations and the 250 mm Ø bulk supply pipe the La Motte booster pump stations to the Groendal reservoir. The velocity in these pipes are between 1,5 and 2,0 m/s.

Klapmuts

The static analysis indicates no areas where pressures exceed 90 m.

The residual pressures in the existing system under peak hour demand conditions in the higher lying areas east of the reservoirs experience pressures below 24m, however this is not a concern as it is only slightly below 24 m.

The 200 mm Ø supply pipe from the CoCT's Wemmershoek line to the Klapmuts Lower reservoir as well as the 200 mm Ø rising main from the Lower reservoir to the upper reservoir experience velocities exceeding 1,5 m/s. The network 200 mm Ø and 250 mm Ø supply pipes from the upper reservoir also experience velocities exceeding 1,5 m/s.

Raithby

The static analysis indicates no areas where pressures exceed 90 m. When the booster pump is not operational, the pressure in the higher lying areas of the Raithby booster zone are below 24 m.

The residual pressures in the existing system under peak hour demand conditions in the higher lying areas of Raithby are below 24 m.

There are no pipes with velocities exceeding 1,5 m/s in the system.

Faure system

The static analysis indicates no areas where pressures exceed 90 m.

The residual pressures in the existing system under peak hour demand conditions reach near 70 m in the lower lying areas.

There are no pipes with velocities exceeding 1,5 m/s in the system.

Polkadraai system

The static analysis indicates pressures of almost 90 m in the lower lying areas of the Skoonheid reservoir zone.

The residual pressures in the existing system under peak hour demand conditions reach below 24 m in the Skoonheid PRV 2 zone.

A section of pipe in the Skoonheid PRV 2 zone experiences flow velocities exceeding 1,5 m/s under peak demand conditions.

Koelenhof system

The static analysis indicates that the lower lying areas in the Koelenhof system experience pressures exceeding 90 m.

The residual pressures in the existing system under peak hour demand conditions in the higher lying areas, towards Elsenburg pump station and to the South West edge of the network experience pressures below 24m.

The 225 mm Ø supply pipe from the CoCT's Wemmershoek line to the Koelenhof reservoir experience velocities exceeding 1,5 m/s.

Muldersvlei system

The static analysis indicates no areas where pressures exceed 90 m.

The residual pressures in the existing system under peak hour demand conditions are within the range of 24 m to 90 m.

There are no pipes with velocities exceeding 1,5 m/s in the system.

Meerlust

The static analysis indicates no areas where pressures exceed 90 m.

The residual pressures in the existing system under peak hour demand conditions are within the range of 24 m to 90 m.

There are no pipes with velocities exceeding 1,5 m/s in the system.

Helderberg & Croydon

The static analysis indicates no areas where pressures exceed 90 m.

The residual pressures in the existing system under peak hour demand conditions are within the range of 24 m to 90 m.

There are no pipes with velocities exceeding 1,5 m/s in the system.

6.1.3 Replacement value

Table SW6.1 gives an estimate of the replacement value of the existing Stellenbosch system, based on the cost functions shown on Table SW5.4.

6.2 EXISTING BULK SUPPLY SYSTEM

Table SW6.2 is a summary of the reservoir and feeder evaluation of the existing system. For each reservoir it shows:

- The potential present AADD of the zone(s) served by the reservoir, which might include a PRV or booster zone.
- The volume of the reservoir, in relation to the AADD served by the reservoir (expressed as h x AADD). The available balancing volume is the total volume minus the required 30 h x AADD emergency volume (except for the Dwars River area where the required emergency volume is 54 h x AADD). If this is more than 18 h x AADD, the surplus is regarded as "spare" capacity.
- The feeder mains to the reservoir, and their capacities expressed as a ratio of the AADD served by the reservoir. Feeder main capacities have been estimated based on a maximum flow velocity of 1,8 m/s, and not on the actual hydraulic capacity. The required flow of feeder mains is also listed, based on the amount of balancing storage available, and the peak factors and pattern of demand in the reservoir zone. Where the feeder capacity exceeds the required flow, a "spare" capacity is indicated. Feeder mains with a negative "spare" capacity are deficient.

6.2.1 Reservoirs

Evaluated on a town-for-town basis, Stellenbosch, Dwars River, Franschhoek, Raithby Polkadraai and Koelenhof all have insufficient reservoir storage in some of their zones and requires additional storage. Dwars River, Franschhoek, Klapmuts, Polkadraai and Koelenhof are the only areas where the overall storage for the area is sufficient.

In Stellenbosch the zones with insufficient storage are the Cloetesville, Central, Papegaaiberg, and Jamestown zones. The Papegaaiberg zone can be supplied through 2 x PRV's from the Paradyskloof 1 zone as well, and it can be reasoned that the spare capacity in the Paradyskloof 1 reservoir could be utilized for the storage deficit in the Papegaaiberg zone. In the Uniepark reservoirs there is spare capacity that could be utilized for the storage deficit in the Cloetesville zone.

In the Dwars River area there is a storage deficit at the Pniel Upper, Pniel Lower and Lanquedoc zones. In the case of the Lanquedoc zone, there is no reservoir for the zone as it is supplied directly from the bulk system. The new Kylemore reservoirs are currently under construction to provide adequate storage capacity for the area.

In the greater Franschhoek area the reservoirs with insufficient storage are La Motte, Wemmershoek, Groendal and Langrug. The new Franschhoek reservoir however has ample spare capacity.

In Klapmuts the Klapmuts New (Lower) reservoir has sufficient capacity to supply the Klapmuts area.

In Raithby the Raithby reservoir and booster zones have insufficient storage capacity.

Faure does not have its own reservoir storage capacity, water is supplied directly from the CoCT's Faure Reservoirs.

Polkadraai's Skoonheid reservoir has insufficient storage capacity.

6.2.2 Feeder mains

In Stellenbosch the 150 mm Ø feeder main between the Cloetesville tower and the Cloetesville pump station requires upgrading.

When all the supply to the Papegaaiberg reservoir is supplied from the Idas Valley WTP through the Central zone, the 225 mm Ø supply pipe to the reservoir does not have sufficient capacity. The capacity is however sufficient if the supply is augmented from the Paradyskloof 1 reservoir through the 450 mm Ø supply pipe.

When all the supply to the Kayamandi reservoir is supplied from the Papegaaiberg reservoir via the Kleinvallei reservoir, the 200 mm Ø rising main between the Papegaaiberg Old pump station and the Kleinvallei reservoir does not have sufficient capacity. The capacity is however sufficient if the supply is augmented from the Papegaaiberg new pump station and rising main or from the Kayamandi pump station and 2 x 150 mm Ø rising mains.

In Franschhoek the 110 mm Ø raw water supply pipe from the Perdekloof source in the mountains to the batch plant next to the Fransche Hoek Lower reservoir has insufficient capacity to supply water to the eastern zones of Franschhoek during peak demand conditions.

6.2.3 Pumping stations

The capacity of the Papegaaiberg Old pump station was recently augmented with the Papegaaiberg New pump station, which has sufficient capacity to supply the entire Kayamandi zone with water during peak demand conditions.

In the Dwars River area the Kylemore pump station is presently at capacity and requires upgrading shortly, the construction of a new pump station is currently under way along with the new reservoirs construction in Kylemore.

In the greater Franschhoek area the the Langrug pump station are presently at capacity and require upgrading.

6.3 MASTER PLAN – STELLENBOSCH TOWN

6.3.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4a.

The changes to the existing distribution zones are the following:

- The Kayamandi reservoir and Kayamandi PRV zones are increased to include future development areas S10 to S14, S16 & S18.
- A new Kayamandi Upper reservoir and PRV zones are proposed to accommodate future development areas S15 & S17. These zones should be supplied from a new reservoir with a TWL of 245 m and the setting of the PRV's for the PRV zone should be 30 m (Energy grade line (EGL) of 200 m).
- Two new booster zones are proposed in Kayamandi for the future system, viz. the new Kayamandi Lower booster zone for future development area S82 and the new Kayamandi Upper booster zone for the higher lying future development area S81. It is proposed that an emergency connection is made between the proposed Kayamandi Upper reservoir zone and the Kayamandi Lower booster zone to supply the booster area with lower pressures when the booster pumps are not operational.
- The boundaries of the Cloetesville reservoir zone are increased to include future development areas S1 to S3.
- New Nietvoorbij reservoir and PRV zones are proposed to accommodate future development areas S19 & S20. These zones should be supplied from a new reservoir

with a TWL of 200 m and the setting of the PRV's for the PRV zone should be 35 m (EGL of 180 m).

- Rezoning of the existing Uniepark 1 network is proposed in order to implement the Uniepark 1 PRV zone.
- A new Mountain Retreat reservoir zone is proposed to accommodate future development area S33.
- A removal of the old Arbeidslus PRV 1 and a new Arbeidslus PRV 1 installation to accommodate area S31. A new Arbeidslus PRV 2 to accommodate area S30.
- The boundaries of the existing Papegaaiberg zone are increased to accommodate future development areas S44 to S51, S55 and the lower lying erven of future areas S43, S57 & S58.
- The boundaries of the existing Paradyskloof 1 zone are increased to accommodate future development areas S56, S59, S60, S63, S64, S73, the lower lying erven of future areas S65 & S67 and the higher lying areas of future areas S57 & S58.
- A PRV is installed in the lower parts of the Paradyskloof 1 zone in order to lower the pressures in the lower parts of the zone.
- The boundaries of the existing Paradyskloof 2 reservoir zone are increased to accommodate the lower lying erven of future area S66 and a portion of future area S67.
- The boundaries of the existing Brandwacht reservoir zone are increased to accommodate the higher lying erven of future areas S66 & S67.
- A new Jamestown Upper Reservoir zone is proposed to accommodate future area S79. It is proposed that this zone is supplied from the Paradyskloof 2 reservoir through the proposed bulk supply pipeline to the new Jamestown reservoir.
- The boundaries of the existing zones are increased to accommodate future development areas.

6.3.2 Proposed future system and required works

The existing Stellenbosch water distribution system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

The proposed master plan items are presented in Figure SW6.5a.

A few distribution pipelines are required to reinforce water supply within the Stellenbosch distribution network.

New distribution pipelines are proposed to supply future development areas with water when they develop.

A new supply pipe from the proposed Jamestown 7 Mℓ reservoir to the existing Jamestown network is proposed with a non-return valve to prevent inflow from the proposed higher lying reservoir to the existing reservoirs.

Pressure reducing valves and rezoning of the existing system are proposed in order to implement the Central & Uniepark 1 PRV zones.

Emergency connections between the proposed Nietvoorbij PRV and the existing Cloetesville reservoir zones, between the Kayamandi Upper reservoir and Kayamandi Lower booster zones are proposed in order to improve redundancy in the system.

6.3.3 Bulk System

The existing bulk water supply system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

Table SW6.5 is a summary of the reservoir and feeder evaluation of the future system for the future water demand.

<u>Reservoirs</u>

The following new reservoirs will be required in future.

- A new 7,0 Mℓ reservoir (Top water lever (TWL) = 180 m) is proposed at Jamestown to augment reservoir storage for the Jamestown reservoir and booster zones.
- A new 1,5 Mℓ reservoir is proposed at the existing Paradyskloof 2 reservoir site to augment reservoir storage in the Paradyskloof 2 reservoir and PRV zones.
- A new 7,0 Mℓ reservoir is proposed at the existing Cloetesville reservoir site to augment reservoir storage in the Cloetesville reservoir and tower zones.
- A new 3,0 Mℓ Nietvoorbij reservoir (TWL = 200 m) is proposed for the proposed Nietvoorbij reservoir and PRV zones.
- A new 10,0 Mℓ reservoir is proposed at the existing Rosendal reservoir site to augment reservoir storage for the Central zone.
- A new 0,5 Mℓ Mountain Retreat reservoir (TWL = 400 m) is proposed for the proposed Mountain Retreat zone (the cost of the storage capacity is for the account of the private development).
- A new 7,0 Mℓ reservoir is proposed at the existing Papegaaiberg reservoir site to augment reservoir storage in the Papegaaiberg reservoir zone.
- A new 6,0 Mℓ Kayamandi Upper reservoir (TWL = 245 m) is proposed for the proposed Kayamandi upper reservoir, booster and PRV zones.
- A new 1,5 Mℓ reservoir is proposed at the existing Brandwacht reservoir site to augment reservoir storage in the Brandwacht reservoir zone.

<u>Feeder mains</u>

The following new feeder mains will be required in future:

- New 315 mm Ø supply pipe between the existing Jamestown reservoirs and the proposed 7,0 Mℓ Jamestown reservoir to supply the new reservoir (item SSW.B5).
- New flow-control valve at the inlet of the Paradyskloof 2 reservoir in order to control flow into the reservoir from the Paradyskloof WTP (item SSW.B7).
- New 355 mm Ø supply pipe between the existing Idas Valley pump station and the Uniepark 2 reservoir (item SSW.B11).
- New 200 mm Ø supply pipe to the proposed Nietvoorbij reservoir with a flow-control valve at the reservoir inlet in order to control flow into the reservoir (items SSW.B16 & B17).
- New dedicated 600/450 mm Ø bulk supply pipe from the Idas Valley 2 reservoir to Papegaaiberg reservoir (item SSW.B20).
- New flow-control valve at the inlet of the Kayamandi sump in order to control flow into the sump and sustain the pressure in the Central network (item SSW.B22).
- New 355 mm Ø supply pipe between the existing Papegaaiberg pump stations and the Kleinvallei reservoir (item SSW.B24).
- New 315 mm Ø supply pipe to the proposed Kayamandi Upper reservoir (item SSW.B30).
- New 110 mm Ø supply pipe to the proposed Mountain Retreat reservoir (item SSW10.2, the cost of the feeder main is for the account of the private development).

The following feeder mains require upgrading in future:

- New 600 mm Ø parallel reinforcement of the existing 400/300 mm Ø bulk supply pipeline from the Paradyskloof WTP to the Paradyskloof 1 reservoir with a flow-control valve at the reservoir inlet in order to augment supply to the reservoir and control flow into the reservoir (items SSW.B8 & B9).

<u>Pumping stations</u>

The following new/upgrading to existing pump stations will be required in future:

- Upgrading of the Idas Valley pump station to improve redundancy (item SSW.B10).
- It is proposed that the capacity of the existing Cloetesville tower pump station is investigated (item SSW.B15).
- New Papegaaiberg pump station when existing supply to Kleinvallei reservoir reaches capacity (item SSW.B23).
- Decommission existing Papegaaiberg old pump station when item SSW.B23 is implemented (item SSW.B25).
- New Kleinvallei pump station when existing supply to Kayamandi reservoir reaches capacity (item SSW.B26).
- New Kayamandi Upper pump station when the Kayamandi Upper reservoir is constructed (item SSW.B29).
- New Mountain Retreat pump station (item SSW10.1, the cost of the pump station is for the account of the private development).
- New Kayamandi Upper booster pump station (item SSW20.1).
- New Kayamandi Lower booster pump station (item SSW21.1).

6.3.4 Cost estimates of future works

The cost estimates for the proposed future reinforcements to the Stellenbosch system are summarised in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The proposed projects with the highest priority in Stellenbosch are included in Table SW6.4c.

6.4 MASTER PLAN - DWARS RIVER

6.4.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4b.

The changes to the existing distribution zones are the following:

- A new Pniel PRV zone is implemented in the lower lying areas of the existing Pniel lower zone.
- The boundaries of the existing reservoir zones are increased to accommodate future development areas in the Dwars River area.
- The boundaries between the Kylemore Lower and Upper zones are adjusted.
- A new Boschendal Lower reservoir and PRV zone are proposed to accommodate future development areas DR19 to DR26. These zones should be supplied from a new Boschendal Lower reservoir with a TWL of 260 m and the setting of the PRV’s for the PRV zone should be 25 to 30 m (EGL of 225 m).
- A new Boschendal Upper reservoir zone is proposed to accommodate future development area DR10, supplied from a new Boschendal Upper reservoir with a TWL of 330 m.

6.4.2 Proposed future system and required works

The existing Dwars River water distribution system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

The proposed master plan items are presented in Figure SW6.5b.

A few distribution pipelines are required to reinforce water supply within the Dwars River distribution network.

New distribution pipelines are proposed to supply future development areas with water when they develop.

Pressure reducing valves and rezoning of the existing system are proposed in order to implement the Pniel and Lanquedoc PRV zones.

6.4.3 Bulk System

The existing bulk water supply system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

Table SW6.5 is a summary of the reservoir and feeder evaluation of the future system for the future water demand.

Reservoirs

The following new reservoirs will be required in future.

- A new 8,0 Mℓ Boschendal Lower reservoir (TWL = 260 m) is proposed for future development areas DR191 to DR29 and to alleviate the deficit in storage in the Pniel and Johannesdal reservoirs.
- A new 6,0 Mℓ reservoir proposed at the existing Kylemore Lower reservoir site and a new 2,0 Mℓ Kylemore Upper reservoir proposed to replace the existing Kylemore Upper reservoir are currently being constructed.
- A new 1,5 Mℓ reservoir is proposed at the existing Johannesdal Upper reservoir site to augment reservoir storage in the Johannesdal Upper zone.
- A new 0,3 Mℓ Boschendal Upper reservoir (TWL = 330 m) is proposed for the high lying erven of future development area DR10.

Feeder mains

The following new feeder mains will be required in future:

- New 315 mm Ø bulk supply pipe from the proposed second bulk connection on the CoCT Wemmershoek pipeline to the proposed bulk pump station no. 3 (item SDW.B2).
- New 315 mm Ø bulk supply pipe from the proposed bulk pump station no. 3 to the proposed Boschendal Lower reservoir (item SDW.B4).
- New 250 mm Ø supply pipe from the Boschendal Lower reservoir to Pniel in order to augment bulk supply to Pniel and Johannesdal (item SDW.B7).
- The new 160 mm Ø supply pipe to the new Kylemore Upper reservoir (item SDW.B10) is under construction.
- New 75 mm Ø supply pipe to the proposed Boschendal Upper reservoir (item SDW.B18).

Pumping stations

The following new/upgrading to existing pump stations will be required in future:

- New pumping station and sump to supply water to the proposed Boschendal Lower reservoir (items SDW.B3a & SDW.3b).
- New pumping station to supply water from the proposed Boschendal Lower reservoir to the Pniel Lower reservoir (item SDW.B6).
- A New pumping station at the Kylemore Lower reservoir to supply water to the new Kylemore Upper reservoir (item SDW.B9) is under construction.
- Decommission existing Kylemore pump station when item SDW.B9 is implemented (item SDW.B13).

- Upgrading of the Johannesdal pump station between the Johannesdal Lower zone and the Johannesdal Upper reservoir (item SDW.B15).
- New pumping station at the Boschendal Lower reservoir to supply water to the new Boschendal Upper reservoir is proposed (item SDW.B17).

6.4.4 Cost estimates of future works

The cost estimates for the proposed future reinforcements to the Dwars River system are summarised in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The proposed projects with the highest priority in Dwars River are included in Table SW6.4c.

6.5 MASTER PLAN - FRANSCHHOEK

6.5.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4c.

The changes to the existing distribution zones are the following:

- A new Langrug Upper zone is proposed to accommodate the higher lying erven of the existing Langrug zone, supplied from a new Langrug Upper reservoir with a TWL of 400 m. It is proposed that this zone is supplied in the interim from the Mooiwater booster pump station.
- It is proposed that the boundaries of the existing Groendal zone and Franschhoek Reservoir PRV zone be increased to accommodate future areas FH2, FH4, FH5, FH9, FH16, FH17 as well as the lower lying erven of future area FH18. It is further proposed that the above mentioned area be supplied with water from the new Central Lower reservoir (TWL = 315 m) which gives the Municipality the option to supply the Onder-Dorp zone with water from the new Groendal/Central zone (water supplied from the Wemmershoek source rather than from the Perdekloof source).
- The boundries of the Franschhoek reservoir zone is to be increased to accommodate future areas FH7, FH14, FH19 to FH22 and the higher lying erven of future area FH18.
- The boundaries of the existing Franschhoek reservoir zone are adjusted to include 2 new PRV zones.
- The La Avenue booster zone is accommodated in the existing Bo-Dorp PRV zone.
- The boundaries of the existing reservoir zones in Wemmershoek, La Motte and Franschhoek are increased to accommodate future development areas in the greater Franschhoek area.

6.5.2 Proposed future system and required works

The existing Franschhoek water distribution system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

The proposed master plan items are presented in Figure SW6.5c.

New distribution pipelines are required to reinforce water supply within the greater Franschhoek distribution network.

New distribution pipelines are proposed to supply future development areas with water when they develop.

6.5.3 Bulk System

The existing bulk water supply system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

Table SW6.5 is a summary of the reservoir and feeder evaluation of the future system for the future water demand.

Reservoirs

The following new reservoirs will be required in future.

- A new 3,5 Mℓ Central Lower reservoir (TWL = 315 m) is proposed to augment reservoir storage capacity in the Groendal/Central zone and to give the Municipality the option to supply the Onder-Dorp zone with water from the proposed Central Lower reservoir.
- A new 1,2 Mℓ Langrug Upper reservoir (TWL = 400 m) is proposed for the Langrug Upper zone and to augment reservoir storage and to alleviate the deficit in storage that exists in the existing Langrug Lower reservoirs.
- A new 1,5 Mℓ reservoir is proposed at the existing Wemmershoek reservoir site to augment reservoir storage in the Wemmershoek zone.
- A new 1,5 Mℓ reservoir is proposed at the existing La Motte reservoir site to augment reservoir storage in the La Motte zone.

Feeder mains

The following new/upgrading of existing feeder mains will be required in future:

- New 110 mm Ø supply pipe to the proposed Langrug Upper reservoir (item SFW.B7).
- Augmentation of the existing Wemmershoek water scheme to Franschhoek by constructing a new 355 mm Ø supply pipeline parallel to the existing bulk supply scheme from the existing bulk connection point on the CoCT Wemmershoek pipeline to the existing Groendal reservoir in Franschhoek (items SFW.B13, SFW.B18 & SFW.B22).
- Replace the existing 110 mm Ø supply pipe to the Wemmershoek reservoir with a 160 mm Ø pipe and control the flow into the reservoir with a flow-control valve (items SFW.B15 & SFW.B16).
- New flow-control valve at the inlet of the La Motte reservoir in order to control flow into the reservoir (item SFW.B20).

Pumping stations

The following new/upgrading to existing pump stations will be required in future:

- Upgrading of the Langrug pump station (item SFW.B2).
- New pump station to supply water to the proposed Langrug Upper reservoir (item SFW.B6).
- New pump station to supply water from the proposed Central Lower reservoir to the Franschhoek reservoir (item SFW.B9).
- Upgrading of the existing pumps at the Wemmershoek booster 1 & 2 pump stations (items SFW.B12a & SFW.B12b).
- Two new bulk pump stations to augment the existing Wemmershoek water scheme to Franschhoek (items SFW.B14 & SFW.B19).

6.5.4 Cost estimates of future works

The cost estimates for the proposed future reinforcements to the Franschhoek system are summarised in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The proposed projects with the highest priority in Franschhoek are included in Table SW6.4c.

6.6 MASTER PLAN - KLAPMUTS

6.6.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4d.

The changes to the existing distribution zones are the following:

- A new Klapmuts Upper zone is proposed for the higher lying areas of future development area K4 as well as for future development area K6. It is proposed that this zone is supplied from the existing Klapmuts Upper reservoir.
- The existing Klapmuts zone is enlarged to accommodate all the future development areas south of the N1. It is proposed that this zone is supplied from a new reservoir, viz. the Klapmuts Lower reservoir at a TWL of 235 m.

6.6.2 Proposed future system and required works

The existing Klapmuts water distribution system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

The proposed master plan items are presented in Figure SW6.5d.

A number of distribution pipelines are required to reinforce water supply within the Klapmuts distribution network as well as new supply pipelines for the new future development areas.

6.6.3 Bulk System

The existing bulk water supply system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

Table SW6.5 is a summary of the reservoir and feeder evaluation of the existing system for the future water demand.

<u>Reservoirs</u>

The following new reservoirs will be required in future.

- A second 9,0 Mℓ reservoir is proposed next to the existing new 7,0 Mℓ reservoir when the first reservoir reaches capacity.

<u>Feeder mains</u>

The following new feeder mains and upgrades will be required in future:

- Upgrade of the existing 200 mm Ø feeder main from the existing connection point on the CoCT’s Wemmershoek pipe to the beginning of the new 400 mm Ø (item SKW.B1a).
- New 400 mm Ø feeder main to the proposed Klapmuts bulk pump station and sump (items SKW.B1b).
- New 400 mm Ø feeder main from the proposed Klapmuts bulk pump station and sump to the New Klapmuts Lower reservoir (item SKW.B4)

<u>Pumping stations</u>

The following new pump stations are proposed for the future:

- New pump station and sump to supply water to the proposed Klapmuts Lower reservoir (items SKW.B2, SKW.B3a).

- Upgrading of the proposed Klapmuts bulk pump station when it reaches capacity (item SKW.B3b).

6.6.4 Cost estimates of future works

The cost estimates for the proposed future reinforcements to the Klapmuts system are summarised in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The proposed projects with the highest priority in Klapmuts are included in Table SW6.4c.

6.7 MASTER PLAN - RAITHBY

6.7.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4e.

The changes to the existing distribution zones are the following:

- The Faure service reservoir is to serve as reservoir storage capacity for the Raithby zone. Replacing the Raithby reservoir.
- The boundary of the Raithby zone is increased in order to accommodate future development areas R3 & R4.
- The boundary of the existing Raithby booster zone is increased in order to accommodate future development areas R1 & R2.

6.7.2 Proposed future system and required works

The existing Raithby water distribution system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

The proposed master plan items are presented in Figure SW6.5e.

A few distribution pipelines are required to reinforce water supply within the Raithby distribution network for the new future development areas.

A non-return valve is proposed between the Raithby reservoir and Raithby booster zones in order to supply water from the reservoir zone to the booster zone when the pumps are not operational and to prevent flow from the booster zone to the reservoir zone when the pumps are running.

6.7.3 Bulk System

The existing bulk water supply system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

Table SW6.5 is a summary of the reservoir and feeder evaluation of the future system for the future water demand.

<u>Reservoirs</u>

The following new reservoir will be required in future.

- The EGL of the existing Raithby reservoir is too low relative to the supply zone and can therefore not supply enough pressure into the zone.

(SM is attempting to secure reservoir capacity for Raithby in the existing 5 Mℓ service reservoir of the Faure WTP of the CoCT. The Faure service reservoir will then serve as reservoir for the Raithby area).

<u>Feeder mains</u>

The following new feeder mains and upgrades will be required in future:

- A new 160 mm Ø connection should be made at the existing connection that SM has to the Faure service reservoir. (item SRW1.1).

6.7.4 Cost estimates of future works

The cost estimates for the proposed future reinforcements to the Raithby system are summarised in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The proposed projects with the highest priority in Raithby are included in Table SW6.4c.

6.8 MASTER PLAN - FAURE

6.8.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4e.

There are not proposed upgrades in the future Faure area, the Faure supply zone is however increased to accommodate a section of the Polkadraai system.

6.9 MASTER PLAN - POLKADRAAI

6.9.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4f.

The changes to the existing distribution zones are the following:

- It is proposed that a new reservoir is built at the existing Skoonheid reservoir site and that a new Polkadraai reservoir be built to supply the new Polkadraai reservoir PRV zone. The new Polkadraai PRV zone will include the old Skoonheid PRV zone and the boundary of this zone will be increased in order to accommodate future development areas PD2 & PD3.

6.9.2 Proposed future system and required works

The existing Polkadraai water distribution system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

The proposed master plan items are presented in Figure SW6.5f.

A few distribution pipelines are required to reinforce water supply within the Polkadraai distribution network for the new future development areas as well as a new supply pipeline from the proposed new Polkadraai reservoir.

6.9.3 Bulk System

The existing bulk water supply system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

Table SW6.5 is a summary of the reservoir and feeder evaluation of the future system for the future water demand.

<u>Reservoirs</u>

The following new reservoir will be required in future.

- A new 0,5 Mℓ Skoonheid reservoir is proposed at TWL = 204 m on the existing Skoonheid reservoir site.
- A new 4,5 Mℓ Polkadraai reservoir is porposed at TWL = 165 m to provide water to the new Polkadraai reservoir zone.

<u>Feeder mains</u>

The following new feeder mains and upgrades will be required in future:

- A new feeder main from CoCT connection point to the Blackheath reservoirs (item SPW.B1).
- A new 315 mm Ø feeder main from Blachhealth reservoir is proposed to the new Polkadraai reservoir (item SPW.B4).
- A new 315 mm Ø feeder main from the new Polkadraai reservoir to the existing Papegaaiberg reservoir in Stellenbosch is proposed (item SPW.B7).

<u>Pumping stations</u>

The following new pump stations are proposed for the future:

- A new dedicated pump station from Blackheath reservoirs to the new Polkadraai reservoir (item SPW.B2)

6.9.4 Cost estimates of future works

The cost estimates for the proposed future reinforcements to the Polkadraai system are summarised in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The proposed projects with the highest priority in Polkadraai are included in Table SW6.4c.

6.10 MASTER PLAN - KOELENHOF

6.10.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4g.

The changes to the existing distribution zones are the following:

- It is proposed that a new connection to the CoCT Wemmershoek line be made for additional water supply to the proposed Simonsig reservoir. The boundary of this zone will include a part of the existing koelenhof zone and it will be increased in order to accommodate sections of the Sonop PRV zone as well as future development areas KP1, KP4, KP6, KP8 & KP9. The existing Sonop PRV zone is increased to accommodate future development areas KP10, KP11, KP14, KP15 & KP17.
- The Koelenhof reservoir zone is also increased toe service a portion of the Muldersvlei area.

6.10.2 Proposed future system and required works

The existing Koelenhof water distribution system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

The proposed master plan items are presented in Figure SW6.5g.

A few distribution pipelines are required to reinforce water supply within the Koelenhof distribution network for the new future development areas as well as a new supply pipeline from the proposed new Simonsig reservoir.

6.10.3 Bulk System

The existing bulk water supply system has insufficient capacity to supply the future water demands for the fully occupied scenario and the additional future development areas.

Table SW6.5 is a summary of the reservoir and feeder evaluation of the future system for the future water demand.

Reservoirs

The following new reservoir will be required in future.

- A new 4,0 Mℓ Simonsig reservoir is porposed at TWL = 210 m to provide water to the new Simonsig reservoir zone.

Feeder mains

The following new feeder mains and upgrades will be required in future:

- A new feeder main from a new CoCT connection point to the proposed pump station pumping to the new Simonsig reservoir (item RKW.B6a & RKW.B6b).
- A new 315 mm Ø feeder main to the new Simonsig reservoir is proposed (item RKW.B10).

Pumping stations

The following new pump stations are proposed for the future:

- A new station from the new CoCT connection point to the Simonsig reservoir pump station (item RKW.B5)
- A new pump station to the proposed Simonsig reservoir (item RKW.B9)

6.10.4 Cost estimates of future works

The cost estimates for the proposed future reinforcements to the Koelenhof system are summarised in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The proposed projects with the highest priority in Koelenhof are included in Table SW6.4c.

6.11 MASTER PLAN - MULDERSVLEI

6.11.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4g.

There are not proposed upgrades in the future Muldersvlei area, however a section of the Muldersvlei network is rezones to be accommodate in the Koelenhof network.

6.12 MASTER PLAN - MEERLUST

6.12.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4b.

There are not proposed upgrades in the future Meerlust area.

6.13 MASTER PLAN - HELDERBERG & CROYDON

6.13.1 Proposed distribution zones

The proposed distribution zones are indicated on Figure SW6.4e.

There are not proposed upgrades in the future Helderberg and Croydon area.

6.14 MASTER PLAN - FIRE FIGHTING

The provision of sufficient capacity in water distribution networks to adhere to fire fighting flow and pressure requirements can often dominate the selection of component sizes. In general, areas where static pressures are relatively low and/or pipe diameters are 75 mm Ø or less provision for sufficient capacity in this respect could be a problematic issue. This is also the case in SM. No specific upgrading of the distribution systems in SM for the purpose of fire fighting has been proposed, but an assessment of the risk of each area related to fire occurrence should be made by the authority and detailed investigations performed accordingly.

6.15 OPERATION AND MAINTENANCE COSTS

This CAPEX plan allows only for CAPEX required to upgrade the system to meet future growth. No provision is made in this master plan for the following:

- Increased operation and maintenance costs that go hand in hand with the infrastructure upgrades
- Replacement of old infrastructure that reaches the end of reliable operation.

6.16 UPDATING AND MAINTENANCE OF THE COMPUTER MODEL AND MASTER PLAN

The calibrated computer model of the distribution system is a handy tool for the day to day management of the system and can also be used as a basis for the calculation of services contributions by developers. The utility value of the model will however be lost if it is not properly maintained. The model should therefore be kept up to date with new developments and extensions to the system, and a link to the treasury water sales data.

6.17 MONITORING OF THE SYSTEM

An extensive monitoring programme is suggested which will gather information to assist with the updating of the master plan and the day to day management of the system. This programme has even more significance in the context of the Water Services Act 2007, which basically enforces proper system- and water demand management.

Monitoring of the system could be through a live link like telemetry and through a system which is updated only periodically such as SWIFT. Telemetry monitoring can be used for a number of reasons, some of which are:

- To monitor reservoir levels for operational reasons.
- To monitor pumps on or off for operational reasons.
- To continuously log flow meters to determine flow/demand patterns, also giving an indication of when the maximum flow velocities or pipeline capacities are reached.
- To monitor network residual/static pressures where problems are expected/ experienced.

Monitoring of the system through SWIFT is a more long-term process and typical objectives are:

- To determine the total system NRW as obtained from the meter database.
- To determine the NRW per subsystem, again as per meter database.
- To pick up meter irregularities such as broken meters, meters slowing down, meters which were replaced, meters which clocked over, etc.

6.18 WATER DEMAND MANAGEMENT

Continuous attention and support to water demand management with the aim of permanent reduction in demand should be considered as it could substantially impact the capital expenditure required to meet the future demand. A long-term water conservation and water demand management strategy study was conducted for the SM, defining priorities for water loss reduction and demand management measures for each town. The SM should ensure that these strategies are pursued actively.

6.19 ASSET MANAGEMENT

It is recommended that the current databases as well as hydraulic analyses and master planning results be extended and applied to support the asset register (AR) and asset management plan (AMP). The following aspects are of importance in this respect:

- The data bases must be revisited to ensure compliance with the AR with respect to componentization and hierarchy. Due to the process followed in compiling the databases it is not expected that this will be a major task, but the specific rules for componentization, hierarchy and continuous update of the AR within e.g. a unique numbering system was not available at the time.
- Similarly the master plan projects should be aligned with the format stipulated in the AMP.
- The data integrity allocation during the establishment of the data base should be applied to inform the data improvement plan which is a subset of the AMP.
- The results of the hydraulic analyses should be applied to assist in determining important component attributes in the AR, such as criticality, utilization, performance and remaining useful lifetime.
- Attributes that will assist in performing AMP related actions, such as risk based pipe replacement prioritization, should be captured. These would e.g. include geological environment, location with respect to areas or consumers sensitive to spillages or flooding etc.
- The units and unit rates used should be checked and adjusted to be consistent for the determination of asset valuations in line with current replacement cost (CRC), fair values according to depreciated replacement cost (DRC) and budgets which include both operational expenditure (OPEX) and CAPEX.

6.20 CONCLUSION

It is recommended that the water master plan as described in this report be implemented in order to allow the water distribution system of the SM to keep in step with the anticipated growth and expansion of water demand.

Table SW6.1: Existing water system replacement value – Summary19

Table SW6.2: Bulk supply capacities – Existing system20

Table SW6.3: Present and future zone AADD's21

Table SW6.4 (a): Proposed works, cost estimates & phasing – Future system 22

Table SW6.4 (b): Proposed projects, cost estimates & phasing – Future system 23

Table SW6.4 (c): Priority water project – Stellenbosch Municipality 24

Table SW6.5: Bulk supply capacities – Future system25

Figure SW6.1(a): Existing system static pressure – Stellenbosch44

Figure SW6.1(b): Existing system static pressure – Dwars River & Meerlust45

Figure SW6.1(c): Existing system static pressure – Franschhoek46

Figure SW6.1(d): Existing system static pressure – Klapmuts47

Figure SW6.1(e): Existing system static pressure –Raithby, Faure, Helderberg & Croydon48

Figure SW6.1(f): Existing system static pressure – Polkadraai49

Figure SW6.1(g): Existing system static pressure – Koelenhof & Muldersvlei50

Figure SW6.2(a): Existing system residual pressure – Stellenbosch51

Figure SW6.2(b): Existing system residual pressure – Dwars River & Meerlust52

Figure SW6.2(c): Existing system residual pressure – Franschhoek53

Figure SW6.2(d): Existing system residual pressure – Klapmuts54

Figure SW6.2(e): Existing system residual pressure – Raithby, Faure, Helderberg & Croydon55

Figure SW6.2(f): Existing system residual pressure – Polkadraai56

Figure SW6.2(g): Existing system residual pressure – Koelenhof & Muldersvlei57

Figure SW6.3(a): Existing system peak flow velocity – Stellnebosch58

Figure SW6.3(b): Existing system peak flow velocity – Dwars River & Meerlust59

Figure SW6.3(c): Existing system peak flow velocity – Franschhoek60

Figure SW6.3(d): Existing system peak flow velocity – Klapmuts61

Figure SW6.3(e): Existing system peak flow velocity – Raithby, Faure, Helderberg & Croydon62

Figure SW6.2(f): Existing system peak flow velocity **– Polkadraai63**

Figure SW6.2(g): Existing system peak flow velocity **– Koelenhof & Muldersvlei64**

Figure SW6.4(a): Future distribution zones –Stellenbosch65

Figure SW6.4(b): Future distribution zones – Dwars River & Meerlust66

Figure SW6.4(c): Future distribution zones – Franschhoek67

Figure SW6.4(d): Future distribution zones – Klapmuts68

Figure SW6.4(e): **Future distribution zones – Riathby, Faure, Helderberg & Croydon69**

Figure SW6.2(f): Future distribution zones – Polkadraai70

Figure SW6.2(g): Future distribution zones –Koelenhof & Muldersvlei71

Figure SW6.5(a): Required works –Stellenbosch72

Figure SW6.5(b): Required works – Dwars River & Meerlust73

Figure SW6.5(c): Required works –Franschhoek74

Figure SW 6.5(d): Required works – Klapmuts75

Figure SW6.5(e): Required works – Raithby76

Figure SW6.5(f): Required works – Polkadraai77

Figure SW6.5(g): Required works – Koelenhof & Muldersvlei78

7. MASTER PLAN COST SUMMARY

This report describes the study undertaken with respect to the updating of the master plan for the water distribution system of the Stellenbosch Municipality (SM). The initial water master plan was compiled by GLS consulting engineers (GLS) and documented in a report, dated December 2011. This master plan was subsequently updated by GLS and documented in this report, dated June 2018.

7.1 SCOPE OF WATER MASTER PLAN STUDY

The scope of this update study was briefly defined as the following:

- Updating of existing computer models for the SM water distribution systems.
- The linking of these models to the latest water meter data and analysis of water demand based on the treasury's financial system.
- Evaluation and master planning of the water distribution systems.
- Present all information electronically in geographic information system (GIS) format as well as a master plan document including tables and plans.

7.2 STUDY AREA

The location of SM within the Western Cape is shown on Figure SW1.1. The urban areas within the boundary of the SM are:

- Stellenbosch
- Dwars River
- Franschhoek
- Klapmuts
- Raithby

The rural areas within the boundary of the SM are:

- Faure system
- Polkadraai system
- Koelenhof system
- Muldersvlei system
- Meerlust
- Helderberg
- Croydon

Figure SW1.2 shows the suburbs with suburb names entered during this investigation for all records in the GIS database. The total area of these suburbs indicates the study area of this investigation.

7.3 WATER SOURCES

7.3.1 Stellenbosch town

Stellenbosch is supplied with water from two sources, namely the Eerste River/Idas Valley dams and the Theewaterskloof scheme.

During the winter months the Eerste River in the Jonkershoek Valley supplies water directly to the Idas Valley WTP. Surplus water from the Eerste River is transferred to the Idas Valley dams (564 Mℓ and 1 818 Mℓ). In the dryer summer months there is a shortage from the Eerste River and water is supplemented from the Idas Valley dams. Water from the Idas Valley dams and the Eerste River is purified at the Idas Valley WTP from where it is supplied into the Stellenbosch network.

Stellenbosch Municipality also has an allocation of 3 million m^3/annum from the Theewaterskloof tunnel. Raw water from this source is purified at the Paradyskloof WTP from where it is supplied into the distribution network.

In 1998 a bulk water transfer scheme was commissioned where 12,5 Mℓ/d of purified water could be transferred between the two sources.

7.3.2 Dwars River

The Dwars River area purchases water in bulk from the City of Cape Town (CoCT). This water from the CoCT is purified water from the Wemmershoek scheme.

7.3.3 Franschhoek

Franschhoek is supplied with water from two sources. Its own source in the adjacent mountains, the so-called Perdekloof source and purchased water from the CoCT. La Motte and Wemmershoek are only supplied with water purchased from the CoCT. The water from the CoCT is purified water from the Wemmershoek scheme while the raw water from the Perdekloof is purified at a package plant next to the Fransche Hoek Estate Lower reservoir.

7.3.4 Klapmuts

Klapmuts purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

7.3.5 Raithby

Raithby purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Faure WTP.

7.3.6 Faure system

Fuare purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Faure WTP.

7.3.7 Polkadraai system

Polkadraa purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Blackheath WTP.

7.3.8 Koelenhof system

Koelenhof purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

7.3.9 Muldersvlei system

Muldersvlei purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

7.3.10 Meerlust

Meerlust purchases water in bulk from the CoCT. This water from the CoCT is purified water from the Wemmershoek scheme.

7.3.11 Helderberg & Croydon

Helderberg and Croydon both purchase water in from the CoCT. This water from the CoCT is purified water from the Faure WTP.

Note: Investigation of, and comments on the sufficiency of the existing water sources are beyond the scope of this study.

7.4 GENERAL DESCRIPTION OF THE WATER SUPPLY SYSTEM

The water distribution system layouts are shown on Figures SW2.1, with a Figure for each area Stellenbosch, Dwars River, Franschhoek, Klapmuts, Raithby, Faure, Polkadraai, Koelenhof, Muldersvlei, Meerlust, Helderberg and Croydon operated by the SM.

7.4.1 Bulk supply system

The analysis of the raw water system upstream of the WTP's is beyond the scope of this study.

7.4.2 Water treatment plants

Raw water from the various sources in SM is supplied to the following WTP's where it is treated:

• Stellenbosch (Idas Valley)	- Capacity	25,0 Mℓ/d
• Stellenbosch (Paradyskloof)	- Capacity	15,0 Mℓ/d
• Franschhoek	- Capacity	?? Mℓ/d
Total Capacity		**40,0 Mℓ/d**

7.4.3 Reticulation systems

With reference to Figures SW2.1 & SW2.2, the following water systems are operated by the SM:

<u>Stellenbosch town</u>

The system is operated in 26 zones. There are 22 reservoirs (of which the Jonkershoek, La Coline, Kayamandi Old 1, Kayamandi Old 2 and Onder-Papegaaiberg reservoirs are currently not in use), one break pressure tank (BPT), 12 pressure reducing valve (PRV) zones and one tower zone for a higher lying area.

Jamestown zone is supplied from the Jamestown reservoir which receives its water from the Faure WTP via the supply scheme which supplies Spier and the De Zalze Golf Estate. The Jamestown reservoir can also be supplied with water through the Jamestown reservoir network with water supplied through the Paradyskloof 1 zone.

<u>Dwars River</u>

The system is operated in 10 zones supplied from 6 reservoirs. Some zones are supplied with water directly from the bulk system.

<u>Franschhoek</u>

Franschhoek is operated in 14 zones supplied from 12 reservoirs. The La Motte and Wemmershoek systems are each operated in 1 single zone, supplied from a single reservoir, respectively.

Klapmuts

Klapmuts purchases bulk water from the CoCT's Wemmershoek scheme. From the connection point the water gravitates to the Klapmuts Old reservoir. From here it is pumped to the New Klapmuts reservoir. The Klapmuts zone is supplied from the New Klapmuts reservoir through a PRV next to the Klapmuts Old reservoir.

Raithby

The Raithby reservoir is supplied with water from the Raithby bulk pump station with a connection point on the CoCT's pipe next to the Faure reservoir. From the Raithby reservoir the Raithby zone is supplied while a booster pump station supplies a higher lying area adjacent to the reservoir.

Fuare system

The Faure system is supplied with water from with a connection point on the CoCT's pipe next to the Faure reservoir. From here water gravitates to the Faure pump station that pumps to the Jamestown reservoir.

Polkadraai system

Polkadraai is supplied with water from with a connection point on the CoCT's pipe from the Blackhealth WTP. Blackheath reservoirs where it is pumped to the Skoonheid reservoir and to the Polkdraai system. From the Skoonheid reservoir there are 4 PRV's that feed into 3 PRV zones and feed the Longlands and Digteby reservoirs that feed the Longlands and Diteby estates respectively.

Koelenhof system

The Koelenhof reservoir is supplied with water boosted from a connection on the CoCT's Wemmershoek scheme. The reservoir then feeds the Elsenburg area through the Elsenburg booster pump station that pumps water to the Elsenburg reservoir.

Water from the Koelenhof reservoir also gravitates down to the Devon Valley and Sonop pump station where it is boosted to the two reservoir respectively. The Sonop reservoir feeds to Sonop reservoir zone as well as the Sonop PRV zone.

Muldersvlei system

Muldersvlei is supplied with water from a bulk connection point from the CoCT.

Meerlust

Meerlust is supplied with water through a connection from the CoCT's wemmershoek scheme.

Helderberg & Croydon

Helderberg and Croydon are both supplied with water from the CoCT's network.

7.4.4 Reservoirs

The reservoir storage volumes for the systems in SM are:

- Stellenbosch - Capacity 58,9 Mℓ
- Dwars River - Capacity 2,3 Mℓ
- Franschhoek - Capacity 11,1 Mℓ
- Klapmuts - Capacity 9,4 Mℓ
- Raithby - Capacity 0,2 Mℓ
- Faure - Capacity 0,0 Mℓ

•	Polkadraai	- Capacity	4,4 Mℓ
•	Koelenhof	- Capacity	8,3 Mℓ
•	Muldersvlei	- Capacity	0,0 Mℓ
•	Meerlust	- Capacity	0,0 Mℓ
•	Helderberg & Croydon	- Capacity	0,0 Mℓ
Total Capacity			**90,3 Mℓ**

The total storage capacity of 90,3 Mℓ represents ± 58 hours x the present AADD of 37,4 Mℓ/d for the SM.

7.4.5 Pumping stations (PS)

The following PS's are in the respective systems:

- Stellenbosch: 13 PS
- Dwars River: 5 PS
- Franschhoek: 7 PS
- Klapmuts: 1 PS
- Raithby: 2 PS
- Faure: 1 PS
- Polkadraai: 4 PS
- Koelenhof: 4 PS
- Muldersvlei: 0 PS
- Meerlust: 0 PS
- Helderberg & Croydon: 1 PS

7.4.6 Pipelines

The total length of pipelines in the SM supply system amounts to 696,89 km.

7.4.7 Replacement value

The year 2018/19 replacement value of the system (excluding raw water storage dams, water treatment plants, control valves and other small components) is estimated as follows:

Stellenbosch	R	1 077,58 million
Dwars River	R	110,08 million
Franschhoek	R	192,15 million
Klapmuts	R	90,15 million
Raithby	R	17,22 million
Faure	R	70,85 million
Polkadraai	R	96,98 million
Koelenhof	R	113,03 million
Muldersvlei	R	15,21 million
Meerlust	R	1,34 million
Helderberg & Croydon	R	5,00 million
Total	**R**	**1 748,71 million**

7.5 WATER DEMAND

A summary of all the present and future water demands on the water supply system is shown on Table SW4.2.

7.5.1 Present water demand

The analysis of the meter reading data from the municipal treasury data as well as bulk water meter reading data indicated that:

- The present annual total water demand (TWD) supplied from June 2017 to July 2018 is 8 926 967 kℓ (bulk water input from the WTP's) which equates to an AADD of 24,5 Mℓ/d.
- The present water sold to consumers during the same period is 6 758 778 kℓ.
- The unaccounted for water (UAW) is therefore 2 168 189 kℓ, or 24,0% of total bulk water input.
- For planning and evaluation purposes, the UAW figures were rationalised on a regional (wider-area) basis, as allowed by the sensibility of the results. After allowance was made for unmetered consumers and faulty bulk meters in the area, an UAW figure of 30% for Stellenbosch town, 30% for the Dwars River area, 30% for the greater Franschhoek area, 20% Klapmuts, 20% for Raithby 20% for Faure, 20% for Polkadraai, 20% for Koelenhof, 20% for Muldersvlei, 30% for Meerlust and 20% for Helderg and Croydon were applied.
- The present water demand used for modelling of the existing SM water systems equates to an AADD of 37,41 Mℓ/d.

7.5.2 Future water demand

With all vacant erven within the municipality occupied and the municipal wide unaccounted for water figure for SM reduced, the AADD of the existing SM could increase from 37 406 kℓ/d to 46 682 kℓ/d. In addition to this it is estimated that the future developments (as shown on Figure SW4.1) can contribute a further 34 123 kℓ/d, bringing to 80 805 kℓ/d the total future AADD for the SM reticulation system for which this planning study was performed.

7.6 COMPUTER MODEL ANALYSIS AND EVALUATION OF EXISTING SYSTEM

The existing computer model of the existing water supply system was updated with the latest as-built information, using the water distribution system optimization program (WADISO) SA software. The model is complete, detailed, and geographically accurate, and can therefore also serve as the GIS "as-built" record of the system.

The model was subjected to a typical present peak hour demand (PHD), and evaluated with respect to:

- Supply rates to reservoirs in relation to demand served
- Reservoir capacities in relation to demand served by reservoir
- Flow velocities
- Minimum pressures
- Static pressures

7.6.1 Reticulation system

Presently the water supply systems operates and functions without major problems, and this was reflected in the computer model analysis. A few localised problems were however identified. The analysis of the water systems for each area can be summarised as follows:

<u>Stellenbosch town</u>

- The static analysis indicates no areas in the network where pressures are below 24 m.
- The residual pressures in the existing system under peak hour demand conditions are mainly in the 24 m to 90 m range, except for the higher lying areas

of the Mosterdsdrif suburb in the Central zone, the higher lying areas of the Idas Valley suburb in the Uniepark 1 and Idas Valley 2 reservoir zones, the higher lying areas in the Papegaaiberg and Jamestown reservoir zones and some areas in the Kayamandi suburb in the Kayamandi reservoir and Kayamandi PRV 1 to 4 zones, where the pressures are below 24 m.
- There are a few pipes which have a velocity under peak hour demand conditions which exceeds 1,5 m/s.

Dwars River

- The static analysis indicates no areas in the network where pressures are below 24 m apart from the higher lying areas in the Pniel Upper zone.
- The residual pressures in the existing system under peak hour demand conditions are mainly in the 24 m to 90 m range, except for the Kylemore Lower and Upper zones and the higher lying areas of the Pniel Upper zone, where the pressures are below 24 m.
- The only pipes with flow velocities exceeding 1,5 m/s in the system are the main 100 mm Ø supply pipes from the Kylemore Lower reservoir to the Kylemore Lower zone and from the Kylemore Upper reservoir to the Kylemore Upper zone.

Franschhoek

- The static analysis indicates no areas in the network where pressures are below 24 m apart from the higher lying areas in the Langrug zone and the La Avenue booster and Southern booster zones when the pumps are not operational, where the pressures are below 24 m. Pressures in the lower lying areas of the Fransche Hoek Estate Lower PRV zones are above 90 m as well as the lower lying areas in the Franschhoek reservoir zone.
- The residual pressures in the existing system under peak hour demand conditions are mainly in the 24 m to 90 m range, except for the higher lying areas of the Langrug zone and the supply pipeline to the Southern booster zone where the pressures are below 24 m and the higher lying areas in the La Avenue booster zone.
- The only pipes with flow velocities exceeding 1,5 m/s in the system are the 100 mm Ø supply pipe to the Bagatelle (Onder Dorp) reservoir, the 300 mm Ø pipe from the CoCT's Wemmershoek line draw off point to the Wemmershoek booster pump stations and the 250 mm Ø bulk supply pipe the La Motte booster pump stations to the Groendal reservoir. The velocity in these pipes are between 1,5 and 2,0 m/s.

Klapmuts

- The static analysis indicates no areas where pressures exceed 90 m.
- The residual pressures in the existing system under peak hour demand conditions in the higher lying areas east of the reservoirs experience pressures below 24m, however this is not a concern as it is only slightly below 24 m.
- The 200 mm Ø supply pipe from the CoCT's Wemmershoek line to the Klapmuts Lower reservoir as well as the 200 mm Ø rising main from the Lower reservoir to the upper reservoir experience velocities exceeding 1,5 m/s. The network 200 mm Ø and 250 mm Ø supply pipes from the upper reservoir also experience velocities exceeding 1,5 m/s.

Raithby

- The static analysis indicates no areas where pressures exceed 90 m. When the booster pump is not operational, the pressure in the higher lying areas of the Raithby booster zone are below 24 m.
- The residual pressures in the existing system under peak hour demand conditions in the higher lying areas of Raithby are below 24 m.
- There are no pipes with velocities exceeding 1,5 m/s in the system.

Faure system

- The static analysis indicates no areas where pressures exceed 90 m.
- The residual pressures in the existing system under peak hour demand conditions reach near 70 m in the lower lying areas.
- There are no pipes with velocities exceeding 1,5 m/s in the system.

Polkadraai system

- The static analysis indicates pressures of almost 90 m in the lower lying areas of the Skoonheid reservoir zone.
- The residual pressures in the existing system under peak hour demand conditions reach below 24 m in the Skoonheid PRV 2 zone.
- A section of pipe in the Skoonheid PRV 2 zone experiences flow velocities exceeding 1,5 m/s under peak demand conditions.

Koelenhof system

- The static analysis indicates that the lower lying areas in the Koelenhof system experience pressures exceeding 90 m.
- The residual pressures in the existing system under peak hour demand conditions in the higher lying areas, towards Elsenburg pump station and to the South West edge of the network experience pressures below 24m.
- The 225 mm Ø supply pipe from the CoCT's Wemmershoek line to the Koelenhof reservoir experience velocities exceeding 1,5 m/s.

Muldersvlei system

- The static analysis indicates no areas where pressures exceed 90 m.
- The residual pressures in the existing system under peak hour demand conditions are within the range of 24 m to 90 m.
- There are no pipes with velocities exceeding 1,5 m/s in the system.

Meerlust

- The static analysis indicates no areas where pressures exceed 90 m.
- The residual pressures in the existing system under peak hour demand conditions are within the range of 24 m to 90 m.
- There are no pipes with velocities exceeding 1,5 m/s in the system.

Helderberg & Croydon

- The static analysis indicates no areas where pressures exceed 90 m.
- The residual pressures in the existing system under peak hour demand conditions are within the range of 24 m to 90 m.
- There are no pipes with velocities exceeding 1,5 m/s in the system.

7.6.2 Bulk supply system

The analysis of the existing pump stations and supply rates to reservoirs and reservoir capacities in relation to demand served by the reservoir (as shown in Table SW6.2) showed that:

- Evaluated on a town-for-town basis, Stellenbosch, Dwars River, Franschhoek, Raithby Polkadraai and Koelenhof all have insufficient reservoir storage in some of their zones and requires additional storage. Dwars River, Franschhoek, Klapmuts, Polkadraai and Koelenhof are the only areas where the overall storage for the area is sufficient.

- Polkadraai's Skoonheid reservoir has insufficient storage capacity.In Stellenbosch the supply to Papegaaiberg reservoir from the Idas Valley WTP is insufficient, however the supply can be augmented from the Paradyskloof 1 reservoir.
- The Franschhoek raw water supply from Perdekloof has insufficient capacity to supply water to the eastern zones of Franschhoek during peak demand conditions.
- The Wemmershoek booster from La Motte to Groendal also has insufficient capacity to supply water to the Groendal reservoir during peak demand conditions
- In the greater Franschhoek area the Langrug pump station is presently at capacity and requires upgrading.

7.7 MASTER PLAN FOR SYSTEM EXTENSIONS/AUGMENTATION

7.7.1 Planning horizon

The extensions to the existing system were planned to keep in step with a growth in demand from the present (2018) AADD of ± 37,4 Mℓ/d, to a planning horizon AADD of 80,81 Mℓ/d. At a growth rate of ± 4,0% this AADD will be realised in the year ± 2038 (20 year planning horizon).

7.7.2 Raw water source

The analysis of the raw water sources is beyond the scope of this study.

7.7.3 Water treatment plants

The analysis of the capacities of the existing SM WTP's is beyond the scope of this study.

7.7.4 Required works

An extended computer model representing the future scenario was set up to plan and size the components of the future water supply system. The motivation for the works and a detailed description for each component, are provided in the main body of the report.

The required works to reinforce the system for existing and potential future deficiencies, are shown on Figure SW6.5 and listed with short descriptions in Table SW6.4a. These proposed master plan items are grouped together in proposed projects which are summarised in Table SW6.4b.

The major new components of the future system with the highest priorities are summarized below:

- Water demand management: Franschhoek rezoning
- Connect new bulk supply line from Paradyskloof to Jamestown Reservoirs
- Network upgrades: Kylemore Lower reservoir zone
- Klapmuts supply augmentation from Lower reservoir & accompanying infrastructure
- New Kylemore Upper reservoir & network upgrades (under construction)
- Cloetesville reservoir storage & bulk supply augmentation
- Improvement of supply from Kleinvallei reservoir
- Brandwacht PRV zone network upgrades
- Dwars River bulk augmentation scheme - phase 1 (under construction, to be completed 2019)
- Upgrade capacity of Langrug pump station
- Jamestown New reservoir & bulk supply
- Development related infrastructure: Klapmuts
- Implement Uniepark 1 PRV zone
- Augmentation of Idas Valley 1 reservoir capacity
- Implement Pniel Lower & Lanquedoc PRV zones

- Short term network upgrades & improvements: Franschhoek
- Augmentation of Idas Valley 1 reservoir capacity
- Paradsykloof 1 zone pressure management
- Polkadraai infrustructure upgrade
- Improvement of network conveyance in Central zone
- Kayamandi bulk infrastructure upgrades - phase 3
- Network upgrades to Polkadraai network

7.7.5 Cost estimates and phasing in of works

The total cost (year 2018/19 value) for the required works is estimated at R 648,29 million (including P&G's, contingencies and fees, excluding VAT). This total can be broken down as follows:

Water reticulation network	:	R	167,42 million
Bulk supply items	:	R	477,83 million
Water demand management	:	R	3,04 million
Total		**R**	**648,29 million**

The capital investment of R 648,29 million is required over time to increase the system capacity from the present AADD of roughly 37,04 Mℓ/d, to the future horizon of 80,81 Mℓ/d AADD.

Tables SW6.4a & SW6.4b also gives an indication of when the works are required. The required expenditure should be phased to remain in line with the increase in AADD.

The proposed projects with the highest priority in the SM system are included in Table SW6.4c. The estimated cost of items required over the next 4 to 5 years is ± R 208,49 million.

7.8 MASTER PLAN UNIT COST

The required capital expenditure for these priority water infrastructure projects is as follows:

- R 5,91 million for the 2018/19 financial year
- R 69,48 million for the 2019/20 financial year
- R 99,65 million for the 2020/21 financial year
- R 33,46 million for the 2021/22 financial year

Table SW7.1 is a summary of the total costs associated with the proposed master plan for the water system for the next 20 to 25 years, which amounts to R 648,29 million.

The master plan implementation at cost of R 648,29 million will increase the SM system capacity from its present AADD of 37,04 Mℓ/d to the future AADD of 80,81 Mℓ/d. This amounts to an implementation unit cost of ± R 14 808 R/kℓ/d.

7.9 UPDATING AND MAINTENANCE OF THE COMPUTER MODEL AND MASTER PLAN

The calibrated computer model of the distribution system is a handy tool for the day to day management of the system and can also be used as a basis for the calculation of services contributions by developers. The utility value of the model will however be lost if it is not properly maintained. The model should therefore be kept up to date with new developments and extensions to the system, and a link to the treasury water sales data.

7.10 MONITORING OF THE SYSTEM

An extensive monitoring programme, mainly through an extension of the already established telemetry system, is suggested which will gather information to assist with the updating of the master plan and the day to day management of the system.

7.11 WATER DEMAND MANAGEMENT

Continuous attention and support to water demand management with the aim of permanent reduction in demand should be given as it could substantially impact the capital expenditure required to meet the future demand.

7.12 ASSET MANAGEMENT

It is recommended that the current databases as well as hydraulic analyses and master planning results be extended and applied to support the asset register (AR) and asset management plan (AMP).

7.13 CONCLUSION

It is recommended that the water master plan as described in this report be implemented in order to allow the SM water distribution system to keep in step with the anticipated growth and expansion of water demand.

Table SW7.1: Master plan cost summary26