

TECHNICAL NOTE

Bulk Water & Sewerage Services

Msunduzi Central Area and CBD Extension Node Local Area Plan

1 INTRODUCTION

1.1 PURPOSE AND APPROACH

Purpose of this technical note

This technical note presents a review of available information on existing infrastructure, projected needs as per studies completed and a list of plans, projects and other measures identified by various stakeholders to address these needs. The intention of this situational analysis is to identify the magnitude and the level of service, to assess the capacity and capability of existing infrastructure and proposed measures to meet these needs, both now and in the future, and to identify gaps and shortfalls that will remain after the implementation of the identified measures

This technical note focuses on:

- A review of existing infrastructure and its ownership
- Assessment of capacity of existing infrastructure
- A review of the projected need for services
- A review of planned measures and a high level analysis of the adequacy of these planned measures to satisfy backlogs meet the projected needs

1.2 THE STUDY AREA

The CBD extension node encompasses around 15,7 km² and includes diverse land use types. It lies mainly to the north of the Msunduzi river and to the west of the N3 highway, although there are portions of the zone that extend to the south of the Msunduzi and to the east of the N3.

In addition to the historical CBD area, the extension zone includes the area between Ohrtmann Road and the Msunduzi river (Newton Road residential area and Wiganthorpe Industrial Area), Motor World and Bird Sanctuary Site (west of the N3), the showground area of the Royal Agricultural Society (RAS), Town Hill Hospital, Voortrekker High School and the Mayor's Walk area as far westwards as the boundary of the National Botanical Gardens, the prison in Foundry Road, Napierville and the railway workshop area. To the east of the N3 the CBD extension node includes the Midlands Mall and wooded area below Melsetter Road and Chasedene to the north.

To the south of the Msunduzi the zone encloses the area between the Msunduzi and McAlister Avenue, College Road, Alexandra Road, Woodhouse Road and Darvill Road to the south. This

includes Maritzburg College, the Oval, Harry Gwala stadium, Woodburn Rugby Stadium, Collegians Grounds and neighbouring residential area, Merchiston Primary School and all surrounding parks and sportsfields, the Geere Street and Payn Street commercial areas.

This area has been extended, for purposes of the sectoral study, as follows:

- in respect of water supply; to include the water source and connecting infrastructure up to the boundary of the study area
- in respect of sanitation; to include the outfall sewers and the wastewater treatment facilities at Darvill Wastewater Treatment Works outside of the study area

1.3 SECTORAL PROCESS AND METHODOLOGY

The major stakeholders in the field of water supply and Sanitation in Msunduzi are the Msunduzi Municipality (through the Water & Sewerage Department) and Umgeni Water. The Responsible department heads of the two major stakeholders were consulted at the outset of the study and delegated tasks to various officials in the answering of questions and provision of information.

The stakeholder engagements are reflected in Tables 1-1 to 1-3 following.

Table 1-1: Officials consulted at Msunduzi Municipality

Name of Official:	Function/ Department:	Date of Contact:	Outcome:
Dhabendra Ragoonandan	Water & Sewerage Dept	2013-04-23 at 08h30	He has been briefed by Mr Sivparsad. However he is not personally aware of the latest status in bulk water supply. He will organize a meeting for me with Nithia Pillay and Clifford Enoch.
Clifford Enoch	Water & Sewerage Dept	Visit morning of 2013-04-24	Clifford checked that information transfer is taking place
Brenden Sivparsad	Water & Sewerage Dept: Process Manager	Visit morning of 2013-04-24	Brenden checked that information transfer is taking place
Anesh Sewparsad	Water & Sewerage Dept:	Visit morning of	Discussed supply capacities and supply figures for Reservoirs servicing CBD. Anesh

Name of Official:	Function/ Department:	Date of Contact:	Outcome:
	Monitoring Section	2013-04-24	downloaded 12 months monitoring data for Symons Res from SCADA for my use. Anesh confirmed that no data are presently available for Mason's Reservoir due to vandalism of equipment (Res is temporarily out of commission and flow is being bypassed via Langenhoven BPT).
Kishal Rajkumar	Water & Sewerage Dept: Drawing Office	Visit morning of 2013-04-24	Kishal assisted me with locating relevant Water Services Record Drawings (dating up to the 1970's but not more recent). Kishal confirmed that the municipality has no design drawings nor updates to the records dating to the period between the 1970's and the present.
Dhabendra Ragoonandan	Water & Sewerage Dept	2013-04-25 at 08h30 (E-mail) Tel call at 15h00	The E-mail listed information gaps to be filled with respect to Wastewater Treatment Dhabendra referred me to the Consulting firms GOBA, TLS Consultants and Sukuma Consulting Engineers
Loven Pillay	Water & Sewerage Dept- Monitoring section	2013-04-26 Tel call at 08h30 Email data	Explanation of 2012 Symons Res configuration and monitoring data, download from SCADA and mailed historical Masons Res data

Table 1-2: Officials consulted at Umgeni Water

Name of Official:	Function/ Department:	Date of Contact:	Outcome:
Stephen Burke	Engineering Design section, E&SS Dept.	2013-04-23 at 09h00	Steve recommended that I contact Kevin Meier (Manager, Planning).
Kevin Meier	Manager, Planning Dept.	2013-04-23 at 09h30 (email)	Kevin detailed Gavin Subramanian to liaise with me Kevin followed up with me on the data collection during my visit to UW

Name of Official:	Function/ Department:	Date of Contact:	Outcome:
			on 2013-04-24
Gavin Subramanian	Engineer, Planning Dept.	2013-04-23 at 10h30	Gavin briefed me on the framework for the Msunduzi South-Eastern Districts and referred me to the UW Infrastructure Masterplan for more details. On Darvill expansion he referred me to the Project Manager, Tim Cornish.
Tim Cornish	Project Manager for Darvill Expansion, Project Officer	2013-04-23 at 12h00 and visit on 2013-04-24 at 16h30	Tim informed me of the planned capacity increases at Darvill WWTW as follows: Present capacity: 65 ML/day Increase #1: to 100 ML/day by Dec 2015 – March 2016, with some components increased for ultimate 120 ML/day capacity Increase #2: to 120 ML/day by around Dec 2018 (exact dates to be determined later) Informed me of plans to reroute end of trunk sewer(s) to align with new position of Head of Works
Gavin Subramanian	Engineer, Planning Dept.	Visit 2013-04-24 at 11h30 and again at 16h00	Gavin referred me to JGP 2002 Msunduzi Bulk Water Masterplan for functional description of Msunduzi bulk water system. Gavin provided information on the routes of bulk water supply into PMB CBD from UW's Inland System via Msunduzi Reservoirs. Provided confirmation of details of UW's supply into South Eastern Districts
Mbali Njoko		2013-05-03 E-mail and visit to UW at	Provided detailed data on Ambleton pipeline, Ashburton pipeline & 63 Pipeline

Name of Official:	Function/ Department:	Date of Contact:	Outcome:
		15h30.	

Name of Consultant:	Firm:	Date of Contact:	Outcome:
		2013-05-09 at 16h00 visit	

Table 1-3: Members of Consulting Firms consulted

Name of Consultant:	Firm:	Date of Contact:	Outcome:
Presh Jangali	Sukuma Consulting Engineers	2013-04-25 at 15h30	Presh informed me their work was for the property developer Cherry Moss. He informed me that the Mpushini Business Park development has since been cancelled and the land is to be auctioned off. He briefed me on the sewer reticulation system, sewage pumpstation and WWTW serving the approx. 150 properties in Lynnfield Park.
Dominic Collett	Royal HaskoningDHV	2013-04-25 at 15h30	Dominic out of office until Monday 29 April. Shian or Brandon to phone me back.
Sthembiso Khumalo	TLS Engineers and Project Managers	2013-04-25 at 15h45	Sthembiso out of office until Monday 29 April. To contact Sthembiso via Cell. He will email sthembiso@tlsengineers.co.za
Tex Westgate	GOBA	2013-04-25 at 16h00	Tex is out of office. To phone back tomorrow.
Tex Westgate	GOBA	2013-04-26 at 08h30	Tex contacted me back to confirm information requirements
Sthembiso Khumalo	TLS Engineers and Project Managers	2013-04-27 at 17h30	Sthembiso contacted me back with the Final Report of the 2010 Msunduzi Wastewater Treatment Plan
Tony van Schijndel	Jeffares & Green	2013-05-08 & 2013-05-09 (phone calls)	Tracked existing copy of 2002 Bulk Water Services Master Plan Report. Reviewed report at J&G library.

1.4 SOURCE DOCUMENTS REFERRED

Reports referred to:

- Pietermaritzburg City Bulk Water Master Plan, Jeffares Green Parkman Consultants, February 2002, Msunduzi Municipality
- Finalisation of Water Master Plan, HR Africa / Ninham Shand, November 2004
- Umgeni Water Infrastructure Master Plan, 2012
- Finalisation of Bulk Sanitation Master Plan, HR Africa / Ninham Shand, November 2003
- Wastewater Treatment Plan Report, 30 September 2010, TLS Civils & Project Managers, Ziyanda Consulting, Liebenberg, Jenkins & Partners, 2011

Plans referred to:

- Plans and Schematics in the Umgeni Water Infrastructure Master Plan, 2012
- Various maps and drawings of the water reticulation network at the Msunduzi Municipality Water & Sewerage Department
- Record drawings held at the Drawing Repository, Msunduzi Municipality Water & Sewerage Department
- Sewer network layout plan produced by Royal HaskoningDHV under the Msunduzi Municipality project: 'Monitoring and Reduction of Storm Water Inflow into Sewers in the Msunduzi Municipality area of Jurisdiction' and submitted to Msunduzi Municipality as an Annexure to the Stormwater Infiltration Report of March 2013

2 POLICY ENVIRONMENT

2.1 LEGISLATION/POLICY

The pertinent aspects of the regulatory framework for Water Supply and Sanitation were reviewed by Consultants TLS Civils & Project Managers, Ziyanda Consulting & Liebenberg, Jenkins & Partners and are presented in their 2011 Wastewater Treatment Plan Report.

2.1.1 Constitution

The Constitution of the Republic of South Africa (Act 108 of 1996) states that the objective/mandate of local government is to ensure the provision of services to communities in a sustainable manner (Clause 152.1b). One such service is the provision of potable water and sanitation services, which is vested in local government (Schedule 4A and 5A) and everyone has the right to have access to sufficient water (Clause 27.1b).

2.1.2 National Water Act

The National Water Act (Act 36 of 1998) sets the tone for ensuring that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account the following factors, amongst other

- Meeting the basic human needs of present and future generations.
- Promoting equitable access to water resources.
- Promoting the efficient, sustainable and beneficial use of water in the public interest.
- Providing for growing demand for water use.

2.1.3 Water Services Act

The Water Services Act (Act 108 of 1997) legislate the municipal function of ensuring provision of water supply and sanitation. The main objects of the Act are to provide for

- The right of access to basic water supply and the right to basic sanitation necessary to secure sufficient water and an environment not harmful to human health or well-being.
- The setting of national standards and norms and standards for tariffs in respect of water services.
- The gathering of information in a national information system and the distribution of that information.
- The accountability of Water Service Providers (WSP's).
- The promotion of effective water resource management and conservation.

Section 9(1) of the Water Services Act (1997) defines the service level standards that every citizen is entitled to as follows:

Minimum standard for basic sanitation services;

- The provision of appropriate health and hygiene education; and
- A toilet which is safe, reliable, environmentally sound, easy to keep clean, provides privacy and protection against the weather, well ventilated, keeps smells to a minimum and prevents the entry and exit of flies and other disease carrying pests.

Minimum standard for basic water supply services;

- The provision of appropriate education in respect of effective water use; and
- A minimum quantity of potable water of 25 litres per person per day or 6 kilolitres per household per month at a minimum flow rate of not less than 10 litres per minute within 200m of a household; and with 98% effectiveness (i.e. no consumer is without a supply for more than seven full days in any year)

2.1.4 Municipal Structures Act

The Municipal Structures Act (Act 117 of 1998, as amended in 2000) provides for the establishment of municipalities in accordance with the requirements relating to categories and types of municipality and the division of powers and functions between municipalities who have concurrent jurisdiction (category B and C).

The Act gives district municipalities (DMs) the powers and functions to perform the Water Service Authority (WSA) function as contained in the Water Services Act, but the Minister of Provincial and Local Government may authorise a local municipality, after consultation, to be a WSA.

2.1.5 Municipal Systems Act

The Municipal Systems Act (Act 32 of 2000) provides for the core principles, mechanisms and processes to enable municipalities to move progressively towards the social and economic upliftment of communities. It has the following stipulations regarding provision of water services:

- Differentiation between authority and provider functions of a municipality
- Institutional forms that may be utilised for the delivery of municipal services, such as municipal entities, which include multi-jurisdictional service utilities and service utilities established through bylaws.

2.1.6 Municipal Finance Management Act

The Municipal Finance Management Act (MFMA), (Act 56 of 2003), aims to ensure sound and sustainable management of the financial affairs of municipalities; establish treasury norms and standards for the local sphere of government; and provide for matters connected therewith.

2.1.7 National Water Resource Strategy

The National Water Resource Strategy (NWRS), defines the framework for managing water resources and defines the three fundamental objectives grounded in the provisions of the Bill of Rights. These are:

- To achieve equitable access to water
- To achieve sustainable use of water by making progressive adjustments to water use with the objective of striking a balance between water availability and legitimate water requirements
- To achieve efficient and effective water use for optimum social and economic benefit.

2.1.8 Strategic Framework for Water Services

The Strategic Framework for Water Services (SFWS), approved by Cabinet in September 2003, addresses policy and strategic issues in the sector, and provides a comprehensive framework for water services implementation.

The SFWS defines the institutional status quo and challenges in the sector and commits the sector to a process of institutional reform of water services provision, based on the following key objectives:

- Ensure the provision of an appropriate level of water and sanitation services which are sustainable to all households in South Africa and to implement the free basic water and sanitation policies effectively and efficiently.
- Improve the performance of WSP's.
- Improve the financial viability and sustainability of the water services sector by significantly enhancing revenue collection and improving consumer management.
- Use existing capacity, skills and resources in an integrated and optimal way and to attract, develop and retain the necessary professional and technical skills, and improve employment and gender equity.
- Improve the efficiency of water use to ensure the wise use of the scarce water resources through appropriate demand management and conservation initiatives.
- Improve the regulation of WSP's to ensure technical and environmental standards are met, services are provided efficiently and services are appropriately priced.

The following key objectives can be gleaned from the legislative and policy framework:

- Executive authority for the sustainable provision of water services is vested in local government (generally District Municipalities but in a limited number of cases Local Municipalities (as is the case with Msunduzi Municipality)
- National water resources must be used efficiently, sustainable and beneficial in an equitable manner
- The promotion of effective water resource management and the efficiency of water use to ensure the wise use through appropriate demand management and conservation initiatives

2.2 KEY DEVELOPMENT PRINCIPLES/DIRECTIVES

There are certain aspects of the policy framework that need to be given attention in the context of municipal functions to ensure sustainable service provision in the Municipality. The Strategic Framework for Water Services (Sept 2003) mandates Institutional reform to use existing capacity, skills and resources in an integrated and optimal way and to attract, develop and retain technical skills, furthermore that alternative mechanisms for providing services must always first consider internal mechanisms. In this light we wish to highlight the importance of Council prioritising both new service delivery and the maintenance and operational functions of existing services. For this to be sustainable the retention and development of key technical staff is required as well as the introduction and implementation of systems for proper and effective record keeping and accessibility and security of archived data.

3 ASSESSMENTS

3.1 RAW WATER SOURCE AND WATER PURIFICATION

Msunduzi Municipality purchases its entire purified water requirements from Umgeni Water. The primary bulk water system supplying Msunduzi is the Upper Mgeni System. This is operated by Umgeni Water as the 'Izintaba' or Inland System. The source of raw water for the supply to Msunduzi is Midmar Dam. The yield of the dam itself (at 99% assurance of supply) is 322,5 MI/day. However this yield has been augmented by the Mooi-Mgeni Transfer Scheme (MMTS-1) and will be further increased to 476,2 MI/day once Spring Grove dam and the second phase of the transfer scheme (MMTS-2) is commissioned.

Water is purified at the Midmar WTW (existing capacity 250 MI/day, planned extension to 375 MI/day) and at the DV Harris WTW (capacity 110 MI/day, excluding a 30 MI/day DAF plant). These two water works together will have capacity to purify the entire 99% assured yield of Midmar dam of 476 MI/day that will apply following the implementation of Spring Grove dam and MMTS-2. Part of this water is consumed upstream of Msunduzi Municipality, with uMgungundlovu District Municipality.

Potable water from Midmar WTW is conveyed through the Midmar tunnel with a capacity of 330 MI/day. This water is not solely dedicated for Msunduzi however, and is shared with uMgungundlovu DM and eThekweni Metro. As of October 2011 the demand off the Upper Mgeni System was 300,5 MI/day and was shared between

Msunduzi Municipality	(58%)
eThekweni Metropolitan Municipality	(29%)
uMgungundlovu District Municipality	(13%)

The balance of supply will change as eThekweni implements the increased capacity of the Western Aqueduct in order to reduce pumping of supply from the Durban Heights WTW to the Durban Outer West region of Cato Ridge to Hillcrest and other areas presently supplied from the Durban Heights WTW.

The increased yield of Midmar dam following MMTS-2 will not be adequate for these greater demands within eThekweni, however, and further water resources will need to be developed to serve the increasing water needs of eThekweni Municipality. These developments will need to be outside of the Mooi-Mgeni system and the leading candidate scheme is the Mkomazi Water Project (MWP). It is not expected that this scheme can be commissioned before 2023.

The specific part of the Upper Umgeni system relevant to supply to Msunduzi is the sub-system Midmar WTW to Umlaas Road Reservoir, which is centered around the 61 pipeline. This pipeline was commissioned in 1981 and conveys water from the DV Harris Waterworks via Worlds View & HD Hill Reservoirs to the Umlaas Road Reservoirs. The 61 pipeline is gradually being duplicated to increase conveyance capacity to the upstream controlled supply limit of 330 MI/day.

3.2 WATER RETICULATION NETWORK

Msunduzi Municipality purchases bulk purified water at various points of sale and distributes the water via its own bulk distribution network to a system of municipal reservoirs, from where it is drawn by the diverse parts of the reticulation network. Each major reservoir commands and defines one or more reticulation zones served from the reservoir and used as discrete water balance accounting units.

The information in this section is partly drawn from the 2002 bulk water master planning report produced by Jeffares Green Parkman Consultants (JGP) and supplemented by study of the water record drawings, reservoir inlet and outlet configurations and data from the Monitoring section of the Water and Sewerage Department. The 2002 Master Plan exercise was conducted as part of the creation of the Water Services Development Plan (WSDP) for the then Pietermaritzburg-Msunduzi TLC, as required by the Water Services Act and mandated in the Council's Co-Ordinated Policy Framework Document. Project Management for the formulation of the WSDP was provided by HR Africa Consulting¹.

Water for the supply of the central area of Msunduzi CBD and surroundings is drawn from the Balancing Reservoirs at the old HD Hill Water Works situated on the ridge near Signal Hill. These are known as the 'Balancing Reservoirs' and are presently owned by Umgeni Water although negotiations are underway for these to be taken over by municipality. The Balancing Reservoirs have a combined storage capacity of 2 x 23,4 MI and supply the Symons, Haythorn, Masons and Bisley reservoirs and the Masons Industrial Break Pressure Tank (BPT) as well as the 'Balancing Zone' directly. The supply to the CBD is via the Masons Reservoir/Langenhoven BPT and via Symons Reservoir.

Masons Reservoir has a capacity of 9,2 MI but is presently (April 2013) out of service and supply is being bypassed via the Langenhoven BPT. Masons Reservoir/Langenhoven BPT is

¹ Pietermaritzburg City Bulk Water Master Plan, Jeffares Green Parkman Consultants, February 2002, Executive Summary

supplied from Balancing Reservoirs via 2 No. pipelines (DN250 and DN600) with a combined maximum allowable flow (at $v=3\text{m/s}$) of 995 l/s (equivalent to 86 MI/day over 24 hours). Outlets from Mason's Reservoir distribute water to the Oribi and Bisley reservoirs in the South of the city as well as directly supplying the Mason's Reticulation Zone. Around 52% of the flow into Mason's reservoir during 2001 was routed onwards to Bisley Reservoir.

The supply zones serviced from Masons Reservoir are as follows. Consumptions stated below refer to consumer account details for the period Sept 1999 to August 2000:

- Masons' No. 1 Zone comprises the CBD bordered by the railway, (west of) Peter Kerchhoff street and (north of) Berg Street (consumption: 31,5 MI/month).
- Masons' No. 2 Zone comprises the SE areas of the CBD bordered by (south of) Berg Street, (west of) Peter Kerchhoff street, the river and the railway (40% of CBD) (consumption: 91,8 MI/month).
- Masons' No. 3 Zone comprises Napier Hospital, Napierville and parts of Prestbury (consumption: 45,1 MI/month).

The above three supply sub-zones together constitute the western part of the CBD Extension Zone. Total 1999/2000 consumption out of Masons Reservoir was 168,4 MI per month or an average 5,6 MI/day. Monitoring data for 2005/06² (the last year for which monitoring equipment was functional) showed an average consumption of 6,8 MI/day for the same area, representing a growth of 22% over the intervening 6 years (growth rate of 3,3% per annum).

Symons Reservoir is a 24,7 MI capacity storage. The main supply route to Symons is from Clarendon Reservoir via Wembley BPT by means of a DN600 pipeline. This pipeline route has a combined maximum allowable flow (at $v=3\text{m/s}$) of 848 l/s (equivalent to 73 MI/day over 24 hours). There is also a second supply route to Symons Reservoir from the Balancing Reservoirs via a DN375 steel main.

The Symons Zone is a large zone including the majority of the CBD. Symons Reservoir supplies four reticulation zones, as listed below, each via a BPT. Consumptions stated below refer to consumer account details for the period Sept 1999 to August 2000:

- Symons No. 1 Zone comprises Athlone (consumption: 15,6 MI/month).
- Symons No. 2 Zone comprises Clarendon (consumption: 14,4 MI/month).

- Symons No. 3 Zone comprises the residential area of lower Howick Road and the CBD bordered by the railway, Chief Albert Luthuli Road and Peter Kerchhoff Street (consumption: 58,6 MI/month).
- Symons No. 4 Zone comprises Chase Valley, Montrose, Wembley and Northern Park as well as the CBD east of Chief Albert Luthuli Road (consumption: 186,3 MI/month).

Symons No. 3 Zone and parts of Symons No. 4 zone constitute the northern supply areas of the CBD Extension Zone. Total 1999/2000 consumption out of Symons Reservoir was 275 MI per month or an average 9,1 MI/day. Monitoring data for 2012/13³ showed an average total consumption out of Symons reservoir of 16,6 MI/day, representing a growth of 82% over the intervening 13 years (growth rate of 4,7% per annum).

Assuming that 90% of the supply to Symons No. 3 Zone and 60% of the supply to Symons No. 4 Zone is consumed in the CBD area, it is estimated that the supply to the CBD extension zone in 1999/2000 was around 165 MI per month or an average 5,4 MI/day. The monitoring data for 2012/13 reported metered flows at Symons inlets 1-1 & 1-2 and at outlets 1-3, 1-4, 1-5 & 1-6. The relation between the presently numbered outlets with the zone numbers previous reported in the 2002 Master Plan report is not apparent and correlation was not attempted.

Taking the accumulated supply from the Masons reservoir and the calculated portion from the Symons Reservoir the total supply to the CBD extension area in 1999/2000 is calculated to have been 11 MI/day. This was around 15% of the estimated total water supply to the combined municipal area in 1999/2000.

3.3 SEWER RETICULATION NETWORK

The CBD zone traverses several sewer sub-catchments and is connected to various interceptors sewers that traverse and border the area. The various catchments and the interceptor sewers that services them, are described in the paragraph below. Ultimately, however the interceptors converge, towards the south-east side of the zone, into a single trunk sewer that delivers the combined flow to the Darvill Waste Water Treatment Works (WWTW) to the east.

The central CBD area is provided with a sewer reticulation network comprising generally 225mm diameter and, in places, 315mm diameter discharging, according to local topography, into one of the interceptor sewers bounding the CBD zone. Residential areas have reticulation

² SCADA Data exported as Excel spreadsheet by Loven Pillay & Anesh Sewpersad, Monitoring Section, Msunduzi Water & Sewerage Department. Data cover the period October 2005 to September 2006, the last year for which monitoring equipment was functional at this location

³ SCADA Data exported as Excel spreadsheet by Loven Pillay & Anesh Sewpersad, Monitoring Section, Msunduzi Water & Sewerage Department, data selected cover the period from 01 February 2012 to 31 January 2013

networks generally of 160mm diameter and above. Sewers have been sized according to the 'Red Book'⁴ based on estimates of sewage contribution per household or per square meter area of commercial and industrial properties.

Details of the sewerage of the CBD Extension zone are taken from the sewer network layout plan produced for the exercise: Monitoring and Reduction of Storm Water Inflow into Sewers in the Msunduzi Municipality area of Jurisdiction' and submitted to Msunduzi Municipality as an Annexure to the Stormwater Infiltration Report of March 2013⁵. Please refer to attached Figure showing the relationship between sewer catchments, interceptor and trunk sewers in the Msunduzi Municipality network.

- The Liberty Midlands Mall area and Chasedene, to the east of the N3 highway, as well as the Bird Sanctuary area, Motor World, Town Hill Hospital area and Northern Park to the west of the N3, are served by the Town Bush Interceptor (diameter 533mm). This is the smallest interceptor sewer and is already under capacity pressure due to extensive developments in the upper reaches of Town Bush road and Chase Valley that were not anticipated at the time of construction of the interceptor. The Town Bush Interceptor delivers into the Dorpspruit Interceptor
- The north-eastern part of the CBD (comprising around 70% of the central CBD area) as well as areas to the west (Mayors Walk, Railway Area and Napierville) are served by the Dorpspruit Interceptor (diameter 838mm) that lies along the route of the Dorpspruit to the north of the CBD.
- The Sherwood Road area to the south of Railway Street and the area around Moses Mabhida road as far south as the north bank of the Msunduzi, together with the southern city catchment (comprising around 30% of the central CBD area) and the Newton Road and Wiganthorpe Road areas, are served by the main Edendale – Darvill Interceptor sewer that lies to the south of the central CBD, along the northern bank of the Msunduzi. This interceptor is of diameter 1 500mm where it borders the central CBD.
- The extensive area of parks, sportgrounds and institutions to the south of the Msunduzi and bordered by Camps Drift Road, McAlister Avenue, College Road, Alexandra Road, Chief Albert Luthuli Street (south of Woodburn stadium),

Woodhouse Road and Darvill Road is served by the Trelawney Road Interceptor (diameter 686mm) that is connected into the Edendale-Darvill Interceptor immediately upstream of the inverted siphon adjacent to Scotts Bridge.

- The Woodhouse road area south of the Msunduzi is serviced by the Foxhill Interceptor (diameter 914mm).

With reference to Figure, and using the formulae adopted for calculating wastewater contributions from various sectors of the municipal economy, it has been calculated that an Average Daily Wastewater Contribution of 10,26 Ml/day is presently (2013) generated from the CBD expansion node, out of a total Average Daily Flow of 88,26Ml/day for the network (11,6% of total wastewater flow presently emanates from the CBD expansion zone).

3.4 TRUNK SEWERS AND BULK WASTEWATER TREATMENT FACILITIES

The Interceptor sewers of the Msunduzi Sewer Network, with the exception of the Lincoln Meade rising main, combine their flows into a single trunk main, constructed in 1982 under the Edendale to Darvill Trunk Sewer project. This sewer, in its downstream reach east of Boshoff Street, is generally of reinforced concrete construction in diameter 1800mm, although inverted siphons and 2 No. pipe bridges over the Msunduzi are constructed in steel pipe of varying diameters. The active 1982 trunk sewer was laid parallel to the original trunk sewer, completed in 1951, which is generally of 1500mm diameter. The last several kilometres of the older trunk sewer has been mothballed and is not in service.

A condition assessment of the sewer network, conducted in 2010, returned results that were generally favourable regarding the current condition of the Msunduzi sewer network. This exercise excluded the trunk sewer from its scope, however, due to the impracticability of interrupting services in the trunk sewer, together with difficulties of access and imposing health and safety hazards. An area of concern is the remaining lifetime of this very strategic asset, bearing in mind that the design lifetime is said to have been 30 years, which period has now elapsed. Although sewers are known to commonly outlast their design lifetimes there is particular concern around corrosion of steel pipeline elements in the inverted siphons that are laid beneath major roads and streams and the pipe bridge crossings of the Msunduzi.

Ultimately the carrying capacity of the main trunk sewer, adjacent to and downstream of the CBD, and the treatment capacity at Darvill WWTW, are the limiting factors to development within the sewered areas. Although presently adequate during dry weather flow conditions, the sewer becomes surcharged during and following storm events in the catchments. The same problem negatively affects the integrity of the Darvill WWTW and its treatment process. The status of measures to address these shortcomings are addressed in Section 4.

⁴ Guidelines for Human Settlements Planning and Design, CSIR Building and Construction Technology, 2005

⁵ Draft Stormwater Infiltration Report, Royal HaskoningDHV, 20 March 2013

4 KEY FINDINGS

4.1 BULK WATER SUPPLY CAPACITY

As shown in Section 3.1, of the total capacity of the Umgeni Water 61 Pipeline system supplying Msunduzi Municipality of around 330 Ml/day, only around 58% (around 191 Ml/day) is presently committed to supply to Msunduzi, the remainder being committed to uMgungundlovu District Municipality and downstream eThekweni Metropolitan Municipality. The available supply can be compared to a total municipal water consumption of around 180 Ml/day for Msunduzi.

It should also be noted that the proportion of system capacity dedicated to supplying Msunduzi Municipality is under pressure as demands within eThekweni Municipality's Durban Outer West Zone, and other zones supplied via the Western Aqueduct & 57 Pipeline continue to grow. This situation is only expected to improve in favour of balance of supply to Msunduzi once the Mkomazi Water Scheme is commissioned some 12 to 15 years hence.

4.2 WATER RETICULATION CAPACITY

To determine the utilization factor of the bulk conveyances it is necessary to compare the historical average consumption (such as that measured in 1999/2000), adjust for Unaccounted for Water (calculated as 31% in addition to sales volumes⁶ in 1999/2000), and compare this actual supply with the theoretical supply capacity of the mains feeding the reservoirs. When this calculation is carried out using 1999/2000 reported figures it yields the following results:

Masons Reservoir:

Calculated consumption: 134,4 l/s (Masons Zones: 64,1 l/s; Bisley Zones: 70,3 l/s)

Probable supply when adjusted for UfW ($\times 100/(100-31\%)$) 194,8 l/s

Theoretical maximum supply: 995 l/s

Utilisation factor in 1999/2000: 19,6%

⁶ Pietermaritzburg City Bulk Water Master Plan, Jeffares Green Parkman Consultants, February 2002, Executive Summary, ES-12. This figure quoting the contemporary BKS Water Loss Study. The figure of 31% based on sales volume seems unrealistically low.

Symons Reservoir:

Calculated consumption: 104,6 l/s (Symons Zones 1-4)

Probable supply when adjusted for UfW ($\times 100/(100-31\%)$) 151,6 l/s

Theoretical maximum supply: 848 l/s

Utilisation factor in 1999/2000: 17,9%

Bulk supplies to the reservoirs serving the CBD were thus operating well within their supply capacities in 1999/2000. Even given the growth within the municipal area since 2000, it is likely that the distribution system serving the CBD extension area is still operating within its capacity, provided that routine preventative maintenance and operational monitoring and control remain adequate. The adequacy of existing infrastructure may vary from area to area and an exercise to update infrastructure details, audit monitoring data and verify system capacity is recommended.

4.3 SEWER RETICULATION CAPACITY

The capacity of a sewer cannot simply be deduced from the sewer diameter as it is predominantly influenced by the grade at which the sewer is laid and this grade varies along the length of the sewer. The volume carried by a sewer at any point is also the accumulation of upstream contributions plus any inflow and infiltration that may be occurring less exfiltration to the surroundings. The calculation of sewer capacity available for the present CBD zone and its future development, is therefore a complex issue that cannot be considered in isolation from the other catchment areas of the sewer network.

The CBD zone is one of the lowest lying areas in the municipal sewer network and is therefore downstream to the other catchments. In every case the interceptor sewers convey substantial flow from upstream catchments before they reach the boundaries of the CBD. The remaining flow capacity in the interceptors thus depends on developments in the catchments upstream of the CBD.

In common with most municipalities, there is as yet no monitoring system for the Msunduzi sewers, although this is the subject of an ongoing project. From incidental observation however, it is known that at times, particularly following storm events, the trunk sewer downstream of the CBD is surcharged and this is a function of the degree of stormwater ingress. For much of the time the recommended flow depth to provide accommodation for system growth and flow peaks is also exceeded. In this sense optimum capacity is already exceeded. More analysis and modelling would therefore be required to develop a sound

quantitative assessment of the available and required capacity to meet projected demands for water borne sanitation.

4.4 BULK SEWAGE CONVEYANCE AND TREATMENT CAPACITY

Due to the large size of the trunk sewer, the flat grade at which it is laid and the density of buildings and infrastructure in the vicinity, there are limited options for increasing capacity. This would include the duplication of existing sewers, a highly capital intensive activity with a probable high level of disruption of services. Msunduzi Municipality is presently investigating the rehabilitation and re-commissioning of the older (1952) trunk sewer to provide (in parallel with the 1982 trunk sewer) additional capacity over the downstream reach of the system, thus relieving the problem of surcharge and overflow.

Under the exercise to investigate recommissioning of the 1951 trunk sewer, provision has been made to perform an internal inspection of the steel pipe section immediately upstream of Darvill WWTW. The information from this assessment may not be of direct relevance to the newer sewer, due to the different lining technologies used and the differing lengths of service. However it is recommended that, should the old pipe bridge be capable of being recommissioned, the opportunity be taken to perform an internal inspection of the newer trunk sewer thereby shedding light on the condition and remaining lifetime of this strategic asset.

Darvill WWTW is presently overloaded, with a daily dry weather flow that averages 80 MI/day compared to a calculated treatment capacity of 65 MI/day. The capacity limitation applies mainly to the process and aeration capacity of the Biological Nutrient Removal reactors. The capacity of the WWTW is presently under expansion from the nominal 65 MI/day to a new capacity of 100 MI/day. This will provide for roughly 25% excess treatment capacity over and above the presently level of dry weather flow but will not be adequate to deal with the magnitude of storm flows that result after storm events.

In order to address the problem of excessive storm water ingress to sewers the municipality has initiated the project; 'Monitoring and Reduction of Storm Water Inflow into Sewers in the Msunduzi Municipality area of Jurisdiction'. This project is scheduled to introduce by late 2014 a permanent real-time monitoring network of sewer flow, area-wise rainfall (plus sewage quality in certain areas), with corrective measures being implemented during 2014 and 2015 using the information generated by the monitoring network.

A view of the possible growth trajectories and proposed development plans for sewage treatment in Msunduzi is presented in the 2010 Wastewater Treatment Plant study⁷. It is expected that this outlook will be updated and consolidated under the present project for the expansion of the Darvill WWTW.

⁷ Wastewater Treatment Plan Report, 30 September 2010, TLS Civils & Project Managers, Ziyanda Consulting, Liebenberg, Jenkins & Partners, p37