MASILONYANA LOCAL MUNICIPALITY

WINBURG WATER BULK LINE SUPPLY- POTABLE WATER FROM SEDIBENG WATER RESERVOIRS TO WINBURG RESERVOIRS

PRELIMINARY DESIGN REPORT

November 2021

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WINBURG WATER BULK LINE SUPPLY
PRELIMINARY DESIGN REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abbreviations/ Acronyms/ Definitions

3LPE	Trilaminate polyethylene coating
AADD	Annual Average Daily Demand
AWWA	American Water Works Association
cml	Cement-mortar lining (for steel pipes)
DCP	Dynamic cone penetrometer
DN	Nominal diameter
DTM	Digital terrain model
DWA, DWS	Department of Water Affairs, Department of Water & Sanitation
EA	Environmental authorisation
GAADD	Gross Annual Average Daily Demand (= AADD + losses)
IS	Informal Settlement
kℓ	Kilolitre

km	Kilometre
kPa	Kilopascals
LDPE	Low Density Polyethylene (eg "Sintakote" steel pipe coating)
ℓ/s	litres per second
MLM	Masilonyana Local Municipality
m	Metre
m/s	Metre per second
m^3/s	Cubic metres per second
MV or LV	Medium Voltage (11kV) or Low Voltage (400kV or less)
MCC	Motor Control Centre (electrical switchboard for controlling motors etc)
mPVC	Modified Polyvinyl Chloride (plastic spigot and socket pipes)
Mℓ	Megalitre
Mℓ/d	Megalitres per day
mm	Millimetre
Mm^3/a	Million cubic metres per annum
masl	metres above sea level
MPa	Mega Pascal
PN	Nominal pressure
PTO	Permission to occupy
R/m	Rand per metre
s	Seconds
SCADA	Supervisory Control and Data Acquisition
SDD	Summer Daily Demand (= AADD x SPF)
SPF	Summer Peak Factor (as a multiplier of AADD)
WTW	Water Treatment Works

EXECUTIVE SUMMARY

Following the inception reports of the project done by the previous consulting engineers Proper Consulting Engineers, Umzuzo Infrastructure were appointed to execute stage 2 up to stage 6 of the project as per ECSA guidelines. It is well documented in previous reports (inception) that various bulk water supply options were presented, and the final option named B4-3, *Potable water from Sedibeng Water, upgrade and refurbish both Winburg and Theunissen Water Treatment Works* (Refer to Annexure A of Bulk Water Supply from Sedibeng Water Further Investigations into Options B2 and B4 dated 9 January 2017) was adopted.

The above-mentioned option included supplying water to Theunissen and Winburg from Sedibeng Reservoirs along R30 at coordinates 28°17'52.74"S (Latitude) and 26°45'57.69"E (Longitude). This B4-3 option was then the most preferred option due to its efficiency as it relied on purchasing water from Sedibeng Water to augment the existing supply from the existing Theunissen and Winburg WTWs.

A reconnaissance study report was carried out by Umzuzo Infrastructure to determine the need to augment the supply to Theunissen town and Masilo Township with water from the proposed project. After thorough analysis of available data and ongoing upgrade of the bulk supply from Theunissen WTW, it was then concluded that the proposed bulk pipeline should be from Sedibeng Reservoirs to Winburg Reservoirs only and exclude Theunissen/ Masilo Township.

The proposed bulk water pipeline is to be a 250mm PVC-U and Steel Material, 48.4km in length. The project will include a pumpstation at the Sedibeng Reservoir site, with two booster pumpstations along the 48.4km pipe length. The total project cost estimate including, construction and professional fees, land acquisition and other additional services is R386 565 260.59 **(Including VAT)**.

WINBURG WATER BULK LINE SUPPLY
PRELIMINARY DESIGN REPORT

1. INTRODUCTION

1.1. Project Background

Masilonyana Local Municipality (MLM) is currently experiencing problems with its bulk water supply with all the towns developing at a rapid pace thus the water demand increasing, therefore putting a strain on the current inadequate water supply. Masilonyana Local Municipality appointed Worley Parsons Consultants to carry out the all-town feasibility study during the 2012/13 Financial Year. The feasibility study was completed, and the projects identified on the feasibility study were prioritized and some were implemented.

The municipality appointed Proper Consulting Engineers under the Contract 2014/12/003 for the Winburg raw water bulk line supply. Masilonyana Local Municipality then ended the services of Proper Consulting Engineers with Proper Consulting Engineers having submitted an inception report to the municipality with detailed various water supply options.

Masilonyana Local Municipality appointed Umzuzo Infrastructure to implement the following scope from Stage 2 (Concept and Viability also termed Preliminary Design) up to stage 6 (close out):

1. Inception - (feasibility report by Worley Parsons and inception report done by Proper Consulting Engineers)
2. Concept and Viability (also termed Preliminary Design) – This report
3. Design Development (also termed Detailed Design)
4. Documentation and Procurement
5. Contract Administration and Inspection
6. Close out

1.2. Project Location and Study Area

Masilonyana Local Municipality is situated in the northern part of Lejweleputswa District (Refer to Figure 1 below), There are four towns under the local municipality namely: **Winburg/Makeleketla**, Theunissen/Masilo, Verkeerdevlei/Tshepong and Brandfort/Majamasewu.

The areas of supply, Winburg Town and Makeleketla Township is situated on the east of Masilonyana Local Municipality with central coordinates 28°31'9.36"S, 27° 0'40.49"E.

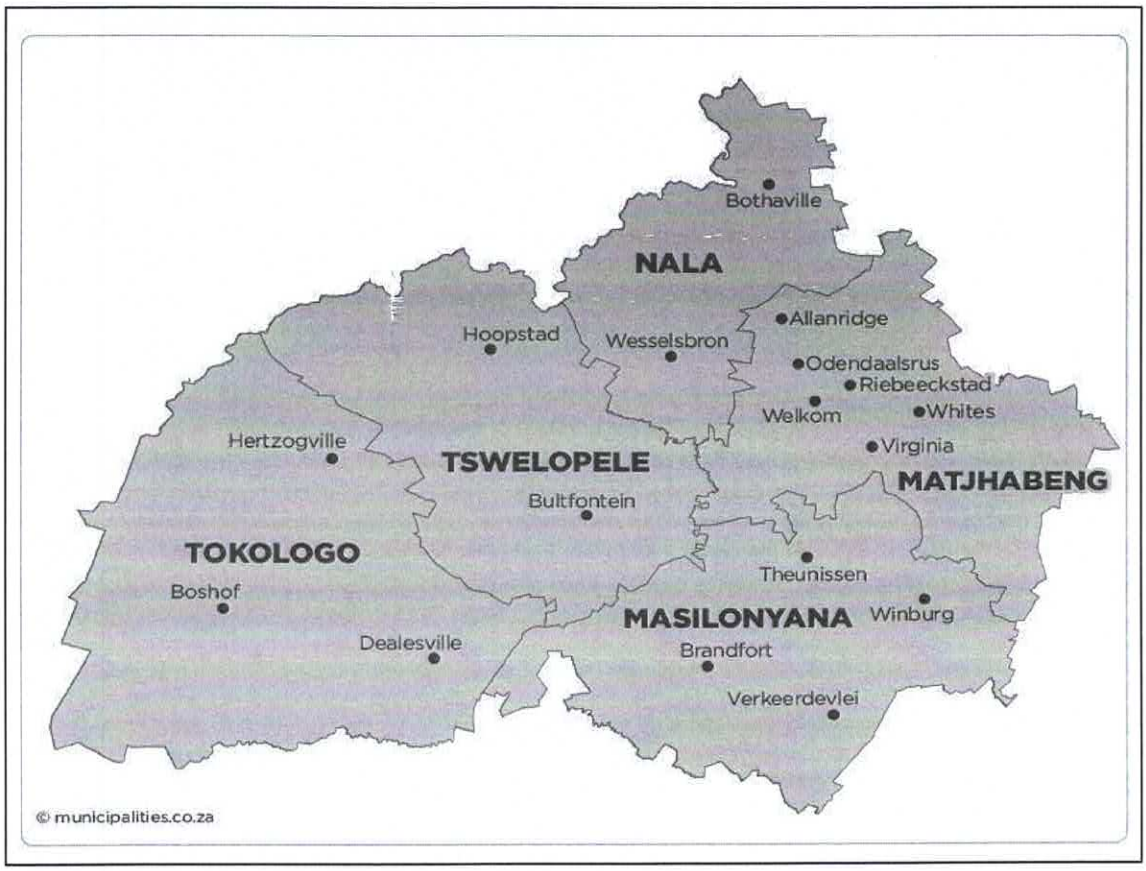

Figure 1: Winburg Town Locality

2. WINBURG DEMOGRAPHICS

2.1. Current Population and Future Demand Projections

The current and projected population of Winburg and Makeleketle using the growth rate of 1.07% per annum as per the Stats S.A website: (http://www.statssa.gov.za/?page_id=993&id=masilonyana-municipality). The projections are on 5 years basis from 2011 stats and projected up to 2045.

STATS SA 2021			Population Projections @1,07% growth rate per annum					
Area	Households	Population	2020	2025	2030	2035	2040	2045
Winburg Town	423	1373	1511	1594	1681	1773	1869	1972
Makeleketle	3051	12701	13978	14742	15548	16397	17294	18239
		TOTAL	15489	16335	17228	18170	19163	20210

Table 1: Population Projections

3. EXISTING WATER SUPPLY INFRASTRUCTURE

The below existing services currently supply Winburg and Makeleketle:

- Sedibeng Reservoirs (Supply Point)
- Winburg Reservoirs (4Ml)
- Winburg Water Treatment Plant (design capacity 2.5Ml/days)

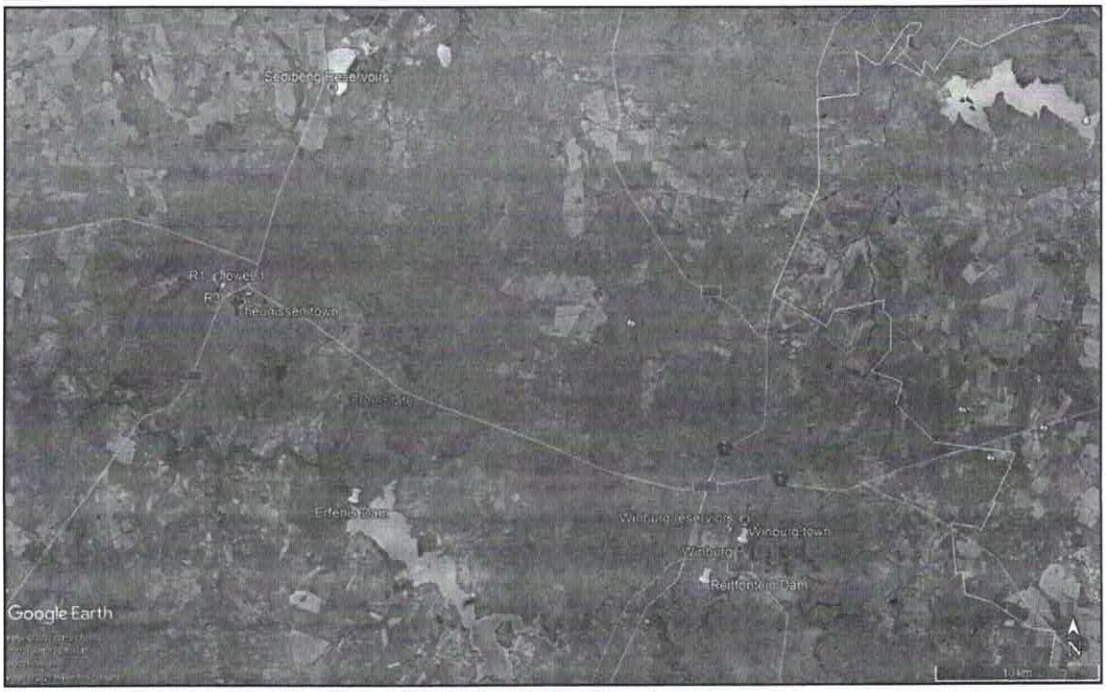

Figure 2: Geographic location of existing infrastructure

The geographic location of the existing infrastructure within the project areas is listed in table 2.

No.	Infrastructure	Location	
		Longitude	Latitude
1	Winburg WTW	26°59'30.77"E	28°33'8.76"S
2	Winburg Reservoirs	27°01'11.89"E	28°31'34.29"S
3	Sedibeng Reservoirs	26°45'57.69"E	28°17'52.74"S

Table 2: Geographic location of the existing infrastructure

3.1. Raw Water Supply

Raw water is currently extracted from Wolwas 1, water supply is sometimes interrupted during dry periods when the water level of the Wolwas is very low. During these dry periods, water is extracted from Rietfontein Dam near the WTW. Wolwas Dam No.1 has no significant catchment area and is supplemented from Rietfontein Dam when it is at full supply level, something which seldom occurs.

Wolwas Dam No.01 (C402/37) is an 8 m high earth embankment dam with a gross storage of 607 000m^3 and is owned by the Masilonyana Local Municipality. The dam is an off-channel dam located on the farm Rietfontein 5681 approximately 8 km South of Winburg, alongside the Laaispruit river at the head of the Rietfontein Dam (C402/38). It serves as a holding dam that supplies the Winburg WTW near Rietfontein Dam and is filled with water pumped from the Laaispruit river and gravitate to pumps at Rietfontein Dam which pumps to the WTW.

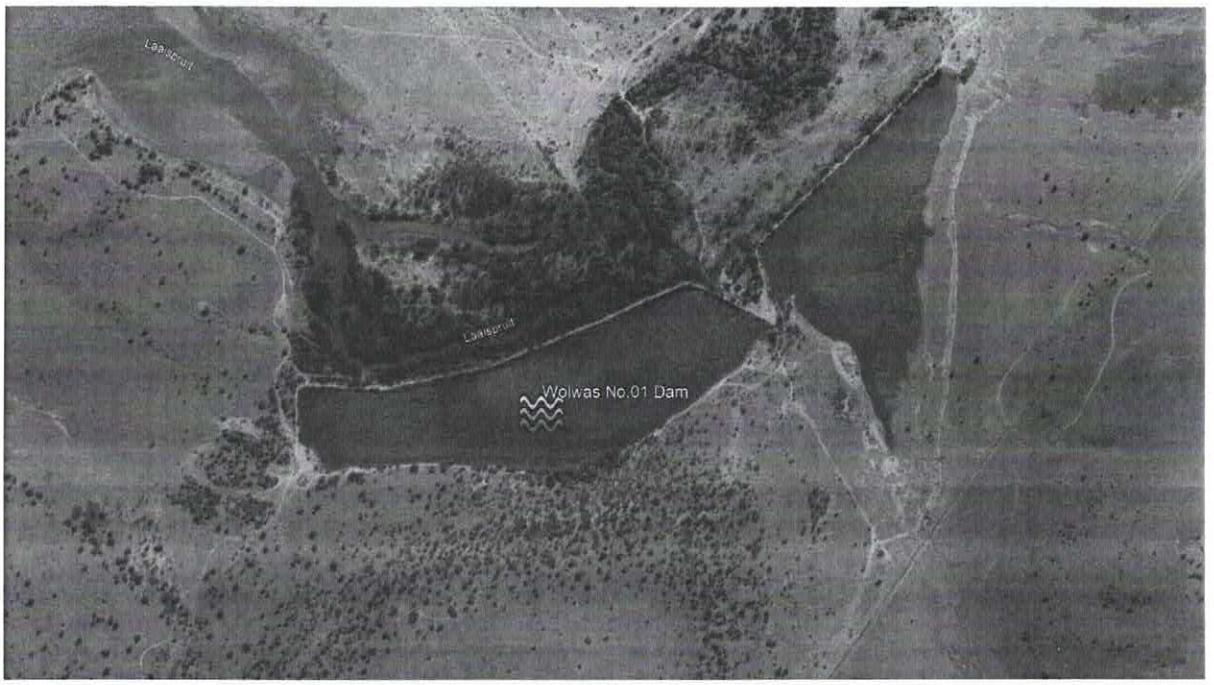

Figure 3: Wolwas Dam No.01

The alternative raw water supply in times when Wolwas Dam No.01 is dry (low water levels) is Reitfontein dam which has water quality that appears to be poor with algae visible on the water surface close to the dam wall. It appears that effluent from the Wastewater Treatment Works (WWTW) discharges into the dam and could contribute to the pollution seen in the dam. This poor quality of water requires intensive treatment to make it suitable for human consumption and meet the SANS 241 requirements.

The current allocation for Winburg from Rietfontein Dam is approximately 3.4 Ml/d (Worley Parsons, 2012). The current yield assurance confidence level is considered to be "Uncertain". Due to the severely deteriorating water quality and unreliable yield of the Rietfontein dam, it was deemed that the dam is not a suitable source of raw water and was consequently not included in the current investigation.

3.2. Winburg Water Treatment Works

The existing Winburg Water Treatment Works (WTW) is located next to the Rietfontein Dam and has a reported theoretic capacity of 2.5 Ml/d which is currently not achieved. The plant is of the conventional type and consists of a dosing facility, a flocculation channel, a sedimentation tank, three rapid gravity sand filters and a chlorination system.

Raw water from the Rietfontein Dam is pumped to the WTW via an inlet in the dam wall through a 150 mm diameter asbestos pipe (currently being replaced in an ongoing construction contract).

Clear water from the WTW is pumped to the service reservoirs utilizing two clear water pumps.

The above-mentioned treatment works are being refurbished under contract No. 2018/08/009- Upgrading and Rehabilitation of Winburg WTW: Civils, Mechanical/ Electrical engineering works,

Figure 4: Winburg WTW Layout

3.3. Storage of Potable Water

Potable water is stored in reservoirs located to the east of Winburg Town. These reservoirs have a combined storage capacity of 4ML which is not fully utilized (filled) due to the shortfall water supply from Winburg WTW. Presently only one reservoir (2Ml) is filled by the water from the WTW and provides only ± 10 hours storage at average annual daily demand.

4. WATER DEMANDS

The water demand has been calculated by using the estimated annual average daily demand (AADD-90 litres per capita per day for low income and 230 litres per capita per day for residential/medium to high income, typical REDBOOK values) and then multiplied by the projected 2045 population from Stats S.A 2011 population. Thereafter, the projected annual daily demand (PADD) is calculated by multiplying the AADD by 10% losses for conveyance losses and 20 % for seasonal peak periods.

The water demand for the proposed pipeline will include both residential areas and other facilities around Winburg Town and Makeleketle Township. Table 3 below shows the estimated current and future water demand for the Winburg area and Makeleketla township. This water demand includes other land uses such as clinics, shopping facilities, educational facilities, fuel stations etc.

Town	Population			2020 Water Demand			2045 Water Demand		
	2020	2045	Water Usage (l/c/d)	AADD (Kl/d)	GAADD (Kl/d)	SDD (Kl/d)	AADD (Kl/d)	GAADD (Kl/d)	SDD (Kl/d)
Winburg Town	1511	1972	230	347.5	382.3	458.7	453.5	498.8	598.6
Makeleketla township	13978	18239	90	1258.0	1383.8	1660.6	1641.5	1805.6	2166.8
Other land uses			132000	132.0	145.2	174.2	132.0	145.2	174.2
TOTAL	**15489**	**20210**	**132320**	**1738**	**1911**	**2294**	**2227**	**2450**	**2940**

Table 3: Water Demand Projections

From the above, the 2045 AADD will be 2.227Ml/d, therefore the required storage will be 4.454Ml. The current combined storage is 4Ml meaning that an additional 0.5Ml reservoir will be needed to maintain the 48hr storage needed by the year 2045.

5. PROPOSED INFRASTRUCTURE

Winburg town and Makeleketle township requires an additional bulk water supply to service the required demand. This proposed bulk pipeline is meant to augment the current supply from Winburg WTW by approximately 2Ml daily from Sedibeng Water Reservoirs.

The proposed scope of works for the Winburg Water Bulk Line Supply is as listed below:

- A proposed 250mm diameter UPVC and Steel pipes 48.4km long bulk pipeline from Sedibeng reservoirs to Winburg reservoirs.
- A proposed pumpstation at Sedibeng reservoir
- Two (2) proposed intermediate booster stations along the pipeline

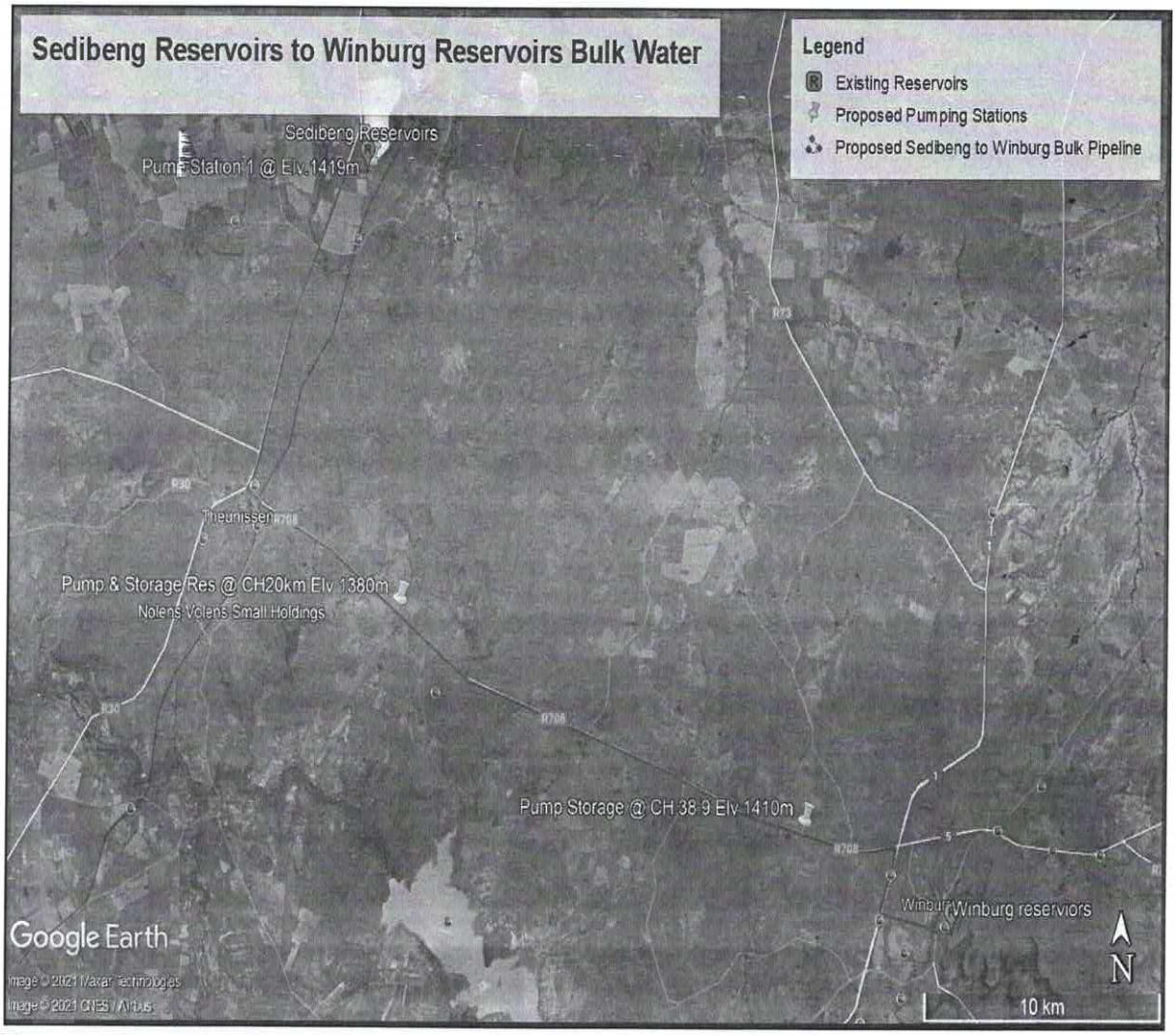

Figure 5: Proposed Bulk Pipeline

Flow from to		Proposed Pipe	Pipe Length	Estimated Pressure Class	Proposed flow rate (l/s)	Static Head (m)	Pumping Head (m)
Sedibeng Reservoirs Pump	Booster Pump No.01	250	20 000	Ductile Iron	34,4	32	36,42
Booster Pump No.01	Pump No.02	250	19000	UPVC CL20	34,4	33	97,5
Pump No.02	Winburg Reservoirs	250	9305,2	UPVC CL16	34,4	68	101,12

Table 4: Proposed Bulk Infrastructure Characteristics

The proposed pipe will comprise a 250mm diameter UPVC pipeline from class 16 to class 20 in places of low pressures (<20bars) and ductile iron pipes in high pressure regions (>20bars). This pipeline will start from the two (2) Sedibeng Water reservoirs (20Ml each) in Leeubult to Winburg Reservoirs (4Ml). This pipeline will augment the current supply and end shortage in Winburg Town and Makeleketle whereby water to reticulation is opened from 5 am to 5 pm daily.

5.1. Water Source

The water source for the augmentation of the bulk supply to Winburg Town and Makeleketla Township is from a connection to the two reservoirs in Leeubult which are each 20Ml each located in the following coordinates 26°45'57.69"E, 28°17'52.74"S.

5.2. Pump Station

A new pump station with duty- standby configuration is proposed at the Sedibeng Reservoirs with approximately 20km flat and undulating topography to a proposed 4hr storage reservoir.

5.3. Booster Pumps

Two (2) booster pump stations will be stationed along the pipeline both capable of delivering 73.6l/s to ensure a velocity of about 1.5m/s. A one duty and one standby approach is recommended. This will however be determined at the detailed design phase.

5.4. Storages

There will be 4 hours of storage tanks/reservoirs in the booster pump sites. This will allow for sufficient water for at least 4 hours if there is maintenance or other

unforeseen events in some sections of the pipeline. It will be determined in the detailed design stage whether to use concrete or steel structures for these two storages.

5.5. Bulk Pipelines

The design guidelines to follow in the next section is to be followed during design. The velocity within the pipelines would be limited to a maximum of 1.5m/s, this will reduce the friction losses and thus the pumping head. These pipelines will be of **UPVC** in low pressures and **ductile iron** pipes in high pressures

6. DESIGN PHILOSOPHY AND CRITERIA

All components of the bulk pipeline have been designed and sized to meet the projected demand for the period up to 2045 which 25 years also includes a maximum of 5 years planning and construction period. The criteria used in the design and sizing are based on the red book and DWA 2004 manual are as follows:

Design Horizon	Bulk Supply Lines- 20 years
House Occupancy	As per STATS S. A
Growth Rate: (up to Design Horizon)	As per STATS S. A
Design Water Usage:	230 l/c/d for low-income households 90 l/c/d for medium to high income households.
Design Loss Factors (LF):	Total conveyance losses, LF, = 10%
Gross Average Annual Daily Demand (GAADD):	GAADD = (1 + LF) * AADD
Summer Peak Factor:	SPF = 1,2
Summer Daily Demand, Bulk Supply Pipelines, (SDDpl):	SDDpl = SPF * GAADD
Storage Reservoirs;	48 Hrs * AADD Pumped from one source
Pipe depth of cover;	Minimum depth of cover to main pipelines: Generally: 600mm Under cultivated land: 900mm Road/Railway crossings: 1000mm
Pump Control:	i) Top inlet to storage. ii) High Pressure/ no flow cut-out switch for pumps – must always switch off even when on manual. iii) Time delay restart for pumps - 3 hours iv) Manual override switch for starting and stopping of pumps.

Table 5: Bulk Water Supply Design Red Book Design Criteria Guidelines

6.1. Cathodic Protection

A specialist service provider will be required to design and manage the implementation of a cathodic protection system should steel material be used for the pipelines. Cathodic protection will increase the life span and integrity of the pipeline.

6.2. Health and Hygiene Education Proposal

Health and Hygiene education form an integral part of any water supply. The lack of this education may lead to the spread of waterborne diseases. An Institutional and Social Development (ISD) practitioner will be engaged to conduct this task. Depending on the community involved, a combination or part of the following may be held for promoting community, household and personal health and hygiene:

- A "health day" event planned early in the project schedule to promote interest in the project and start delivering the health messages
- A school programme, which will include education of educators, learners and parents at both schools and clinics in the project area
- A house-to-house visiting programme to convey messages and assess the community's responses to the project and plan follow-up activities if required.

The methodologies to be used will emphasize involving and capacitating the local community as much as possible. This includes:

- Using and involving current community structures and leadership
- Utilization of local skills available
- Utilization of Community Health Workers subject to their availability
- Child-to-child promotion approach.

6.3. Proposed Job Creation Programme

Several temporary work opportunities will be generated during the construction of the works. There will also be a limited number of permanent work opportunities to later operate and maintain the installation. As much as job creation will be an important part of the project, reliable supply and efficient water use are perhaps the most important factors.

Engagement of youth at tertiary level to work as Resident and Assistant Resident Engineers, Clerk of Works and SMME Consultants and Contractors would create skills development, employment and empowerment. SMME consultants will do 40% of the consulting work in this project and 30% of the contractor's work will be targeted for the empowerment of local contractors.

6.4. Environmental Protection

An Environmental Management Plan (EMP) will be produced as part of the environmental assessment. Furthermore, an independent Environmental Officer will be employed during the construction to ensure compliance to the EMP on behalf of Masilonyana Local Municipality.

An Environmental Impact Assessment and Water use license will be required. A three-quotation system was undertaken. The following specialists namely: Indaloenhle, Turn 180 and Environmental Management Group (EMG). Environmental Management Group (EMG) is the preferred company to carry out the assessment.

6.5. Institutional Social Development (ISD)

This will be a big component of the project, particularly where the pipelines traverse through private land. An ISD practitioner will be appointed to undertake all ISD work that will be required throughout the project. MLM is to advise on their available list of suppliers on the preferred specialist to carry out the task.

6.6. Survey

A survey will be required for the route of the pipeline. The survey will capture all site features along the pipe route, including drainpipes, manholes, telephone and electric poles, cadastral and all other relevant information.

A three-quotation process has been undertaken and the most favourable quotation that fell within the initial estimated budget is that of M + N Geomatics. M + N Geomatics was instructed to survey the bulk infrastructure and have submitted all strip surveys and plans to Umzuzo Infrastructure and were utilised for the design of the pipeline.

7. DISPOSAL OF OTHER WASTE

No other wastes are anticipated from the infrastructure covered by this Preliminary design report as the water is from Sedibeng Water Reservoirs is treated as potable water.

8. POLLUTION RISK

The levels of pollution risks will be determined by the environmental assessment. It is however anticipated that only a basic assessment will be required for this project. An independent environmental practitioner will however ensure compliance throughout the project.

9. ESTIMATED COSTS

A summary of the estimated costs including direct and indirect costs, escalations, and VAT @15% for the proposed water bulk line is given in table 6 below:

TOTAL COST SUMMARY: WINBURG WATER BULK LINE SUPPLY		
Item	**Description**	**Amount**
CONSTRUCTION COST AND CONTINGENCY		
A	Construction Cost	R280 457 592,70
Sub-Total (Item A)		**R280 457 592,70**
PROFESSIONAL FEES AND DISBURSEMENT		
[redacted]		

Table 6: Total Cost of Infrastructure

9.1. Annual Operation and Maintenance Cost

As discussed in the specification's coordination meeting held at Sedibeng Water offices in Virginia on the 6th October 2021, an agreement between MLM and Sedibeng Water will be drafted whereby Sedibeng Water would manage the daily operations and all costs be incorporated in the proposed water tariff (currently R12.69/kl). The maintenance cost would then be billed/invoiced separately, and an invoice sent to MLM.

The final operations and maintenance cost will determine once the agreement has been drafted and approved between the two parties. This will be possible at the design development stage.

10. PROPOSED IMPLEMENTATION PROGRAMME & PROGRESS

A construction strategy plan showing the various tasks including construction has been compiled and outlined. The anticipated construction period is 18 months. Table 7 below gives the planned programme.

WINBURG WATER BULK LINE SUPPLY PROGRAMME & PROGRESS

Task Name	Duration (Months)	Start	Finish	% Complete Actual	Status & Comments
Phase 2-3B-Potable Water Supply from Winburg	**31**	**29-Mar-21**	**31-Oct-23**	**20%**	**In Progress**
Route location	1	24-May-21	30-Jun-21	100%	Complete
Preliminary Draft and Design	**7**	**01-May-21**	**30-Nov-21**	**100%**	**Complete**
Land Legal	4	01-Jul-21	31-Oct-21	98%	In Progress. 1 PTO outstanding, DWS to intervene and resolve the matter.
Town Planning	7	01-Jul-21	21-Jan-22	65%	In Progress
Confirmation of SG Diagrams	1	01-Jul-21	30-Jul-21	100%	Complete
Title deed & other processes	7	01-Jul-21	21-Jan-22	0%	To Be Done

Task Name	Duration (Months)	Start	Finish	% Complete Actual	Status & Comments
Conveyance	7	01-Jul-21	21-Jan-22	78%	To Be Done
Land Surveying	1	01-Jul-21	26-Nov-21	100%	Complete
Geotech Investigation	3	10-Jan-22	03-Mar-22	0%	To Be Done
EIA- Basic Assessment	8	10-Jan-22	30-Aug-22	0%	To Be Done, Request to DESTEA to have process simultaneous with construction
Detailed Design	**1**	**24-Jan-22**	**28-Feb-22**	**0%**	**To Be Done**
Document & Procurement	**2**	**01-Mar-22**	**29-Apr-22**	**0%**	**To Be Done**
Draft tender document	0,5	01-Mar-22	11-Mar-22	0%	To Be Done
Tender Process and Advertisement	0,75	14-Mar-22	08-Apr-22	0%	To Be Done
Evaluation and Adjudication	0,5	11-Apr-22	29-Apr-22	0%	To Be Done
Construction	**18**	**16-Jun-22**	**31-Oct-23**	**0%**	**To Be Done**

Table 7: Implementation Plan

11. CONCLUSION AND RECOMMENDATION

The augmentation of the potable bulk water supply in Winburg and Makeleketla with the proposed water bulk line supply from Sedibeng Water Reservoirs in Leeubult will ensure that the current water supply shortage is eliminated. Masilonyana Local Municipality (MLM) is currently experiencing problems with its bulk water supply with all the towns developing at a rapid pace thus the water demand increasing, therefore putting a strain on the current inadequate water supply with Winburg also experiencing water problems. This has led to MLM resorting to shutting water at the reservoir meter at 5 pm and opening at 5 am daily.

For rapid execution, it is also recommended that approval from the Department of Small Business Development, Tourism and Environmental Affairs (DESTEA) be obtained to enable construction to commence during the authorisation period of the environmental assessment.

Skills development, employment and empowerment are another key focus on this project, with a minimum of 30% of the contractor's work targeted for the empowerment of local contractors with the grades to be appointed will be determined by MLM during construction.

Other key considerations in this preliminary design are:

- Environmental compliance
- Operation and maintenance arrangements and agreements
- Institutional and management capacity

The total cost for the proposed Winburg Water Bulk Line Supply including direct and indirect costs, escalations and VAT @15% is approximately [redacted] (Including VAT).

The successful implementation of this project will ensure that Masilonyana Local Municipality has sufficient bulk water supply to Winburg for the next 25 years and possibly more.

APPENDIX A:

DRAWINGS