



PRELIMINARY DESIGN REPORT

UMDONI SOUTH BULK WATER AUGMENTATION



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EXECUTIVE SUMMARY

The Umgeni Water Masterplan details the constraints of the current South Coast Water System. Comparison of the existing system capacity with water demands indicated that the raw water resources are not aligned with the bulk supply and distribution infrastructure. The various schemes that augment potable water in various communities is consequentially strained and struggle to meet the demand of those respective communities. The UW Masterplan depicts systems as of October 2020 and the potential for growth in the upper and middle South Coast System over the next five, ten, fifteen, twenty and thirty years, respectively.

The South Coast Pipeline (SCP) Project was initiated to extend the supply of water to the South Coast Region. The project is implemented in a phased approach, with Phase 1 and 2a completed. SCP2a comes up to an offtake chamber before Kelso.

The South Coast Phase 2b project will consist of four components:

- Construction of a 2,7km pipeline from the off-take chamber at Scottburgh South Reservoir to the start of the existing Kelso-Pennington pipeline.
- Design and construction of a 5,35km pipeline from the Kelso off-take point to a termination point at the inland side of the N2, west of the Umdoni Reservoir.
- Design and construction of the Umzinto River bridge crossing (550m)
- Design and construction of a 635 m tie-in pipeline to Umdoni Reservoir.

The Umdoni South Bulk Augmentation Project will be connected to the Umdoni Reservoir once the first 2 components are completed.

The South Coast Phase 2b route will tie-in to the South Coast Pipeline and follows the SANRAL servitude along the N2 south to Umdoni. This pipeline will consist of an 800mm diameter NB Steel gravity pipeline with associated chambers and forms two parts extending southwards. An off-take will be provided for a connection to the Umdoni Reservoir in the vicinity of the Malangen off-take.

The second component will be the pipeline designed and constructed on behalf of UGU District Municipality. Provision will need to be made for a booster pump station where the SCP is extended further to Hibberdene.

TABLE OF CONTENTS

DOCUMENT CONTROL	i
EXECUTIVE SUMMARY	ii
TABLE OF CONTENTS	iii
TABLES AND FIGURES.....	vi
1 INTRODUCTION.....	1
2 BACKGROUND	2
2.1 Background and Overview.....	2
2.2 Project Location	2
3 PROJECT OBJECTIVES	4
4 OVERVIEW OF REGIONAL PLANNING STUDIES	5
5 SCOPE OF WORK.....	6
6 WATER SOURCE	7
7 EXISTING INFRASTRUCTURE	8
7.1 Water Treatment Works	9
7.2 Storage Reservoirs	9
7.3 Bulk Pipeline.....	9
7.4 Reticulation	9
7.5 Electricity Infrastructure.....	10
7.6 Road Infrastructure.....	10
8 ESTIMATED CURRENT AND FUTURE WATER DEMANDS	11
8.1 Design Philosophy.....	11
8.1.1 Design Criteria	12
8.2 Umdoni Project Area.....	15
8.3 Peak Demand and Peak factors.....	17
9 PROPOSED INFRASTRUCTURE	18
9.1 Zoning	18
9.2 Pressure Management.....	18
9.3 Secondary Bulk System Layout	19
9.4 Reservoirs	20
9.5 Pipelines	21
9.5.1 Pipeline diameter	21
9.5.2 Material Type Selection	22
9.5.3 Pipeline and joint testing.....	23
9.5.4 Erosion Control Measures	24
9.6 Pump Stations	24



9.6.1	OPTION 1: Two pumpstations between Umdoni Reservoir, Malangeni Reservoir D and Malangeni Reservoir E.....	25
9.6.2	OPTION 2: A single pumpstation pumping from Umdoni Reservoir to Malangeni Reservoir E	26
9.6.3	Summary of the pumpstation options	26
9.7	Reticulation	28
9.8	Metering	28
9.9	Valves and Other Chambers.....	29
9.10	Stream Crossings.....	29
9.11	Road Crossings.....	30
10	AS-BUILT INFORMATION	32
11	APPROVALS / AUTHORISATIONS	33
11.1	Environmental Management.....	33
11.2	Compliance with OHS Act	33
11.3	Department of Water Affairs.....	33
12	SUB-CONSULTANTS	35
13	CURRENT PROJECT STATUS	36
14	IMPLEMENTATION PROGRAMME	37
15	COST ESTIMATES.....	38
15.1	Umdoni Project Area.....	38
15.1.1	Pipeline and Reservoir Costing.....	38
15.1.2	Pumpstation Cost Estimate	40
15.2	Final Consolidated Cost	42
16	ENTERPRISE DEVELOPMENT.....	44
17	PROJECT CHALLENGES	45
18	PROPOSAL FOR THE PROJECT AREA	46
18.1	Umdoni	46
18.2	Malangeni	46
18.3	Mhlangamkhulu.....	46
18.4	Elysium, Ifafa and Bazley	46
18.5	GDP	46
19	CONCLUSION	48
	ANNEXURE A – SCHEMATIC OF EXISTING BULK WATER SYSTEM	2
	ANNEXURE B – DEMAND CALCULATION SHEET	3
	ANNEXURE C – PROPOSED BULK WATER SYSTEM	4
	ANNEXURE D – PUMP CALCULATIONS (OPTION 1)	5
	ANNEXURE E – PUMP CALCULATIONS (OPTION 2)	6

ANNEXURE F – ELEVATION PROFILE FOR PUMPING MAINS7

ANNEXURE G – FLOWS FROM PRIVATE ESTATES.....8

ANNEXURE H – RETICULATION WATER SYSTEM FOR GDP9



TABLES AND FIGURES

Table 1 Coordinates for project area.....	3
Table 2 Reservoir List and existing capacity	9
Table 3 Demand Calculations for the East Portion of the Project Area.....	12
Table 4 Demand Calculations for the West Portion of the Project Area	12
Table 5 Design Criteria	12
Table 6 Growth Rate per zone	13
Table 7 Design Water Usage per zone	14
Table 8 Umdoni House Counts	16
Table 9 Proposed Reservoir capacity.....	20
Table 10 Pipe Lengths for system upgrade	21
Table 11 Pipe Lengths for replacement	22
Table 12 Demands for metering zones for Umdoni Project Area	28
Table 13 Water Course Locations	30
Table 14 Road Crossing Locations	30
Table 15 Existing As-Built Information	32
Table 16 Authorities to provide comments.....	33
Table 17 Umdoni South Bulk Augmentation Project Programme	37
Table 18 Construction Value for the option of using uPVC pipe	38
Table 19 Construction Value for the option of using all steel pipes except for reticulation.....	39
Table 20 Costing for pumpstation option 1a : refurbishing the existing pumpstation	40
Table 21 Costing for option 1b: finding a new location for the Malangeni Reservoir D and a pumpstation.	41
Table 22 Costing for option 2: Pumping from Umdoni Reservoir to Malangeni Reservoir E.....	42
Table 23 Cost for the options as per the Preliminary Report recommendations	43
Figure 1 Umdoni Project Area	3
Figure 2 Mtwalume WTP	7
Figure 3 Umdoni WTP	7
Figure 4 South Coast System Schematic.....	8
Figure 5 Project Area Zoning	18
Figure 6 Bulk System Layout	19
Figure 7 Reservoirs that will be served by Umdoni Main reservoir.....	20

1 INTRODUCTION

UGU District Municipality appointed ENSync Engineers to provide professional services required for the design and implementation of the Umdoni South Bulk Water Augmentation Scheme.

This report covers the preliminary investigation, route selection, planning and costing for the level of design appropriate to make all decisions on feasibility and the selection of the most desirable project option for the implementation of the Umdoni South Bulk Water Augmentation Scheme.

2 BACKGROUND

2.1 Background and Overview

UGU Water Services Masterplan 2020-2025 identified that many secondary bulk pipelines and reservoirs were originally designed based on outdated capacity for 25 l/person/d which is now inadequate.

Urban secondary bulks and storage were designed for smaller communities which now require a pragmatic solution to upgrade which will align realistic supply with demand with a prioritization model to then implement upgrades aligned within the availability and timing of bulk water supply.

Umgeni Water is the primary Bulk Water Services Provider and regularly update an Infrastructure Masterplan 2020-2050 for the entire bulks supply network including the waterworks. A bulk water pipeline by Umgeni Water is under construction and it will supply Umdoni Reservoir with 6.67ML/day and this will be used to supply some communities currently supplied by Umzinto WTW and Mtwalume WTW to ease the demand. A water supply system will have to be designed and implemented from the Umdoni reservoir and supply water to the neighbouring communities.

ENsync Engineers were appointed on 1 Feb 2022 to plan and implement the Umdoni South Secondary Bulk Water Augmentation project. Meetings with UGU PMU, Area North Operations and Umgeni Water identified the scope for Umdoni secondary bulks augmentation to align with supply and demand.

2.2 Project Location

The project area comprises of nine communities namely Umdoni, Pennington, Kelso, Malangen, Sezela, Ifafa, Bazley and Elysium.

The project boundary for Umdoni South Bulk Augmentation Project was discussed extensively between ENsync Engineers and UGU District Municipality. ENsync Engineers presented UGU District with restrictions because of the water supply capacity and on the 6th of June 2023 the final decision was made pertaining to the project area boundary.

The project area is in the uMdoni Local Municipality within the UGU District Municipality in KwaZulu Natal. The project area can be accessed by travelling South along the N2 road from Durban past Scottburgh and Park Rynie. The project area falls on both sides of the N2 freeway – to be accessed by turning into the R102.

The co-ordinates for the project area are listed in table 1 below. These coordinates indicate the reservoir locations that service the communities.

Table 1 Coordinates for project area

	Latitude	Longitude	Local Municipality	District Municipality
Umdoni Reservoir Zone : Existing Res				
Umdoni Reservoir	30°22'30.70"	30°40'13.16"	Umdoni Municipality	UGU Municipality
Kelso reservoir	30°21'59.68"	30°41'58.41"	Umdoni Municipality	UGU Municipality
Pennington reservoir	30°22'43.80"	30°40'56.80"	Umdoni Municipality	UGU Municipality
Hilltop Reservoir	30°23'48.56"	30°40'17.94"	Umdoni Municipality	UGU Municipality
Bazley Reservoir	30°25'51.86"	30°39'44.40"	Umdoni Municipality	UGU Municipality
Ifafa Reservoir	30°27'22.51"	30°38'50.55"	Umdoni Municipality	UGU Municipality
Elysium Reservoir	30°28'23.37"	30°37'24.61"	Umdoni Municipality	UGU Municipality
American Board Reservoir	30°23'15.25"	30°38'29.84"	Umdoni Municipality	UGU Municipality



Figure 1 Umdoni Project Area

3 PROJECT OBJECTIVES

UGU Districts Municipality's objectives for the project are summarised as follows:

- The primary objective is to provide access to a potable water supply to the Malangeni area which is part of the project footprint.
- The secondary objective is to construct new infrastructure that will serve to satisfy the increasing water demand along the coastal areas within the project area.
- To reduce the water services backlog and uplift the standards of living of the communities in question.
- To provide an economically efficient solution to the water supply problem.
- To provide a level of service that will allow for a waterborne sanitation system in future.
- To provide employment for local labour through EPWP (Expanded Public Works Program).
- To provide and encourage skills development through intensive programmes directly involved in the planning, construction, and commissioning of the scheme.

4 OVERVIEW OF REGIONAL PLANNING STUDIES

The following pieces of information were received from the UGU District Municipality and its service providers:

- Billing information for the coastal communities
- Existing infrastructure GIS information (waterlines, pumpstations, WWTW and reservoirs)
- UGU Masterplan
- UW Masterplan
- Umdoni Land Use Schemes Clauses Report



5 SCOPE OF WORK

ENsync Engineers were appointed to provide professional consultancy services for the Umdoni South Bulk Water Augmentation Project as per the project area agreed upon with UGU District Municipality. The summarised scope of works, project milestones are as represented below.

- Inception
- Concept and viability
- Design development.
- Documentation and procurement
- Contract administration and inspection.
- Close-out report

The technical scope of works is the bulk water augmentation which includes the replacement of all pipelines between reservoirs in the Umdoni Municipality, the reservoir refurbishment and replacement, valves, meters, ancillary components and the replacement of the existing bulk water infrastructure, the complete upgrade of the entire system network within the project boundary. The upgraded associated infrastructure will have a design life of 30 years from construction completion.

Additional services as outlined below shall be executed in support of the project and such services are listed in the ECSA guidelines:

- Environmental Impact Assessment
- WULA
- Geotechnical Services
- Construction monitoring
- Topographical surveyor
- Occupational Health and Safety
- Institutional Social Development
- Investigation of available and necessary power supply

6 WATER SOURCE

The majority of the Umdoni system currently receives its water from Umzinto Water Treatment Plant. The Umzinto Water Treatment Plant receives its raw water from two sources. Water is either released into the Umzinto River from the Umzinto Dam, abstracted a few kilometres downstream through a sand abstraction system at Esperanza and pumped to the WTP. Alternatively, raw water can be pumped to the WTP directly from the E.J. Smith Dam situated on the Mzimayi River. Raw water can also be supplied from both sources simultaneously.

The design capacity of the Umzinto WTP is 13,6MI/day, with provision for an upgrade, which will bring the total capacity to 18.2MI/day. The temporary emergency scheme to augment the raw water supply from the E.J. Smith Dam was implemented by Umgeni Water during December 2014 as draught mitigation measure.

The Umdoni System is also supplied from the Mtwalume Water Treatment Plant, and that WTP receives its raw water from a sand abstraction system in the Mtwalume River. The design capacity of Mtwalume WTP has been upgraded from 4.5MI/day to 7.5MI/day. As with the Umzinto WTP, the Mtwalume WTP and bulk water supply infrastructure is owned by UGU District Municipality with Umgeni Water operating the WTP under a management contract.

The raw water supply is constrained by the run-of-river yield. The treated water is sold by Umgeni Water to UGU District Municipality "at the fence," and UGU District Municipality is responsible for the entire distribution network within the Mtwalume Supply System.

The area is currently served by a combination of yard connections, house connections and water being sources from watercarts provided by the Municipality. The existing system does not service the entire area due to infrastructure and capacity constraints on the background of an ever-expanding settlement and a growing demand for 'urban' level water services. The Malangeni area does not have any access to water and the coastal areas within the project scope have a water supply that is being strained due to the area development.

Figure 3 Umdoni WTP



Figure 2 Mtwalume WTP



7.1 Water Treatment Works

The water treatment works that service the Umdoni Project area are Mtwalume Water Treatment Works and Umzinto Water Treatment Works, and the implementation of the project will ease the demand from these Water Treatment Works.

7.2 Storage Reservoirs

Each community within the Umdoni Project area has a storage reservoir and some of these reservoirs receive water from Umzinto Water treatment works and some receive their water from Mtwalume Water Treatment Woks. Some pipelines in the system are gravity fed and some are serviced with the use of pumpstations.

The table below lists all the reservoirs within the project area and will be affected by the implementation of this project.

Table 2 Reservoir List and existing capacity

Reservoir List	Capacity kl
Umdoni Reservoir	1270
Kelso reservoir	260
Pennington reservoir	2900
Hilltop Reservoir	1000
Bazley Reservoir	1000
Ifafa Reservoir	1000
Ellysium Reservoir	5550
American Board Reservoir	500
Malangeni Res D	500
Malangeni Res E	500
Malangeni Res F	500
Malangeni Res G	500

7.3 Bulk Pipeline

The existing bulk water infrastructure is split into sections separated by the storage reservoirs. The material of the bulk pipeline is AC and uPVC, and the pipe sizes vary between 110mm diameter to 250mm diameter. The bulk pipeline will be replaced as part of the project scope as it has shown a level of deterioration and insufficiency.

7.4 Reticulation

The existing reticulation infrastructure spans for the whole project area but some pipes have not been servicing the areas due to capacity constraints. The condition of these reticulation lines is questionable and might also need to be replaced but remain outside the scope of works for this project. The project area which covers Ward 7 – 10 has a lot of illegal connections which led to the collapse of the system. The pipe material used for reticulation is HDPE and the pipe sizes vary from 25mm diameter to 75mm diameter.

7.5 Electricity Infrastructure

Existing electricity infrastructure covers the entire footprint of the areas under the scope of the project. It has been determined that there will be a need for pump stations as part of the solution development, any resultant power requirements will be further investigated as the design develops and is covered adequately.

7.6 Road Infrastructure

The project area is accessible by a combination of gravel and paved road network. It is likely that short connecting access roads may be required to facilitate construction of proposed works as well as for future operations and maintenance activities.

8 ESTIMATED CURRENT AND FUTURE WATER DEMANDS

The demand for the project area will be calculated based on the Annual Average Daily Demand (AADD) which will not only incorporate households, but also special institutions located within the project area such as schools, clinics, restaurants, business parks and so forth.

The water demand is calculated based on standard guidelines. In summary, demands shall be analysed as follows:

- Present demand – to be obtained from physical site counts based on cadastral layout and recent UGU District Municipality aerial photography.
- Future demand – site demands based on the planned land use zoning as well as population growth estimates based on Census statistics.

Umgenti Water Masterplan stipulates a supply at 30 years of 6,7Ml to the Umdoni Command Reservoirs to be distributed around the reservoirs in the project area. Once the future water demand calculations for the project area are done, it was determined that the demand for the project area was more than the UW supply.

The following decisions were made as a solution for the supply and demand balance of the project:

- Malangeni has been divided into 3 zones, where zone 1 is the Mhlangamkhulu area and this area will continue to receive supply from Umzinto WTW.
- Elysium, Bazley and Ifafa are currently being served from Mthwalume WTW and they will continue to receive supply from that Water Treatment Works. The Umdoni South Bulk Water Augmentation project will replace the pipeline, refurbish the reservoirs and all associated infrastructure in these areas and keep the flow the same.

8.1 Design Philosophy

This chapter describes the design parameters that are proposed to be used for the design of the replacement pipeline for this project. These criteria have been compiled using the Human Settlement Planning Design Guidelines (Red Book), Department of Water and Sanitation specifications, standards, and specifications from UGU District Municipality and accepted national design practice.

The below Design Criteria future elaborates the parameters used on the design calculations shown below:

Table 3 Demand Calculations for the East Portion of the Project Area

Reservoir Zones	Zones Covored	GPS House Count	Schools' Enrolment	Demand (l) / capita / day			AADD (kl/day)	Losses @ 15%	Bulk GAADD (kl / day)		Future 30 years Storage 48 hrs
				Dwelling	Non-Domestic	Av. HH Size			Current	Future30yrs	
Supply from SCP 2B											
Umdoni Reservoir	GDP	201		70		5	70,35	10,55	80,90	182,75	365
	Selbourne	93		246		3	68,70	10,30	79,00	129,13	258
	Umdoni Village	445		223		3	297,71	44,66	342,36	342,36	685
	Eden Rock Forest Estate	42		78		3	9,81	1,47	11,28	18,44	37
	Residents	98		200		3	58,80	8,82	67,62	110,52	221
									581,17	783,20	1566
Pennington	Residents	915		200		3	549,00	82,35	631,35	1031,93	2064
	Schools		0		20		0,00	0,00	0,00	0,00	0
	Clinics		137		500		0,69	0,10	0,79	0,79	2
	Community Halls		400		65		26,00	3,90	29,90	29,90	60
	Restuarants		570		65		37,05	5,56	42,61	42,61	85
	Offices		336		400		1,34	0,20	1,55	1,55	3
									706,19	1106,77	2214
Kabo	Residents	499		200		3	299,40	44,91	344,31	562,77	1126
	Schools		0		20		0,00	0,00	0,00	0,00	0
	Clinics		500		500		0,00	0,00	0,00	0,00	0
	Community Halls		0		65		0,00	0,00	0,00	0,00	0
	Restuarants		0		65		0,00	0,00	0,00	0,00	0
	Offices		276		400		1,10	0,17	1,27	1,27	3
									345,58	564,04	1128
Hilltop	Illovo Sugar Mill		1	0	730		730,00	109,50	839,50	839,50	1679
	Sezela Residents	435		200		3	261,00	39,15	300,15	490,59	981
	Schools		1519		20		30,38	4,56	34,94	34,94	70
	Clinics		0		500		0,00	0,00	0,00	0,00	0
	Community Halls		0		65		0,00	0,00	0,00	0,00	0
	Restuarants		0		65		0,00	0,00	0,00	0,00	0
	Offices		706		400		2,82	0,42	3,25	3,25	6
									1177,83	1368,27	2737
									2810,77	3822,3	

Table 4 Demand Calculations for the West Portion of the Project Area

Reservoir Zones	Zones Covered	GPS House Count	ools' Enrolment	Demand (l) / capita / day			AADD (kl/day)	Losses @ 15%	Bulk GAADD (kl / day)		Storage 48 hrs (30)
				Dwelling (5 pp)	Non-Domestic	Av. HH Size			Current	Future30yrs	
Supply from Umdoni Park											
Mhlangamkhulu (Gravity) Res E-G		1123		70		4	314,44	47,17	361,61	816,81	1634
Mhlangamkhulu (Pumping) - Res D	Residents	2821		70		4	789,88	118,48	908,36	2051,85	4104
	Clinics	0	3712		15		55,68	8,35	64,03	64,03	
	Community Halls		0		500		0,00	0,00	0,00	0,00	
	Restuarants		100		65		6,50	0,98	7,48	7,48	
	Offices		50		65		3,25	0,49	3,74	3,74	
		0			400		0,00	0,00	0,00	0,00	
									983,61	2127,10	4254
Mhlangamkhulu Total									1345,21	2943,91	

8.1.1 Design Criteria

The design criteria are summarised as follows, and facilitate the demand calculations as seen on the Annexure B:

Table 5 Design Criteria

Item	Description	Design Parameter	Notes
1.0	Design Horizon	30 years	This design horizon is aligned with the UW Masterplan water supply details.
2.0	Population	- Statistics SA - Census 2011 - Google Earth Desktop Study	The information of the existing reticulation lines was used to establish the supply areas for each reservoir, then Google Earth Aerial Imagery was used to count the number of houses within each supply zone.
3.0	House Occupancy	2 - 4 people per household	These are based on the level of service of each area and are verified by the Statistics SA data.

4.0	Non-Domestic Establishments	- Schools - Community Halls - Restaurants - Clinics - Police Stations - Offices	Umdoni Land Use Scheme Reports and Ward profiles were used to establish the non-domestic facilities within the project areas and the school enrolment details were obtained from the CAPS site.
5.0	Growth Rate	1.5%/2.5% per annum	These are based on land availability and the possibility of growth in the area as per the area analysis of the project supply area.
6.0	Design Water Usage	- Low 40l/c/d - Medium 70l/c/d - High 200l/c/d	An informed decision was made when deciding the flows for the areas based on the DWS standard and UGU masterplan. (DWS has a minimum supply flow of 60l/c/d) Flows for Selbourne Country Estate, Eden Rock Forest Estate, Umdoni Village, and Illovo Sugar Mill were obtained from meter readings of each property.
7.0	Conveyance Losses	15%	
8.0	Peak Factor	1.2	The peak factor used for the bulk system pipeline is 1.2 as per the Redbook.

8.1.1.1 Growth Rate

Table 6 Growth Rate per zone

Zone	Current Average Annual Daily Demand (kL/day)	Growth Rate	Future Average Annual Daily Demand (kL/day)
Umdoni	500.27	1.5%	600.45
GDP	80.90	2.5%	182.75
Pennington	706.19	1.5%	1106.77
Kelso	345.58	1.5%	564.04
Hilltop	1177.83	1.5%	1368.27

Malangeni Reservoir D	361.61	2.5%	816.81
Malangeni Reservoir E	983.61	2.5%	2127.10

Each zone within the Umdoni SBWA project area was given a different growth rate that was based on its land availability and the level of service in that community. The project area is a mix of medium to high level of income communities and this was considered when allocating the growth rate. Ward profiles, land use reports and Statistics SA information on the past growth rate were also used to help with the allocation.

Umdoni Village is a gated community which has no available land for future infrastructure and upon enquiry, the Umdoni Village administration confirmed that there were no plans for any future development and the average household size has remained the same for the past few years. Considering this information, ENSync Engineers allocated a growth rate of 0% for the Umdoni Village supply.

The areas along the coast are high income level communities and even though they do have land available for future growth, it is limited. The growth rate is also affected by the information from the Statistics SA reports that show that even though the communities do grow, but it is not at a high rate. ENSync Engineers allocated a 1,5% growth rate for Kelso, Umdoni Residents, Pennington and Sezela.

The Malangeni and GDP are medium income level communities and according to Statistics SA they have shown growth in the past. ENSync Engineers has allocated a growth rate of 2.5% for these areas because there is land available in the community and there are signs of growth in the area.

8.1.1.2 Design Water Usage

The design water usage depends on the level of service for the respective area, and since the Umdoni South Bulk Water Augmentation Project covers areas that vary – an investigation had to be conducted to allocate the correct design water usage. To determine the level of service for water supply in Umdoni Area the following factors were considered:

- Population: the number of people residing within the area zoning
- Current water demand: the water demand of the area is based on the classification of the area and the known capacity that the residents and industries in the area are known to use.
- Level of income: The level of income within the area determines the amount of water they use as they tend to have more facilities that use water the higher their income is.

Table 7 Design Water Usage per zone

Area	Level Of Service Allocated	Design Water Usage (l/capita/day)
Umdoni	High	200
GDP	Medium	70
Pennington	High	200

Kelso	High	200
Hilltop	High	200
Malangeni Reservoir D	Medium	70
Malangeni Reservoir E	Medium	70

8.1.1.3 Flows

The Umdoni South Bulk Water Augmentation Project covers a vast area that falls in different classifications in terms of level of income. To determine the flows used in this project, ENSync Engineers followed the following process:

- Gathered data: collected the relevant information for the community, such as population size, water sources and any specific factors that may affect water demand (industrial and agricultural activities)
- Estimated population growth: Determine the expected population growth rate of the community using the Statistics SA population data.
- Water demand per capita: Residential areas estimates were used based on research done in the area and assessment done on areas that has similar characteristics, and they were categorised according to the community type and the level of income in the community.
- Estate water demand: This information was derived from water meter readings obtained from relevant areas (attached on Annexure F)
- Non-Residential water demand: This information was obtained from the Red Book
- Account for losses and leakage: these were factored into the calculation for the water demand to account for losses due to leaks, system inefficiencies and other factors.
- Calculate total water demand: These flows, population growth and losses were used to calculate the total water demand as per the calculation shown in the spreadsheet attached on Annexure B

The Umdoni South Bulk Water Augmentation Project has medium to high level of income areas and the flows as stated in the table above were used. For the estates in the project area, flows specifically for those estates have been used and also the same goes for the Illovo Sugar Mill.

8.2 Umdoni Project Area

Current household counts and typical population statistics based on house counts from aerial imagery are shown in table 8. Population estimates were based on the aerial imagery and compared with the average people per household data from Statistics SA covering the specific areas.

Initial indications based on design standards allowed for 5 people per household however, with recent visits to the area and an analysis of the Statistics SA population data, each zone was able to be assigned its' specific average household size which are between 2 and 4 people per unit per plot depending on the level of service in that area.

It is important to note that the project area covers areas with different level of services and so these areas vary in design parameters and thorough investigation has been done for each area to ensure that the level of service aligns with the design parameters used.

The Umdoni SBWA project area is zoned according to pressure for pressure management in the system and not ward boundary, so the zones cover a portion of the wards and not the entire area. The small areas information covered by Statistics SA managed to narrow down the population to the zones that almost aligned with the pressure zoning, and this was used to verify the information received from Google Earth aerial imagery.

A desktop study was conducted in 2023 using the latest Google Earth imagery which resulted in an existing house count of 6 672. Looking at the area, there is not much growth expectation for the areas along the coast, but the Malangeni area has plenty of potential for growth and it is still developing, this is based on land availability and so in that project zone a growth factor of 2,5% was used as a conservation measure.

Current household counts and typical population statistics based on house counts from aerial imagery are shown in the table below. The number of households to be served by this project is 6672 houses for the whole project area.

Table 8 Umdoni House Counts

Sub-Area	Household Counts	Estimated Population
Umdoni	879	2838
Kelso	499	1497
Pennington	915	2745
Hilltop	435	1305
Malangeni Zone 2	2821	11284
Malangeni Zone 3	1123	4492
TOTAL	6672	24 161

The following calculation example and design criteria was used to estimate the current and future demand for the uMdoni SBWA Project area, and this was applied to all zones.

Households

House Occupancy: 2 - 5 people per household (depending on level of income)

Design Period: 30 years

Population Growth: 2.5% per annum for Malangeni and 1.5% for the Coastal Zones

Losses: 15%

Consumption: Low at 40l/c/d, Medium at 70l/c/d and High at 200l/c/d

Therefore, the Gross Annual Average Daily Demand (GAADD) can be calculated as follows:

GAADD= [(201 households x 4ppl/household x 70l/c/d) + 15% losses] = 64 722 l/day **say 64.72kl/day.**

The future GAADD is: $64.72 + 2.5\%$ growth per year for a period of 30 years = **146.20 kl/day**

8.3 Peak Demand and Peak factors

This refers to the additional capacity required to account for peak water usage periods. It is a safety factor that ensures the water supply system can handle the highest demand levels without experiencing pressure drops or flow issues.

The peak demand which will be used to determine the capacity of the various scheme elements are as follows:

Bulk and Secondary Bulk: Peak Factor = 1,2

The peak factor of 1.2 means that the calculated Annual Average Daily Demand is multiplied by 1.2 to determine the required pipe size. By using this peak factor, the water supply infrastructure can handle the highest expected water demand without compromising the systems performance. It helps prevent issues such as low water pressure, inadequate flow rates, or pipe failures due to excessive demand.

9 PROPOSED INFRASTRUCTURE

9.1 Zoning



Figure 5 Project Area Zoning

The assessment conducted in the Umdoni SBWA Project area proved that the existing reticulation in the area was zoned according to the minimum pressure requirement of 2 bars for every household supply. That same zoning was followed but redefined to conduct house counts and determine capacity for the reservoirs in each zone.

A few houses in Pennington side showed a possibility of low pressure and an investigation was conducted to establish if this was considered in the existing supply system. The identified houses showed to be supplied from Umdoni Reservoir which provided them with sufficient pressure.

The zoning followed for the project area also aligned with the Statistics SA small area information counts and this made it easier to compare the data retrieved from desktop study to the Census 2011 information.

Even though the project only covers Umdoni Bulk system, reticulation zoning had to be investigated and verified to do the house counts and demand calculations for the specific area. This also assisted in ensuring that the reticulation would have sufficient pressure to continue serving the zoned areas without the need to move the reservoir site.

9.2 Pressure Management

Pressures in Umdoni SBWA will be managed by splitting the water scheme into hydraulic pressure zones that covers the area that will be supplied by each reservoir. The reservoirs that have a low elevation and will not be able to supply the houses in their immediate surrounding, will have elevated tanks to supply those houses and these are Kelso and Hilltop Reservoir.

The reservoirs have been sized for 48hrs and the reservoirs served by the Umdoni Command Reservoir by gravity will be refurbished with the capacity they currently have on site already, then the rest of the required capacity will be added to the sizing of the Umdoni Reservoir. This

is due to land size constraints in the reservoir locations that does not allow for infrastructure addition. The reservoirs that will require water to be pumped from Umdoni Command Reservoir, will have their capacity increased on the reservoir site and this will accommodate the possibility of pump failure and maintenance.

The project covers the refurbishment and replacement of the bulk system, and this does not include the reticulation in the area. This means that no pressure management valves will be used in the secondary bulk system.

9.3 Secondary Bulk System Layout

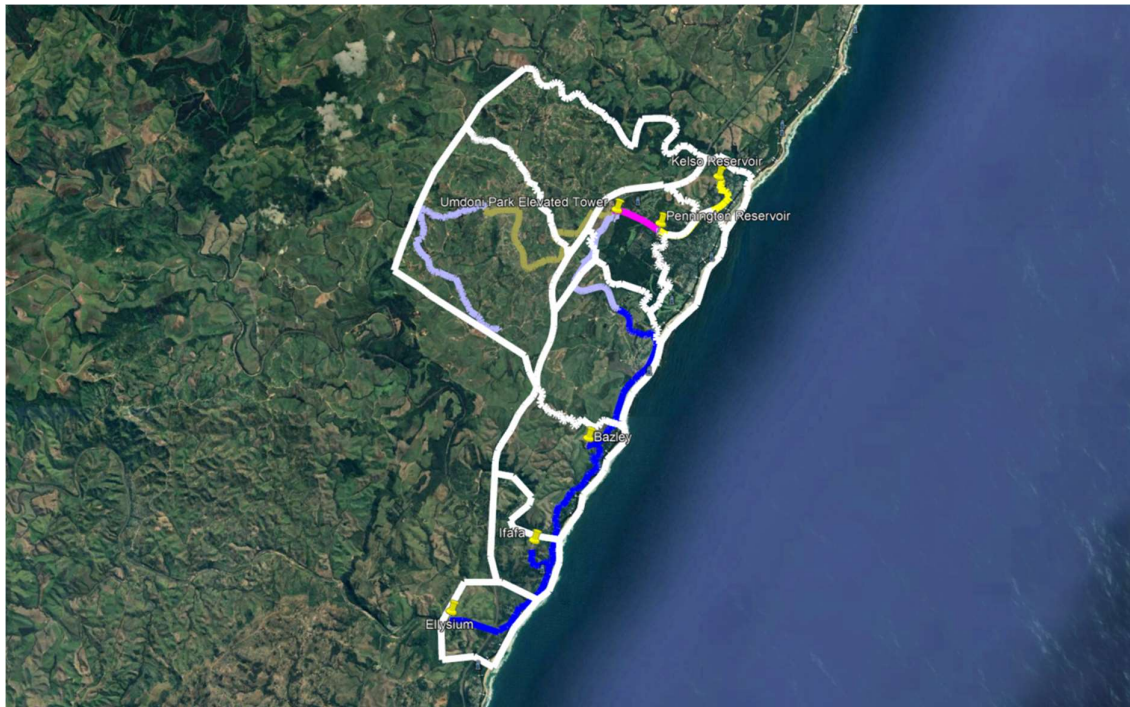


Figure 6 Bulk System Layout

The secondary bulk system will consist of mains varying in diameter from 100mm to 350mm. The layout was chosen following the alignment of the existing infrastructure to mitigate the environmental impact. In the routes where the existing infrastructure could not be followed, the pipeline was re-routed to choose a better route.

The Umdoni SBWA project covers the refurbishment and replacement of the bulk system in Umdoni, and this means that the reservoir locations will be in the same location, except for Malangen Reservoir D. Malangen Reservoir D will be relocated to an area with sufficient space for the reservoir capacity increase that cannot be accommodated by its current location.

The SCP2a (pipeline by UW) will supply water to the Umdoni Command Reservoir. This reservoir will have its capacity increased to have 48hr supply and this will have a 315mm diameter pipeline from Umdoni Command Reservoir that will supply water to the Malangen Reservoir D and Reservoir E through a pumped system and a 250mm diameter pipeline to supply Kelso, Pennington and Hilltop.

The Umdoni SBWA project area already has a bulk system from the offtake at SCP1 to Kelso, Pennington and to Umdoni. These pipelines will be replaced and upgraded, then have their flow reversed from Umdoni to Pennington to Kelso. A new pipeline will be laid in the new route to Hilltop passing through GDP, which will also have its own designated pipeline for secondary bulk supply supplied from the existing 1,27MI Umdoni Reservoir.

The secondary bulk water system layout is attached on Annexure C, showing the pipeline route, the reservoir locations and the zoning guided by pressure management.

The bulk system for Elysium, Bazley and Ifafa will have the pipeline replaced to the same pipe diameters that are currently supplying the area, because these communities have seen very minimal growth in the past few years and just need infrastructure change due to the area being supplied by AC and deteriorated pipes.

9.4 Reservoirs

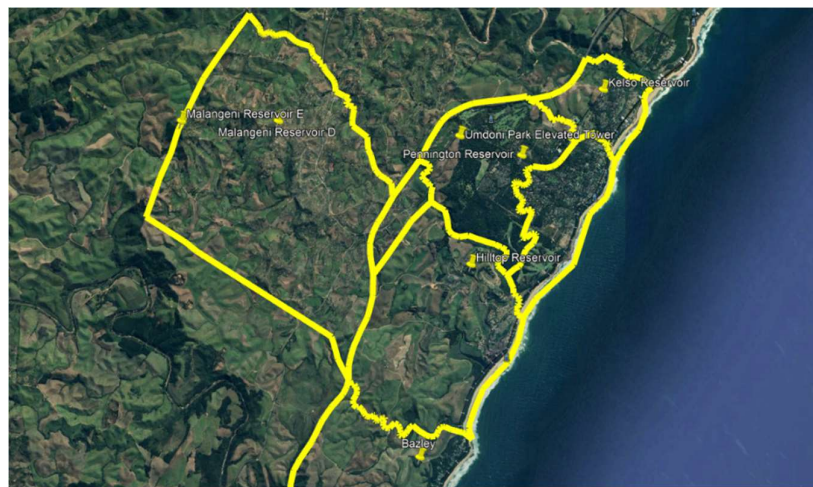


Figure 7 Reservoirs that will be served by Umdoni Main reservoir.

All primary reservoirs (Umdoni Reservoir, Malangenhi Reservoir D and Malangenhi Reservoir E) should be sized to carry 48hrs storage of the supply area's Average Annual Daily Demand (AADD), in line with the Red book and DWS (Department of Water and Sanitation) guidelines for water supply into communities. Elevated tanks will solely be used for boosting of pressures for Umdoni, Hilltop and Kelso for reticulation purposes and as such, are sized to carry 24-hour storage of the area's AADD. This also is in line with the DWS's guidelines. With 48hr storage having been allocated to a supply area, command and service reservoirs within the communities will be sized to share the 48hr storage required per area.

Table 9 Proposed Reservoir capacity.

Hydraulic Zone	48hr storage (kL)	Existing Reservoir Capacity (kL)	Additional Capacity Required	To be constructed
Umdoni Main Reservoir	4171	1270	2901	2500
Umdoni Residents	1566	0	1566	Refurbished
Kelso	1128	260	868	Refurbished

Pennington	2214	2900	0	Refurbished
Hilltop /Sezela Residential	2737	1000	1737	Refurbished
Mhlangamkhulu - Res E	1634	500	1134	1500
Mhlangamkhulu - Res D	4254	500	3754	4000

The Umdoni SBWA project includes the refurbishment or replacement of reservoirs, and this means a structural analysis will have to be conducted to determine the viability of the reservoirs. The project area all consists of existing reservoirs with capacity that are now outdated for their areas, the Umdoni Reservoir, Malangeni Reservoir D and Malangeni Reservoir E will be sized for 48 hr storage while the other reservoirs are kept at their existing storage. Any storage shortfall for Kelso, Pennington and Hilltop will be accommodated in the Umdoni Reservoir capacity.

The capacity allocation will ensure that the area has enough storage for the water supply required by the Umdoni Project area.

The reservoir design capacity is calculated as follows and represented in the above table 9.

For Kelso Reservoir:

GAADD= [(499 households x ppl/household x l/c/d) + 15% losses] = 344.31 kl/day
 The future GAADD is: 344.31 + 2.5% growth per year for 30 years = 562.77 kl/day
 say 570 Kl/day
 For 48 hr storage = 1128kL
 Current capacity is **260kL** and therefore additional required storage is **868kL**

9.5 Pipelines

9.5.1 Pipeline diameter

Pipe sizing has been done according to the AADD for the respective supply zones and considering the peak factor for the bulk water system of 1,2.

The pipe diameters and lengths are as follows and they are dependent on the flow that will be supplied to each area.

Table 10 Pipe Lengths for system upgrade

Hydraulic Zone	Flow (l/s)	Proposed Diameter (uPVC)	Proposed Diameter (GMS)	Pipe Length
Umdoni Main Reservoir (Inlet from Umgeni SCP2)	92,59	355	350	
GDP	6,77	110	100	1920
Kelso	7,83	110	100	3272,78

Pennington	15,37	160	150	52,478
Hilltop	16,36	160	150	4334,77
Malangeni (Res E)	11,34	160	150	2180,16
Leg 1 (Hilltop, Kelso, and Pennington)	91,80	250	250	86.54
Leg 2 (Kelso + Pennington)	23,21	200	200	1388.67
Leg 3 (Malangeni)	52,23	315	300	6890.911
				20 126.301

Table 11 Pipe Lengths for replacement

Hydraulic Zone	Proposed Diameter (uPVC)	Pipe Length
Hilltop – Bazley	160	5486.187
Bazley - Ifafa	160	6348.609
Elysium	160	5467.711
		17 302.507

9.5.2 Material Type Selection

9.5.2.1 PVC Pipe

The pipe material for a bulk water system pipeline is selected according to the pressure levels in the design. The options for bulk water systems are uPVC and GMS pipe.

uPVC is selected for the following reasons:

- The light weight of the pipe is ideal for handling – suited to labour intensive projects.
- It is easy to install.
- It is durable and tough – resistant to installation damage.
- It has a low frictional resistance and enhanced hydraulic performance.

UPVC is used for bulk mains greater than 50mm diameter, with pressure less than 16 bar because it offers uPVC Class 16 and 12.

9.5.2.2 GMS Pipe

The GMS pipes are rolled, grooved, and jointed using couplings and wrapped with Denso tape (as shown in Annexure G) are proposed to be used because:

- Pipes are like klambon however, the type of wrapping differs (TOSA wrap for Klambon and Denso Wrap for the other groove ended pipes)
- Pipes can withstand high pressures.
- May be used above ground.
- Can easily be jointed using couplings.
- Pipe require cathodic protection.
- Makes any illegal connections harder to do.

GMS pipe will be used in the Umdoni South Bulk Water Augmentation project as requested by UGU District Municipality. The area has a high rate of illegal connections and the request to use steel has been made to try and prevent any future connections that disrupt the functionality of the scheme. Even though GMS will be used, ENSync Engineers will provide costing for both potential pipe materials as required by the design to be compared against the option chosen by the client.

9.5.3 **Pipeline and joint testing.**

Specifications will be included in the procurement stage. All construction contracts to cover the handling, laying, jointing, installation, and testing of the pipes will be as per SANS 1200 and the Client's specification. The specifications and the quality control requirements of the pipes will be used to test the pipes and inspect if it has been laid, joint and installed correctly.

9.5.3.1 Hydraulic Pressure Testing

This test is performed to check the ability of the pipeline to withstand the designed pressure. The pipeline is filled with water and subjected to a specified pressure for a certain duration to ensure it does not leak or burst.

The pressure test process will be as per Clause 7.3 of SABS 1200L.

After attaining the full test pressure, the pressure decrease rate is recorded and compared with the allowable decrease rate and relevant actions taken depending on the result. The pressure in the pipe is then decreased in steps and the pipe pressure recorded.

9.5.3.2 Destructive testing

Random samples of butt-welds are cut out of the pipe and subjected to destructive tensile tests (and bending tests if ordered) either by an approved in-field testing process (preferred to save time), or by the Southern African Plastic Pipe Manufacturers Association (SAPPMA) or any other approved testing authority.

9.5.3.3 Visual and dimensional Inspection

These inspections will be done by the client's representative to check the dimensions of the pipeline to ensure that it meets the specified standards and tolerances, and visually check the pipe for visible defects such as cracks, deformities, or surface irregularities in the pipeline.

9.5.4 Erosion Control Measures

The topsoil will be removed along the proposed pipeline route to suit trench width, at a depth of 150mm and stockpiled separately from the other excavated material.

After pipe laying and the backfilling and compacting of the trench material, the topsoil will be reinstated and lightly compacted.

On downhill slopes the trench will also be backfilled so that the backfill material forms cut-off berms at regular intervals, at least 150mm higher than the ground either side of the trench to prevent surface water from running along the trench and eroding the backfilled material.

An environmental consultant has been appointed to address all environmental requirements and ensure compliance on the overall project.

9.6 Pump Stations

Pumpstations play a crucial role in a bulk water system by ensuring the reliable and efficient distribution of water to consumers. They are designed to overcome elevation differences and maintain adequate pressure throughout the system.

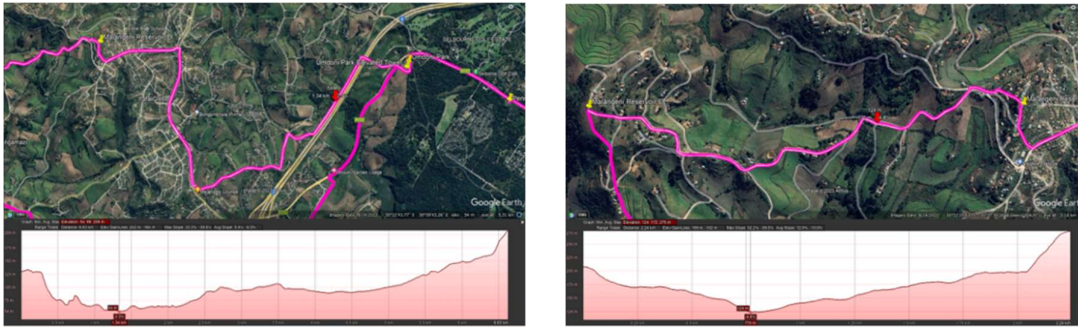
The Umdoni Bulk Water system will be rehabilitating existing reservoirs with fixed levels that cannot be changed since the Umdoni Reservoir has a lower elevation of 131m than the Malangeni area, the supply to Malangeni must be through a pumped system.

These pump stations will have back-up generators to ensure that the system continues to function even during loadshedding. These generators will be specified according to the desirable conditions and sized to meet these conditions. However, they are not included in the preliminary design but will form part of the final design as it will require further investigation of the system and for certain decisions to have been made.

The Malangeni Reservoir D – Malangeni Reservoir E secondary bulk line has an existing pumpstation which is Malangeni D&E Pumpstation. This pumpstation site consists of a masonry building structure which houses four multi-stage pumps. Two of these pumps are pumping to Malangeni Reservoir E and the other two are pumping to Reservoir D, from the supply at Mhlangamkhulu Reservoir. With the changes that will be made to Malangeni System, the pumpstation will be used to pump only from Malangeni Reservoir D – Malangeni Reservoir E, provided that is the suitable option as per the options to be presented below.

The primary option is to pump from Umdoni Reservoir to Malangeni Reservoir D, then from Malangeni Reservoir D to Malangeni Reservoir E but due to the space limitations and accessibility constraints at Malangeni Reservoir D, there is an alternative option to pump the water from Umdoni Reservoir all the way to Malangeni Reservoir E. The calculations for these options are attached on Annexure D and Annexure E to show the parameters for the pumps required to pump water between these reservoirs for each option presented by ENSync Engineers. These calculations are based on the elevation profile of the pipe routes for the two pumping options presented on the below pictures.

9.6.1 OPTION 1: Two pumpstations between Umdoni Reservoir, Malangeni Reservoir D and Malangeni Reservoir E



This is the first option for the Malangeni area system. In this option, there will be a new pump station constructed between Umdoni Reservoir and Malangeni Reservoir D (these reservoirs will have their capacity increased), and either an existing pump station would be used between Malangeni Reservoir D and Malangeni Reservoir E or there will be a new pumpstation constructed between Malangeni Reservoir D and Malangeni Reservoir E.

9.6.1.1 Option 1a (Refurbishing the existing Malangeni D/E Pumpstation to pump from Malangeni Reservoir D to Malangeni Reservoir E)

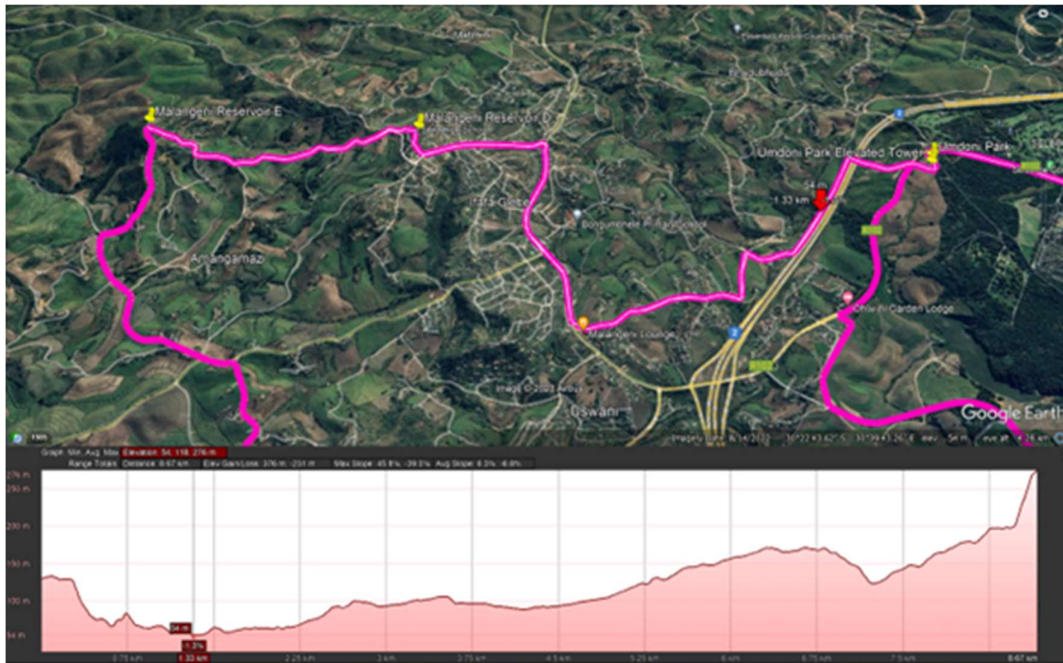
There is an existing pumpstation Reservoir D/E, this pumpstation currently pumps water from Mhlangamkhulu to Reservoir D and Reservoir E. This pumpstation has been assessed and the structure of the pumpstation needs refurbishment but it can be used in this system. This option entails using the existing Malangeni Reservoir D site to build a new reservoir for the capacity increase then refurbishing the existing pumpstation for D/E to pump from Malangeni Reservoir D to Malangeni Reservoir E.

9.6.1.2 Option 1b (To construct a new pumpstation from Malangeni Reservoir D to Malangeni Reservoir E)

The Malangeni area requires the Malangeni Reservoir D to be increased in capacity, if this cannot be achieved at its current site but still the option of having 2 pumps in the system is favourable – a new site will be sourced from the available land in the Malangeni area that is within the required level and a new Reservoir and pumpstation will be constructed on that site.

The issue from option 1a is accessibility for construction and maintenance of that reservoir D at Malangeni. The Malangeni Reservoir D has a very steep and narrow access road, which possess as a huge risk to the construction plant that will be required in the construction of that reservoir. Access to the nearing houses will also be affected by the fencing of the Reservoir site that will now be bigger due to the capacity increase, hence the introduction of option 1b.

9.6.2 OPTION 2: A single pumpstation pumping from Umdoni Reservoir to Malangeni Reservoir E



The option to have only one pump station in the system is present due to the space limitations and accessibility constraints at the Malangeni Reservoir D site and also the possibility of not being able to find another location to build the new Malangeni Reservoir D, which would prevent the increase of capacity of this reservoir hence disallowing this reservoir to have the capacity to pump the required supply to Malangeni Reservoir E.

The option to have a direct supply from Umdoni Reservoir to Malangeni Reservoir E is presented as an alternative to the first option. In this alternative option, water would be supplied from Umdoni Reservoir to Malangeni Reservoir E, then from Malangeni Reservoir E it will gravitate to Malangeni Reservoir D, G and H. This though will increase the length of pipe in the pumping system for that single pump station.

These pump stations will face many challenges including power outage, mechanical failure, clogging and system leaks, so they will have to be maintained and have back up system for power outages.

9.6.3 Summary of the pumpstation options

The table below presents a summary of the pumpstation options.

	Option 1		Option 2
	Option 1a	Option 1b	
Description	Refurbished Pumpstation from Malangeni Reservoir D to Malangeni Reservoir E and new pumpstation from	New pumpstation from Malangeni Reservoir D to Reservoir E and new	New pumpstation from Umdoni to Malangeni Reservoir E

	Umdoni to Malangeni Reservoir D	pumpstation from Umdoni to Malangeni Reservoir D	
System	Pumping from Umdoni Reservoir to the existing Reservoir D, then pump from Reservoir D to Reservoir E	Pumping from Umdoni Reservoir to Reservoir D's new location, then pump from Reservoir D to Reservoir E	Pumping from the Umdoni Reservoir to Reservoir E, then gravitating from Reservoir E to Reservoir D.
Constraints	*No space for capacity increase at Reservoir D *Construction accessibility to the existing Reservoir D *Fencing the Reservoir will affect access roads for the houses near the Malangeni Reservoir D	*Finding a suitable location for the new Reservoir D and pumpstation *Reconnecting the existing reticulation from the existing Reservoir D to the new one	*Additional pipe length of 2180m between Reservoir D and Reservoir E which amounts to R6 867 000.000
Advantages	*Increased capacity: By increasing the capacity at Malangeni Reservoir D, the overall capacity of the system is increased. *Redundancy: With two pumps, there is a backup in case one pump fails, ensuring a continuous water supply to some parts of the community. *Reduced pressure drops: By dividing the distance into smaller segments, the pressure drop along the pipeline can be minimize., improving the efficiency of water transportation.		*Simplicity: Having only one pump reduces the complexity of the system, making it easier to operate and maintain. *Cost-effective: A single pump setup is generally less expensive maintain compared to multiple pumpstations. *Reduced maintenance: a single pumping line system will mean there is only one pumpstation to maintain.
Disadvantages	*Higher installation and maintenance costs: The increasing the capacity at Malangeni reservoir B and an extra pump increases the initial investment and ongoing maintenance expenses. *Increased complexity: The system becomes more complex with the addition of another reservoir and pump, requiring more advanced monitoring and control mechanisms.		*Limited capacity: Depending on the distance between the reservoirs, a single pump may have limitations in terms of the volume of water it can transport efficiently. *Increased pressure drops: Over long distances, the pressure drop in the pipeline may be significant, reducing the overall effectiveness of the pump.

			*Lack of redundancy: If the single pump fails, there is no backup, which could result in a complete disruption of water supply until the pump is repaired.
Capital Cost	R3 985 153,94	R2 708 067,97	R3 511 472,97
Operation Cost (Year)	R2 234 924,84	R2 171 070,54	R2 917 087,23

With the above taken into consideration, ENSync Engineers proposes that a new location is established for Malangeni Reservoir D for a completely new construction of both the reservoir and the pumpstation.

9.7 Reticulation

The areas of supply that are covered by the Umdoni SBWA project have existing reticulation. The coastal area is currently receiving water through these systems hence the reticulation does not fall part of the scope of works for this project.

This is said for all areas except the newly developed area of GDP which does not have an existing reticulation system. The Umdoni South Bulk Water Augmentation Project does not have a reticulation component but ENSync Engineers is aware of the need to supply water to GDP. ENSync Engineers has provided a preliminary design drawing (attached on Annexure H) and high-level cost estimate for the implementation of a reticulation system in the GDP community, and this will be made available to UGU District Municipality to help inform the decision of implementation for this portion of the water supply.

9.8 Metering

The bulk water system will have bulk meters constructed at the off-take chambers from the Umdoni Command Reservoirs which means that reservoirs to the respective zones will be metered. The metering zones will be the same as the hydraulic zones and this will enable relatively accurate water balances to be carried out for the system within the metering zones. The table below shows the current Gross Annual Average Daily Demand for the Umdoni metering zones.

Table 12 Demands for metering zones for Umdoni Project Area

Hydraulic Zone	House Count	Demand (l/capita/day)	AADD (kl/day)	Losses @ 15%	GAADD (kl/day)
Umdoni Reservoir	879	Varies	493.59	74.04	567.00
Pennington	915	200	614.08	92.11	706.19

Kelso	499	200	300.50	45.08	345.58
Sezela/Hilltop	435	200	1024.20	153.63	1177.83
Malangeni Res E	1123	70	314.44	47.17	361.61
Malangeni Res D	2821	70	855.31	128.30	983.61
Total	6672				4142.44 kl/day

9.9 Valves and Other Chambers

The valves and chambers in a bulk water system play a role of controlling the flow of water and maintaining the systems efficiency. Here are some valves that will be found in the Umdoni South Bulk Water Augmentation:

- Bulk Meters: these valves will measure the total quantity of water that has passed through them.
- Control valves: these valves will be used to regulate the flow of water within the system. They can be operated manually or automatically, allowing for the precise control over the water flow rate.
- Gate valves: these valves are commonly used in bulk water systems to completely stop or allow the flow of water.
- Air Valves: these valves are used to release air pockets that can accumulate in the system, preventing airlocks and maintaining the systems efficiency. They are installed at all local high points and at a maximum spacing along the flat areas where the pipe runs.
- Scour Valves: these valves are used to remove sediments and debris that may accumulate in the pipe over time and will be installed at all local low points along the bulk mains.
- Flow meter: these valves will be used to measure the rate of flow of water at a particular point in the system.

The type of valves that will be used will be detailed in the valves and chamber drawings and specified under the tender documents.

9.10 Stream Crossings

There are a few watercourses which will need to be crossed along the proposed pipeline route. A geotechnical investigation will be done during the design stage to determine whether a stream crossing below ground would be viable versus a bridge strapping for which is also available for some crossings.

The locations of all watercourses that will be crossed by the pipeline are shown in the table below:

Table 13 Water Course Locations

Water Course Name	Location	
	Latitude	Longitude
Mkhumbane River	30°22'54,67"S	30°39'53,59"E
Sezela River	30°24'50,58"S	30°40'37,32"E
Sezela River	30°23'40,25"S	30°39'14,71"E
	30°25'32,47"S	30°40'15,52"E
Fafa River	30°27'1,70"S	30°39'12,94"E
Mvuzi River	30°28'8,03"S	30°38'49,61"E
	30°28'25,75"S	30°38'29,08"E

In the stream crossings that are along the coast, a railway bridge is available where the existing pipeline is currently strapped. Upon construction, the existing pipe will be replaced with the new pipeline which will be a GMS pipe instead of the material in use currently. Due to the recent floods – it is also a better option for the pipes to be secured on the bridge so that it does not get washed away when the water comes in high and strong.

Where it is not possible to strap the pipe onto a bridge, pipelines will be buried below the ground to avoid any obstruction of the natural stream flow.

A clear methodology will be finalised between the contractor and the consultant before the installation of these sections.

9.11 Road Crossings

The pipeline route crosses a few surfaced road crossings, one of which is the N2. It is the requirement of the Department of Transport DoT that all road crossings be carried out by pipe boring whilst it is proposed that gravel road crossings be carried out by open cut trenching with the necessary provision for traffic deviations and control. This proposal will be confirmed with DoT prior to construction whilst allowance is made for pipe boring for all road crossings.

For the N2 road crossing, a pipe jack used for the South Coast Pipeline Phase 2 will be used for the crossing from Umdoni reservoir to Malangeni Reservoir D. This will be subject to SANRAL's approval and the size of the sleeve that will be used in the pipe jack.

Table 14 Road Crossing Locations

Road Name	Latitude	Longitude
N2	30°22'27,57"S	30°39'55,91"E

Msinsi Road	30°23'50.81"S	30°40'16.40"E
	30°22'44.48"S	30°38'31.66"E
	30°22'24.48"S	30°38'35.66"E
	30°22'29.22"S	30°38'04.67"E
R102	30°22'30.40"S	30°40'09.11"E
R102	30°23'11.90"S	30°39'39.48"E
Sezela Drive	30°23'31.88"S	30°39'29.89"E
Willow Road	30°24'11.39"S	30°40'33.67"E
Syringa Lane	30°24'11.81"S	30°40'52.98"E
Marine Drive	30°26'24.60"S	30°39'43.37"E
Leucharas Drive	30°27'39.41"S	30°39'06.23"E
Bullock Drive	30°27'37.00"S	30°38'58.44"E
Headlands Road	30°28'36.29"S	30°38'13.62"E
N2	30°28'34.66"S	30°38'09.38"E

10 AS-BUILT INFORMATION

There is information of the existing water system in the Umdoni Municipality area. GIS information for the current system provides location for the pipelines, reservoirs and pumpstations. The pipelines for the reticulation and bulk systems range from 50mm diameter to 250mm diameter pipes and the pipe material includes uPVC, AC and even HDPE. The as-builts of these water lines is outdated as there have been several repairs and pipe route changes along the years and the design life for the system has lapsed so a thorough investigation will be done to determine the system. The current locations and sizes of the reservoirs are as shown in the table below:

Table 15 Existing As-Built Information

Existing Reservoirs	MSL	Capacity	Location	
			Latitude	Longitude
Umdoni Reservoir	131	1.27	30°22'30.70"	30°40'13.16"
Kelso Reservoir	82	0.26	30°21'59.68"	30°41'58.41"
Pennington Reservoir	93	2.9	30°22'43.80"	30°40'56.80"
Hilltop Reservoir	98	1	30°23'48.56"	30°40'17.94"
Malangeni Reservoir D	209	0.5	30°22'23.26"	30°38'02.48"
Malangeni Reservoir E	276	0.5	30°22'22.58"	30°36'53.57"
Bazley	78	1	30°25'51.86"	30°39'44.40"
Ifafa	78	1	30°27'22.51"	30°38'50.55"
Elysium	96	5.55	30°28'23.37"	30°37'24.61"

Based on the recent design, ENSync Engineers will provide complete as-built drawings according to the survey of the pipelines constructed. GIS shapefiles will also be provided with the associated attributes together with the close-out report.

11 APPROVALS / AUTHORISATIONS

Consultation with authorities and other service providers whose services could be affected during construction will be done to provide details of their existing services and any requirements they may have for protecting or moving services where necessary.

11.1 Environmental Management

An environmental consultant has been appointed to apply for Environmental Authorisation for the project with the Department of Economic Development, Tourism and Environmental Affairs (EDTEA). An EMPr and ROD will also be received from the Environmental Consultant who will still be appointed under the detail design stage.

11.2 Compliance with OHS Act

As the employer's agent, ENSync Engineers will appoint a Health and Safety Agent to review all designs at design stage, review all documents and drawings for tender and provide a risk assessment and health and safety specification, audit the contractor's compliance and close-out.

11.3 Department of Water Affairs

The Umdoni SBWA pipeline will affect a lot of areas under various authorities, so this will need to be taken into consideration.

The table below lists the authorities that will be considered to provide comments on the proposed water scheme:

Table 16 Authorities to provide comments.

No.	Authority	Comments
1.	Transnet	There is a railway line running along the coastline of Umdoni Municipality and there will be servitude encroachment in some sections and even crossings. Approvals are still to be obtained.
2.	KZNDOT	Trenching not allowed in road crossings and pipes exceeding 100mm diameter to be laid 2m outside road reserve. Road reserves currently being determined. Approvals are still to be obtained.
3.	Umdoni Local Municipality	There are a few road crossings for the municipal roads, and even though there are not a lot of restrictions – approvals will still need to be obtained.
4.	Telkom	No underground infrastructure. Overhead infrastructure will be visible on site. Approvals are still to be obtained.

5.	SANRAL	The pipeline will be crossing the N2 using a pipe jack, and the approval for the pipe jacking approval will be done under the South Coast Pipeline Phase 2.
6.	Eskom	No underground infrastructure. Overhead infrastructure will be visible on site. Approvals are still to be obtained.
7.	DWA (Department of Water Affairs)	Water Use License Application will be submitted for water use authorization
8.	DAEA	Basic Assessment Report will be submitted to the Environmental Authorization during the design stage

12 SUB-CONSULTANTS

The project is currently in planning stage and 2 sub-consultants have already been appointed for scope of works required to complete planning. These subconsultants are:

- The Surveyor
- The Environmental Consultant
- Enterprise Development
- M&E subconsultant
- Professional Land Valuator
- Geotechnical

Other sub-consultants that are still going to be appointed during the design stage for further investigation, such as:

- Occupational Health and Safety

13 CURRENT PROJECT STATUS

Preliminary designs are 100% complete for the project and the draft Business Plan for implementation stage is in progress and will be submitted for review once completed.

The environmental specialists, Enterprise Development Consultant, the surveyor, and the M&E subconsultant are currently on site carrying out the scope of works as expected to be completed for the planning phase. These are going according to programme and will be complete by February 2024, in time to start the final design phase.

The challenges currently being experienced in the project are the space limitations and potential access constraints at the Malangeni Reservoir D site. This is an issue due to the need to increase the capacity of this reservoir in order to provide 48hr storage for the Malangeni community.

The Environmental consultant has also experienced a delay due to enquiries from EDTEA that led to the requirement of an inspection and assessment of the conditions on site. As a result, the EIA had been halted in the presence of suspected presence of compliance issues related to the proposal of the project. Only after resolving the compliance matters can the EIA resume.

14 IMPLEMENTATION PROGRAMME

The table below represents the milestone end dates as per the project programme.

Table 17 Umdoni South Bulk Augmentation Project Programme

Umdoni South Bulk Augmentation Project Programme		
	Milestone End Dates (as per programme submitted to the client)	Actual End dates
Preliminary design complete	15 December 2023	02 February 2024
Submission of business plan	14 February 2024	29 February 2024
Approval of business plan	10 April 2024	31 August 2024
Detailed design complete	31 January 2024	30 May 2024
Tender Advertising	08 May 2024	01 October 2024
Procurement	19 August 2024	30 January 2025
Tender appointment	05 August 2024	01 March 2025
Commencement of contract	20 August 2024	01 April 2025
Commencement of Works	24 September 2024	01 May 2025
Duration	24 Months	36 Months
Completion works	24 September 2026	30 June 2028
Close-Out	26 October 2026	08 October 2028

15 COST ESTIMATES

The construction cost for the Umdoni South Bulk Augmentation Project is as represented in the terms below.

15.1 Umdoni Project Area

The construction value includes preliminary and general costs.

15.1.1 Pipeline and Reservoir Costing

The tables below represent the cost estimate for the pipeline and the construction of reservoirs. The pipeline lengths are based on the drawings attached on Annexure C which shows that the system in Malangeni is supplied from Umdoni to the existing Malangeni Reservoir D and works on the assumption that the Malangeni Reservoir D will have an additional Reservoir built in the same location to increase capacity.

Table 18 Construction Value for the option of using uPVC pipe

DETAILS					Total Estimate (incl VAT)
DESCRIPTION	Unit	Qty	Rate		
DIRECT COST					
Umdoni Reservoir Supply Zone					
Storage Reservoir					
Umdoni Reservoir	no	1	R7 590 254,18		R7 590 254,18
Malangeni Reservoir D	no	1	R3 140 794,83		R3 140 794,83
Malangeni Reservoir E	no	1	R9 945 850,31		R9 945 850,31
Secondary Bulk Lines					
Umdoni Upgrade	m	19700	R2 720,00		R53 584 000,00
Umdoni Replacement	m	17400	R1 440,00		R25 056 000,00
Reticulation Water System					
GDP	m	10400	R1 170,00		R12 168 000,00
Sub-Total (incl VAT)					R111 484 899,32
INDIRECT COST - FEES					
Professional Engineer					
ECSA Fee Guidelines	%	111 484 899	10,50%		R11 705 914,43
Additional Services					R0,00
Environmental	%	111 484 899	1,00%		R1 114 848,99
WULA	%	111 484 899	0,20%		R222 969,80
Geotechnical	%	111 484 899	0,60%		R668 909,40
Topographical Survey	%	111 484 899	1,00%		R1 114 848,99
Health and Safety	%	111 484 899	0,15%		R167 227,35
Mech and Elec Assessments	%	111 484 899	0,35%		R390 197,15
Power Supply Network Assessment	%	111 484 899	0,15%		R167 227,35
Wayleaves, Consents, Valuations	%	111 484 899	0,25%		R278 712,25
Conveyancer	%	111 484 899	0,30%		R334 454,70
			4%		R4 459 395,97
Construction Monitoring (Phase 2)	mnths	36	75 000		R2 700 000,00
Sub-Total (incl VAT)					R18 865 310,40
TOTAL (incl VAT)					R130 350 209,72

This cost estimates indicates the construction value of the project using the pipes as required by the design. The design requires uPVC pipes on the gravity supply lines and steel for the gravity main supply lines. This option is shown to highlight the cost difference between what UGU District Municipality requires and what the minimum requirements are as per the design. Only one option will be chosen and therefore the final cost will only be represented with one cost.

Table 19 Construction Value for the option of using all steel pipes except for reticulation

DETAILS					Total Estimate (incl VAT)
DESCRIPTION	Unit	Qty	Rate		
DIRECT COST					
Umdoni Reservoir Supply Zone					
Storage Reservoir					
Umdoni Reservoir	no	1	R7 590 254,18		R7 590 254,18
Malangeni Reservoir D	no	1	R3 140 794,83		R3 140 794,83
Malangeni Reservoir E	no	1	R9 945 850,31		R9 945 850,31
Secondary Bulk Lines					
Umdoni Upgrade	m	19700	R3 150,00		R62 055 000,00
Umdoni Replacement	m	17400	R1 440,00		R25 056 000,00
Reticulation Water System					
GDP	m	10400	R1 170,00		R12 168 000,00
Sub-Total (incl VAT)					R119 955 899,32
INDIRECT COST - FEES					
Professional Engineer					
ECSA Fee Guidelines	%	119 955 899	10,50%		R12 595 369,43
Additional Services					R0,00
Environmental	%	119 955 899	1,00%		R1 199 558,99
WULA	%	119 955 899	0,20%		R239 911,80
Geotechnical	%	119 955 899	0,60%		R719 735,40
Topographical Survey	%	119 955 899	1,00%		R1 199 558,99
Health and Safety	%	119 955 899	0,15%		R179 933,85
Mech and Elec Assessments	%	119 955 899	0,35%		R419 845,65
Power Supply Network Assessment	%	119 955 899	0,15%		R179 933,85
Wayleaves, Consents, Valuations	%	119 955 899	0,25%		R299 889,75
Conveyancer	%	119 955 899	0,30%		R359 867,70
			4%		R4 798 235,97
Construction Monitoring (Phase 2)	mnths	36	75 000		R2 700 000,00
Sub-Total (incl VAT)					R20 093 605,40
TOTAL (incl VAT)					R140 049 504,72

The cost estimate above represents the construction value of the project using steel pipes as requested by UGU District Municipality. Investigation has shown that Bazley, Ifafa and Elysium have experienced very minimal growth and are unlikely to have illegal connections, so for the pipe replacement along that section – the pipes will be uPVC.

15.1.2 Pumpstation Cost Estimate

The tables below represent the cost estimate for the pumpstation options as discussed in the pumpstation section. It shows a summary of the options covering the pump set, electrical installation, mechanical installation, the civil structure, and the operating costs for each option.

Table 20 Costing for pumpstation option 1a : refurbishing the existing pumpstation

PUMPSTATION OPTION 1a					
New pumpstation at Umdoni Reservoir and refurbishing the existing Reservoir D Pumpstation					
Item	Description	Unit	Qty	Rate	Amount
1	<u>New Pumpstation (Umdoni Reservoir)</u>				
1.1	<u>Pump Cost</u>				
1.1.1	Pump Installation set	no.	2	R199 635,00	R399 270,00
1.2	<u>Building Cost</u>				
1.2.1	Civil building	no.	1	R1 281 585,97	R1 281 585,97
1.2.2	Mechanical Installations	no.	1	R85 000,00	R85 000,00
1.2.3	Electrical Installation	no.	1	R432 080,00	R432 080,00
2	<u>Refurbishing Pumpstation (Reservoir D)</u>				
2.1	<u>Pump Replacement Cost</u>				
2.1.1	Pump Set Installation	no	1	R137 924,00	R137 924,00
2.2	<u>Building Refurbishment</u>				
2.2.1	Civil refurbishment	no.	1	R60 000,00	R60 000,00
2.2.2	Mechanical refurbishment	no.	1	R30 000,00	R30 000,00
2.2.3	Electrical refurbishment	no.	1	R282 208,00	R282 208,00
	Sub Total				R2 708 067,97
3	<u>Operating Cost (for both pumpstation)</u>				
3.1	Maintainance	year	1	R135 403,40	R135 403,40
3.2	Running Power	year	1	R2 035 667,14	R2 035 667,14
	Sub Total				R2 171 070,54
	TOTAL				R4 879 138,51

Table 21 Costing for option 1b: finding a new location for the Malangeni Reservoir D and a pumpstation.

PUMPSTATION OPTION 1b					
New Pumpstation at Umdoni Reservoir and a new pumstation at Reservoir D					
Item	Description	Unit	Qty	Rate	Amount
1	<u>New Pumpstation (Umdoni Reservoir)</u>				
1.1	<u>Pump Cost</u>				
1.1.1	Pump Installation set	no.	2	R199 635,00	R399 270,00
1.2	<u>Building Cost</u>				
1.2.1	Civil building	no.	1	R1 281 585,97	R1 281 585,97
1.2.2	Mechanical Installations	no.	1	R85 000,00	R85 000,00
1.2.3	Electrical Installation	no.	1	R432 080,00	R432 080,00
2	<u>New Pumpstation (Reservoir D)</u>				
2.1	<u>Pump Cost</u>				
2.1.1	Pump Installation set	no	1	R137 924,00	R137 924,00
2.2	<u>Building Cost</u>				
2.2.1	Civil building	no.	1	R1 281 585,97	R1 281 585,97
2.2.2	Mechanical Installations	no.	1	R60 000,00	R60 000,00
2.2.3	Electrical Installation	no.	1	R307 708,00	R307 708,00
	Sub Total				R3 985 153,94
3	<u>Operating Cost (for both pumpstation)</u>				
3.1	Maintanance	year	1	R199 257,70	R199 257,70
3.2	Running Power	year	1	R2 035 667,14	R2 035 667,14
	Sub Total				R2 234 924,84
	TOTAL				R6 220 078,78

Table 22 Costing for option 2: Pumping from Umdoni Reservoir to Malangeni Reservoir E

PUMPSTATION OPTION 2					
New pumpstation at Umdoni Reservoir to Reservoir E					
Item	Description	Unit	Qty	Rate	Amount
1	<u>New Pumpstation (Umdoni Reservoir)</u>				
1.1	<u>Pump Cost</u>				
1.1.1	Pump Installation set	no.	2	R483 630,00	R967 260,00
1.2	<u>Building Cost</u>				
1.2.1	Civil building	no.	1	R1 281 585,97	R1 281 585,97
1.2.2	Mechanical Installations	no.	1	R130 000,00	R130 000,00
1.2.3	Electrical Installation	no.	1	R1 132 627,00	R1 132 627,00
	<u>Sub Total</u>				R3 511 472,97
3	<u>Operating Cost</u>				
3.1	Maintanance	year	1	R175 573,65	R175 573,65
3.2	Running Power	year	1	R2 741 513,58	R2 741 513,58
	<u>Sub Total</u>				R2 917 087,23
	TOTAL				R6 428 560,20

15.2 Final Consolidated Cost

The cost represented below is the cost of the options recommended by ENSync Engineers. The following options are being recommended:

- Pipeline will all be steel pipes to minimise illegal connections (this will exclude the section between Bazley and Elysium).
- Reservoirs will be constructed at Umdoni Reservoir, Malangeni Reservoir D and Malangeni Reservoir E to increase the supply capacity.
- Malangeni Reservoir D will be constructed in a new site along with its pumpstation and the old infrastructure will be abandoned.
- GDP will have reticulation constructed.

Table 23 Cost for the options as per the Preliminary Report recommendations

DETAILS					Total Estimate (incl VAT)
DESCRIPTION	Unit	Qty	Rate		
DIRECT COST					
Umdoni Reservoir Supply Zone					
Storage Reservoir					
Umdoni Reservoir	no	1	R7 590 254,18		R7 590 254,18
Malangeni Reservoir D	no	1	R3 140 794,83		R3 140 794,83
Malangeni Reservoir E	no	1	R9 945 850,31		R9 945 850,31
Secondary Bulk Lines					
Umdoni Upgrade	m	19700	R3 150,00		R62 055 000,00
Umdoni Replacement	m	17400	R1 440,00		R25 056 000,00
Reticulation Water System					
GDP	m	10400	R1 170,00		R12 168 000,00
Pumpstations					
Umdoni - Reservoir D	no	1	R3 197 447,35		R3 197 447,35
Malangeni Reservoir D - Malangeni Reservoir E	no	1	R2 599 955,34		R2 599 955,34
Sub-Total (incl VAT)					R125 753 302,01
INDIRECT COST - FEES					
Professional Engineer					
ECSA Fee Guidelines	%	125 753 302	10,50%		R13 204 096,71
Additional Services					R0,00
Environmental	%	125 753 302	1,00%		R1 257 533,02
WULA	%	125 753 302	0,20%		R251 506,60
Geotechnical	%	125 753 302	0,60%		R754 519,81
Topographical Survey	%	125 753 302	1,00%		R1 257 533,02
Health and Safety	%	125 753 302	0,15%		R188 629,95
Mech and Elec Assessments	%	125 753 302	0,35%		R440 136,56
Power Supply Network Assessment	%	125 753 302	0,15%		R188 629,95
Wayleaves, Consents, Valuations	%	125 753 302	0,25%		R314 383,26
Conveyancer	%	125 753 302	0,30%		R377 259,91
			4%		R5 030 132,08
Construction Monitoring (Phase 2)	mnths	36	75 000		R2 700 000,00
Sub-Total (incl VAT)					R20 934 228,79
TOTAL (incl VAT)					R146 687 530,81

16 ENTERPRISE DEVELOPMENT

An Enterprise Development consultant has been appointed on this project. The responsibilities of the Enterprise Development Consultant are to:

- Form and capacitate the Project Steering Committee (PSC).
- Fully brief and keep updated the community, municipal and traditional structures on all aspects of the project.
- Submit monthly reports to the municipality providing brief details of meetings held, community perceptions of the project and any other matters of significance.
- Obtain an agreement from the community to provide access to properties for project staff and construction teams, well in advance of commencement of construction work on site.
- Learnership programme will be implemented where students will have access to site and learn about water pipeline construction.
- Training will be a requirement including formal training with certification.



17 PROJECT CHALLENGES

Even though the project is still in its planning phase, it has encountered its fair share of challenges.

- ENSync Engineers might encounter a challenge when it comes to obtaining SANRAL N2 road crossing approvals.
- There Environmental application with EDTEA was interrupted by activities in the Bazley area.
- Establishing the new Malangen Reservoir D will have to be done by the time detail design commences.
- Reticulation reconnection when the project is completed, and the old lines are decommissioned.

18 PROPOSAL FOR THE PROJECT AREA

ENsync Engineers has investigated the project area and went through the viable options for the Water Supply system, and it is that investigation that the following proposals are based on.

18.1 Umdoni

The following are the proposal for the Umdoni Reservoir

- The Umdoni Reservoir will be the command reservoir supplying Malangen Reservoir D, Malangen Reservoir E, Hilltop Reservoir, Pennington Reservoir, and the Kelso Reservoir.
- The Umdoni Reservoir will have its capacity increased to provide 48 hr storage for the supply areas.
- Kelso Reservoir, Pennington Reservoir and Hilltop Reservoir to have their size/capacity kept the same but the reservoirs and the chambers will be refurbished. The shortfall from these reservoirs for 48 hr storage will be added to the Umdoni Reservoir.
- All the pipelines connecting the above-mentioned reservoir will be replaced and upgraded according to the design requirements for the 30-year design period.

18.2 Malangen

- The Malangen Reservoir D and Malangen Reservoir E will have their capacity increased to provide 48-hour capacity to supply the Malangen Area.
- If Malangen Reservoir D cannot have its capacity increased in its current site due to land availability, then a new Reservoir site will be established to build a new Malangen Reservoir D.

18.3 Mhlangamkhulu

The following are the proposals for the Mhlangamkhulu Area:

- The Mhlangamkhulu area has been separated from the Umdoni South Bulk Water Augmentation Project and the Mhlangamkhulu Reservoir will be supplied by the Umzinto WTW.

18.4 Elysium, Ifafa and Bazley

The following are the proposals covering the rest of the project area:

- Elysium, Ifafa and Bazley to continue receiving supply from the Mthwalume WTW as there will not be enough supply from the SCP2 to cover them.
- The Elysium Reservoir, Ifafa Reservoir and Bazley Reservoir and their associated chambers will be refurbished.
- The pipeline supplying these reservoirs is mostly AC pipeline and will be replaced to change the pipeline material but not change the pipe diameter.

18.5 GDP

The following are the proposals covering the GDP Area which is just East of the N2:

- GDP will be supplied directly from the Umdoni Reservoir, which will have the demand for the area already in its capacity.

- The existing Umdoni Reservoir will have a designated outlet to supply GDP, and this will allow for GDP's bulk system to be connected independently from the rest of the Umdoni South Bulk Water Augmentation.
- GDP does not have a reticulation system and ENSync Engineers has provided a preliminary design drawing and high-level cost estimate for this area.
- The GDP reticulation system can be added as a component on the Umdoni South Bulk Water Augmentation Project – where after ENSync Engineers will incorporate it in their design and implementation stages.

19 CONCLUSION

The following conclusions are made from the above investigation:

- The Gross Annual Average Daily Demand for the Umdoni Project Area as determined above is 4142.44kL/day. The future demand is 6 766.19kL/day.
- The proposed project area will be divided into hydraulic water supply zones around the existing reservoirs to ensure the water pressures are within the acceptable limits.
- Implementation of this system upgrade will ensure that the system is able to supply water to the project area for 30 years.
- The total estimated cost for the Umdoni South Bulk Water Augmentation Project is R146 687 530.81 (incl. VAT).
- The total estimated cost for the GDP reticulation system is R14 321 520.00 (incl. VAT).

In conclusion, the preliminary design report for the Umdoni Bulk Water System Augmentation Project has provided a comprehensive analysis of the existing system and proposed solutions to meet the growing demand for water supply. Through detailed research, assessment, and consultation, ENSync Engineers has identified the key challenges and developed a preliminary design that addresses these issues effectively.

The report has highlighted the need for system augmentation due to population growth and aging infrastructure. The proposed design includes the replacement of the existing pipeline, construction of additional storage facilities, and the upgrade and construction of pumpstations. These measures aim to increase the system's capacity, improve water quality, and ensure a reliable and sustainable water supply for the future.

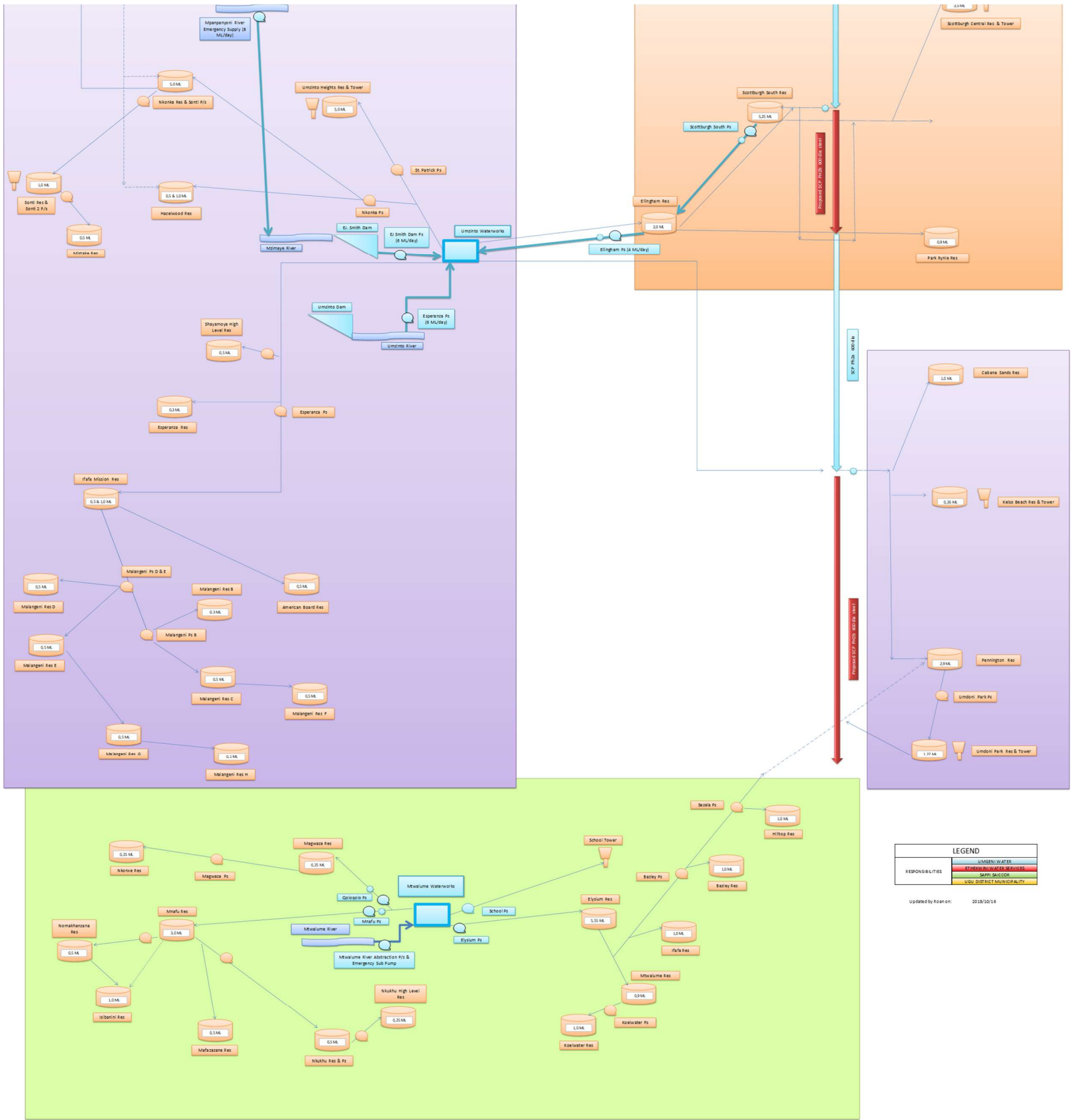
While this preliminary design report provides a solid foundation for the Bulk Water System Augmentation project, further detailed engineering analysis, environmental impact assessments, and stakeholder engagement are required to refine the design and ensure its feasibility. The next phase of the project will involve conducting feasibility studies, cost estimation, and risk assessment to determine the viability of the proposed design.

Overall, this preliminary design report serves as a valuable starting point for the Bulk Water System Augmentation project, outlining the key issues, proposed solutions, and potential benefits. It provides a roadmap for further development and serves as a basis for decision-making and future project planning. With the implementation of the proposed design, we aim to enhance the water supply infrastructure, meet the growing demand, and ensure a sustainable water future for the community.

UMDONI SOUTH BULK AUGMENTATION PRELIMINARY REPORT ANNEXURES



ANNEXURE A – SCHEMATIC OF EXISTING BULK WATER SYSTEM



ANNEXURE B – DEMAND CALCULATION SHEET

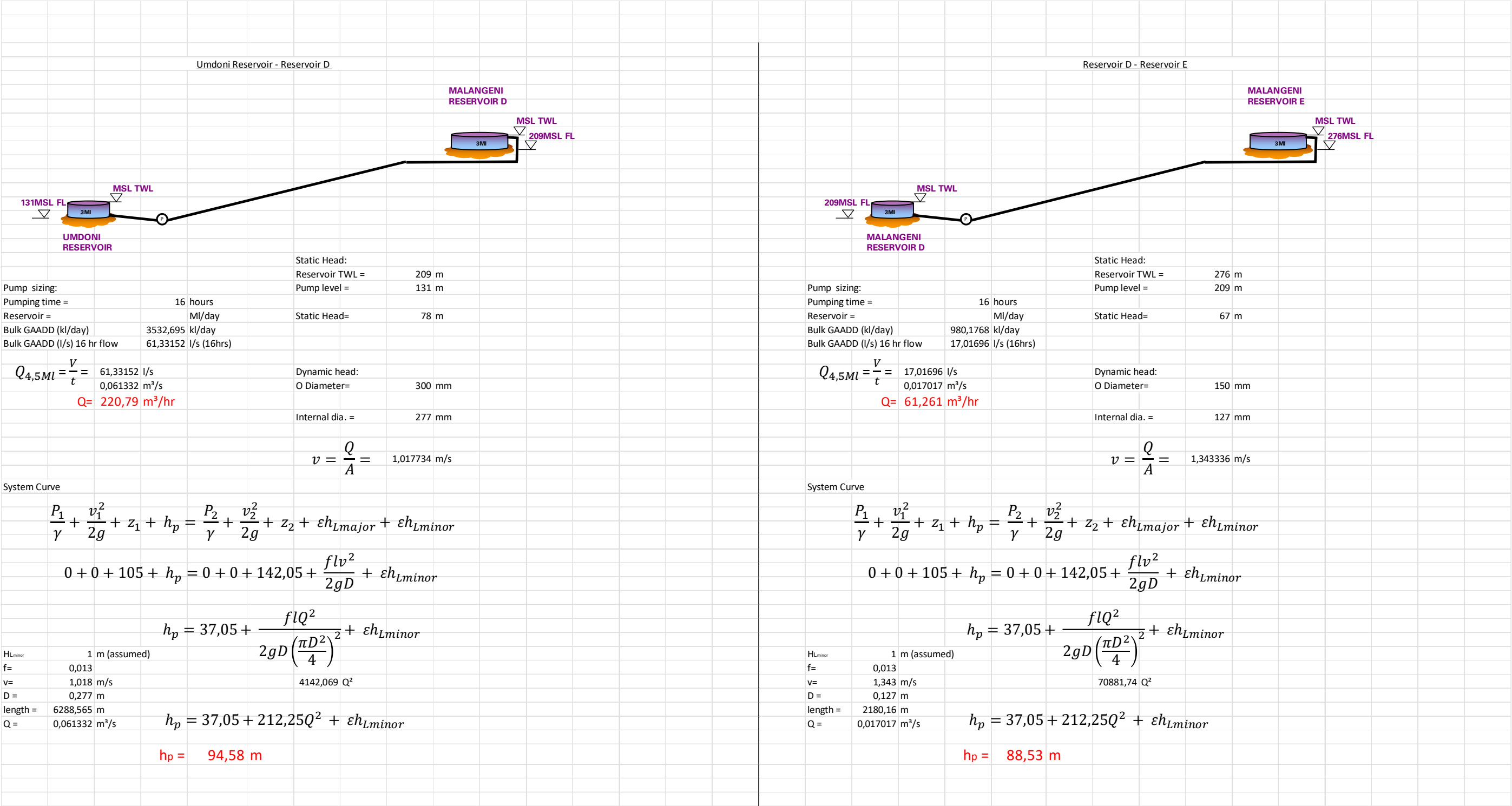
EAST																
RESERVOIR SIZING												PIPE SIZING				
Reservoir Zones	Zones Covored	GPS House Count	Schools' Enrolment	Demand (l) / capita / day			AADD (kl/day)	Losses @ 15%	Bulk GAADD (kl / day)		Future 30 years	Available Storage	Notes	Future 30 years Peak (1,2)	Bulk GAADD l/s 30yrs	MI/day
				Dwelling	Non-Domestic	Av. HH Size			Current	Future30yrs	Storage 48 hrs					
Supply from SCP 2B																
Umdoni Reservoir	GDP	201		70		5	70,35	10,55	80,90	182,75	365			365,4933636	4,230247264	6,7
	Selbourne	93		246		3	68,70	10,30	79,00	129,13	258			600,45	6,94965883	
	Umdoni Village	445		223		3	297,71	44,66	342,36	342,36	685					
	Eden Rock Forest Estate	42		78		3	9,81	1,47	11,28	18,44	37					
	Residents	98		200		3	58,80	8,82	67,62	110,52	221					
									581,17	783,20	1566			939,8366456	92,593	8,0000352
Pennington	Residents	915		200		3	549,00	82,35	631,35	1031,93	2064					
	Schools		0		20		0,00	0,00	0,00	0,00	0					
	Clinics		137		500		0,69	0,10	0,79	0,79	2					
	Community Halls		400		65		26,00	3,90	29,90	29,90	60					
	Restuarants		570		65		37,05	5,56	42,61	42,61	85					
	Offices		336		400		1,34	0,20	1,55	1,55	3					
									706,19	1106,77	2214			1328,12314	15,3717956	1,32812314
Kelso	Residents	499		200		3	299,40	44,91	344,31	562,77	1126					
	Schools		0		20		0,00	0,00	0,00	0,00	0					
	Clinics		0		500		0,00	0,00	0,00	0,00	0					
	Community Halls		0		65		0,00	0,00	0,00	0,00	0					
	Restuarants		0		65		0,00	0,00	0,00	0,00	0					
	Offices		276		400		1,10	0,17	1,27	1,27	3					
									345,58	564,04	1128			676,8445538	7,833849002	0,676844554
Hilltop	Illovu Sugar Mill		1	0	730		730,00	109,50	839,50	839,50	1679					
	Sezela Residents	435		200		3	261,00	39,15	300,15	490,59	981					
	Schools		1519		20		30,38	4,56	34,94	34,94	70					
	Clinics		0		500		0,00	0,00	0,00	0,00	0					
	Community Halls		0		65		0,00	0,00	0,00	0,00	0					
	Restuarants		0		65		0,00	0,00	0,00	0,00	0					
	Offices		706		400		2,82	0,42	3,25	3,25	6					
									1177,83	1368,27	2737			1641,928233	19,00379899	1,641928233
									2810,77	3822,3						
WEST																
RESERVOIR SIZING												PIPE SIZING				
Reservoir Zones	Zones Covored	GPS House Count	hools' Enrolme	Demand (l) / capita / day			AADD (kl/day)	Losses @ 15%	Bulk GAADD (kl / day)		Storage 48 hrs (30)	Available Storage	Notes	Future 30 years Peak (1,2)	Bulk GAADD l/s 30yrs	MI/day
				Dwelling (5 ppl)	Non-Domestic	Av. HH Size			Current	Future30yrs						
Supply from Umdoni Park																
Mhlangamkhulu (Gravity) Res E-G		1123		70		4	314,44	47,17	361,61	816,81	1634	1000		980,1768294	11,34463923	0,980176829
Mhlangamkhulu (Pumping) - Res D	Residents	2821		70		4	789,88	118,48	908,36	2051,85	4104	500				
		0	3712		15		55,68	8,35	64,03	64,03						
	Clinics		0		500		0,00	0,00	0,00	0,00						
	Community Halls		100		65		6,50	0,98	7,48	7,48						
	Restuarants		50		65		3,25	0,49	3,74	3,74						
	Offices		0		400		0,00	0,00		0,00						
									983,61	2127,10	4254			2552,518543	29,54303869	2,552518543
Mhlangamkhulu Total									1345,21	2943,91			24hrs	3532,695373	40,88767792	3,532695373
								Demand	4155,98	6766,19			16hrs (Res D & E)	3532,695373	61,33151689	
								Supply		6700			16hrs (Res E)	980,1768294	17,01695884	
										-66,19						



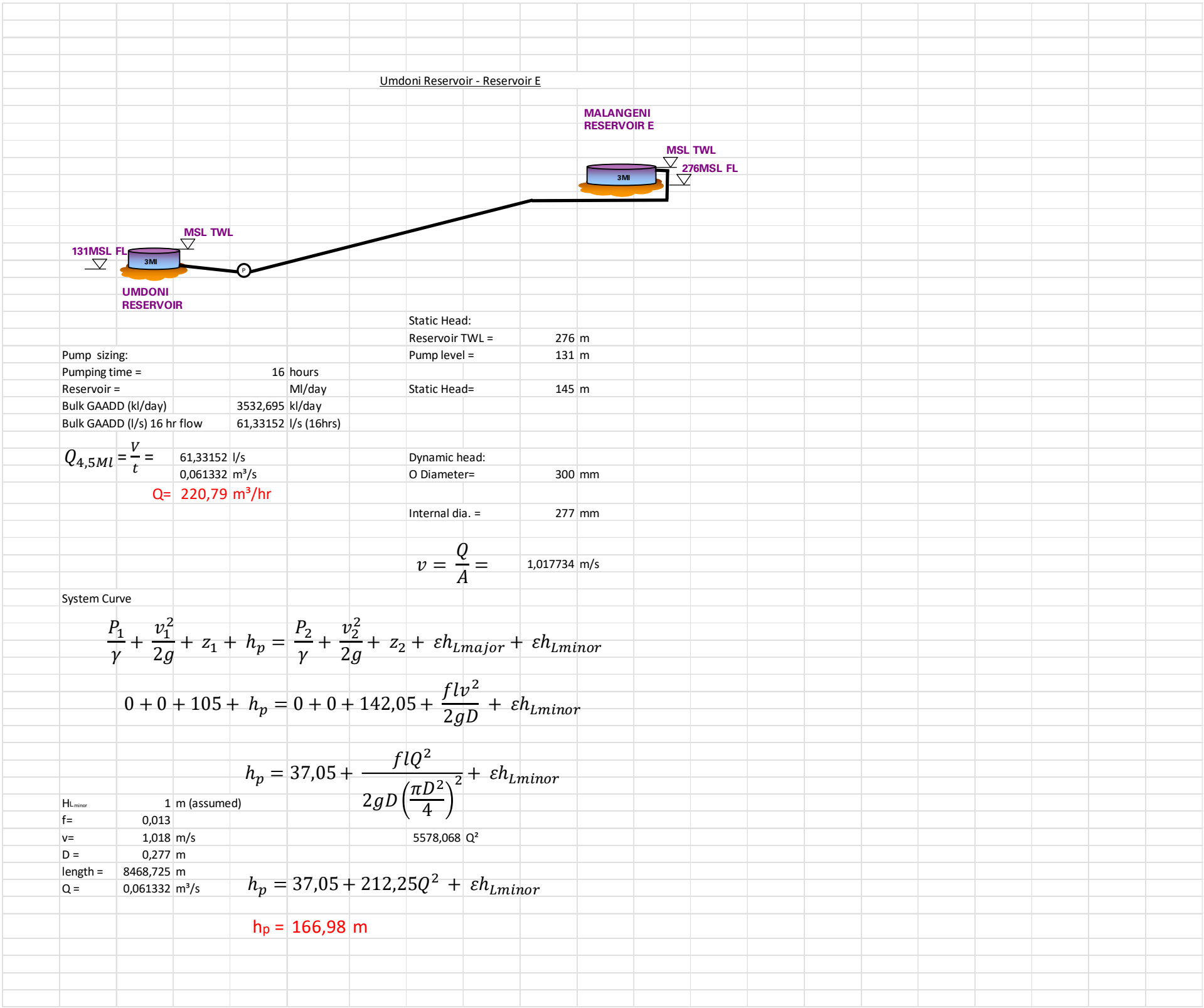
ANNEXURE C – PROPOSED BULK WATER SYSTEM



ANNEXURE D – PUMP CALCULATIONS (OPTION 1)

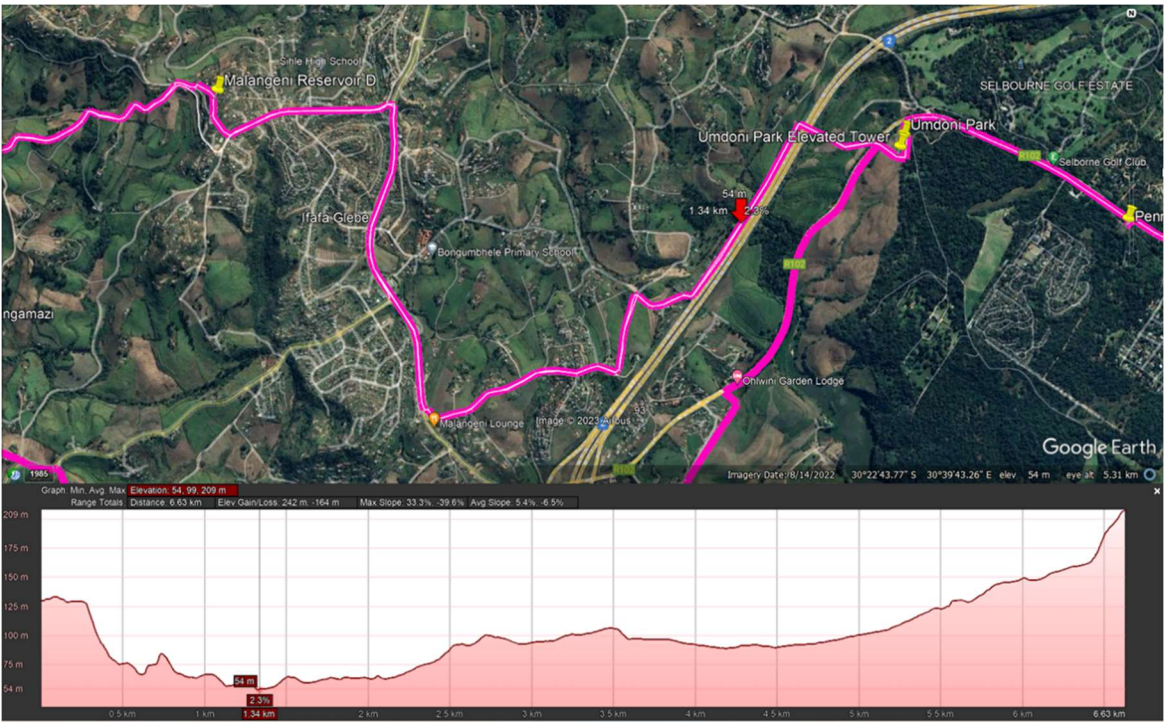


ANNEXURE E – PUMP CALCULATIONS (OPTION 2)

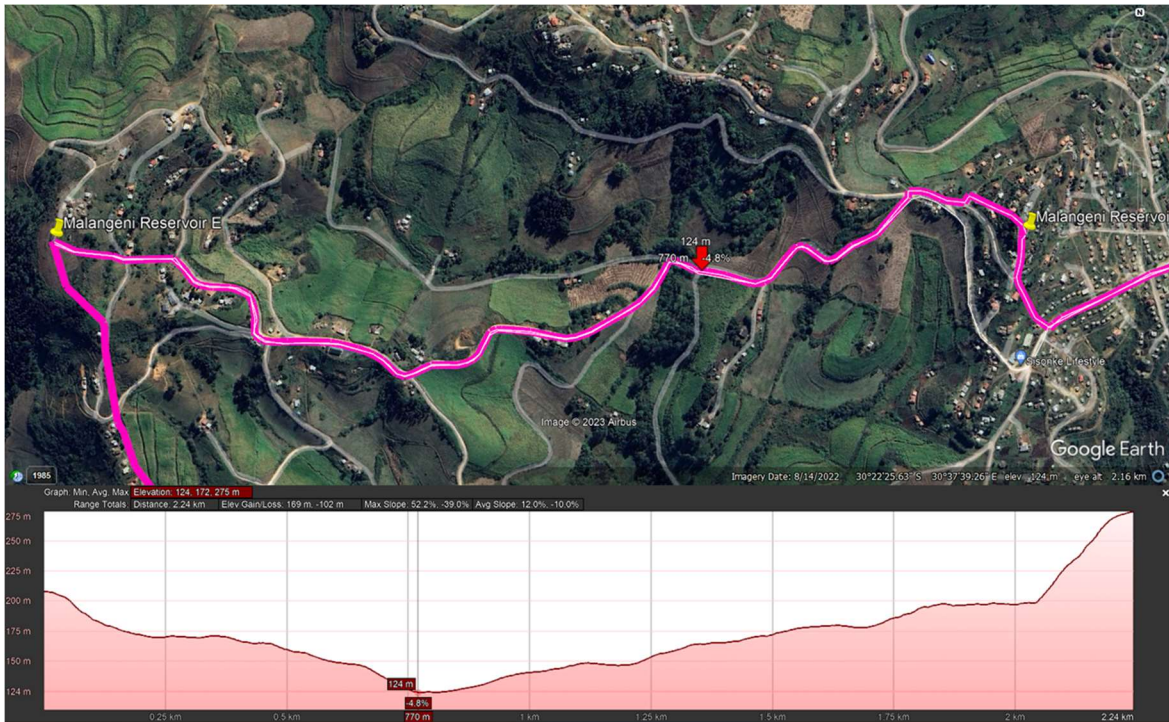


ANNEXURE F – ELEVATION PROFILE FOR PUMPING MAINS

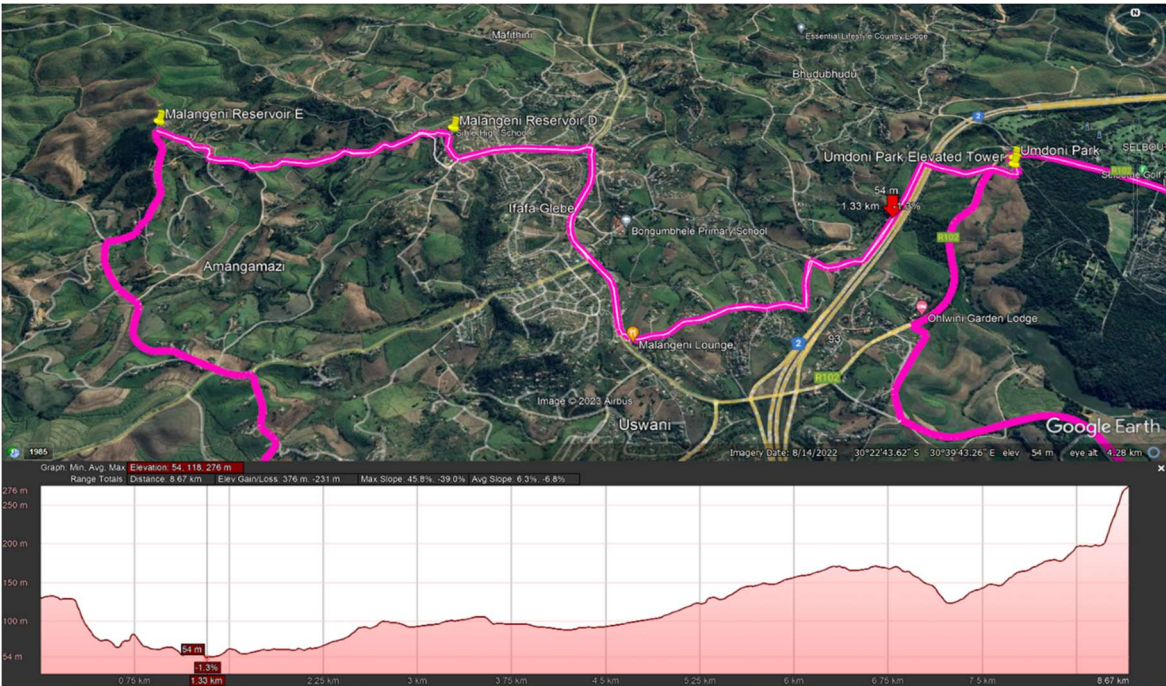
Umdoni Reservoir – Malangen Reservoir D



Malangen Reservoir D – Malangen Reservoir E



Umdoni Reservoir – Malangen Reservoir E



ANNEXURE G – FLOWS FROM PRIVATE ESTATES

Umdoni Village					
	Meter 1	Meter 2	Total Consumption	Days	Average Per Day
Mar-23	1986	6541	8527	31	275,0645161
Apr-23	1539	5425	6964	28	248,7142857
May-23	2288	9882	12170	33	368,7878788
					297,5222269 kl/day

ACCOUNT 10416128

IMBABALA FOREST ESTATE

Date	Meter Number	Reference	Reference 2	Description
1/10/2023		10010471	CBR03327	Payment - Thank You
1/10/2023	PZT442	2023-01-10 WATER CON	2074/ERF NO_	304 KL (Start:63144 End:63448)
1/10/2023	PZT442	2023-01-10 WATER BAS	2074/ERF NO_	Water Basic - Urban
1/10/2023		2023-01-10 SANITATIO	2074/ERF NO_	Sanitation - Charge Per Kilolitre RES
1/10/2023		2023-01-10 SANITATIO	2074/ERF NO_	Sanitation Fixed Charges - Units 35
1/25/2023		25010344	CBR03350	Payment - Thank You
2/10/2023	PZT442	2023-02-10 WATER CON	2074/ERF NO_	304 KL (Start:63448 End:63752)
2/10/2023	PZT442	2023-02-10 WATER BAS	2074/ERF NO_	Water Basic - Urban
2/10/2023		2023-02-10 SANITATIO	2074/ERF NO_	Sanitation - Charge Per Kilolitre RES
2/10/2023		2023-02-10 SANITATIO	2074/ERF NO_	Sanitation Fixed Charges - Units 35
3/1/2023		01031051	CBR03438	Payment - Thank You
3/10/2023	PZT442	2023-03-10 WATER CON	2074/ERF NO_	304 KL (Start:63752 End:64056)
3/10/2023	PZT442	2023-03-10 WATER BAS	2074/ERF NO_	Water Basic - Urban
3/10/2023		2023-03-10 SANITATIO	2074/ERF NO_	Sanitation - Charge Per Kilolitre RES
3/10/2023		2023-03-10 SANITATIO	2074/ERF NO_	Sanitation Fixed Charges - Units 35
4/1/2023		01040350	CBR03529	Payment - Thank You
4/10/2023	PZT442	2023-04-10 WATER CON	2074/ERF NO_	304 KL (Start:64056 End:64360)
4/10/2023	PZT442	2023-04-10 WATER BAS	2074/ERF NO_	Water Basic - Urban
4/10/2023		2023-04-10 SANITATIO	2074/ERF NO_	Sanitation - Charge Per Kilolitre RES
4/10/2023		2023-04-10 SANITATIO	2074/ERF NO_	Sanitation Fixed Charges - Units 35
5/3/2023		03050540	CBR03637	Payment - Thank You

Selbourne		
Month	Meter Reading	
05-Oct	2638,39	
05-Nov	2487,74	
05-Dec	2142,1	
05-Jan	3007,66	
05-Feb	2255,04	
05-Mar	1754,9	
05-Apr	1889,86	
05-May	2074,55	
05-Jun	1679,67	
05-Jul	2189,78	
05-Aug	1723,02	
05-Sep	1895,45	
05-Oct	1947,73	
	27685,89	
	2129,684	kl/month
	68,69948	kl/day

ANNEXURE H – RETICULATION WATER SYSTEM FOR GDP



