INTEGRATED WATER SERVICES REPORT

SUPPORTING REPORT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT OF THE MM SEZ (SOC) SOUTHERN DEVELOPMENT SITE FOR THE ESTABLISHMENT A RANGE OF HEAVY INDUSTRIES, COMMERCIAL- AND RESIDENTIAL SITES

COMPILED FOR THE MM SEZ SOC

BY MATUKANE AND ASSOCIATES (PTY) LTD

August 2020

Project Team

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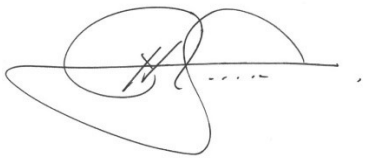
Declaration

I hereby declare that Matukane and Associates (Pty) Ltd and the directors of the company is independent of the MM SEZ SOC and the projects related to this report in terms of the definition of "independent" as stated in the Environmental Impact Assessment Regulations of 2014.



Erik Pretorius

Director Projects: Matukane and Associates (Pty) Ltd

Abbreviations

MM SEZ (SOC) – Musina – Makhado Special Economic Zone State Owned Company

EIA – Environmental Impact Assessment

DWS – Department of Water and Sanitation

VDM – Vhembe District Municipality

LM – Local Municipality

DM – District Municipality

LNW – Lepelle Northern Water

JWC – Joint Water Commission

LIMCOM – Limpopo Watercourse Commission

JWC – Joint Water Commission

LEIP – Limpopo Eco Industrial Park

LRS – Limpopo Water Management Area North Reconciliation Study

WUL – Water Use Licence

WARMS – Water Use Authorization & Registration Management System

Units of Measurement

MW – Megawatt as unit for the supply demand of electricity (1 MW = 1000 kW)

MWh – Quantitative measurement of electricity usage (MW x hours)

Mm3/a – Million cubic meters per annum as large scape water supply / demand expression

Ml – mega litre (=1,000,1000 litre = 1000 kl)

1 Mm3/a = 2.7397 Ml day = 2,739.7 m3/day = 2,739.7 kl/day = 2,739,000 litre per day = 31.7 litre/sec

Contents

1. Introduction

Obtaining environmental authorization to commence with the implementation of a project of the extent and nature of the MM SEZ project, is a legal requirement according to South African Law. The EIA that is prepared in the course of this process will address several important environmental- and legal criteria in such a way that decision makers are supported to consider all the relevant aspects duly; in order to enhance the sustainability of use of resources to protect the interest of others that are sharing the resource or is affected in some way by the use of it. The EIA process fully supports the authorization of water usage that is a core function of the Department of Water and Sanitation.

The purpose of this report is to deal with the water business pertaining to the project. Various aspects under which the water demand, water supply, the nature of resources, sustainability and the impact of supply, usage, transfer, and storage will be considered.

This report was compiled to be submitted as a part of the EIA report pertaining to the Southern Industrial Site, and serve to describe the water requirements in terms of the SEZ envisaged development, based on the short and long term needs of the envisaged activities of the MM-SEZ as an entity, without losing sight of the bigger supply and demand reality.

Many studies on various aspect of water demand and supply has been done. This report serves to integrate the findings of the various reports into a consolidated view.

As will unfold through the report, the water demand is substantial if compared to the current water usage in the region. It will become clear that water demand can only be met by current local resources for minimal usage at commencement of the project. As the implementation progresses, the demand for further construction- and later process water will grow at an increasing rate, soon to be far beyond what can be met by any possible local supply. Tapping from resources further off, becomes incredibly complex.

This report will endeavour to clarify the options and further requirements in a realistic way.

2. Background

The SEZ industrial development will evolve around two nodes, the one in the north on the farm Antonvilla 7 MT, just east of Musina and west of the confluence of the Sand- and the Limpopo Rivers. This site is in the Musina Local Municipal area. The likely southern site is about 40 km south of Musina on the N1 route, with the north eastern corner of the site close to the Baobab tollgate. The farms Dreyer 526 MS, Van der Bijl 531 MS, Steenbok 565 MS, Battle 585 MS and Antrobus 516 MS are in the Musina Local Municipal Area, while the farms Jofre 584 MS, Lekkerlag 580 MS and Somme 611 MS are in the Makhado Local Municipal area.

Although the MM SEZ industrial development over-span the jurisdiction areas of both Musina LM and Makhado LM, the water supply to the SEZ sites is considered to be more interlinked with the Musina LM supply. There are various reasons contributing to this, namely the fact that the resources serving the Makhado area are highly contested, without a “free balance”, the physical obstacle formed by the Soutpansberg mountain, and the possibilities for water supply from the Limpopo and neighbouring countries to the north.

Although this report primarily deals with the EIA for the MM SEZ Southern Site, the context is that the MM SEZ Northern Development site, mining opportunities in the water supply area, increased municipal supply to Musina, Makhado and surrounding other settlements due to the increased economic activities associated with the industrial development, will also impact on water resources, with the effect that the use in a specific development area cannot be considered in isolation. Water resources will thus be discussed at hand of the bigger demand and supply scenario. It will unfold that the water business of the Musina town, the Northern SEZ site and the Southern SEZ site must be considered together.

3. Authoritative Documentation

The DWS developed the 2017 Reconciliation Strategy as the basic planning guideline document pertaining to water requirement and supply in the various supply areas of South Africa. The document "The Development of Limpopo Water Management Area North Reconciliation Strategy" (Final Version February 2017) (Referred to further as the DWS_LRS) is accepted as the authoritative document for reference pertaining to water balances.

Due to the factual nature of such a planning document, facts as known at the time of compilation, and assumptions made at the time, forms the basis of it. During the time of compilation, the nature and water requirements of the MM SEZ was differently perceived than today. During the report development time, the total water requirement was considered to be approximately 35 Mm3/a, whilst the current view is and eventual requirement of approximately 80 Mm3/a for the SEZ Southern Site alone. This brings about the necessity to introduce additional data with due motivation.

Further reference documentation is listed in the Bibliography, included as Section 15 to this report.

4. Geographical Setting

The SEZ project areas are situated in the close proximity of Musina in the northernmost part of Limpopo and South Africa. Musina is the border town supporting the main port toward Africa north of South Africa. It borders directly on Zimbabwe, with the main road (N1) and rail links passing through it on the way to the border and Limpopo River crossing at Beitbridge.

Botswana, South Africa, and Zimbabwe share a common boundary point at the confluence of the Shashe- with the Limpopo River. This point is approximately 70 km west of Musina.

A less frequent route to the Pont Drift border post runs westwards along the R572 and R571 roads. Pont Drift is 110 km from Musina via this route.

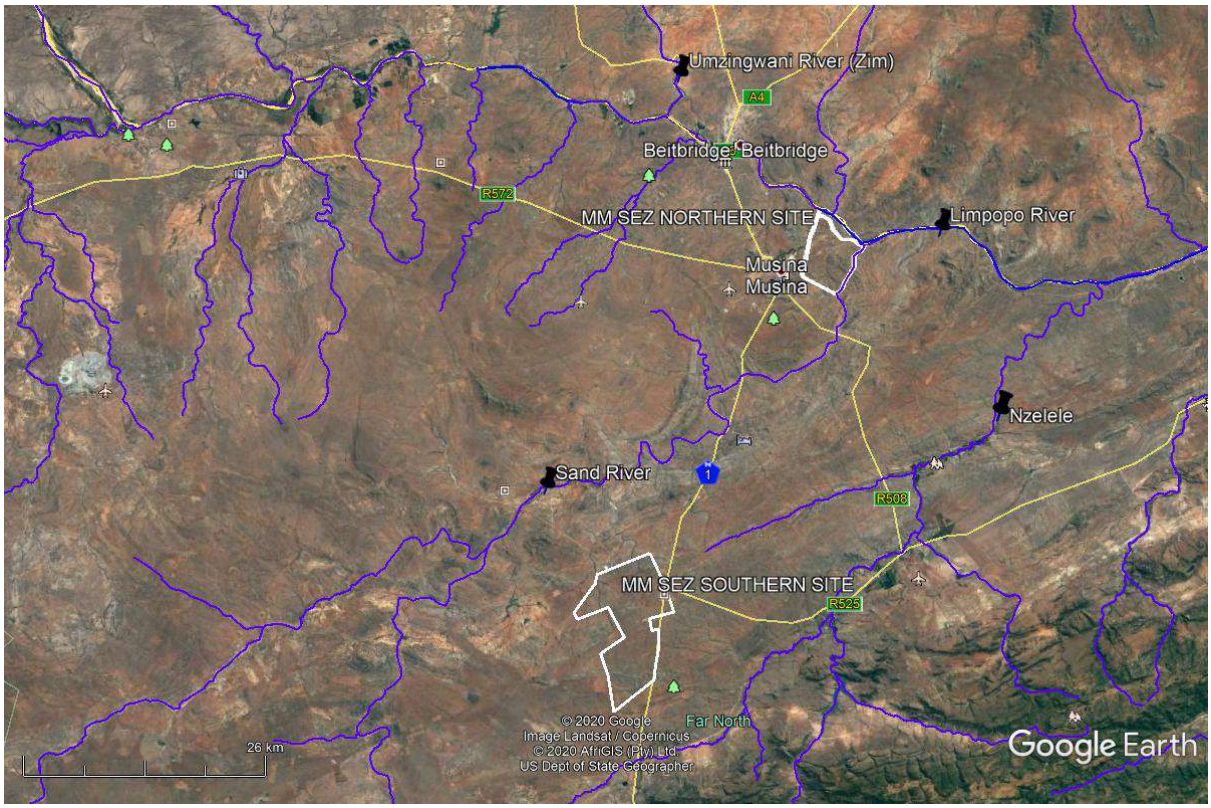


Figure 1: Locality Map

Mozambique, South Africa, and Zimbabwe forms a common boundary point approximately 130 km east of Musina downstream on the Limpopo River. The Pafuri border post between South Africa and Mozambique is 170 km from Musina via the R525 and the S63 roads. This route enters the Kruger Park at the Pafuri Gate.

From the South, Musina is easily reachable through the N1 and railway link from Polokwane and further inland. The port of Musina is the main import and export road link between South Africa and the rest of the continent.

Musina is situated approximately 570 m above sea level.

5. Climate

Musina experiences a hot semi-arid climate with hot temperatures most of the year. Average annual precipitation amounts to 372 mm and is highly concentrated in the summer months from October to April when severe late-afternoon and evening thunderstorms are common. Winter is extremely dry, with almost no precipitation, typically recorded in the driest months from June to August. Clear skies and exceptionally low humidity at this time of the year enable temperatures to plunge close to freezing at night, although frost is fairly uncommon.

Maximum temperatures averaging 32^0C to 33^0C during November, December, and January, while the lowest temperatures of 8^0C is measured in June, July, and August.

6. Hydrological Setting

The northern part of the Southern Site is situated in the (Sand river) A71K Quaternary Catchment area, which also drains the town of Musina and the Northern SEZ site on the farm Antonvilla 7 MT. The Sand River drains into the Limpopo River on the eastern boundary of the Antonvilla.

The southernmost two farms of the SEZ Southern Site is situated in the A80F quaternary catchment where it drains into the Mutamba River. This catchment area drains into the Nzelele River in quaternary catchment area A80G, which drains into the Limpopo approximately 28 km downstream of Musina along the Limpopo River.

The main drainage feature in the area is the Limpopo River which drains a vast area of South Africa, Botswana, and Zimbabwe. On the South African side, the Crocodile-, Matlabas-, Mokolo-, Lephalala-, Mogalakwena and Sand Rivers drains into the Limpopo upstream (west) of Musina. From Botswana, the Lotsane-, Tapalaphala-, Motloutse- and the Shashe River joins the Limpopo from the west and the north, while the major contribution from Zimbabwe west of Mussina is through the Umzingwani River with the Zhove Dam in its headwaters. The Bubye- and Nuanetzi River joins the Limpopo from the north, roughly from the Masvingo area, far east of the project site in Mozambique. These last two Zimbabwe rivers does not contribute naturally to the flow in the Limpopo in the project area, but schemes may be considered to re-route the water towards the Beitbridge area.

As described above, the water cause defined by the Limpopo River directly affects South Africa, Botswana, Zimbabwe, and Mozambique.

Due to the large drainage area of the Limpopo, with local flood events that may occur in any of the contributing catchments due to prevailing weather patterns there, regular flood events occur in the Limpopo around the project area

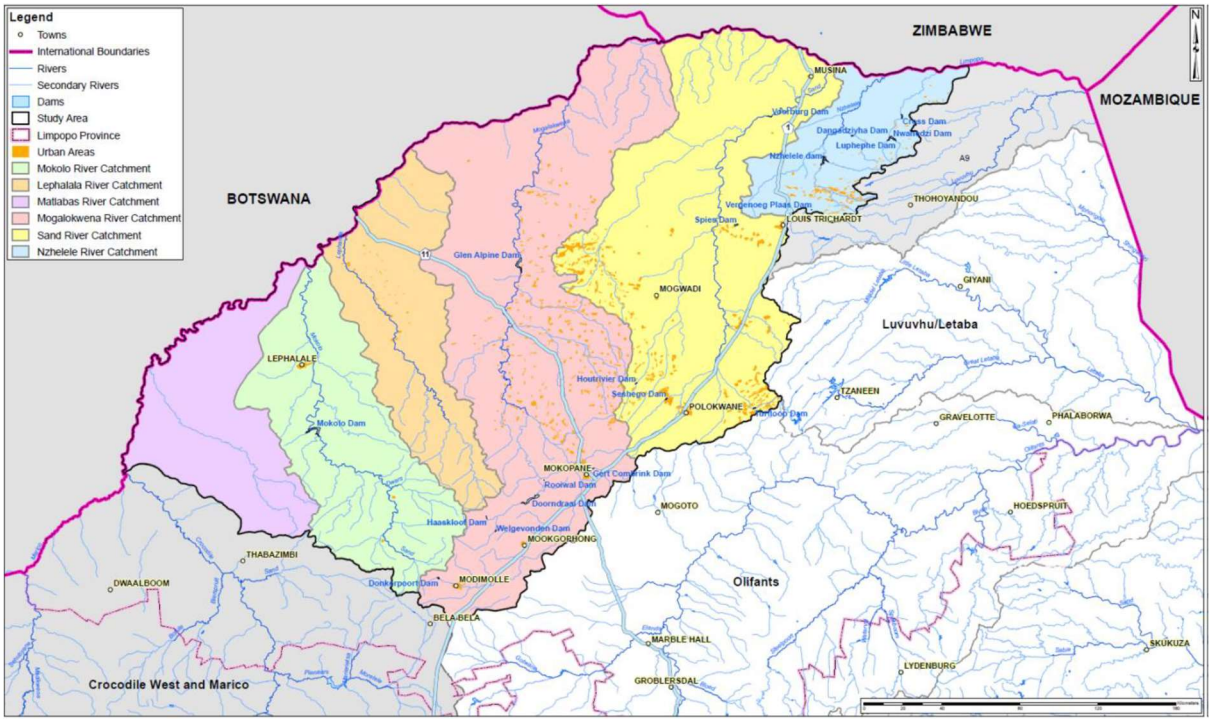


Figure 2: Limpopo Drainage Region (from the DWS-LRS)

A detailed main-stem hydrological study, considering all sub-catchment areas in South Africa, Botswana, Zimbabwe, and Mozambique is required to model the extent and frequency of flood events. Detailed data apart from some flow measurements are not available. A study of this nature should thus me conducted to serve as planning and decision-making tool.

7. Institutional Arrangements

In South Africa, water is regulated by the Department of Water and Sanitation, with the Limpopo Provincial office situated in Polokwane. The management of water in a supply area is the responsibility of Water Supply Authorities (WSA). In the case of this area, the relevant WSA is Vhembe District Municipality (VDM). Water service providers are often appointed to operate supply schemes. Lepelle Northern Water (LNW), for instance, is deployed widely in Limpopo in this capacity.

South Africa, Botswana, and Zimbabwe are all directly affected by the Limpopo River. Joint water interests are attended to through the Joint Water Committee (JWC) of LIMCOM. Each member country is represented by a commissioner. In the case of South Africa, the DWS Chief Director in Limpopo normally serve as commissioner. This links back in South Africa to DWS Provincial, DWS Directorate Strategic Planning and DWS Directorate International Affairs.

The allocation and the use of water is authorised and regulated in South Africa through the issuing of water use licenses. Any authorization must be applied for to DWS in terms of the National Water Act (Act 36 of 1998) and the associated regulations.

8. Water Demand

8.1. The DWS-LRS and Water Demand

The DWS-LRS deals extensively with the water demand of the various water use sectors (it is mining and industrial (clustered together), agriculture (irrigation and livestock) and domestic), and express the requirements as perceived at the time of compilation over a time horizon between 2011 and 2040 per catchment.

Following are tables with the containing the resulting figures:

8.1.1. Irrigation Requirements for the WMA (DWS-LRS Section 2.2)

River catchment	Irrigation water requirements (million m³/a)							
	Surface water				Groundwater			TOTAL
	Run-off-river & Dams	Schemes	Limpopo River	Total	Groundwater	Limpopo River aquifers	Total	
Matlabas	0.6	0.0	1.8	2.4	2	0.3	2.3	4.7
Mokolo	30.9	6.1	0.0	37	3.2	0.0	3.2	40.2
Lephalala	38.5	0.0	4.4	42.9	0.7	26.2	26.9	69.8
Mogalakwena	25.4	7.9	6.1	39.4	43.2	16.8	60.0	99.4
Sand	9.9	0.0	43.7	53.6	126.8	41.3	168.1	221.7
Nzhelele	0.8	18.7	5.7	25.2	3.8	0.1	3.9	29.1
TOTAL	**106.2**	**32.7**	**61.7**	**200.6**	**179.7**	**84.7**	**264.4**	**464.8**

Notes:

- The Irrigation requirements are considered to remain fairly constant due to the following reasons:
    - Resources are fully- or over allocated.
    - Increased production levels are achieved through technological development that leads to increased efficiency of water application through:
        - Irrigation technological development.
        - Improved cultivation practices.
        - Vegetative material development.
        - Precision farming.
        - High value crop (Example Macadamia nuts, mangoes and avos and tomatoes versus traditional cash crops like maize).
        - Marginal irrigation land used for other farming and focussing on high productivity land for irrigation.
        - Deforestation to free water for more productive uses.

- It is notable that almost 57% of the total irrigation requirements are supplied by either groundwater or water from the Limpopo alluvial aquifer.
- The importance of agriculture in terms of primary economic contributor, work opportunities and food security should be recognised.

8.1.2. Domestic Water Requirements in the WMA (DWS-LRS Section 2.3)

Catchment	Domestic water requirements (million m³/a)								
	2011			2015	2020	2025	2030	2035	2040
	SW	GW	Total						
Matlabas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mokolo	3.8	0.8	4.6	4.9	5.2	5.7	6.1	6.6	7.0
Lephalala	0.0	2.8	2.8	3.0	3.2	3.4	3.6	3.8	3.9
Mogalakwena	10.4(1)	19.5	29.9	30.1	30.2	31.3	32.4	32.9	33.3
Sand	38.7(2)	17.1	55.8	58.3	60.7	65.1	69.4	73.6	77.8
Nzhelele	3.7	5.3	9.0	9.4	9.7	10.4	11.1	11.6	12.0
TOTAL	**56.6**(3)	**45.5**	**102.1**	**105.6**	**109.0**	**115.8**	**122.6**	**128.3**	**134.0**

Notes:

- Quoted as comments from the DWS-LRS

(1) Includes transfer of 1.95 million m³/a from Roodeplaat Dam to Modimolle.

(2) Includes allocated transfers of 32.2 million m³/a: 12 million m³/a from Ebenezer Dam to Polokwane (this allocation has been increased to 16.2 million m³/a in 2016),

6.53 million m³/a from Dap Naude Dam to Polokwane, 11.3 million m³/a from Olifantspoort Weir to the portion of the Polokwane LM included in the study area and 2.4 million m³/a from Albasini Dam to Louis Trichardt.

(2) Includes total transfer volume of 35.2 million m³/a from neighbouring WMAs, local surface water only account for 21.4 million m³/a.

(3) Includes total transfer volume of 35.2 million m³/a from neighbouring WMAs, local surface water only account for 21.4 million m³/a.

- Consideration was given in the report population growth according to demographic statistics, but specific provision was made for further growth where economic growth and associated migration are expected due to economic factors.

8.1.3. Industrial and Mining in the WMA (DWS-LRS Section 2.4)

Catchment	Industrial and mining water requirements (million m³/a)								
	2011			2015	2020	2025	2030	2035	2040
	SW	GW	Total						
Matlabas	0.0	0.0	0.0	0.0	6.0	6.0	6.0	6.0	6.0
Mokolo(1)	18.3	0.0	18.3	27.0	35.8	61.1	86.3	110.4	110.4
Lephalala	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Mogalakwena	8.9(2)	6.5	15.3	21.3	26.5	36.8	47.0	55.5	64.0
Sand	7.5	3.3	10.8	15.1	38.3	48.8	56.0	58.8	61.6
Nzhelele	0.5	0	0.5	0.8	4.7	5.2	9.3	6.5	7.0
TOTAL	**26.3**	**9.9**	**45.0**	**64.0**	**111.4**	**157.9**	**204.7**	**237.3**	**249.1**

Notes:

- Forecasts were based upon information available at the time.
- In the DWS-LRS, the industrial water requirement for the MM SEZ was set at around 11 million cubic meters per annum. According to current planning, the real expected requirement is much higher at a long-term demand of 80 million cubic meters per annum. This calls for additional detail and planning adjustment.
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8.1.4. Preliminary Outcome of the DWS-LRS

In dealing with the water requirements specifically of Makhado and Musina, the DWS-LRS concluded that sufficient resources are available to supply in the water requirements of the Musina and the Makhado Local Municipal Areas in the long term. Following are the presented water balances for the areas:

8.1.4.1. Makhado according to the DWS-LRS Section 7.2.5 (c)

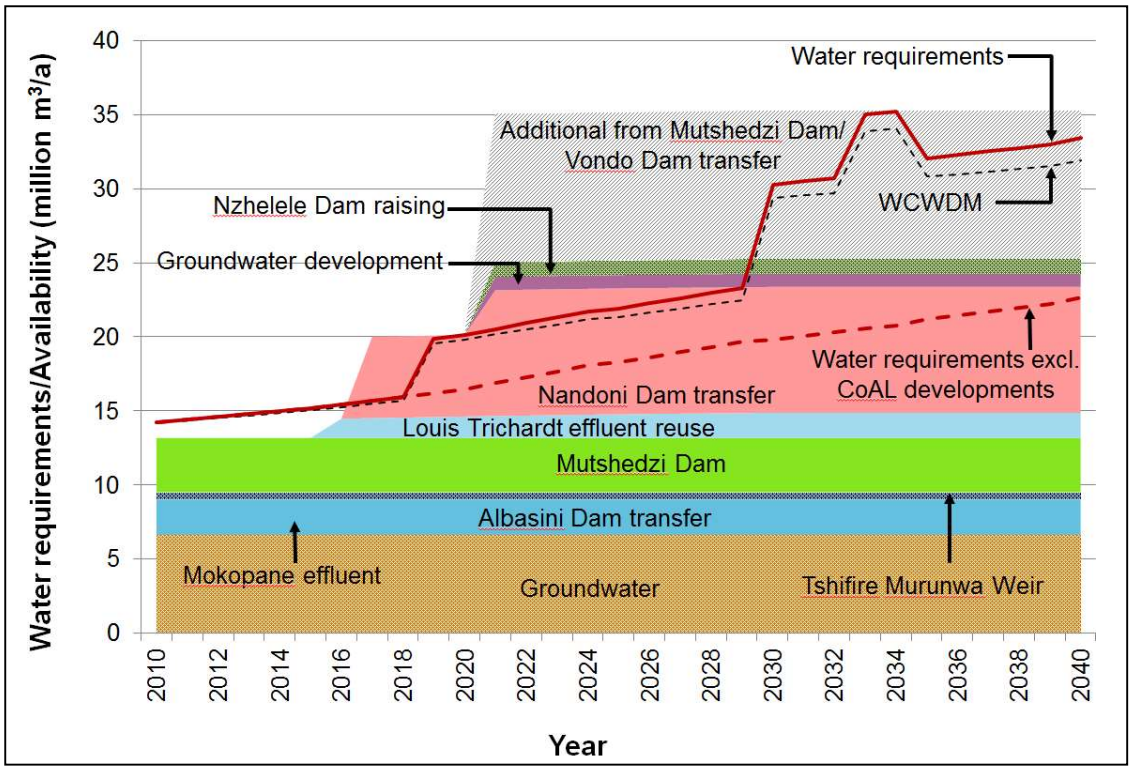

Figure 3: Makhado LM Water Balance (From the DWS-LRS)

Notes: (Recognition to DWS-LRS 7.2.5 (c))

The major increase in water requirement in the Makhado LM area is the expected growth in the domestic, industrial, and especially the mining sector. A number of studies have been conducted to identify potential water sources for the urban areas, as well as for the CoAL developments. Figure 3 shows the water balance for the considered Makhado LM area, including the following interventions:

- Re-use of effluent from Louis Trichardt.
- The Nandoni Dam transfer to Louis Trichardt.
- Bought over irrigation allocation from Nzelele Dam.
- The Nzelele Valley Bulk Water Supply Scheme, which includes:
- Groundwater development.
- Augmenting supply from Nzelele Dam by raising the dam and providing the additional infrastructure.
- Augmenting supply from the Vondo Dam scheme.

It is of importance to note that although sufficient water is available for the supply to Makhado, it is subject to various planned intervention projects. Failing these, water shortages will occur. It is to the best int000erest of the SEZ to monitor the planning and implementation of these projects, not to be caught by surprise by limited supply in the future.

8.1.4.2. Musina Local Municipality according to the DWS-LRS Section 7.2.5.(d)

The following was quoted from Section 7.2.5.(d) from the DWS-LRS, illustrating the level of available information and the interpretation thereof in the study report.

The water requirements in the Musina area are expected to increase significantly due to the development of the LEIP and the SEZ. As mentioned earlier, updated water requirements have been received for the LEIP, but only a very high-level estimate of the projected water requirements of the SEZ was available at the time of compiling this report. However, it is considered that the Musina SEZ refers more to the area that will be occupied by industrial operations, whereas the LEIP refers to the actual industries. In light of this, it is foreseen that some of the SEZ water requirements have been included in the projected LEIP water requirements.

In total the LEIP will require approximately 0.15 million m3/a during construction which is planned to start at the end of 2016, pending the water use license approval. Operations will start from 2017 and 23 million m3/a will be required by 2022 when the LEIP is in full operation. The LEIP will be operated on a zero- liquid discharge basis, with the water used and produced in the various plants being kept within the boundary limits of the particular plant. Used water will be fed to a dedicated effluent treatment facility and treated to be re-used within the park. The developers of LEIP are also negotiating the upgrade of the Musina WwTW to enable re-use of treated effluent. To top up the system, approximately 18 million m3/a is required. Options identified to supply the top-up water include a 20 to 23 million m3/a abstraction from the Limpopo River via an infiltration gallery system, over three months per year, which is then pumped to off-channel storage dams with a combined capacity of 17 million m3.

Due to the close proximity of the LEIP, other SEZ developments and Musina town, it is proposed that a holistic approach is followed when identifying possible water resources. Considering the limited existing water resources, limited potential development options, and other financial and institutional processes and regulations to be followed, it is likely that the LEIP, other SEZ developments and Musina town will need to conjunctively develop, operate and maintain additional resources. It is thus recommended that the water requirements for the other SEZ developments, not included in the LEIP, also be supplied from the Limpopo River via the infiltration gallery and off-channel storage dam or any other alternative identified. It is essential that the correct projected water requirements from the other SEZ developments be included when identifying potential resources and determining the capacities of infrastructure.

The proposed water balance for the Musina focus area is shown in Figure 7.19. (Figure 4 in this report). *The balance shows the effect of implementing WCWDM measures in the area, mainly focused on the domestic water requirements as new industries are expected to use water as efficiently as possible. The estimated additional water requirements for the SEZ are shown as shaded areas.*
In the case of the low water requirement scenario, the water requirements for the municipality and the LEIP can be met by the current Limpopo River sand aquifer abstraction, LEIP re-use and the off-channel storage dams. The additional water requirements by the SEZ can potentially be met via the transfer of surplus water from Zhove Dam in Zimbabwe (refer to Section 6.3.2f)), by 2028. To implement this transfer significant international negotiations and possible additional infrastructure will be required, resulting in a long lead time.

In case of the high water requirement scenario, the current Limpopo River sand aquifer abstraction, LEIP re-use and the off-channel storage dams will only be able to meet the water requirements up to 2028, after which additional interventions, such as the Zimbabwe transfer, need to be implemented to meet the water requirements, especially if the additional SEZ water requirements apply.

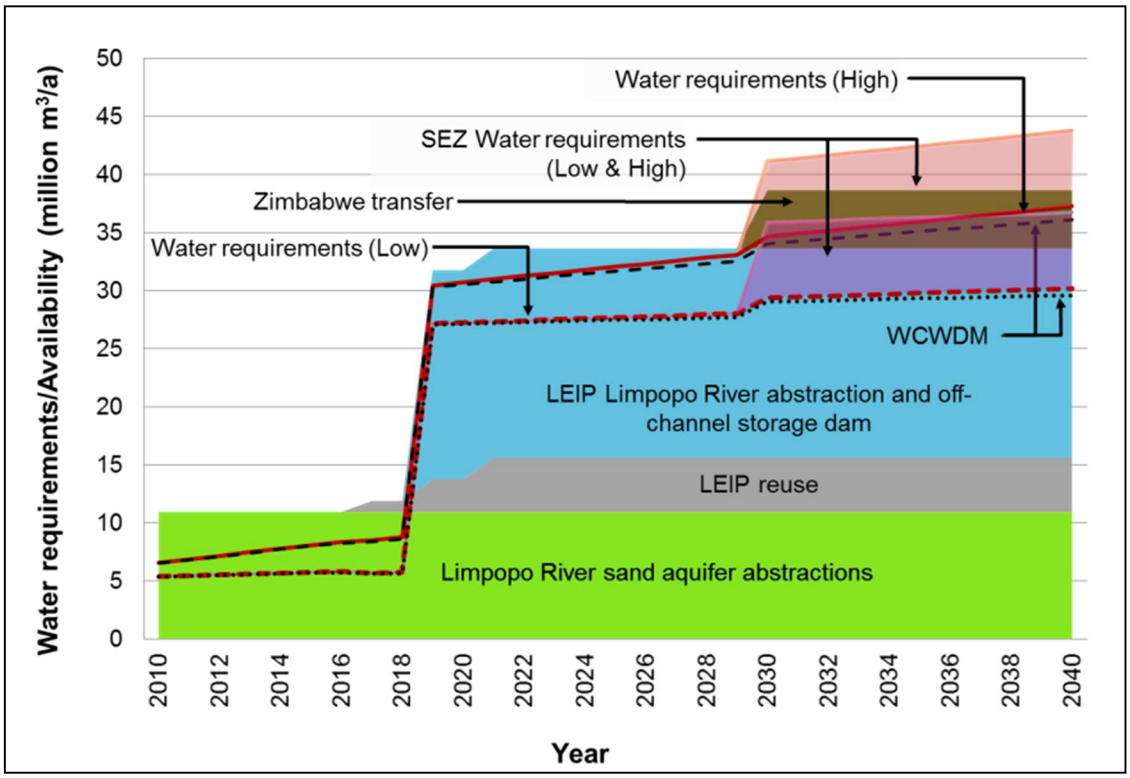

Figure 4: Musina LM Water Balance (From the DWS-LRS)

Subsequent to this, the following transpired:

The LEIP and MM SEZ are riling out as completely different entities, independent of one another.

The following water requirements transpired:

- Musina LM (current 2020) 6.6 Mm3/a of their 11 Mm3/a allocation.
- LEIP, according to available information was granted a WUL for 20 Mm3/a from off-channel storage.
- SEZ Northern Site have an estimated full supply demand of 20 Mm3/a, which will not be reached earlier than 10 year from commencement.
- SEZ Southern Site was defined with the projected full supply demand of 80 Mm3/a within 10 years from commencement.

None of the industrial development on any of the LEIP of SEZ sites have commenced to date.

8.1.5. Conclusive Discussions on Water Demand for the SEZ according to the DWS-LRS

8.1.5.1. Makhado Local Municipal Area

No industrial development is planned for the current Makhado LM supply area under the MM SEZ programme. (*Explanatory note: Although a considerable part of the Southern Development Area is indeed in the Makhado LM area, the Soutpansberg as geographical feature, economics of supply due to high infrastructure demand and the availability of possible sources found the reasoning to include the whole of the Southern Development Area in water supply from the north, that is from the Limpopo*). It is however foreseen that the settlements in the Makhado LM will experience higher than normal growth in population and commercial activities due to the developing minefields and the impact of the MM SEZ industrial development further north.

It is essential that specific assurance is obtained from DWS in terms of the proposed water supply interventions in the DWS-LRS to augment water supply to the area.

8.1.5.2. Musina Local Municipal Area

The water requirements associated with the current industrial planning of the MM SEZ exceed the anticipated requirements substantially. This warrants a complete review of water requirements over the given time horizon, as well as a reconsideration of sources compared to the planning presented in the DWS-LRS.

8.2. Elements of Musina Supply Area Water Demand and Supply

The water supply to a specific component of the envisaged MM SEZ development cannot be seen in isolation from the full development picture, due to the following:-

- The development area is situated in an arid area with limited water resources.
- The volume of water required is huge, rather requiring a ***supply scheme*** than single sources.

- The Musina town, the Northern SEZ development site and the Southern SEZ development site must be considered simultaneously, while the eventual water supply further inland in the Limpopo Province must be taken into consideration as a later option.
- Infrastructure required for water supply to the scheme must be conceptualised in a modular fashion so that infrastructure can grow with demand and supply.

The components under current consideration will thus be:

- Musina Town
    - Current demand: 6.6 Mm3/a (Limpopo Water Management Region Area North Reconciliation Strategy (Final Version – Feb 2017)(Information verified in meeting with the Vhembe District Municipality)(WSA).
    - Total allocation: 10.96 Mm3/a (Limpopo Water Management Region Area North Reconciliation Strategy (Final version – Feb 2017).
    - Future requirement: Currently under further research as the reconciliation study made certain assumptions on the (then) perceived water requirements of SEZ and LEIP, without an estimate for Musina itself). It must be taken into account that both LEDA for the Northern Site and Delta BEC for the Southern Site, made specific provision for residential and commercial use.

- Northern Development Site
    - Situated on the farm:
        - Antonvilla 7 MT
    - Water requirement
        - Industrial and residential / commercial seen together: 20 Mm3/a (= 54.79 Ml/day) (Information from MM SEZ SOC)
- Southern Development Site
    - Situated on the farms:
        - Somme 611 MS
        - Lekkerlag 580 MS
        - Antrobus 566 MS
        - Battle 585 MS
        - Dreyer 526 MS
        - Steenbok 565 MS
        - Van der Bijl 528 MS
        - Joffre 584 MS
    - Water Requirements
        - Industrial: 77,888 Mm3/a (=213.39 Ml/day) (iX Engineers)
        - Residential and commercial: 2.108 Mm3/a (=5.77 Ml/day) (Delta BEC)

The discussion above illustrates that the water business of the Southern Industrial site cannot be considered on its own. It must be seen as a cardinal component of the total picture / master plan.

8.3. Integrated Water Demand over Time Periods

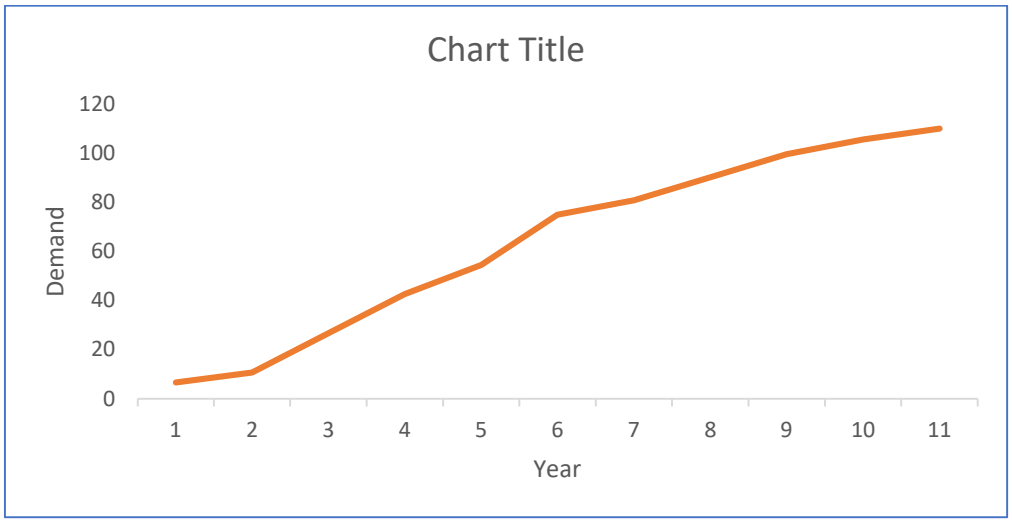

Figure 5: Graph presenting the Musina and MM SEZ (Combined) System Water Demand against Time

From year 10 stable demand of 110 Mm3/a for Musina and Northern SEZ and Southern SEZ. (Musina 11 Mm3/a; SEZ Northern Site 20 Mm3/a; SEZ Southern Site 80Mm3/a)

The following water demand figures are presented in Figure 5:

- Musina (Current demand of 6.6 Mm3/a increasing to 11 Mm3/a)
- MM SEZ Northern Site (Total required demand of 20 Mm3/a, phased in on a straight-line pattern).
- MM SEZ Southern Site (Phased in according to detail supplied by iX Engineers in the table presented as Attachment C.

9. Water Supply

The implementing area is water with limited resources. The current authorized users are playing a part in the local economy as producers, employers and revenue earning taxpayers. Care should be taken not to infringe on their sustainability in terms of available water and surety of supply. Conflict of interest should be anticipated and managed appropriately.

The nature of the envisaged SEZ industrial development and support projects is such that of a growth path with increasing growth and associated increasing water demand is anticipated. Water resource development is complex and capital intensive. It is essential that it is considered to be a process with the roll out of source and infrastructure development hand in hand with the industrial development so that capital resources and capacity development is optimized.

Possible resources and the use of it should therefore be well considered against the lag time in terms of statutory requirements (the processes of water use authorization and environmental authorization, including the public participation components), time required for infrastructure construction and securing of funding.

The water supply development plan will be mapped out in all its complexity as suggestions on the way forward for water supply to the SEZ industrial development, seen as a component of the bigger water supply picture to the region.

9.1. Possible Resources

9.1.1. Surface water from rivers and existing dams

According to SMEC (2018) A study conducted by AECOM et al. (2017) included the water bodies depicted below and analysed all the dams in the Limpopo WMA. The study found that all the major dams in the proximity of the SEZ sites have been over-allocated. This view is also repeated in the DWS-LRS.

Water from existing dams and the rivers feeding them will not be available without infringing existing water use authorizations. This resource is disregarded as potential source for the programme.

Figure 6: Dams and Rivers in the Programme Area (Taken from SMEC Report (October 2018)

9.1.2. Groundwater

9.1.2.1. General in the Catchment Area

Northern Site

Generally, the area has a low groundwater potential. The aquifer is classified as a minor aquifer, meaning that it is not deemed to be a 'sole source' of potable water for a community. Regionally the aquifer is classified as a fractured and intergranular aquifer, meaning that water is mainly stored in open pore spaces within the rock and movement of groundwater takes place along fractures. Water bearing fractures are usually restricted to a shallow zone below the water table. These fractures must be intercepted when drilling a borehole in order to deliver a higher yielding borehole. Typical borehole yield expected across the study area are low, in the order of 0.5 l/sec - 1 l/sec.

The total target groundwater abstraction for the whole area is around 5 litre per second.

Southern Site

Generally, the area has a low to moderate groundwater potential. The aquifer is classified as a minor aquifer, meaning that it is not deemed to be a 'sole source' of potable water for a community. Regionally the aquifer is classified as either a fractured or intergranular aquifer, meaning that water is mainly stored in open pore spaces within the rock and movement of groundwater takes place along fractures. Water bearing fractures are usually restricted to a shallow zone below the water table. These fractures must be intercepted when drilling a borehole in order to deliver a higher yielding borehole. Typical borehole yield expected across the study area are low, in the order of 0.1 l/sec - 2 l/sec. The general groundwater flow direction is expected to follow the dip direction of the sedimentary layers towards the east-west orientated fault structures from where the groundwater flow will be eastward - parallel to the fault systems.

The total target groundwater abstraction for the whole area is between 15 and 18 litre per second.

9.1.2.2. Specific through Groundwater Resource Development Project at the Northern and Southern Sites

The groundwater development project is currently underway. Current yields are supportive of the low yield that was anticipated.

9.1.3. Wastewater Treatment Works Effluent

From an interview with Vhembe District Municipality as WSA and the Musina Local Municipality, the joint capacities of the two wastewater treatment works were confirmed to be 2.008 Mm3/a (it is 5.5 Ml per day). At a water usage estimated by them to be in the order of 6.6 Mm3/a, sewage inflow to the wastewater facilities is anticipated to be in the order of 3.96 Mm3/a. From this, it is evident that the current works are overloaded to an extent, leading to a lower than expected level of compliance to the required effluent standards. It is understood that the upgrade and extension of the Musina wastewater facilities is in planning for the medium to long term. No further detail was available during the compilation of this report.

Taking up effluent from the wastewater treatment works for appropriate industrial use, may be to the advantage of the municipality.

It is recommended that the MM SEZ pursue an agreement with the Vhembe DM and Musina LM accordingly, to supply temporary additional treatment to the required standard, and to use the effluent for suitable industrial processes on the Northern Site.

9.1.4. Unused Authorised Water

Specific data from the official WARMS database was requested from DWS pertaining to farms in close proximity of Limpopo between Greefswald in the west (Sashe confluence) and Esmefour in the

East, as well as along Sand River north of Waterpoort. Due to Covert-19 challenges, the data could not be obtained for inclusion in this report. Currently escalating the request.

Unofficial discussions indicated that existing water use allocations are taken up and used for irrigation as intended.

It also indicates that a considerable volume of water is authorized from the Limpopo along the farms Vryheid, Bokveld and Malala Hoek, just east of the Sand River confluence. As will be indicated later, it is envisaged that approximately 20 Mm3/a will be drawn from this 13 km stretch of Limpopo Alluvial Aquifer to meet the SEZ requirements. The availability of this water still needs to be confirmed in the Limpopo main-stem hydrological study that is foreseen. Should this water or the source not be available, it will have an impact on the long term supply of the Northern Site, and the medium and long term supply of the Southern Site, to the effect that dates will have to be shifted along (further) in accordance with the total time until water can be rendered from the envisaged Musina (or another as may transpire) dam on a sustainable basis.

It is known that 4.4.Mim3/a from Musina LM Limpopo alluvial aquifer is currently not taken up. This water may become available to the SEZ on an agreement basis between Musina LM, Vhembe DM (as WSA) and the MM SEZ (SOC)

9.1.5. Available Water in Limpopo Alluvium

Further available water in the Limpopo alluvial aquifer may be allocated by DWS pending the outcome of the Limpopo main-stem hydrological study that is required by DWS.

9.1.6. Flood Harvesting and Off Channel Storage

The Limpopo River usually presents its flow as a trickle of surface flow with an element of subsurface flow. It is however characterised by very regular seasonal flooding. The flood water passes right into Mozambique where frequent flood damage with loss of life occurs in the lower flood plains. The volume of flood water that pass Musina is estimated to be as high a 2,000 Mm3/a.

It is proposed that a volume of this flood water is harvested, pumped into, and stored in dams that are constructed on suitable confluent steams to the Limpopo River. A single- or a series of dams can be provided to store the required volume of water.

A proposal was rendered to the authorities for the construction of the “Musina Dam” on the lower section of the Sand River. The following detail transpired from the proposal:

- Position of the proposed dam wall: Just south of the confluence of the Sand River with the Limpopo River; approximately at the position of the road bridge that link the western and eastern banks of the Sand River on the “border road”.
- Height: 39 m
- Length: 950 m
- Storing volume: In excess of 200 Mme/a
- There will be relied on Limpopo flood water to fill 85% of the capacity of the dam, while the remaining 15% will serve to receive possible flood water from the Sand River.

To possibly extend to this storage capacity, a second dam of approximate equal capacity can be constructed upstream in the Sand River, just upstream of the current R508 (linking Musina and Tshipise) road bridge over the Sand River.

The advantage locked in this supply option is that it can provide water far beyond the envisaged Musina and MM SEZ requirements, to the extent that water may be available from it for distribution further inland.

The considered perceived advantages pertaining to this proposal includes the following:

- The water to be harvested is considered to be unallocated. After passing the most of it will flow down the river, through Mozambique and into the sea.
- This may contribute towards the kerbing of flood events on the floodplains in Mozambique and may lead to reducing flood damage and loss of life.
- Approximately 20% of flood water will be retained and pumped from the river, thus still allowing downstream users to exercise their rights. Further management rules should be developed as part of the planning and design on order to protect downstream users' rights.

Risk pertaining to this proposal will be addressed through the following:

- Technical feasibility and cost: Feasibility studies to aid in further decision making.
- Consensus flood figures for the Limpopo: DWS will require extensive hydrological studies on the whole Limpopo River, including studies of the contributing Botswana and Zimbabwe catchment areas.
- The South African Government will deal with bilateral issues through the LIMCOM structure that creates a platform for dealing with all issues pertaining to any and all member countries.

An unsolicited bid for the project, also claiming intellectual property rights on some aspects of the proposal was submitted to the authorities. The detail of the submission and the party is not presented in this proposal. It will be subjected to the various required public processes as required.

9.1.7. Northern Neighbouring Countries

Various options to relay water from Botswana or Zimbabwean sources are mentioned as possibilities; and are in some stage of consideration by DWS and other water authorities. These include:

- The Zhove Dam in the Umzingwani River. The Umzingwani- Limpopo River confluence is between 5 and 6 km upstream (west) from Beitbridge, rendering the possibility of gravity flow to an extraction point.
- A further two Zimbabwean options are on the Save River system. The Save River reaches the Indian Ocean approximately 500 km north of the Limpopo River mouth at Xai-Xai.
    - The Tukwi Mukosi dam in the Tugwi River, water relayed via open canal to the Runde River, from where it conceptually can be pumped approximately 185 km to Beitbridge. The Tukwi River flows into the Runde River lower down. It was estimated by others that the yield of this dam may render 175 Mm3/a to South Africa.
    - A further potential option is an envisaged dam, referred to as the Runde Tende Dam, higher up in the Runde River. Depending on the wall height, this dam may

conceptually render between 215 and 500 Mm3/a to South Africa via a pope system along the same route as the Tukwi Mukosi Dam water.

- Botswana options including possibilities from the extension of an envisaged Botswana scheme to supply water from the Zambezi - Chobe River to the Maun area.

The transfer of water from our northern neighbours is a complex subject, with immense work required to realise this supply. Some of the seemingly unlimited list of possibilities and permutations thereof are listed below. All these aspects require in-depth studies and consideration:

- Detailed hydrological determination.
- Current and future water demand in the catchment areas in the context of the bigger sovereign source countries.
- Current and various future demographic, socio-economic and developmental scenarios.
- Funding
- Ownership.
- Supply guarantees.
- Operations.
- Safety of infrastructure and operational personnel.
- Security of supply.
- Current and future international relations.
- Continuity in negotiations through successive administrations, both locally and in neighbouring states.
- Robust agreements.
- Increasing funding scarcity.
- Energy challenges faced by South Africa and our northern neighbours.

It is evident that, although not impossible, the realizing of water supply to South Africa from Northern neighbours is not a matter to underestimate. It will take several years; possibly decades of planning and negotiations to reach agreements.

9.2. Complexity of Supply

During supply planning, whether the resource is local or from a northern neighbour, due attention must be allowed to proper pro-active planning and design. Water supply calls for immense capital investment, as well as for the permanent obligation to operate sustainably.

The supply situation becomes increasingly complex over time when the required demand values increase rapidly, associated with supply options further and further from the point of use, potentially into neighbouring states. Planning and capital commitment / investment need to be made in early stages as foundation to the future Fatal flaws may occur in either infrastructure or industrial development.

The following is a number of technical considerations in planning. The objective with this is not to produce a generic technical checklist, but merely to demonstrate the vast extend of matters to consider, and the diverse expertise that is required for due consideration.

9.2.1. Potential Yield of Resource

- Groundwater theoretical supply
- Groundwater development
- All dams hydrological model of catchment areas including (This must define the potential inflow into a dam currently and in the future)
    - Topography
    - Meteorology
    - Demography
    - Socio Economic Development levels and service levels
    - Individual area development plans that may impact on the eventual yield (Example: What will the local demography look like in terms of current t govt planning of a specific area (say the catchment area of a specific Zim dam…)

9.2.2. Dam Site Specific

- To define to an acceptable level of accuracy the volumetric detail of the specific dam, taking into account for instance:

    - Topographic detail of dam or of the potential dam site.
    - Area / Volume curve
    - Evaporation
    - Silting (impact of this over time)

9.2.3. Existing Offtake Authorizations

- Pertaining to all SA resources.
- Pertaining to all potential neighbouring state resources.
-

9.2.4. Future / Potential Offtake Authorizations

New dams and water conveyance systems will be perceived as:

- Bringing new opportunities for the communities in reach.
- Stirring the waking up of old authorizations (for example: There is solid Google Earth evidence of past farming enterprises along Zimbabwean rivers. These may represent legal authorizations that may revive when the situation becomes conducive. Existing rights, for example of previous farming offtakes from rivers and dams in Zimbabwe, may perhaps be legally stronger than new supply agreements.

9.2.5. Views and Opinions of four different sovereign countries

- With own interests

- With changing administrations
- With changing individuals within administrations
- With changing government policies
- Subject to further off influences pending on aspects like:
    - Financial / fiscal health of each member country.
    - Government stability.
    - Regional development objectives and cooperation between members.
    - Funders / donors.
    - Unexpected events like Corona virus or even war.
    - Climate change.

9.2.6. Infrastructure Requirements with respect to water supply from a Northern Neighbour

Scenario presentation from Salini and others, and own interpretation to illustrate the extent of infrastructure required pertaining to:

- Dams (existing / new / upgrade / maintenance.
- Channelling and measurement structures at source.
- Pipelines and associated structures.
- Road crossings and bridges.
- Road replacement where required.
- Booster pump stations.
- Electricity supply (high energy requirements) (New transmission lines or networks)
- Treatment at source or otherwise.
- Raw water / clean water storage.
- Limpopo River crossing structure(s).
- SA raw water storage.
- SA water treatment.
- SA treated water storage.
- SA transmission to sites.
- SA site distribution.
- Measurement structures and systems for cost accounting.

10. Specific Supply Plan

10.1. Concepts

1. In the early stages, supply for the three distinct points of usage (Musina LM, SEZ Northern and SEZ Southern sites will be separate supply systems.
2. With time, as volume required and supply volume and infrastructure grow, the sources starts to overlap, first between Musina and the SEZ Northern Site, to be followed by the inclusion of the Southern Site.
3. From here onwards, joined operations becomes increasingly important.

4. It is envisaged that a specific entity will have the responsibility for bulk supply, while each entity will distribute from its reservoir onwards. (Internally).
5. It is also envisaged that source development in extent of the Musina and SEZ needs will be possible, thus availing water for further development use beyond.
6. We should thus think in terms of a SUPPLY SCHEME, and the implementing logic should be developed accordingly. (Modular developments).
7. In the light of possible extension of the supply system / scheme, the involvement if supply authorities from the outset onwards is advisable.

10.2. Supply Options

Following is a site focussed discussion of the various supply options as discussed in section 9 above. In this section, consideration is given to the:-

- possible usage of the various water resources.
- per programme user area (Musina Local Municipality, MM SEZ Northern Development Site and MMSEZ Southern Development Site).
- requirements and availability over the short, medium, and long term.

10.2.1. Musina Local Municipality

Musina LM is supplied from a wellfield in the Limpopo Aquifer opposite the Farm Antonvilla. The allocation is approximately 11 Mm3/a ((actually 10.96 Mm3/a), while the current use is in the order of 6.4 Mm3/a, currently leaving 4.4.Mm3/a of the authorized allocation unused. Although no increase in demand is anticipated in the short term, it is foreseen that it will be required in the medium to long terms. It is thus suggested that the MM SEZ “borrows” 4.4 Mm3/a from the Musina LM to contribute towards the MM SEZ short term demand while other appropriate sources are developed.

It must be noted that the full 10.96 Mm3/a is currently not just available to take up. Due to the lower requirements of Musina LM, it could always be delivered with partial development. For any further (additional to 6.6 Mm3/a) abstraction, the wellfield and the associated infrastructure will require upgrading to that volumetric supply extent.

10.2.2. MM SEZ Northern Site

10.2.2.1. Short Term Supply (Northern Site)

The total anticipated short-term supply for MM SEZ (Northern Site) is 5.55 Mm3/a as below:

- Groundwater abstraction within the geo-hydrological established feasible limits. The anticipated supply is 0.15 Mm3/a.
- Taking up the excess of 4.4 off Musina current allocation. (Preceding with agreement with the Musina LM and the Vhembe DM as WSA to “borrow” the part of the allocation, operational agreement for obtaining this water, assessment of wellfield and associated infrastructure and planning for the upgrade, financing, upgrade, reservoir(s) on Antonvilla (EIA preceding, etc.), and a pipe linking current pipeline and reservoirs.

- Utilizing the water of the mineshaft of the old copper mine in the northern part of Musina town that was previously utilised in the Musina LM supply. The yield is said to be in the order of 1 Mm3/a. If this 1 Mm3/a is pumped to the municipal reservoir, it will free an equal volume from the wellfield for delivery to the Northern SEZ site on Antonvilla).

10.2.2.2. Medium Term Supply (Northern Site

The total anticipated medium-term supply for MM SEZ (Northern Site) is 9.51 Mm3/a as below:

- Sources as indicated above, rendering 5.55 Mm3/a
- Musina Wastewater Treatment Works effluent, treated to be of acceptable quality with respect to the specific use, estimated at 60% of the water usage of Musina. With the uptake of 6.6 Mm3/a of fresh water, the yield of this resource is anticipated to be approximately 3.96 Mm3/a.
- The total available volume in the medium term is thus 9.51 Mm3/a.

10.2.2.3. Long Term (Northern Site)

The total anticipated long-term supply for the MM SEZ (Northern Site) is 20 Mm3/a, and will be supplied from the total envisaged supply from the various resources as follows:

- The water as supplied during the medium-term, with the 4.4 Mm3/a "borrowed" from Musina returned, rendering a volume of 5.11 Mm3/a.
- Additional yield from the envisaged Limpopo alluvial wellfield east of the Limpopo – Sand River confluence. Of the anticipated 20 Mm3/a yield of this resource, 14.89 Mm3/a will be required to meet the full long-term demand.
    - ***A separate scenario is developed as contingency plan for the event that physical evidence may proof the eastern wellfield not to be feasible. A volume of flood water can be harvested and stored off-channel for preliminary use, for the period before the completion of the permanent supply volume.***
- The remainder of the envisaged developed supply will be allocated to meet the requirements of the MM SEZ Southern Site, as stated below, and to meet requirements beyond this development programme.
- Upon internal decisions, the SEZ may choose to transfer any volume of available water from the Northern Site to the Southern Site to foster development there. This will be possible within the framework of the required environmental and water use authorizations and the timeous development of required infrastructure.

10.2.3. Southern Site

10.2.3.1. Short Term (Southern Site)

The total anticipated short-term supply for MM SEZ (Northern Site) is 0.4 Mm3/a as below:

- Groundwater abstraction within the geo-hydrological established feasible limits. The anticipated supply is 0.4 Mm3/a.

10.2.3.2. Qualifying Notes on Supply Beyond Short Term

No further existing or "simple to develop" supply options exists, as all further supply options entail complex bilateral agreements with neighbouring countries including Zimbabwe, Mozambique and Botswana, complex technical evaluations of system yields, infrastructure and energy, environmental aspects, etc., locally and on foreign turf.

The various possible supply scenarios are based on the uptake and off channel storage of Limpopo River flood water (9.1.6) or supply options form Zimbabwe or Botswana (section 9.1.7). Preliminary desktop evaluation indicates that of the possible resources, the development of the Limpopo River based supply option holds promise to be the most feasible in terms of time to develop, development cost and the complexity of supply and operational agreements.

10.2.3.3. Medium Term (Southern Site)

For any medium-term supply to be met, substantial infrastructure will be required to pump water in from the Musina area over a distance of approximately 50 km and over a vertical lift of approximately 260 m from the Limpopo River basin. The water can only be supplied with substantial capital expenditure and at a high operational (energy related) cost. ***Under assumption that economic feasibility will be considered on the relevant forum, the focus in this report is limited to possible supply options.***

The medium-term supply of the Southern Site will only be reached with the completion of required infrastructure to collect and store sufficient water in the Musina area, and to convey it to the Northern Site. In practical terms, medium term supply will only be reached on the Southern Site after Long Term supply have been achieved on the Northern Site. Furthermore, due to the high cost associated with the required infrastructure, the conveying pipe and pump system should be designed to cater not only for the medium term, but also for the long-term requirements. Its system should thus be designed to deliver substantially more than the strictly available source. This will enable the delivery of more than the volume stated below, and within the limits of possible lower take off by Musina LM and / or the SEZ Northern Site, pending upon the availability of energy (electricity supply) to do so.

The total anticipated medium-term supply for MM SEZ (Southern Site) is 5.51 Mm3/a as below:

- Groundwater supply of 0.4 Mm3/a as during the short term.
- Remaining balance of the 20 Mm3/a from newly added capacity from the Limpopo alluvial (aquifer as described in 10.2.2.3), rendering 5.11 Mm3/a.

(Please see the concept for a further development scenario, should the Limpopo Eastern Aquifer development concept proof not to be feasible).

10.2.3.4. Long Term (Southern Site)

The long-term supply volume will be reached with the completion of the Musina Dam System, with an anticipated yield of 200 Mm3/a. A component of 74.49 Mm3/a of this will be required to meet

the long-term demand of the Southern Site. The 80 Mm3/a water required will then be supplied as follows:

- Groundwater supply of 0.4 Mm3/a as during the short term.
- A part supply from the Musina Dam of 74.49 Mm3/a.

10.2.4. Excess Water

Water supply will be challenged until the completion of the Mussina dam and associated supply infrastructure to reach Musina, the Northern Site and the Southern Site. From this onwards, the local supply will be met, with excess water available in the scheme for further distribution.

After successful commissioning of the Musina dam, it will be technically possible to discontinue abstraction from groundwater and from the Limpopo alluvial aquifer, and to supply the full demand of Musina, and both SEZ sites, still leaving a substantial balance of approximately 70 Mm3/a in the event that only the Musina dam is constructed. If the Sand River Dam is constructed as well, another approximately 180 Mm3/a will be added to the water balance. Substantial further supply options (at high cost) can furthermore potentially be unlocked from northern neighbouring countries.

10.2.5. Infrastructure Challenges

1. Substantial Infrastructure Expenditure will be required to get any water other than groundwater to the Southern Site
2. The lack of other options warrants us to spend more on Southern groundwater development

11. Infrastructure Requirements

Huge infrastructure requirements exist to fully serve the Musina LM and MM SEZ water requirements. The eventual cost will amount to billions of Rands. To make economic sense, infrastructure must be planned and designed to serve the requirements of the current development stage of a site. To kerb fruitless expenditure, the infrastructure of each phase must be useful in all following phases. ***A modular development methodology and infrastructure supply is thus required***.

Conceptual infrastructure requirements will be discussed here per phase and per site following the discussions in Section 10 above. This will be followed with a first order costing in Section 12.

11.1. Musina

It is suggested that the SEZ “borrows” part of the Musina LM allocation for the short-term supply to the SEZ Northern Site. For this purpose, it is suggested that the SEZ upgrades the municipal supply infrastructure of Musina LM and link it to the SEZ reservoir so that uninterrupted water supply to Musina can be guaranteed. It will entail upgrading to the Limpopo Alluvial wellfield (adjacent to Antonvilla), the collector manifold, wellfield pump station facility and the pipeline to the Musina

reservoirs in town. It will also include the upgrading of the pump facilities at the mine in town. As source development grows, it is envisaged that the “borrowed” allocation will in due time be “returned” to Musina, or that the Musina LM may be supplied from the envisaged new supply scheme.

Below follows the growing infrastructure demand, illustrated with Google Earth Images, and detailed with in the data table.

11.2. Northern Site

Due to the comparative readily available water resources to the SEZ Northern Site compared to the Southern Site, it is anticipated that development on the Northern Site will commence first.

The following serve to illustrate the concept detail. As noted, before, water supply in the Northern Site, to Musina LM and to the Southern Site cannot be seen in isolation. Hence this comprehensive discussion.

Figure 7 below depict the outline of the Farm, Antonvilla 7 MT. This farm represents the whole MM SEZ Northern Site. The indicated part in the centre, south of the tar road that traverses the farm and opposite the Artonvilla Mine turn off towards the north is on fairly level ground and is considered by the MM SEZ as the primary development area. We will consider that as focus area for initial water supply.

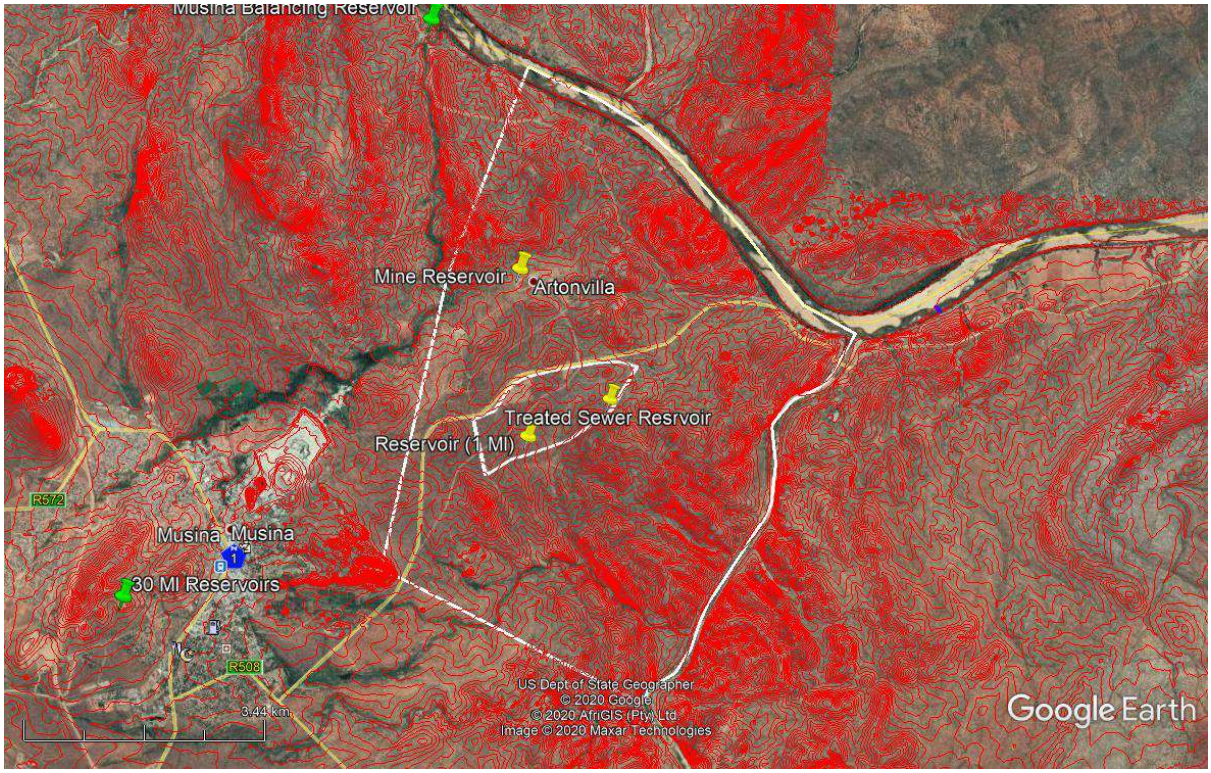

Figure 7: The farm Antonvilla 7 MT outlines with 5-meter contours, and the central primary development area.

11.2.1. Northern Site Short Term Supply Infrastructure

In the state that is presently, there is no supply of water to this farm, and no sustainable source on it.

11.2.1.1. First component - Groundwater

(Infrastructure indicated in YELLOW on plans depicted below)

The geo-hydrologic assessment that was done under the supervision of Matukane and Associates (Pty) Ltd indicated low groundwater potential. Ground water development was done by drilling at targeted positions. As anticipated, the yield was established to be low, with the total recommended abstraction of 4.75 litre per second (converting to 0.15 Mm3/a). Although low, it is considered suitable to be used for the commencement of basic site infrastructure and the development of further resources, also required for the short term.

It is recommended that these two boreholes are suitably equipped and connected to a reservoir for initial storage. This reservoir is conceptually placed on high ground near the envisaged initial development area as identified by the SEZ.

Figure 8 below show the two newly drilled boreholes recommended for use, a service reservoir of 1 Ml capacity, placed on a suitable high ground position in the primary development area, and connecting pipelines from the two boreholes. on the Antonvilla farm.

This will be able to supply approximately 4.75 l/s (it is 0,15 Mm3/a), which will be available for commencement of construction.

Suitable monitoring equipment must be installed to constantly monitor the water level and abstraction as management tool.

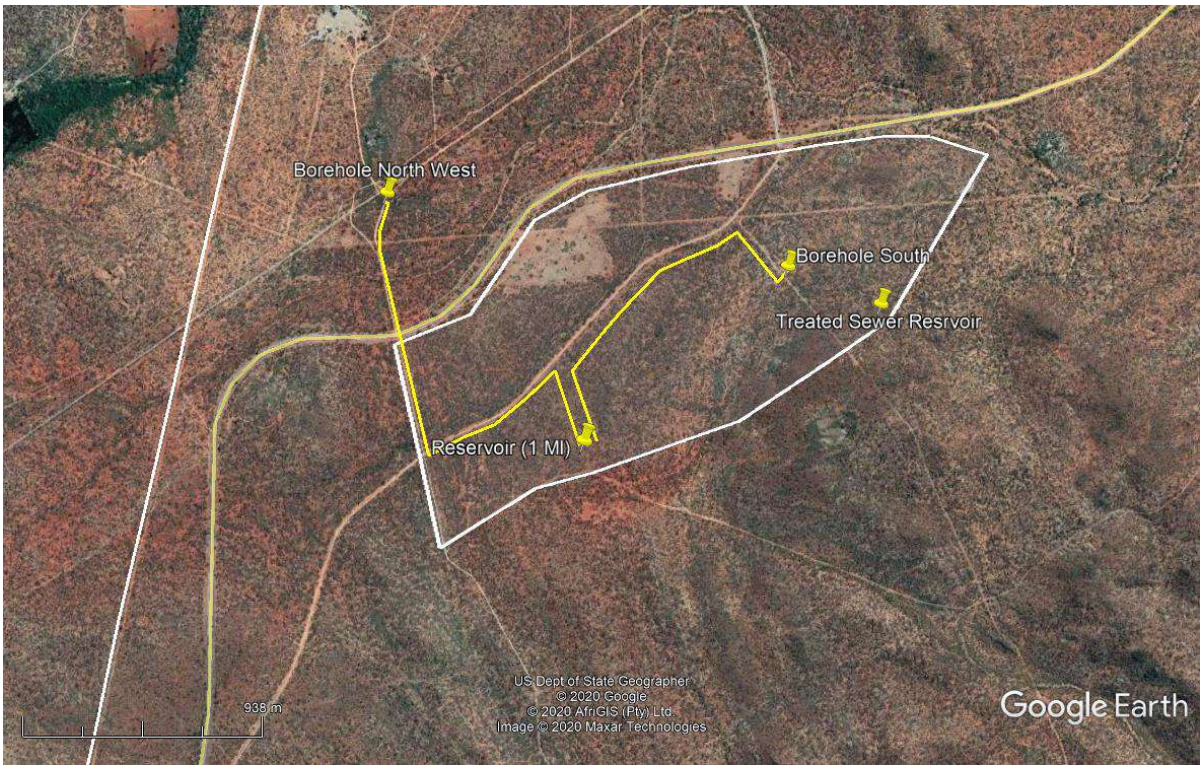

Figure 8: Groundwater resources as component to the short-term supply

11.2.1.2. The second component – 4.4 Mm3/a from Musina LM Limpopo Alluvial Aquifer

(Indicated in GREEN on Figure 9 below)

An agreement is pursued whereby the MM SEZ enter into an agreement with the Musina LM and the Vhembe District Municipality as WSA to "borrow" 4.4 Mm3/a of their allocation. The infrastructure requirements for this will entail:

- The upgrade of the wellfield in the Limpopo Aquifer north of the farm Antonvilla pertaining to:
    - existing wells,
    - new wells as required,
    - Collecting pipe manifold,
    - Electricity supply
    - Collecting reservoir
    - Pump installation
    - Treatment facilities
    - Connecting pipeline between the wellfield and the existing municipal reservoir system in Musina
- New infrastructure required:
    - Connection pipe from the Wellfield-to-Musina rising main pipeline to the 1 Ml reservoir on the primary development site.

- A 35 Ml reservoir in the pipeline mentioned above. (One of three eventually required to serve the bigger scheme that will develop over time).

This second component will supply 4.4 Mm3/a towards the short-term needs.

11.2.1.3. Third Component – Refurbishment of pump and pipe connection to supply for the Musina Mine Shaft to Musina LM

(Indicated in GREEN on Figure 9 – see the segment at the mine east of Musina)

The third component is the refurbishment of the pump installation in the Musina Mine shaft that was previously used for municipal sully. Due agreement with the municipality is pursued.

This third component will add 1 Mm3/a towards the short-term needs.

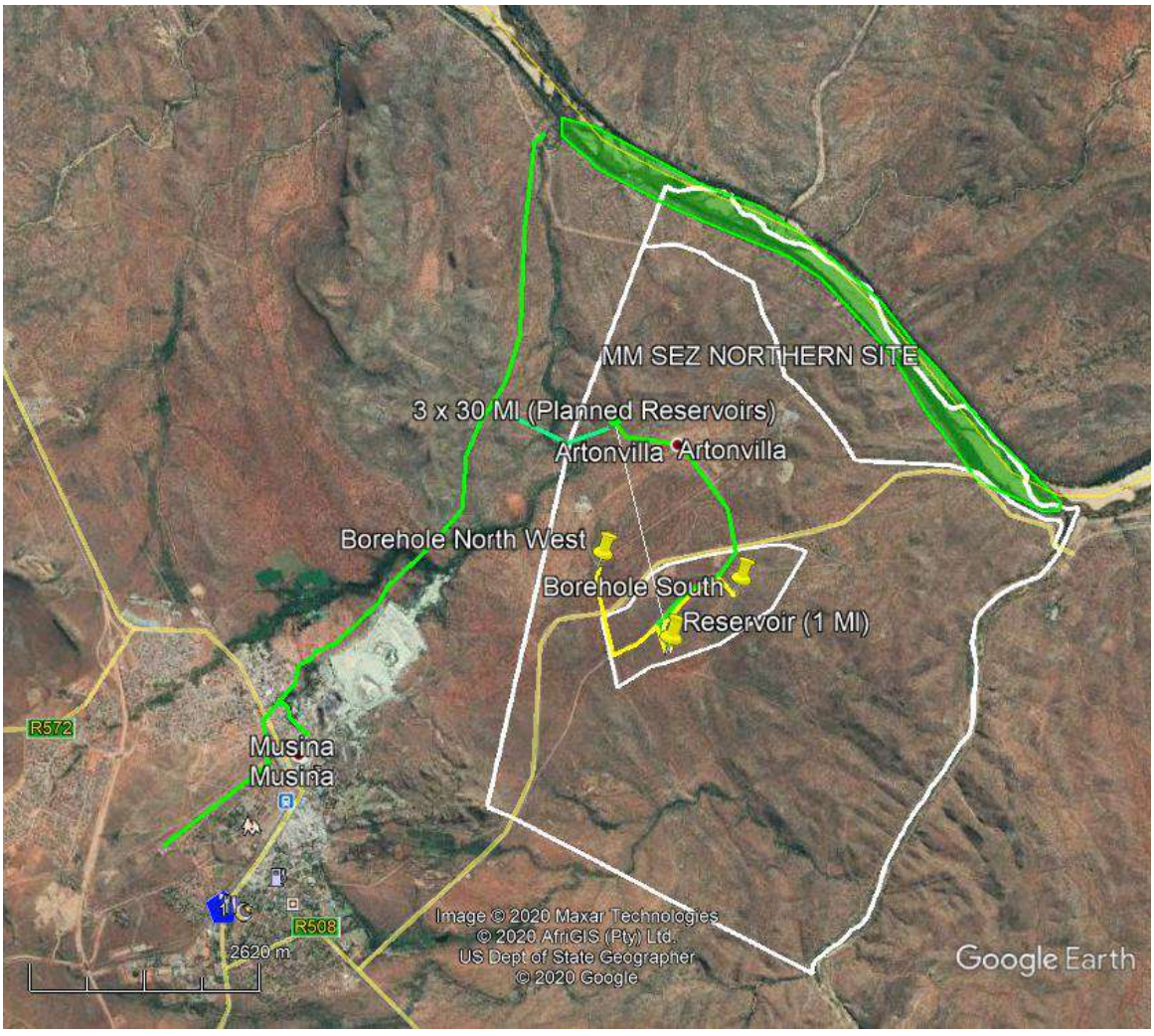

Figure 9: Second and Third components of Short-Term Water Supply, dealing with the current Musina unused allocation and sources.

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11.2.1.4. Northern Site Short Term Resource Plan Summary

Northern Site - Short Term Infrastructure Requirements				
Resource	**Equipment**	**Description**	**Image Reference**	**Volume (Mm^3/a)**
Southern Borehole	Electricity Supply (ESKOM Point)	25 kVA point at borehole	Figure 8	0.15
	Borehole Equipment and security measures	"Mono" pump and 3 phase electric motor		
	Monitoring and control instrumentation	Measure and transmit / store operational data		
	Local 3 m tank for bowser filling	10,000 l Plastic tank on approved stand		
	Connection to distribution pipeline			
North western Borehole	Electricity Supply (ESKOM Point)	25 kVA point at borehole	Figure 8	
	Borehole Equipment and security measures	"Mono" pump and 3 phase electric motor		
	Monitoring and control instrumentation	Measure and transmit / store operational data		
	Local 3 m tank for bowser filling	10,000 l Plastic tank on approved stand		
	Connection to distribution pipeline			
Development Site Reservoir	Reservoir	1 Ml	Figure 8	
	Borehole linking pipes	50 mm HDPE Class 6		
	Monitoring and control instrumentation	Measure and transmit / store operational data		
Enabling Share of Municipal Allocation from Wellfield	Upgrade of wellfield and collecting system	Assess condition and upgrade	Figure 9	4.4
	Upgrade treatment facility	Assess condition and upgrade		
	Upgrade pump-to-reservoirs facilities	Assess condition and upgrade		
	Upgrade conveying wellfield-to-Musina pipeline	Assess condition and upgrade		
	35 Kl Reservoir	New pre-casted reservoir	Figure 9	

New infrastructure to share in municipally allocation	Pipeline: Musina pipeline to 35 Kl reservoir	New pipeline		
	Pipeline: 35 Kl reservoir to development site reservoir	New Pipeline		
Enabling Musina Mine Borehole	Upgrade Electricity Supply	Assess condition and upgrade	Figure 9	1
	Upgrade pump installation	Assess condition and upgrade		
	Upgrade pipe link to rising main	Assess condition and upgrade		
	Monitoring and control instrumentation	Measure and transmit / store operational data		
Total for Northern Site - Short Term				5.55

11.2.2. Northern Site Medium Term Supply Infrastructure

11.2.2.1. Musina LM treated Wastewater Treatment Works effluent

(Indicated in RED on figure 10 below)

An offtake agreement is pursued whereby the MM SEZ will take the treated effluent from the Musina WWTW's for suitable industrial use, depending on the effluent quality and industrial processes. The effluent can also be subjected to additional treatment processes on the SEZ site for further use. This treatment can be up to the quality of potable water as may be required.

The following infrastructure will be required:

- Holding facility on high ground in the SEZ initial development area. This will allow for further treatment and distribution as may be required. A 5 Ml reservoir is foreseen. (This holding capacity can then be increase modular as required going forth)
- Pump installations at the various WWTW's.
- Conveying pipelines linking the various WWTW's with the receiving reservoir.

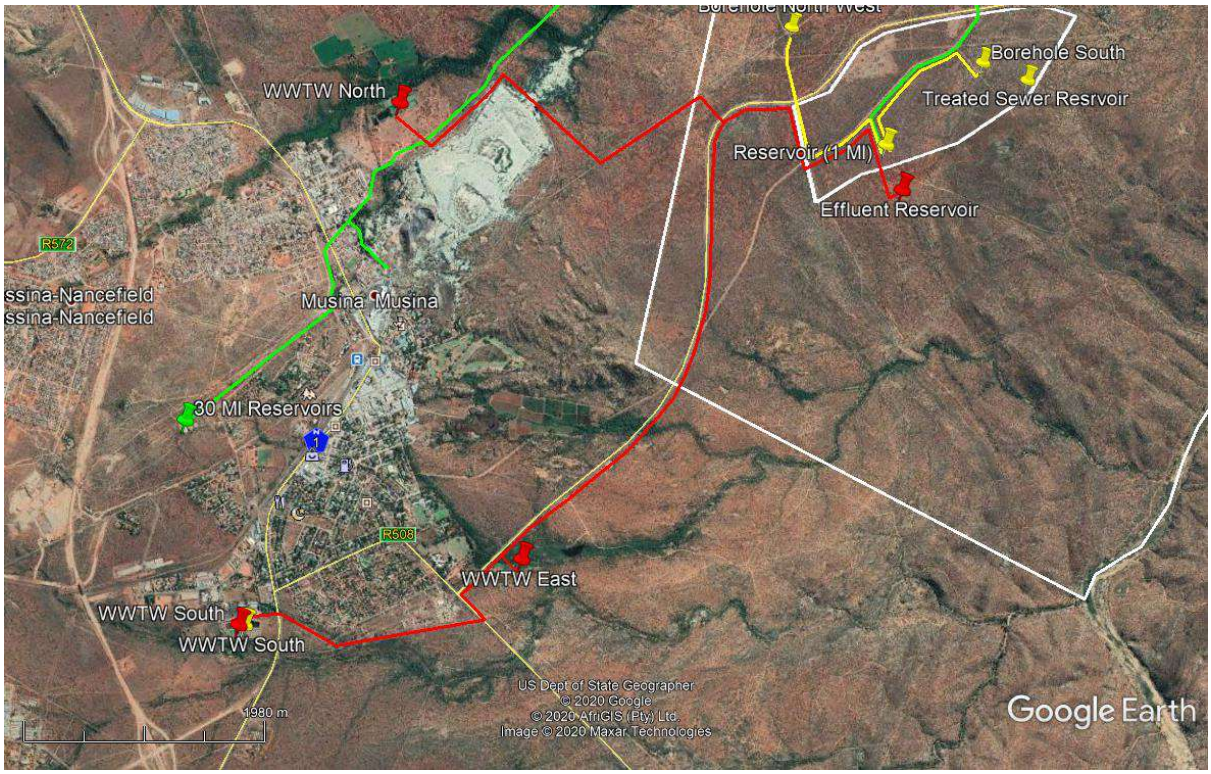


Figure 10: Fourth Component – Musina Wastewater Treatment Works Effluent

11.2.2.2. Northern Site Medium Term Resource Plan Summary

Northern Site - Medium Term Infrastructure Requirements				
Resource	**Equipment**	**Description**	**Image Reference**	**Volume (Mm^3/a)**
Developed for Short Term Use				5.55
Wastewater Collection	Upgrade at WWTW's to secure acceptable effluent quality	Pending on industrial process requirements	Figure 10	3.96
	Pump installations	To match effluent flow rate		
	Pipelines	To match effluent flow rate		
	Effluent Reservoir	5 Ml		
Total for Northern Site - Medium Term				9.51

11.2.3. Northern Site Long Term Supply Infrastructure

Indicated in PINK on Figure 10 below.

It is anticipated that large volumes of water may still be available in the Limpopo Alluvial Aquifer. It is anticipated that a further 20 Mm3/a may be harvested from this source downstream to the Sand River confluence, on the farms Vryheid 8 MT, Bokveld 12 MT and Malala Hoek 13 MT.

There are no current scientific grounds for this assumption. I full mainstem hydrological study is required and will be done to substantiate the extent of available water in the Limpopo Aquifer to take up without infringing the allocation rights of others.

It must therefore be noted that a zero-supply scenario from this resource should also be considered to clarify the impact of it on the development.

An alternative scenario is also under development. (Refer to 10.2.2.3)

11.2.3.1. Supply Infrastructure

The following infrastructure is envisaged:

- The construction of a further two 35 Ml reservoirs on Antonvilla Indicated at the end of the supply line (PINK) and the beginning of the municipal supply system (GREEN). Further project related supply to sites all over Antonvilla will also be from this group of three 35 Ml reservoirs.
- Up to 30 wells on the Limpopo Aquifer, with or without a weir type structure as will be directed by the detailed investigations and planning g at the time. The development area is indicated with the PINK outlined polygon on Figure 12.
- Collector pipe manifold to convey water to a suitable point to be treated and pumped onwards to the Antonvilla reservoirs.

11.2.3.2. Conceptual Alternative Supply Infrastructure

The conceptual Limpopo Eastern Alluvial Aquifer serves essentially a temporary supply function to the SEZ to foster site development while the Musina Dam as permanent supply solution is still in progress. It is possible (and anticipated) that the long-term supply will rely to a large extend on the dam for ease of operation. With the risk associated to a negative outcome of the scientific Limpopo mainstem hydrological study that must be done to verify availability of water in the aquifer, it is wise to probe into alternatives to this supply option.

The principle for long term supply is the harvesting of flood water from the Limpopo and the off-channel storage thereof for use during the year. It is worth wile to consider a smaller application of the same principle to serve the medium-term needs with between 10 Mm3/a and 30 Mm3/a as target. Ideally this should then be serviced with pump- and pipeline infrastructure that is planned and constructed as modular components of the final infrastructure. It is anticipated that the cost associated with this option will not exceed the potential aquifer development cost, to the contrary, it may be much lower, depending on the locality of an applicable site.

This option is currently under investigation.

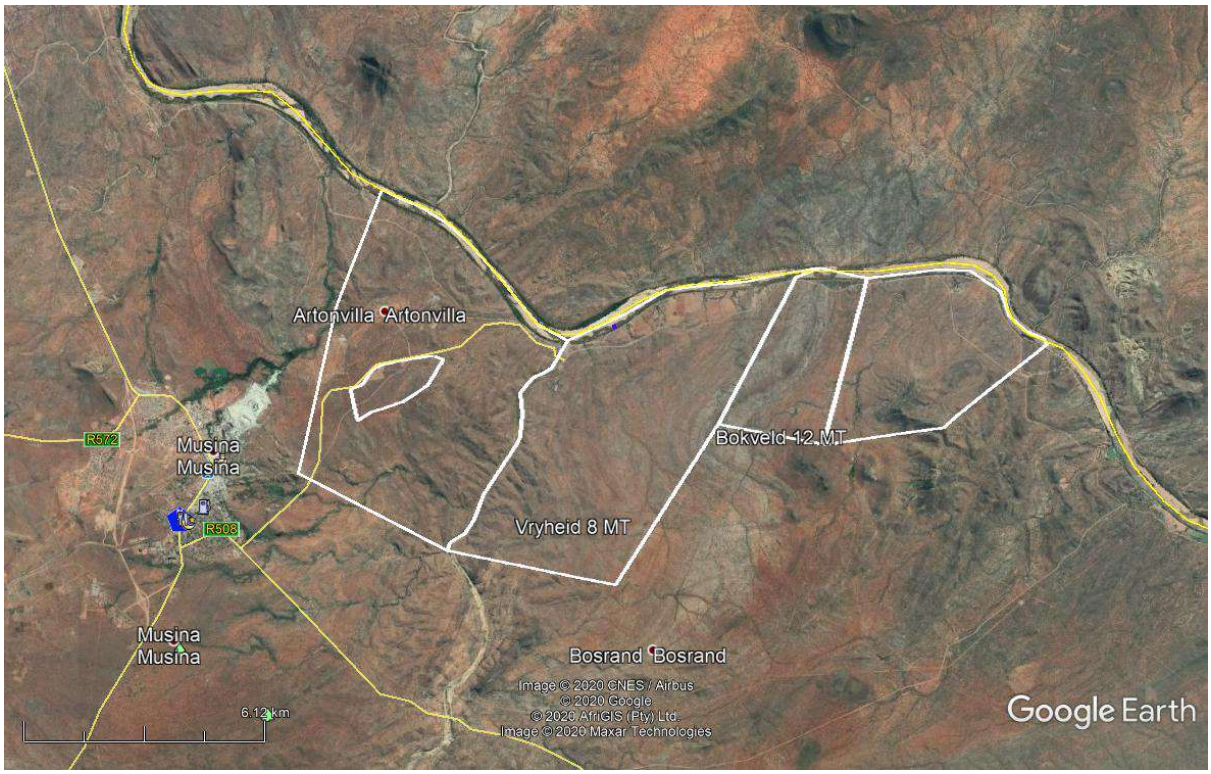


Figure 11: Outline of the farms along which the Limpopo River is earmarked for the further development of the Limpopo Alluvium Aquifer

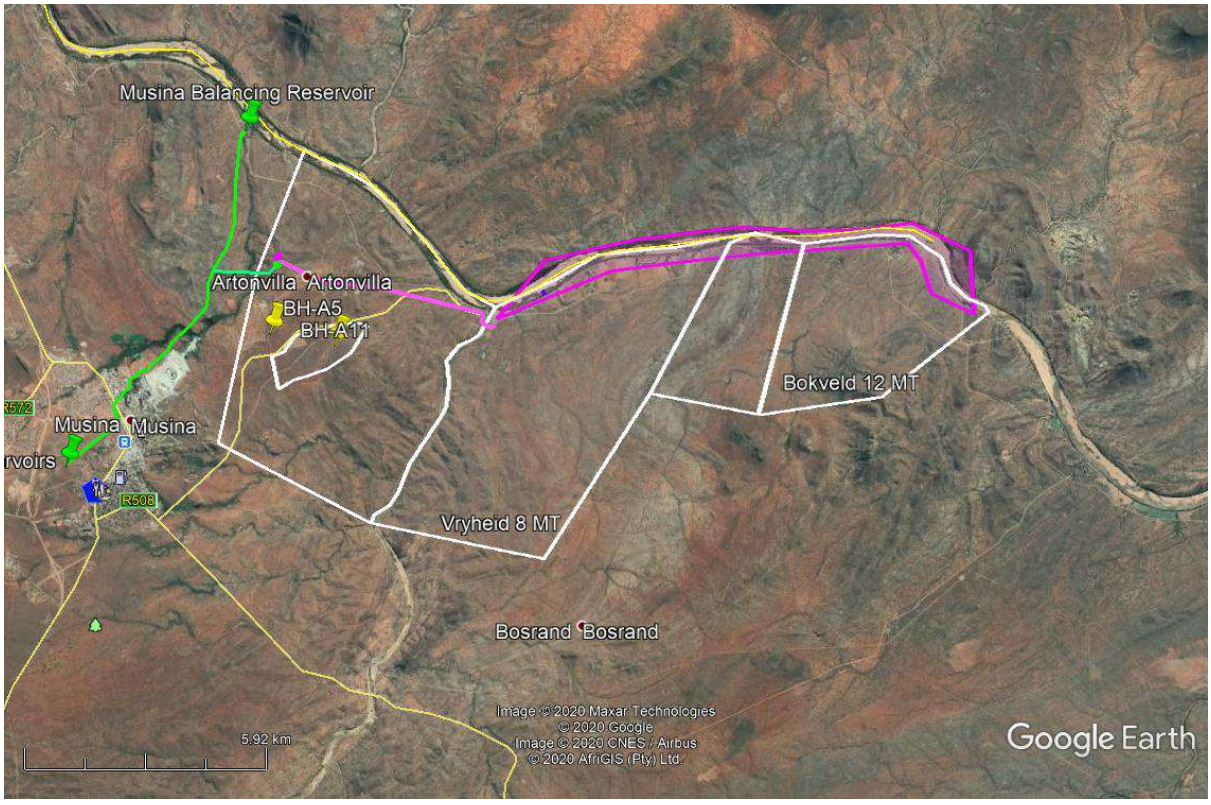


Figure 12: The supply infrastructure fir the long term

The requirements for the long-term supply then would be as follows:

11.2.3.3. Northern Site Long Term Resource Plan Summary

Northern Site - Long Term Infrastructure Requirements				
Resource	**Equipment**	**Description**	**Image Reference**	**Volume (Mm^3/a)**
Developed for Medium Term Use				9.51
Wastewater Collection	Development of additional Limpopo Aquifer east of Sand River confluence	Pending on Limpopo Mainstem Hydrological Study	Figure 10	20
	Wells, pumps, and collector manifold	To match effluent flow rate		
	Pipeline: From wellfield to Antonvilla Reservoir	To match effluent flow rate		
	Extension of Antonvilla Reservoirs	2 x 35 Ml Additional to capacity developed during the "short term development"		
		Return the borrowed 4.4 Mm3/a to Musina		-4.4
		Re-allocate to Southern Site		-5.11
Total for Northern Site - Long Term				20

11.2.4. Beyond Full Supply

As the bigger impact sources are developed, the usage of individual smaller and higher risk resources should be re-considered. Infrastructure modules should be designed in such a way to facilitate such re-considerations.

11.3. Southern Site

The MM SEZ Southern Development site currently has no direct access to any sustainable water resources sources, apart from groundwater. As discussed, the groundwater potential of the area is very low. Over usage will lead to dewatering, with lowering water tables impacting on the environment, and the authorizations and existing commercial interests of others. For any supply for industrial use, water will need to be transferred from where available to the site. As discussed, the only feasible supply will be from the various sources around Musina as described already under resources for the Northern development area. Figure 13 below illustrates the Southern Development site in context to the local roads, rivers, Musina and the Northern Development site.

Water must be conveyed from over approximately 50 km, and through a vertical lift of approximately 260 meters.

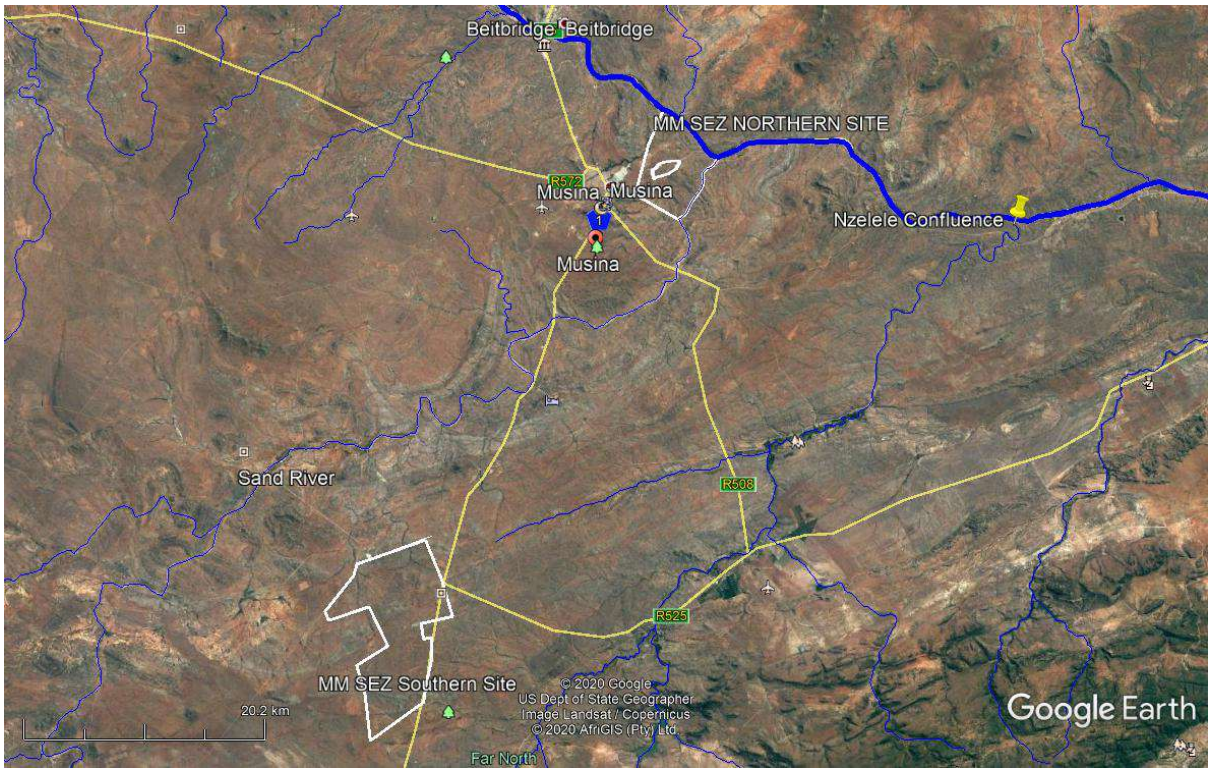


Image 13: MM SEZ Southern Development site in context

The infrastructure requirements to achieve this will make the supply of water to this area complex and with a high cost pertaining to both capital and operational expenditure.

11.3.1. Southern Site Short Term Supply Infrastructure

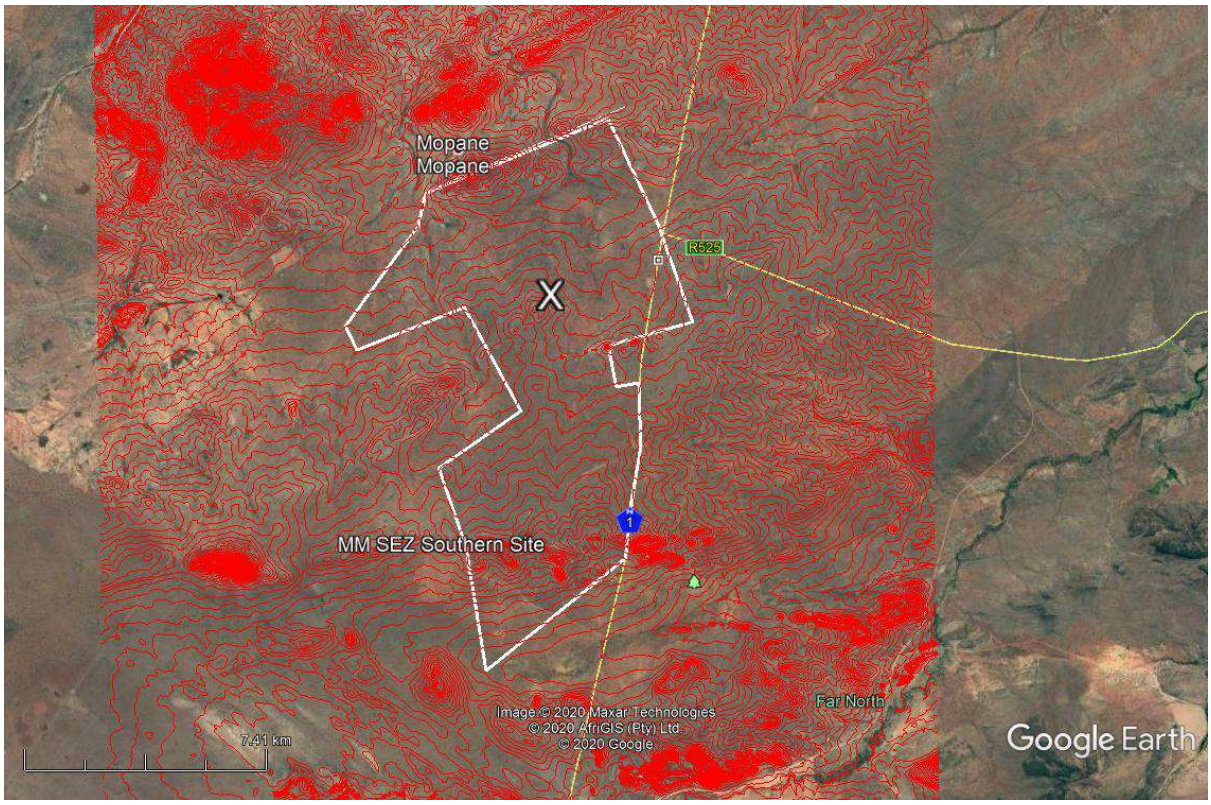


Figure 14: The MMSEZ site with convenient high point for a central distribution reservoir marked with the X

11.3.1.1. Groundwater Supply

(Indicated in YELLOW on Figure 15 below).

The groundwater study that was done indicated a low potential for groundwater supply, with the volume to be extracted limited to a maximum of 18 l/s to prevent the de-watering of the area.

The groundwater exploration process is currently underway and scattered fairly low yielding boreholes will be used in combination. A suitable high point on the site was identified for a reservoir for use in the interim period.

The boreholes to utilize (***more are currently in the development process***) and the point for envisaged 1 Ml reservoir, are indicated on Figure 15 below.

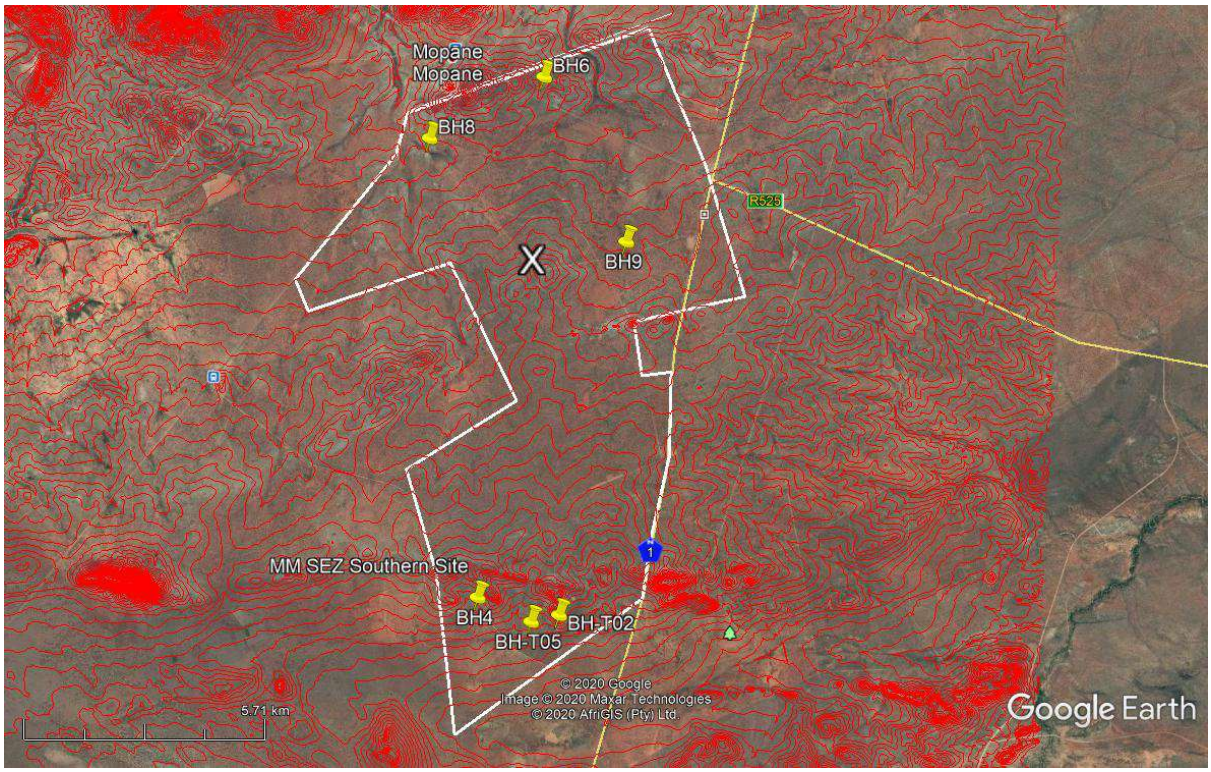


Figure 15: Groundwater supply consisting of boreholes with a central reservoir

11.3.1.2. Southern Site Short Term Resource Plan Summary

Northern Site - Short Term Infrastructure Requirements				
Resource	**Equipment**	**Description**	**Image Reference**	**Volume (Mm^3/a)**
Groundwater (Equipment for 12 units)	Electricity Supply (ESKOM Point)	25 kVA point at borehole	15	0.5
	Borehole Equipment and security measures	"Mono" pump and 3 phase electric motor		
	Monitoring and control instrumentation	Measure and transmit / store operational data		
	Local 3 m tank for bowser filling	10,000 l Plastic tank on approved stand		
	Connection to distribution pipeline			
Development Site Reservoir	Reservoir	1 Ml	15	
	Borehole linking pipes	90 mm HDPE Class 6 network		
	Monitoring and control instrumentation	Measure and transmit / store operational data		
Total for Northern Site - Short Term				0.5

11.3.2. Southern Site Medium Term Supply Infrastructure

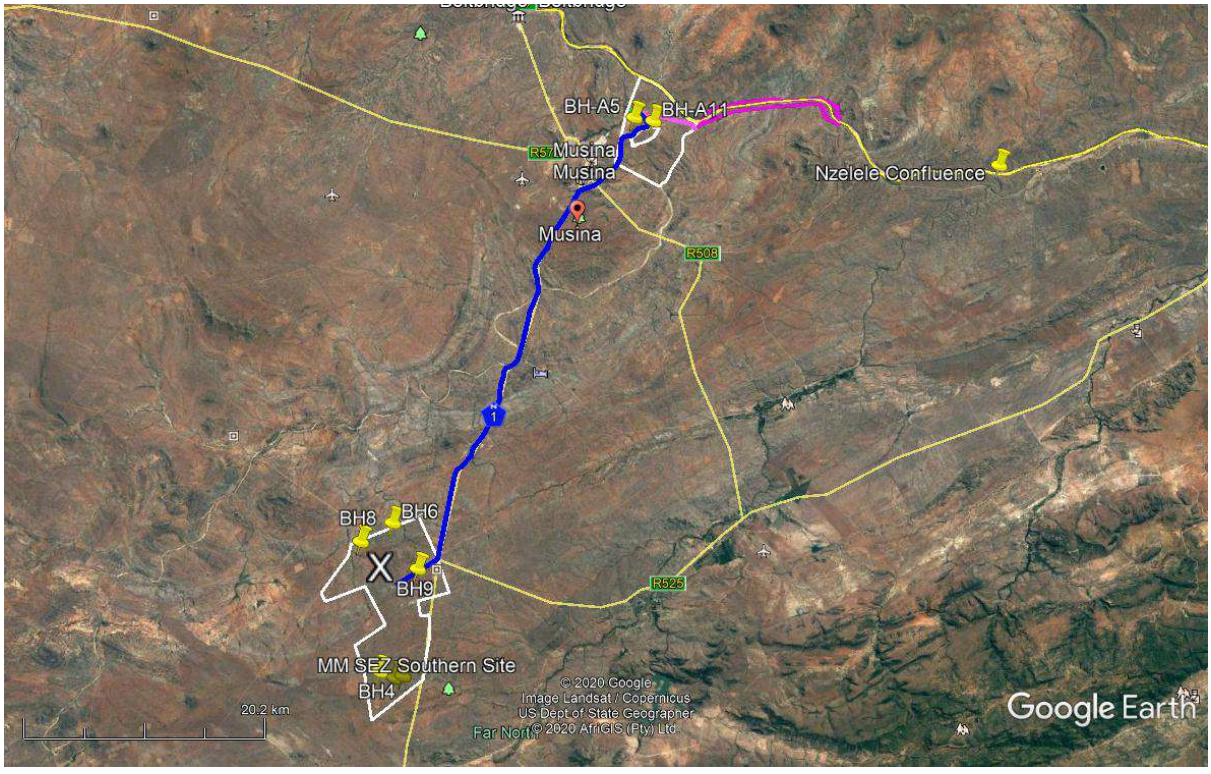
(Indicated on BLUE on Figure 16 below).

It is envisaged that this will be reached simultaneous with reaching the long-term supply goal on the Northern Site. The infrastructure to provide water from the different source then already exist in the North, and the available water must then be conveyed over 50 km and 260 m vertically to the site. In concept, it is envisaged that:

- potable water will be pumped from the distribution reservoirs on Antonvilla,
- through a supply pipeline that will conceptually run along the N1 road for the most of its length.
- To provide for three days storage capacity on site, a reservoir of approximately 18 Megalitre will be required.

A services corridor along the pipe route will be required. The magnitude of the pipelines that will eventually be required to convey the water is such that river crossing will require support structures similar to the current road bridges.

Figure 16 below illustrates the infrastructure described.



:Figure 16: Supply line for potable water from the Northern Site to the Southern Site.

In concept, the BLUE line represents the pipeline from a pump station at the Antonvilla distribution reservoirs to the 18 Ml holding reservoir on the Southern site.

11.3.2.1. Medium Water Supply Infrastructure

The following will be required:

- Pump station at Antonvilla to pump and lift approximately 5.11 Mm3/a over 50 km and 260m.
- Pipeline to convey the water over 50 km. A 600 mm steel line above ground is envisaged.
- Receiving reservoir of 50 Ml capacity on the Southern Site.

11.3.2.2. Southern Site Medium Term Resource Plan Summary

Northern Site - Medium Term Infrastructure Requirements				
Resource	**Equipment**	**Description**	**Image Reference**	**Volume (Mm^3/a)**
Developed for Short Term Use				0.5
Potable water from Antonvilla Distribution Reservoirs	Pump station at Antonvilla (potable water)	To convey 5.11 Mm3/a over 50 km and with 280 m vertical lift	16	5.11
	Electrical supply for Antonvilla Pump station			
	Conveying pipeline	600 mm diameter steel, 50 km long		
	Suitable river and stream crossings			
	50 Ml reservoir	Concrete (to serve the long terms potable water supply)		
Total for Northern Site – Medium Term				5.61

11.3.3. Southern Site Long Term Supply Infrastructure

(Indicated on PINK on Figure 17 below).

Reaching the long-term water requirement will occur after the completion of the Musina (or other relevant dam) for the storage of Limpopo flood water. Upon completion of this, it is anticipated that sufficient resources will exist to satisfy the total needs of these projects, and beyond. Bulk raw water from the Musina Dam will then be pumped to a suitable receiving reservoir on site for further treatment, distribution, and usage

11.3.3.1. Long Term Water Supply

The following infrastructure is envisaged:

- A pump installation below the Musina dam wall, of suitable design and capacity to pump 80 Mm3/year (= 2.54 cubic meter per second around the clock) over 50 km and through a 260 m vertical lift.
- Electricity supply network and infrastructure for the pump installations at the dam wall.
- Pipeline of suitable design. (3 parallel pipelines of 1,100 mm diameter or the hydraulic equivalent thereof are foreseen).
- Suitable receiving and storage reservoir on site from which water will be handled further. To facilitate a three-day inflow capacity, a reservoir of 660,000 cubic meter will be required. (The iX Engineers development plan indicates a 14-day capacity reservoir. That would require a storage reservoir of approximately 3 million cubic meters.
- This can for instance be provided by an open, plastic lined soil structure, or with a dam wall in a suitable drainage line.

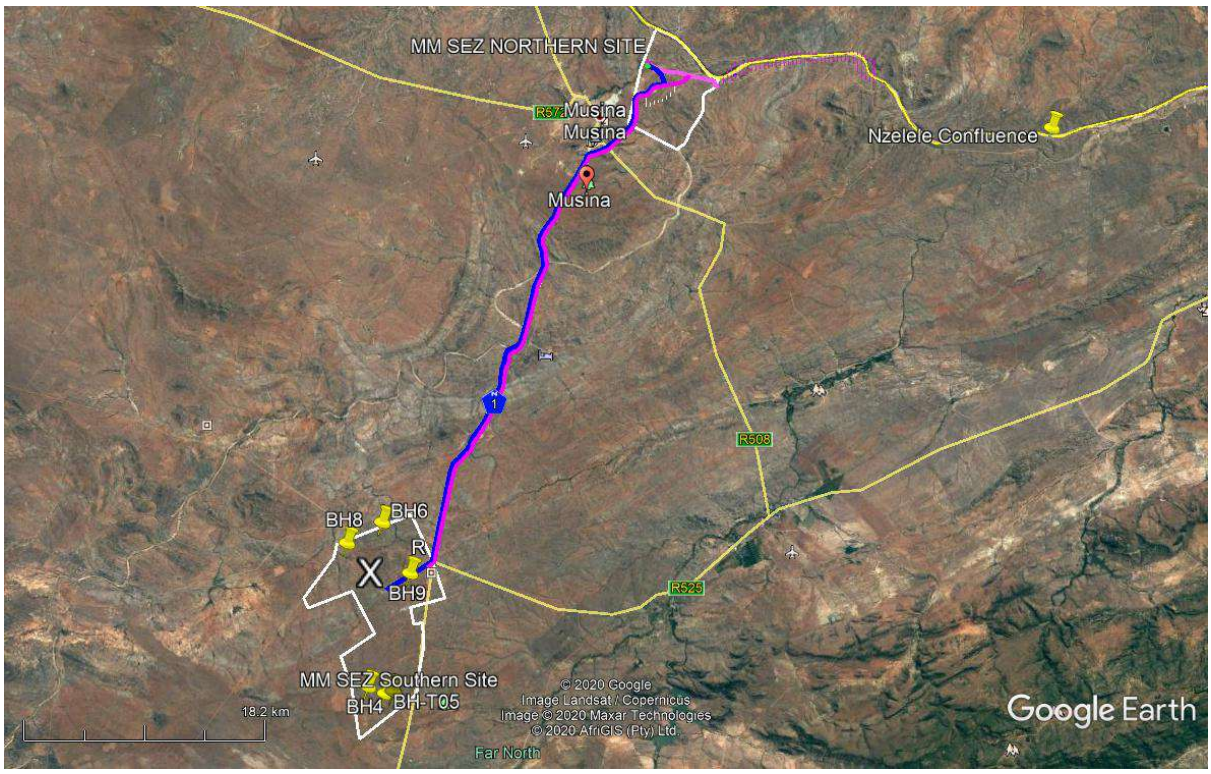


Figure 17: Long term supply infrastructure for the Southern Site

11.3.3.2. Southern Site Long Term Resource Plan Summary

Northern Site - Long Term Infrastructure Requirements				
Resource	**Equipment**	**Description**	**Image Reference**	**Volume (Mm^3/a)**
Developed for Short Term Use				5.61
Raw water from Musina Dam	Pump station at Musina Dam (raw water)	To convey 74.39 Mm3/a over 50 km	17	74.39

		and with 260 m vertical lift		
	Electrical supply for Antonvilla Pump station			
	Conveying pipeline	3 x 1,000 mm diameter steel, 50 km long		
	Suitable river and stream crossings			
	18 Ml reservoir	Open reservoir pending on site availability and design		
Total for Northern Site - Long Term				80

11.3.4. Beyond Reaching Long Term Supply

The conceptual Musina Dam is envisaged to have a yield of 180 Mm3/a. By applying the various resources strictly as discussed above, only 74.39 of this will be required for this Musina and MM SEZ direct requirements, with in excess of 100 Mm3/a available for the regional water balance.

The second dam upstream in the Sand River, may contribute another envisaged 200 Mm3/a of stored Limpopo flood water to the balance, with further possible ultra-long-term augmentation from resources further north as listed in Section 9.1.7.

12. Conceptual Capital Cost

Northern Site - Short Term Infrastructure Requirements								
Resource	**Equipment**	**Description**	**Qty**	**Unit**	**Estimated Rate**	**Estimated Cost**	**Image Reference**	**Volume (Mm^3/a)**
2 x Boreholes	Electricity Supply (ESKOM Point)	25 kVA point at borehole	2	each	R400 000.00	R800 000.00	Figure 8	0.15
	Borehole Equipment and security measures	"Mono" pump and 3 phase electric motor	2	each	R150 000.00	R300 000.00		
	Monitoring and control instrumentation	Measure and transmit / store operational data	2	each	R120 000.00	R240 000.00		
	Local 3 m tank for bowser filling	10,000 l Plastic tank on approved stand	2	each	R100 000.00	R200 000.00		
	Connection to site tank	90 mm Class 12	100	m	R668.00	R66 800.00		
Development Site Reservoir	Reservoir	1 Ml	1	each	R2 400 000.00	R2 400 000.00	Figure 8	
	Borehole linking pipes	90 mm Class 12	3 300	m	R668.00	R2 204 400.00		
	Monitoring and control	Measure and transmit / store operational data	1		R150 000.00	R150 000.00		
Enabling Share of Municipal Allocation from Wellfield	Upgrade of wellfield and collecting system	Assess condition and upgrade	1	Estimation	R50 000 000.00	R50 000 000.00	Figure 9	4.40
	Upgrade treatment facility	Assess condition and upgrade						
	Upgrade pump-to-reservoirs facilities	Assess condition and upgrade						
	Upgrade conveying wellfield-to-Musina pipeline (Rising main)	Assess condition and upgrade						
	Upgrade of electricity supply	Assess condition and upgrade						
New infrastructure to share in municipally allocation	35 Ml reservoir	New pre-casted reservoir	3	unit	R49 000 000.00	R147 000 000.00	Figure 9	
	Pipeline: Musina pipeline to 35 Kl reservoir	New pipeline	1 600	m	R1 700.00	R2 720 000.00		
	Pump station able to transfer 6.6 Mm3/a to municipal supply	500 mm pipe	1	Estimation	R7 000 000.00	R7 000 000.00		
	Pipeline: 35 Kl reservoir to development site reservoir	Estimate at 300 mm pipe	3 800	m	R1 260.00	R4 788 000.00		
Enabling Musina Mine Borehole	Upgrade Electricity Supply	Assess condition and upgrade	1	Estimation	R3 800 000.00	R3 800 000.00	Figure 9	1.00
	Upgrade pump installation	Assess condition and upgrade						
	Upgrade pipe link to rising main	Assess condition and upgrade						
	Monitoring and control instrumentation	Measure and transmit / store operational data						
Sub Total (Excluding Fees and VAT)						**R221 669 200.00**	**Total available end of term**	**5.55**
Professional and management provision			**15%**			**R33 250 380.00**		
VAT			**15%**			**R38 237 937.00**		
Total for Southern Site - Long Term						**R293 157 517.00**		

Northern Site - Medium Term Infrastructure Requirements								
Resource	**Equipment**	**Description**					**Image Reference**	**Volume (Mm^3/a)**
		Developed for Short Term Use						5.55
Waste Water Collection	Upgrade at WWTW's to secure acceptable effluent quality	Pending on industrial process requirements	2	Estimation	R3 000 000.00	R6 000 000.00	Figure 10	3.96
	Pump installations	To allow for 3 Mm3/a each	2	Estimation	R3 000 000.00	R6 000 000.00		
	Pipelines	300 mm to allow for 3 Mm3/a flow	13 250	m	R1 600.00	R21 200 000.00		
	Effluent Reservoir	5 Ml	1	Estimation	R7 000 000.00	R7 000 000.00		
	Electricity supply upgrade	To match increased pump demand	1	Estimation	R4 000 000.00	R4 000 000.00		
		Sub Total (Excluding Fees and VAT)				**R44 200 000.00**	**Total available end of term**	**9.51**
		Professional and management provision	**15%**			**R6 630 000.00**		
		VAT	**15%**			**R7 624 500.00**		
		Total for Southern Site - Long Term				**R58 454 500.00**		

Northern Site - Long Term Infrastructure Requirements								
Resource	**Equipment**	**Description**					**Image Reference**	**Volume (Mm^3/a)**
		Developed for Medium Term Use						9.51
Limpopo Eastern Alluvial Aquifer	Development of additional Limpopo Aquifer east of Sand River confluence	Pending on Limpopo Mainstem Hydrological Study	1	Estimation	R100 000 000.00	R100 000 000.00	Figure 11 & 12	20.00
	Wells, pumps and collector manifold	To match effluent flow rate	1	Estimation	R100 000 000.00	R100 000 000.00		
	electricity supply	To match the new pump demand			R200 000 000.00	R200 000 000.00		
	Pipeline: From wellfield to Antonvilla Reservoir	To match effluent flow rate	5 500	m	R2 000.00	R11 000 000.00		
	Pump station able to transfer 20 Mm3/a to the Southern Site		4	Estimation	R19 000 000.00	R76 000 000.00		
		Return the borrowed 4.4 Mm3/a to Musina						-4.40
		Re-allocate to Southern Site						-5.11
		Sub Total (Excluding Fees and VAT)				**R487 000 000.00**	**Total available end of term**	**20.00**
		Professional and management provision	**15%**			**R73 050 000.00**		
		VAT	**15%**			**R84 007 500.00**		
		Total for Southern Site - Long Term				**R644 057 500.00**		

Southern Site - Short Term Infrastructure Requirements								
Resource	**Equipment**	**Description**					**Image Reference**	**Volume (Mm^3/a)**
Groundwater	Electricity Supply (ESKOM Point)	25 kVA point at borehole	12	each	R400 000.00	R4 800 000.00	Figure 15	0.56
	Borehole Equipment and security measures	"Mono" pump and 3 phase electric motor	12	each	R150 000.00	R1 800 000.00		
	Monitoring and control instrumentation	Measure and transmit / store operational data	12	each	R120 000.00	R1 440 000.00		
	Local 3 m tank for bowser filling	10,000 l Plastic tank on approved stand	12	each	R100 000.00	R1 200 000.00		
	Connection to distribution pipeline		12	m	R668.00	R8 016.00		
Development Site Reservoir	Reservoir	1 Ml	1	Estimation	R3 400 000.00	R3 400 000.00	Figure 15	
	Borehole linking pipes	90 mm HDPE Class 6 network	30 000	m	R668.00	R20 040 000.00		
	Monitoring and control instrumentation	Estimated	7	Estimation	R150 000.00	R1 050 000.00		
		Sub Total (Excluding Fees and VAT)				**R33 738 016.00**	**Total available end of term**	**0.56**
		Professional and management provision	**15%**			**R5 060 702.40**		
		VAT	**15%**			**R5 819 807.76**		
		Total for Southern Site - Long Term				**R44 618 526.16**		

Southern Site - Medium Term Infrastructure Requirements								
Resource	**Equipment**	**Description**					**Image Reference**	**Volume (Mm^3/a)**
		Developed for Short Term Use						0.56
Excess water from Antonvilla (Upon reaching 'long term" status at the Northern site)	First Conveyance pipeline from Antonvilla for potable water. (To pump the required volume over 18 h/day at a flow rate of 1 m/s, the required pipe diameter is 600 mm.	Assuming a 20 Mm3/a yield of the additional Limpopo Alluvial Aquifer development (High cost due to allowance for servitudes and river bridges)	50 000	m	R5 000.00	R250 000 000.00		5.11
	Pump station at Antonvilla reservoirs to transfer potable water at a rate of 0.21 M3/s to the Southern Site reservoir (Pump station and booster along the route)		2	Estimation	R19 000 000.00	R38 000 000.00		
	Electrical supply for the pump station		2	Estimation	R4 000 000.00	R8 000 000.00	Figure 16	
Site Reservoir for 3-day storage of potable water	Reservoir of 3 day flow capacity potable water	46,600 m3, say 50 Ml	1	Estimation	R70 000 000.00	R70 000 000.00		
		Sub Total (Excluding Fees and VAT)				R366 000 000.00	**Total available end of term**	**5.11**
		Professional and management provision	15%			R54 900 000.00		
		VAT	15%			R63 135 000.00		
		Total for Southern Site - Long Term				**R484 035 000.00**		

Southern Site - Long Term Infrastructure Requirements								
Resource	**Equipment**	**Description**					**Image Reference**	**Volume (Mm^3/a)**
Developed for Medium Term Use								5.67
New water from the Musina Dam (Anticipated yield 200 Mm3/a)	Musina Dam in Sand River	39 m high and 9XX m long wall at the position of the current road bridge just south of the Sand River confluence with the Limpopo River	Provision	Estimations made at the hand of unsolicited bid document	Provision	R4 500 000 000.00	Figure 17	74.33
		Spillway				R700 000.00		
		Roads				R300 000 000.00		
		Admin and staff facilities				R300 000 000.00		
	Collection system civil works					R500 000 000.00		
	Collection and transfer pump stations	From the river to the dam and from the dam to the Southern Site				R1 000 000 000.00		
	Collection and transfer system electricity supply, sub stations and transmission lines	Major network development envisaged				R1 400 000 000.00		
	Conveyance pipelines with capacity to pump 80 Mm3/a raw water from the Musina Dam to the Northern Development site over 50 km and 280 m height.	3 parallel pipes of 1.1 m diameter each to convey cumulatively 80 Mm3/a				R1 350 000 000.00		
	Site storage to be defined	To be defined				R750 000.00		
Sub Total (Excluding Fees and VAT)						R9 351 450 000.00	**Total available end of term**	**80.00**
Professional and management provision			15%			R1 402 717 500.00		
VAT			15%			R1 613 125 125.00		
Total for Southern Site - Long Term						**R12 367 292 625.00**		

Summary of Conceptual Water Supply Cost			
Northern Site Short Term	R293 157 517.00		R5.55
Northern Site Medium Term	R58 454 500.00		R3.96
Northern Site Long Term	R644 057 500.00		R10.49
Northern Site Total	R995 669 517.00		R20.00
Southern Site Short Term	R44 618 526.16		R0.56
Southern Site Medium Term	R484 035 000.00		R5.11
Southern Site Long Term	R12 367 292 625.00		R74.33
Southern Site Total	R12 895 946 151.16		R80.00
Grand Total	R13 891 615 668.16		R100.00

With a capital loan of R13,891,615,668 (refer to Schedule 12 above), repayable over a period of 20 year, and considered at full supply volume, the capital cost portion of the supply is calculated to be R10.86 per cubic meter (including VAT)*

* For a conceptual cost estimation, costing is normally done conservatively. A cost exercise following upon preliminary design, will probably indicate lower capital cost and accordingly lower long-term unit costs.

13. Energy Requirements

With the level of detail known at this stage it is not possible to draw up the full extent of operational costing. The operational regime, the implementing stage, the level of service required, and the detail of design will all play a role.

However, with the geographic and water demand figures at hand, certain indicative conclusions can be made. The table below present various values that indicates the extend of the envisaged development in real terms.

The power demand figures were applied to the estimated unit cost (per Mega Watt Hour) for the system. We conclude that this will bring about a yearly electricity bill of R193,500,188 (Excluding VAT), and that the energy component of the water cost will be around R1.67 / cubic meter.

	Water Volume		Period		Head including friction allowance (m)	Power Demand				Total	Cost	
Detail of Usage	Mm3/s	l/s	Months per year	Hours per Day		Max (MW)	Min (MW)	Ave (Ave)	Ave Daily Usage	Yearly Consumption (MWh)	Unit Cost R/MWh Estimate	Total Cost
Lift water from inlet into Musina Dam (MW)	110	1273	3	20	10 m - 45 m	9.4	2.09	5.745	114.9	10 485	R1 500	R15 726 938
From Musina Dam to Antonvilla Reservoir (MW)	20	761	12	20	61.6	0.76	0.76	0.76	15.2	5 548	R1 500	R8 322 000
From Musina Dam to Musina Reservoir (MW)	11	418	12	20	187	1.27	1.27	1.27	25.4	9 271	R1 500	R13 906 500
From Musina Dam to Antonvilla Reservoir (MW)	80	3044	12	20	286	14.205	14.205	14.205	284.1	103 697	R1 500	R155 544 750
Maximum Demand						25.635						
							Total Energy Running Cost					R193 500 188
							Volume of water per year (Cubic meter)					110 000 000
							Average energy cost (R per cubic meter) (Excl					R1.76

14. Impact Assessment

The impact assessment following was done according to methodology and instructions provided by the EMAP of

Aspect: Taking Groundwater from a Resource	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking Groundwater from a Resource Groundwater abstraction Northern and Southern Sites. From a view of aquifer sustainability for all users on the relevant aquifers.	Geo-hydrological assessment of abstraction potential for the site. Individual borehole test analysis and abstraction determination. Design of pump installation within the limits of recommended abstraction. Abstraction monitoring, recording and control to prevent over abstraction and dewatering of any particular borehole.	-	Without	16	2	5	1	23
		-	With	2	1	1	0.5	2

Aspect: Taking Water from Musina Resources	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking water from any resource allocated for the use of Musina LM (from the perspective that due to reasons associated with due consideration and management of consequences either the project or the Musina LM will suffer shortages)	Due agreement (MOU) to be reached with the Musina LM and VDM (WSA) with respect to the following: - Principal agreement defining the various resources, the volume to be abstracted and the duration of the agreement pertaining to a specific resource. - Capacity of the abstraction infrastructure, the operational condition, design limitations, upgrade requirements, planning and design, funding and implementing of the required upgrades. - Source monitoring to manage resource deterioration. - Operational requirements and capacity. Compliance to WUL and Environmental procedures,	-	Without	16	4	3	1	23
		-	With	1	4	2	0.5	3.5

Aspect: Utilizing 4.4 Mm3/a from Musina LM	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking up 4.4 Mm3/a of the municipal allocation form the Limpopo Aquifer bordering on Antonvilla (From the perspective of insufficient infrastructure development. Management and / or compliance)	From the MOU between the MM SEZ and WSA, ensure that: - Infrastructure - technical requirements are met. - Monitoring and recording requirements are met. - Operations within functional guidelines. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	4	3	1	23
		-	With	4	4	3	0.5	5.5

Aspect: Utilizing 4.4 Mm3/a from Musina LM	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking up 4.4 Mm3/a of the municipal allocation form the Limpopo Aquifer bordering on Antonvilla (From the perspective of insufficient infrastructure development. Management and / or compliance)	From the MOU between the MM SEZ and WSA, ensure that: - Infrastructure - technical requirements are met. - Monitoring and recording requirements are met. - Operations within functional guidelines. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	4	3	1	23
		-	With	4	4	3	0.5	5.5

Aspect: Using 1 Mm3/a from Musina Copper Mine	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking 1 Mm3/a from the Musina Copper Mine	From the MOU between the MM SEZ and the WSA: - Design the required infrastructure according to functional requirements, applicable standards, guidelines and procedures. - Obtain the required approvals, wayleaves and servitudes as may be applicable. - Construction according to design. - Operations within functional guidelines. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	4	3	1	23
		-	With	4	4	3	0.5	5.5

Aspect: Scientific Motivation for Taking Water from the Limpopo River	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking Water from a further Eastern Wellfield from the Limpopo Alluvial Aquifer between the Sand River confluence and the eastern extent of the farm Malala Hoek 20 Mm3/a and the uptake off Limpopo flood water to the foreseen extend of 180 - 400 Mm3/a approximately at the Sand River confluence pertaining to yield capacity. Perspective: Scientific proven resource availability.	The uptake of water beyond the current Musina LM allocation of 11 Mm3/a, both from the alluvial aquifer and from flood water, will be subject to the main-stem hydrological study of the Limpopo River that will clarify the available water in the alluvial aquifer and as storm water to be harvested. DWS will consider the study outcome for the allocation of further water. This will serve to protect the interest of: - Downstream South African users. - Zimbabwean users. - Mozambiquan users and the exposure of Mozambique to Limpopo River flood events. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	5	5	1	26
		-	With	8	3	3	0.5	7

Aspect: Possible Limitations due to Global Warming	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Possible reducing river yield due to global warming. Seen from the perspective of possible change in weather patterns.	As part of the hydrological study as described above, a climatological study will be required to determine: - The anticipated impact on rainfall over the catchment area. - The anticipated impact on run-off. - The anticipated impact on yield at the proposed points of abstraction.	-	Without	16	5	5	0.75	19.5
		-	With	8	3	3	0.5	7

Aspect: Using water from the proposed Eastern (Limpopo) Alluvial Aquifer	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking Water from a further Eastern Wellfield from the Limpopo Alluvial Aquifer between the Sand River confluence and the eastern extent of the farm Malala Hoek, Seen from the perspective of insufficient infrastructure development, management and / or compliance.	In accordance with available researched volumes from this resource: - Proper consideration of technical- and economic feasibility. - Design the required infrastructure according to functional requirements, applicable standards, guidelines and procedures. - Obtain the required approvals, wayleaves and servitudes as may be applicable. - Construction according to design. - Establishment of operational structure including the measurement, monitoring and recording of the required parameters, system operational requirements and operational structure. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	5	5	1	26
		-	With	2	3	3	0.5	4

Aspect: Using Water from the proposed Off-Channel Storage Dams in the Sand River	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Taking 180 - 400 Mm3/a floodwater from the Limpopo River for off-channel storage. Seen from the perspective of insufficient infrastructure development, management and / or compliance.	In accordance with available researched volumes from this resource: - Proper consideration of technical- and economic feasibility. - Design the required infrastructure according to functional requirements, applicable standards, guidelines and procedures. - Obtain the required approvals, wayleaves and servitudes as may be applicable. - Construction according to design. - Establishment of operational structure including the measurement, monitoring and recording of the required parameters, system operational requirements and operational structure. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	5	5	1	26
		-	With	2	3	3	0.5	4

Aspect: On-Site Distribution Infrastructure on the Northern Site	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Construction of various elements of water supply, - storage and - distribution network linking the various resources to the farm Antonvilla 7 MT, constituting the Northern Site. Seen from the perspective of insufficient infrastructure development, management and / or compliance.	In accordance with available researched volumes from this resource: - Proper consideration of technical- and economic feasibility. - Design the required infrastructure according to functional requirements, applicable standards, guidelines and procedures. - Obtain the required approvals, wayleaves and servitudes as may be applicable. - Construction according to design. - Establishment of operational structure including the measurement, monitoring and recording of the required parameters, system operational requirements and operational structure. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	5	5	1	26
		-	With	2	3	3	0.5	4

Aspect: On-Site Distribution Infrastructure on the Southern Site	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Construction of various elements of water supply, - storage and - distribution network linking the various resources to the group of farms constituting the Southern Site. Seen from the perspective of insufficient infrastructure development, management and / or compliance.	In accordance with available researched volumes from this resource: - Proper consideration of technical- and economic feasibility. - Design the required infrastructure according to functional requirements, applicable standards, guidelines and procedures. - Obtain the required approvals, wayleaves and servitudes as may be applicable. - Construction according to design. - Establishment of operational structure including the measurement, monitoring and recording of the required parameters, system operational requirements and operational structure. Compliance to WUL and Environmental procedures and conditions.	-	Without	16	5	5	1	26
		-	With	2	3	3	0.5	4

Aspect: Effluent Quality	Mitigation Measures	Status	Mitigation	Intensity (I)	Extent (E)	Duration (D)	Probability (P)	Significance (I+E+D)xP
Effect on water quality arising from the envisaged water use. Seen from a perspective that: - Anticipated final effluent volumes are not estimated yet. - The exact quality of input water is not yet known. - The effect on the water due to the various possible industrial processes is not defined yet. - The objective to limit water demand through the re-is of water is stated by the investors as one of their project objectives>	Clear effluent quality objectives based upon the required DWS standards will be defined and incorporated in the various MOU's to be develop with the various investors. Strict compliance monitoring.	-	Without	16	5	5	1	26
		-	With	2	5	5	0.5	6

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