INFRASTRUCTURE CAPACITY ASSESSMENT REPORT
LETHABO PARK EXTENSION
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1 INTRODUCTION

1.1 BACKGROUND

Reneilwe Consulting and Plannerswere appointed through Macroplan to undertake engineering services investigations amongst other investigations for the proposed Lethabo Park Extension Settlement located in Kimberly in the Sol Plaatje Local Municipality as part of the township establishment process that is currently being undertaken. In this regard, Reneilwe Consulting and planners had to undertake investigation of the status of existing services that were identified to potentially supply the proposed area in question in which most of the services were located in Roodepan settlement, which is adjacent to the proposed Lethabo settlement. Information was gathered from the Sol Plaatje Local Municipality specifically from the engineering services department as well as the town planning department; site visits were also conducted within Roodepan settlement to assess the physical conditions of the existing infrastructure.

This report presents the findings of the infrastructure investigations in as far as existing capacity as well as physical condition of the current infrastructure is concerned in addition to the proposed Lethabo settlement.

1.2 PURPOSE OF REPORT

The purpose of the report is to report on the status quo of the infrastructure on existing Roodepan settlement and proposed Lethabo Park Extension Settlement through demand calculations.

2 METHODOLOGY

2.1 ONSITE PHYISICAL INVESTIGATIONS

In conducting the assessment the existing infrastructure was taken into consideration. The infrastructure assessment included water, sewer and electricity services.

3.1.1 WATER SUPPLY

Through site visits and meetings with the municipality technical personnel, the following information was obtained regarding water supply:-

- There are two pipes(600 and 965 mm diameter) running on a provincial road adjacent to Roodepan which come from a water purification plant that serves the entire municipality
- A 350mm diameter steel pipe connects to the 600 mm diameter pipe with a pressure reducing valve on the 450 mm diameter steel pipe
- The 350 mm diameter steel pipe was meant to supply water to a 0.75 Mega litre concrete pressure tower that would eventually supply the Roodepan settlement.
- However due to physical structural integrity concerns observed from the 0.75 Mega litre tower the configuration was discontinued and the settlement is now fed directly from the 350 mm diameter pipe with no back up storage.
- The reticulation system consists of main lines which range from 110 to 450 mm diameter connecting to services lines which are 100mm to 63/50 mm diameter

In addition to the network configuration explained above, it was discovered that the pressure-reducing valve is currently being used to operate/control the water network in as far as pressure and flow is concerned. More over the municipality personnel confirmed that there is hardly any water interruption issues because the supply is in a way fed by the main pipes from the water purification plant, which also supply the rest of the municipality.
However, it was also observed that the pressure control tower showed signs of deterioration through exposed reinforcement and cracked concrete. The images below give an illustration of the current physical condition of the pressure tower:-

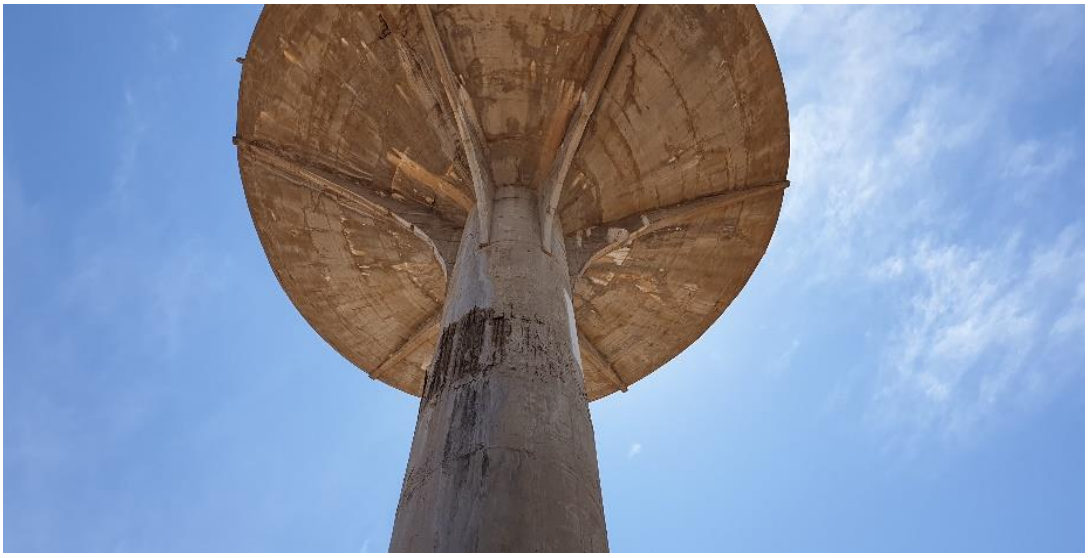

Figure 1: Exposed Reinforcement

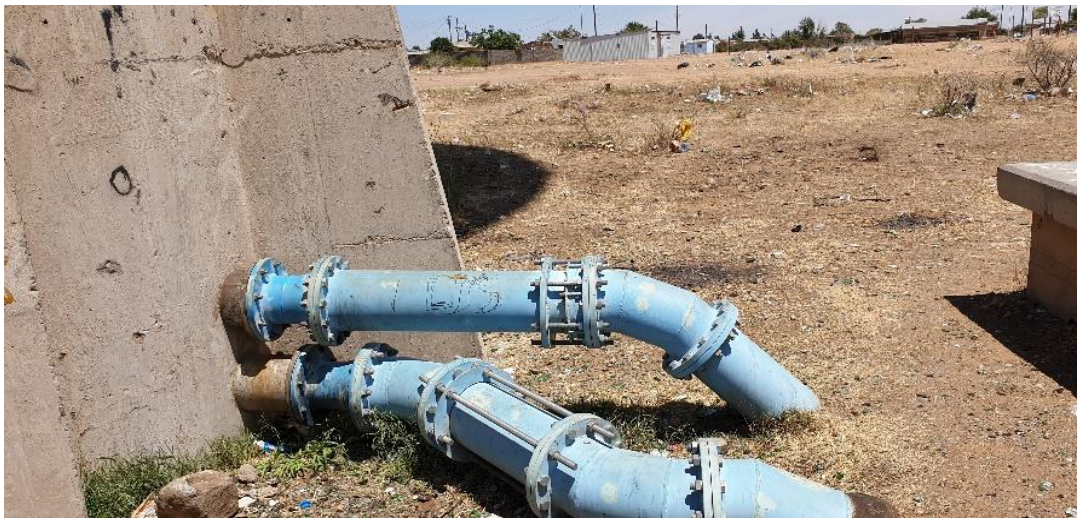

Figure 2: Visible Cracks

The photo below depicts the main connection of the 600mm diameter with a 350mm diameter pipe as well as the pressure reducing valve as discussed:-

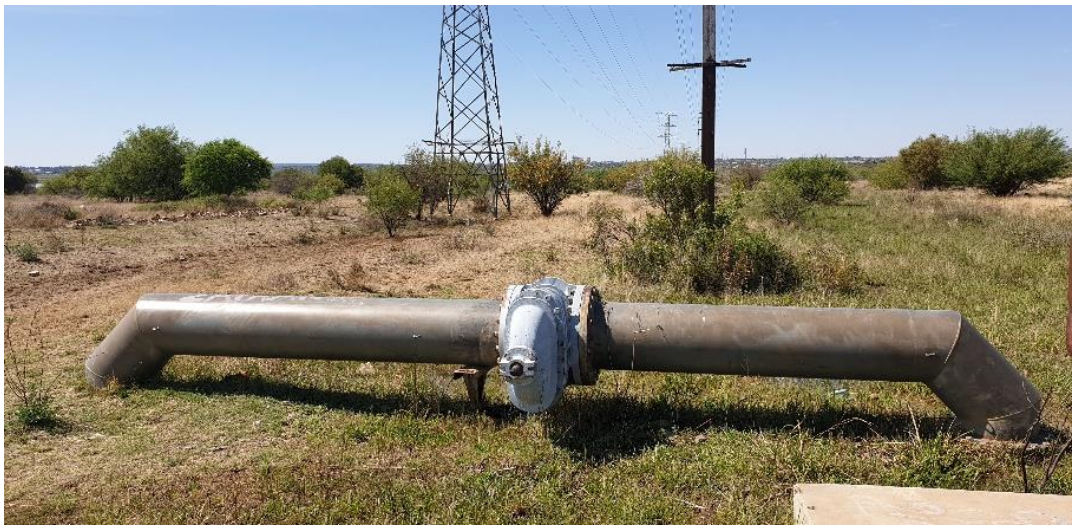

Figure 3: Main 350 Connection point

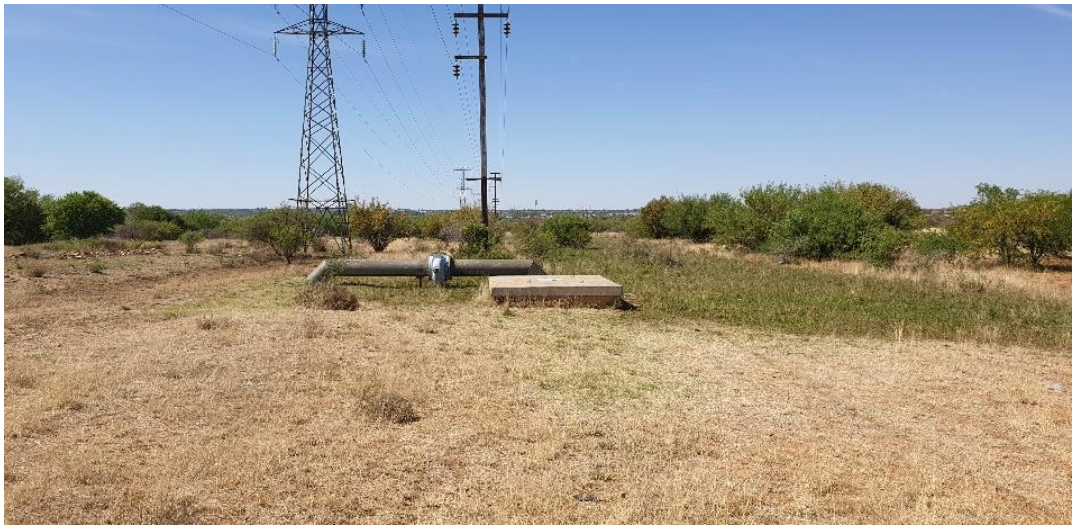

Figure 4: Main connection point with PRV chamber

In order to determine the capacity requirements, **demand calculations for the existing service area as well as the proposed Lethabo development** area in order to work out the difference. Once that is complete, then a determination of required capacity based on relevant industry norms will be deduced and recommendations will thus be made accordingly.

2.1.2 SANITATION

Through site visits and meetings with the municipality technical personnel, the following information obtained regarding sanitation services:-

- The Roodepan area is serviced by the main waste water treatment plant which services the entire Kimberly
- The wastewater treatment plant currently has a capacity of 48 Megalitre per day, which was recently upgraded from 33 Megalitre.
- According to municipal technical personnel, it is currently operating at 23 Megalitre at peak demand, which is more than half of its full capacity.
- The main bulk sewer line is connected by five lift stations located along the western part of the settlement, the area's topography is very flat and as such, the lifting stations ensure that sewer lines are not very deep due to minimum slope required for self-cleansing velocity amongst other hydraulic requirements.
- According to the information received from council, there is a 200 mm diameter sewer line which is mainly a rising main connected to most of the lift stations and an outfall gravity line of 450 mm diameter which eventually connects to the waste water treatment plant.
- Some of the lift stations are not in a good operating condition although they are still functioning, it was observed that there is many overflows as well as lack of maintenance.
- The network is made up of predominantly 160 mm diameter AC pipes, which are more than 15 to 20 years old. **Many pipe leakages were observed within the sewer network and this is suspected to be due to high demand as well as aging infrastructure.**

The council technical personnel further indicated that there is currently an outfall sewer line, which is being designed by another consulting firm. The design report was not available at the time of this report, as it would clarify what capacity has been designed for and what future demands have been calculated.

The following photos depict the lift stations that were visited on site:-

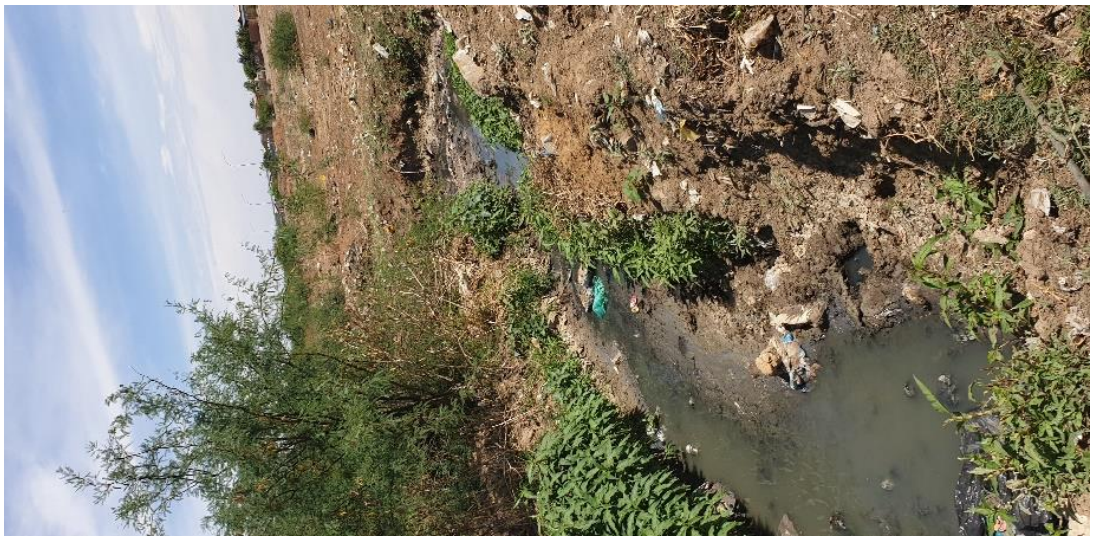

Figure 5: Lift station overflow

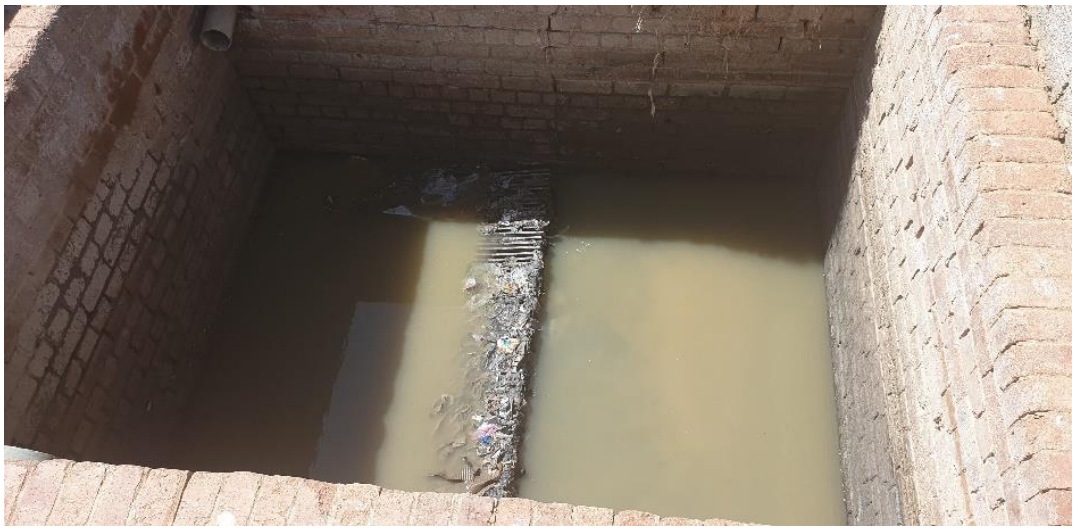

Figure 6: Screening Inlet

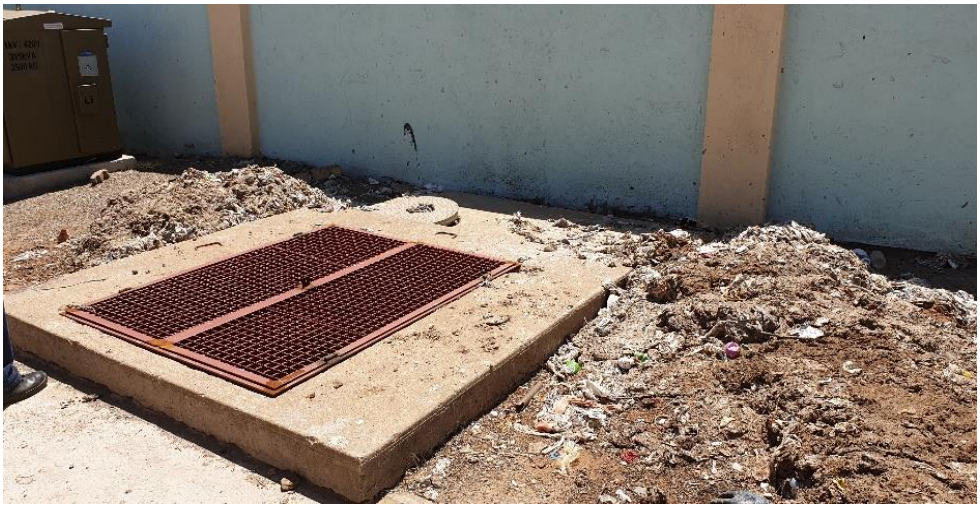

Figure 7: Lack of waste collection

2.1.3 Roads and Stormwater (Roodepan Stormwater Systems)

The area has underground conventional storm water network that collects through street kerbs and channeled through underground storm water pipes. It should however be noted that due to the flat slope of the area the storm water network is divided into various sub networks which drain at different drainage pans around or adjacent to the area.

The internal roads are normal surfaced roads with widths varying from four to six meters and there are sections, which are underdeveloped, and they have informal gravel roads in some cases. The main road connected through a provincial road, which is the MR 909, which will be investigated in a form of a traffic impact study within the project as well.

2.2 INFRASTRUCUTURE CAPACITY CALCULATIONS

2.2.1 WATER DEMAND CALCULATION

For the calculations of maximum average annual daily demand **(AADD)** the following assumptions were made:-

- Similar water consumers will peak with the same peak factor e.g residential areas
- All residential consumers are in the same income class therefore consumptions is on average similar.
- Immediate post development capacity calculation will only include the immediate consumption to be generated by the existing.
- The probability of every user type peaking at the same time is highly unlikely but for the sake of this project Peak will only be accounted for residential use.
- Reference is made to “the red book water supply table 9.11, water consumptions in areas equipped with stand pipes, yard connections and house connections” for house connection (developed areas).
- Reference is made to “the red book table 9.12, domestic water consumption” for 20 litres per capita per day.
- Reference is made to “the red book sanitation table C.1: average daily flows per family dwelling unit”.
- Reference is made to “the red book water supply table 9.15: Peak factors for developing areas”.
- Reference is made to “the red book water supply table 9.14: Water demand for developed areas”.
- Reference is made to “the red book water supply 9.18: design fire flow and 9.19: duration of design fire flow”.
- Reference is made to “the red book water supply pg. 25 velocity in pipes”.
- An annual growth rate of the town will be used to calculate the growth factor
- Reference is made to “the regulations relating to minimum uniform norms and standards for public school infrastructure” by the Department of basic education *Annexure G:*

2.2.2 WATER DEMAND CALCULATION FOR ROODEPAN SETTLEMENT

The water demand calculation for Roodepan settlement were calculated and are attached in **Annexure A** of this report**.**

Summarised results on the pipe sizing are presented in the tables below;

Main Pipe sizing(Current Roodepan)		
Description	**unit**	**Quantity**
Average velocity	m/s	1,2
Generated flow	m3/s	0,10
Cross sectional area	m2	0,08
Pipe diameter	mm	328,27
Adjusted according to standard pipes	mm	355

Table 1: Roodepan Current water main pipe sizing

The table above show that the main pipe on site which is 350 mm will be sufficient since the demand calculation require a 328.27 mm where a 350 can be used.

The tables below show water pipe sizing for Lethabo settlement for three main pipes divided in different sections that are attached in Annexure A of this report.

Main Pipe sizing(Pipe 1 to Lethabo)		
Description	**unit**	**Quantity**
Average velocity	m/s	1,2
Generated flow	m3/s	0,01
Cross sectional area	m2	0,01
Pipe diameter	mm	112,84
Adjusted according to standard pipes	**mm**	**125mm**

Table 2: Lethabo Park Pipe 1 water main pipe sizing

Main Pipe sizing(Pipe 2 to Lethabo)		
Description	**unit**	**Quantity**
Average velocity	m/s	1,2
Generated flow	m3/s	0,01
Cross sectional area	m2	0,01
Pipe diameter	mm	112,84
Adjusted according to standard pipes	**mm**	**125mm**

Table 3: Lethabo pipe 2 water pipe sizing

Main Pipe sizing(Pipe 3 to Lethabo)		
Description	**unit**	**Quantity**
Average velocity	m/s	1,2
Generated flow	m3/s	0,01
Cross sectional area	m2	0,01
Pipe diameter	mm	112,84
Adjusted according to standard pipes	**mm**	**125mm**

Table 4: Lethabo pipe 3 water main pipe sizing

Pipe sizing was then done for both settlements to determine a main pipe. The results were then shown below;

Main Pipe sizing		
Description	**unit**	**Quantity**
Average velocity	m/s	1,2
Generated flow	m3/s	0,13
Cross sectional area	m2	0,11
Pipe diameter	mm	374,24
Adjusted according to standard pipes	**mm**	**400mm**

Table 5: Water main pipe sizing for both Roodepan and Lethabo settlement

From the above calculation the following findings were deduced:

- Roodepan settlement has 9 Megalitre 1 day storage requirement based on design calculations attached in Annexure A of this report.
- After water demand calculations done for both settlement a 12 Megalitre 1 day storage reservoir will be recommended as a 1 day storage reservoir is required according to the Redbook.
- A calculated pipe size of 355mm for Roodepan settlement only which is slightly bigger than the existing pipe main of 350mm, which seems to be adequate.
- After incorporating the water capacity for the two settlements a main pipe size of 400mm will be required. The 350mm existing main pipe will have to be upgraded to a 400mm to handle the water demand capacity.

It should be noted that the **12 Mega litre storage is only for 1-day** storage and it depends on the reliability of the water source and maintenance teams, in some cases 2-day storage suffices for most areas but will influence a substantial increase in cost for constructing a **24 Mega litre storage** reservoir hence rendering a **1 day storage more feasible.**

2.2.3 SEWER DEMAND CALCULATIONS

For the sewer calculations maximum average wet weather flow (AAWWF) the following assumptions were made:

- Similar water consumers will peak with the same peak factor e.g residential areas
- According to the Red book “the discharge from day schools and business sites need not be taken into account, since these are relatively minor flows that do not peak at the same time as the main residential flow”, however they will also be calculated for the sake of the maximum possible flows that can be generated from the entire network
- In determining the flow generated from business sites, churches, clinics, institutions an average daily flow of 600 litres per day for every 100 m2 of erf size should be used as per the Redbook, Annexure C.

- Design period for outfall sewer lines are usually in a range of 15-30 years according to normal practice and the same for waste water treatment systems.
- The probability of every user type peaking at the same time is highly unlikely but for the sake of maximum calculations this will be ignored.
- Design peak factors were reduced in accordance with graph in Figure C.1 in accordance to the Red Book
- Peak factor for extraneous flow allowing for storm-water infiltration and groundwater ingress according to the red book is 15%
- The settlement is regarding as low income residential area and according to the red book the average daily flows per single family dwelling unit is 500 l/day
- Reference is made to “the national minimum uniform norms and standards for school infrastructure” by the Department of education *Table 5: Minimum and Maximum capacity of a school* regarding a maximum of 620 pupils for a medium primary school.
- Reference is made to “SABS 0252-2: 1993, Water supply and drainage for buildings Part 2: Drainage installations for buildings” regarding 37l/student daily flow sewage in a day school.
- Current capacity calculation will only include the immediate consumption to be generated by the existing population

The demand calculations are attached in **Annexure B** of this report. A summary of the result will be shown below:

- The total capacity for the existing Roodepan settlement was calculated in order to determine the outfall pipe.
- Roodepan has a total of estimated 6463 stands and 93.3 l/s flow is generated. From the design calculation a 315 mm pipe would be sufficient but the pipe onsite is a 450mm which is sufficient.
- Adding extra flow from the Lethabo settlement with 1838 stands/units which generates a flow of 19.9 l/s the onsite pipe needs to have enough capacity to handle both flows.
- Flow generated from both settlement according to the sewer demand calculations is 113.2 l/s and the outfall sewer 450 mm pipe has a capacity of 310.17 l/s showing that it can handle both capacities.

- The outfall sewer services a waste water treatment with a capacity of 23 Mega litres at peak factor, therefore the 9.73 Mega litres produced by the two settlements can be accommodated.
- A detailed sewer design for the existing Roodepan sewer system and the proposed Lethabo settlement was then established.
- The sections were outlined based on the existing sewer line layout which is attached in Annexure B of this report.
- The results based on the capacity generated and pipe sizing are shown below;

Sewer flow pipe sizing for Lethabo Park Settlement						
Reference	**Section**	**Description (stands/units)**	**flow (l/s)**	**Calculated pipe size (mm)**	**Standard pipe sizes (mm)**	**Pipe connection to pump stations**
Macroplan town and regional planner: First conceptual drawing	1	666	3,12	44,6	160	Connecting to Camelia St. Pump Station
Macroplan town and regional planner: First conceptual drawing	2	183	3,69	49	160	Connecting to a raising main pipe of maximum diameter 200 mm from Camelia St. Pump station
Macroplan town and regional planner: First conceptual drawing	3	613	7,26	68, 8	160	Pipe connecting to the Midlands Pump station.
Macroplan town and regional planner: First conceptual drawing	4	442	5,71	63	160	Pipe that is connected to a gravity line servicing the 3 Sai Battalion Kimberly Military School, which is connected to another section serving part of Roodepan then connected to Camelia pump station

Table 6: Sewer pipe sizing flows for Lethabo Park settlement

Sewer flow pipe layout for Roodepan Settlement					
Reference	**Section**	**Description (stands/units)**	**flow (l/s)**	**Pipe capacity (l/s)**	**Existing pipe size**
Macroplan town and regional planner: First conceptual drawing	1	1766	22,69	39.2	A 160 mm pipe on site is sufficient for the capacity generated by this section which connects to Camelia Pump station
Macroplan town and regional planner: First conceptual drawing	2	287	4,98	39.2	A 160 mm pipe on site has sufficient capacity generated by this section which connects to Camelia Pump station
Macroplan town and regional planner: First conceptual drawing	3	1563	20,35	39.2	A 160 mm pipe on site has sufficient capacity generated by this section which connects to Eagle Street Pump Station
Macroplan town and regional planner: First conceptual drawing	4	446	6,66	39.2	A 160 mm pipe on site has sufficient capacity generated by this section which connects to Midlands Pump Station
Macroplan town and regional planner: First conceptual drawing	5	937	12,7	39.2	A 160 mm pipe on site sufficient capacity generated by this section which connects to a 450mm pipe which then connects to Legaeng Pump Station
Macroplan town and regional planner: First conceptual drawing	6	371	5,8	39.2	A 160 mm pipe on site has sufficient capacity generated by this section which connects to Roodepan Pump Station

Table 7: Sewer layout for Roodepan settlement

The above design calculations show that the pipes are connected to pumps station in the Roodepan areas. The capacities at the pump station were calculated and the capacity to the outfall sewer was also determined. The detailed connections and calculations are attached in the Annexure B of this report.

The table below show summarized capacities at the pump stations:

Capacity for pump stations				
Pump stations	**Calculated Capacity l/s**	**Rising main capacity l/s**	**Rising main pipe (mm)**	**Details on the connection to the main sewer**
Camelia street pump station	36.5	140	300	The raising mine can handle the generated capacity connecting to Eagle pump station
Legaeng street pump station	12,7	140	300	The raising mine can handle the generated capacity connecting to Eagle pump station
Eagle street Pump station	76,93	140	300	The raising mine can handle the generated capacity. The rising main connects to the 450mm outfall sewer line
Midlands pump station	13,92	77.5	225	The raising mine can handle the generated capacity that connects to the 450mm outfall sewer line
Roodepan Cementery Pump Station	5,8	5.8	160	The raising mine can handle the generated capacity. The pipe connects to the out fall sewer line of 450mm
450mm outfall sewer line	96,65	310	450	The pipe can handle the generated capacity from both settlements.

Table 8: Capacity of the pump stations from both settlements

From the above design calculation the pipe sizes for the new Lethabo Park Extension settlement park were determined. The existing sewer design was can handle the capacity generated by both settlements.

The sizing of the sumps stations is shown in the table below. A depth of 5m was used in the sizing. The sizes of the existing sumps station were not available when compiling this report.

Pump stations	**Capacity (l/s)**	**Pump sizes (L*B*H) m**
Camelia street pump station	36,5	2,7*2,7*5
Legaeng street pump station	12,7	1,6*1,6*5
Eagle street Pump station	76,93	3,9*3,9*5
Midlands pump station	13,92	1,7*1,7*5
Roodepan Cementery Pump Station	5,8	1,1*1,1*5

Table 9: Sump station services

Due to the fact that the existing sump stations sizes were not available a comparison could not be made. It is important to note that from the physical investigation most of the lift station were overflowing although they were still operational.

2.2.4 STORM WATER DEMAND CALCULATIONS

The stormwater management demand calculation for Roodepan were calculated and the pipe sizes were determined for the minor and major systems. The calculations are attached in **Annexure C** of this report.

The following steps were undertaken to determine flows and the pipe sizes.

- A catchment area was determined using Google earth. The catchment area is shown below:

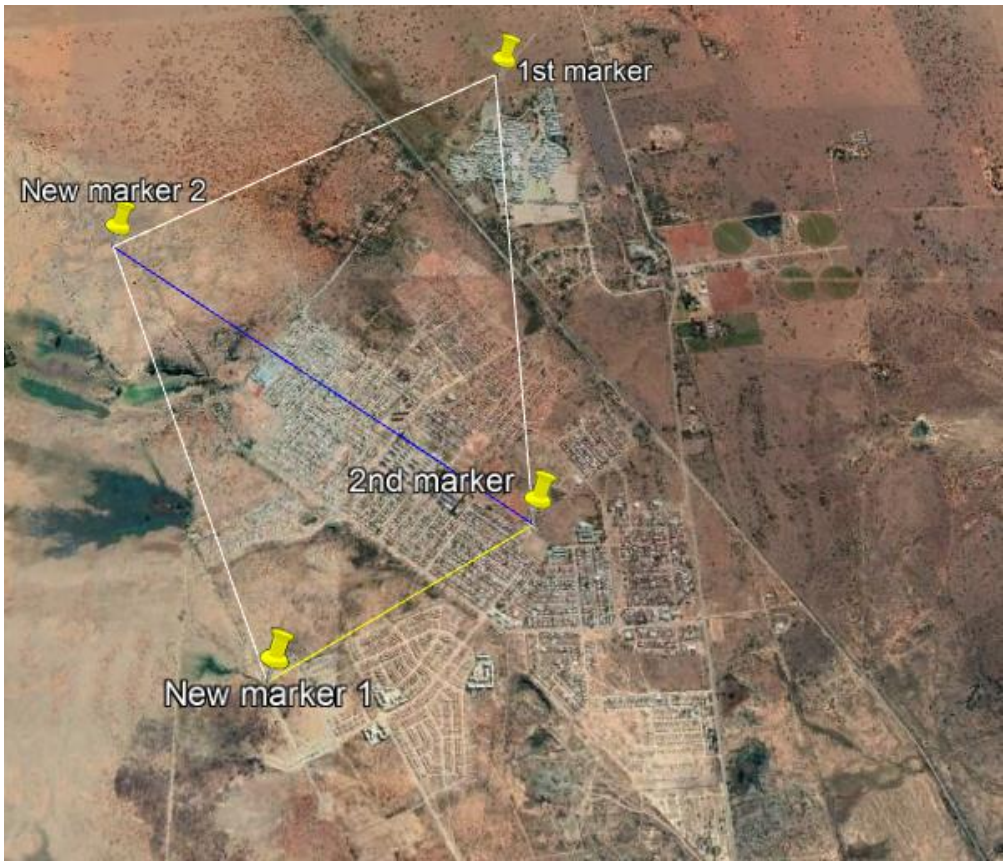

Figure 8: Outline Catchment Area

- The area of the catchment is 5.19 km2 and the longest watercourse was determined to be 2.83 km.
- The mean annual precipitation (MAP) for the area is 414mm based on the Kimberley weather station number 0290468A.
- The slope based on the elevations at 10% and 85% of the watercourse was determined to be 0.01
- 0.87hours was the time of concentration for the catchment area.
- The following table shows the characteristic coefficients as per the area.

Rural (α)	90%
Urban (γ)	10%
Rural (α)	
Flat areas	85%
Hilly	15%
Permeable	50%
Semi-permeable	50%
Grasslands	40%
No Vegetation	60%
Urban (γ)	
Sandy, flat (<2%)	30%
Houses	40%
Streets	30%

Table 10: Characteristic coefficients of the catchment area

- To determine the stormwater flows the Rational methods were used. All three methods; Rational method Alternative 1, Rational method Alternative 2 and Rational method Alternative 3.

- The flow results are shown in the table below for return period of 5 years and 20 years.

	Q (m3/s)	
	Return period (years)	
Method	**5**	**20**
Rational Method Alternative 1	13,31	24,31
Rational Method Alternative 2	14,49	27,46
Rational Method Alternative 3	13,95	19,84
Average Flow Q (m3/s)	**13,92**	**23,87**

Table 11: Average storm water flows

- From the above flow the pipe sizing was then calculated for the minor system of 5 year return period and for major system with a 20 year return system.
- Manning's formula was used to determine the pipe sizes.
- The table below shows pipe sizing for a minor system

Pipe sizing for Minor Systems (5 year return period)	
Q m3/s	14
slope	0,67
n	0,012
Area of pipe m2	0,57
Pipe size (mm)	427

Table 12: Pipe size for minor system

- The table below shows pipe sizing for a major system

Pipe sizing for Major System (20 year return period)	
Q m3/s	23,87
slope	0,67
n	0,012
Area of pipe m2	0,855
Pipe size (mm)	522

Table 13: Pipe sizing for major system

2.2.5 ELECTRICAL DEMAND CALCULATIONS GENERAL ASSUMPTIONS

For the calculations of maximum electrical demand from the 30MVA substation, the following assumptions and references were made:-

- Average daily demand for each house hold NERSA Electricity supply Stats table 8.2a)
- Average daily demand School NERSA electricity supply Stats table 8.2b)
- Average daily demand Clinic NERSA electricity supply Stats table 8.2a)
- This formulae has been used to convert kWh to kVA

- The apparent power S in kilovolt-amps (kVA) is equal to the real power P in kilowatts (kW), divided by the power factor PF:
  S (kVA) = P (kW) / PF
  The PF (power factor we shall assume (0.8-1.15)
  Hence 1kVA=1kw/pf

For a clear indication of capacity availability, all settlements serviced by the 30MVA substation have been calculated. The calculations of the tables are attached in **Annexure D** of this report.

A summary of the results is shown in the table below:

	Settlement	**Demand(MVA)**
1.	Roodepan	12,5974
2.	Jacksonville	4,02
3.	Army Camp	1,42
4.	Vooruitzight- Farms	2,1974
5.	Lerato Park	5,32
6.	Lethabo park	11,17
7.	**Total Demand**	**36,7248**
8.	**Supply Capacity**	30
9.	**Demand Capacity**	36,7248
10.	**Capacity required**	**6,7248**

Table 14: A summary of the electrical demand for all the areas

From the above table a capacity of 6.73 MVA upgrade is required to be able to supply both Lethabo and Roodepan settlement.

3 CONCLUSION AND RECOMMENDATIONS

3.1 WATER

From the water demand calculations done for both settlement, a 12 Megalitre 1 day storage reservoir will be recommended. The Roodepan settlement currently does not have storage which is highly recommended so as to ensure constant supply of water.

After incorporating the water capacity for the two settlements a main pipe size of 400mm will be required. The 350mm existing main pipe will have to be upgraded to a 400mm to handle the water demand capacity.

3.2 SEWER

The design calculations showed that the Roodepan sewer pipes had enough capacity to handle the generated capacity. An outfall sewer pipe of 450mm has a capacity of 310 l/s which can handle the generated capacity of 96.5 l/s by both Roodepan and Lethabo settlements.

In sizing the pump stations the existing sizes were not provided therefore a conclusion could not be reached but from the physical investigations done it was observed that there was overflow either due to lack of maintenance or the sizing of the sump stations. The leakages observed could be due to the aging infrastructure or the pipes were not well connected during construction stages.

3.3 STORMWATER

Stormwater demand calculations depended on the catchment area in Lethabo Park and part of Roodepan settlement showed that a 450mm pipe will be needed for minor systems and a 550mm pipe will be needed for the major systems.

The minor system collects storm water through street kerbs and channels it to the major systems which are channeled through underground storm water pipes.

3.4 ELECTRICITY

The electricity demand calculation indicated a need for upgrade of capacity 6.73 MVA is required to be able to supply both Lethabo and Roodepan settlement.

4 ANNEXURE

4.1 WATER DEMAND CALCULATION

4.1.1 ROODEPAN _LETHABO WATER DEMAND LAYOUT

4.2 SEWER DEMAND CALCULATION

4.2.1 ROODEPAN SEWER SECTIONING

4.2.2 LETHABO SEWER SECTIONING

4.3 STORMWATER DEMAND CALCULATION

4.4 ELECTRICAL ENERGY SUMMARY