CLIENT:

PROJECT:

CIVIL ENGINEERING BULK SERVICES INVESTIGATION AND REPORT:

PROPOSED TOWNSHIP STEINKOPF

NAMA KHOI LOCAL MUNICIPALITY

SERVICES PROVIDERS:

BARZANI HOLDINGS
CIVIL ENGINEERING BULK SERVICES INVESTIGATION AND REPORT:

PROPOSED TOWNSHIP STEINKOPF

(NAMA KHOI LOCAL MUNICIPALITY)

JUNE 2020

Technical Report Prepared by	:	B D Bensley
Date	:	June 2020 (Revised)
On behalf of	:	G3T CONSULT
For	:	BARZANI HOLDINGS
Attention	:	Mr I van der Westhuizen

CIVIL ENGINEERING SERVICES

INVESTIGATION AND REPORT: PROPOSED TOWNSHIP STEINKOPF (NAMA KHOI LOCAL MUNICIPALITY)

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CLIENT: DEVELOPER AND SERVICE PROVIDERS DETAILS

1.1 Developers Details:

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2. BACKGROUND

Steinkopf is a town in Namakwa District Municipality in the Northern Cape province of South Africa. The town is located about 45 km north-north-west of Springbok. Formerly known as Kookfontein, it was established as a mission station of the London Missionary Society but was later taken over by the Rhenish Mission. It is named after Karl Steinkopf (de), foreign secretary on the British and Foreign Bible Society.

Figure 1 Town Location

Steinkopf lies in the northern most portion of the Namaqualand floral region (see Fig 1 above). The town itself is in the Namaqualand Klein Koperberge, but the \eastern pastures are part of Bushmanland and the western ones sandveld. Livestock are also pastured in the area, and the mountains around the town feature three distinct plant biomes, namely Cape fynbos, Kamiesberge, and Richtersveld. Steinkopf serves a large communal stock farming area and many inhabitants work on the outlying mines in Namaqualand.

Steinkopf became part of Cape Colony in 1847, when the colonial border shifted to the Orange River, but it was not until 1913, with the implementation of the Mission Stations and Communal Reserves Act of 1909, that direct state control was established. In the early years of the mission, Steinkopf was wracked by violence between the San hunter-gatherers and pastoral communities. A mass grave of 32 Nama children at Kinderlê just north of town testifies to the bloody struggles that almost wiped out the San from the area. When the railway was built to carry copper from the mines near Okiep, it passed through Steinkopf on the way to Port Nolloth, growing the mission town considerably.

Steinkopf was also invaded by the Boer forces during the Second Boer War, under the leadership of Gen. Jan Smuts, and many fled to the refugee camp in Port Nolloth. Several local citizens served the British as part of the Town Guards and Border Scouts. Around 10 km north of town on the road to Port Nolloth, near Klipfontein, there remain graves of soldiers killed in the war and ruins of the railway station and hotel that served passengers on the copper line. Annenous Station and Nonahams Station were built in the 1860's. Annenous Station was the historic steam train station for the transport of copper and Nonahams Station the watering point where the original fountain and dam still exist.

Steinkopf was once a major educational centre and featured what was for decades the only high school in Namaqualand for those the National Party government deemed Cape Coloureds. The school drew students from far and wide. Today, organizations such as the E.J. Appies House old age home and the Immanuel Centre for the Disabled here serve people from around Namaqualand.

3. SITE DESCRIPTION

3.1 LOCATION

The proposed development site, Steinkopf Extension, Nama Khoi Local Municipality, approximately 112 hectares in size, is situated to the Southern side of Steinkopf and approximately 45 Km North Northwest of Springbok.

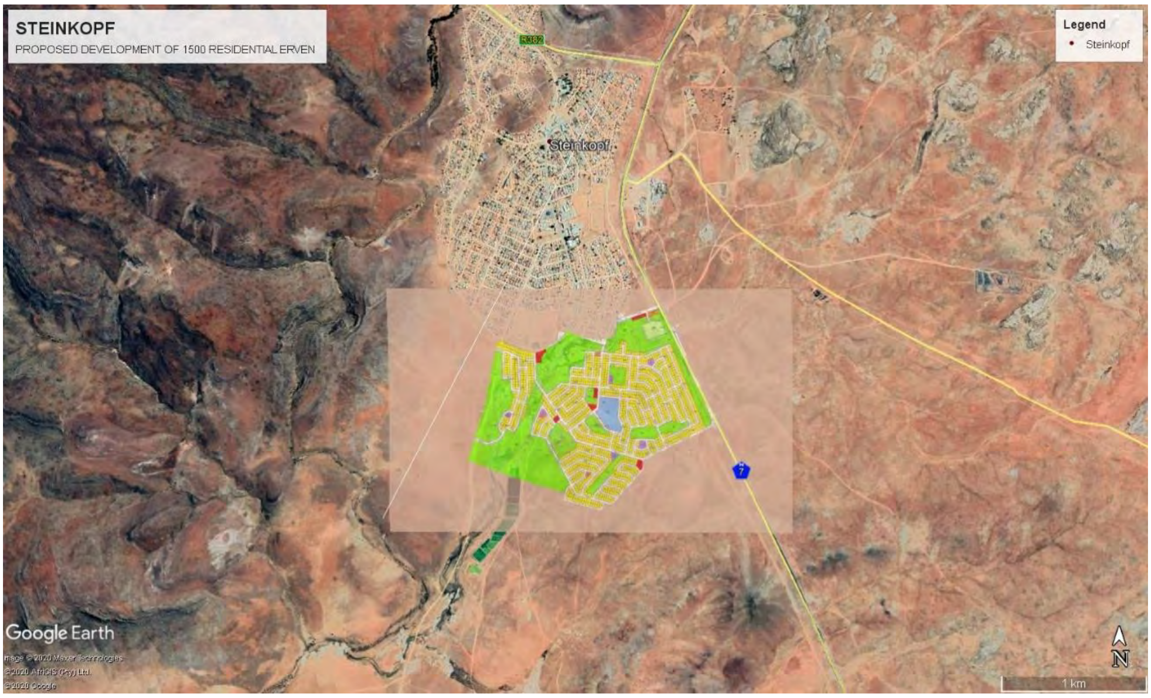

Figure 2: Proposed Development of 1500 Residential Erven

The site is accessible from the N7 national road, leading towards Vioolsdrif. (See Figure 2 above).

3.2 TOPHOGRAPHY

The site is located to the southern side of the existing Steinkopf town.

Figure 3: Site Elevation

The proposed site has a gradual slope from the west towards the east of approximately 21m over a distance of 1.3kms, 800 to 818 Metres Above Sea Level. The site indicates an average slope of 1.3% to 2.7% across the entire site. These elevation differences may be seen as the area consists of mountains and deep sandy valleys between the mountains. Figure 3 above depicts the gradient of the proposed site.

3.3 CLIMATE

3.3.1 Rainfall

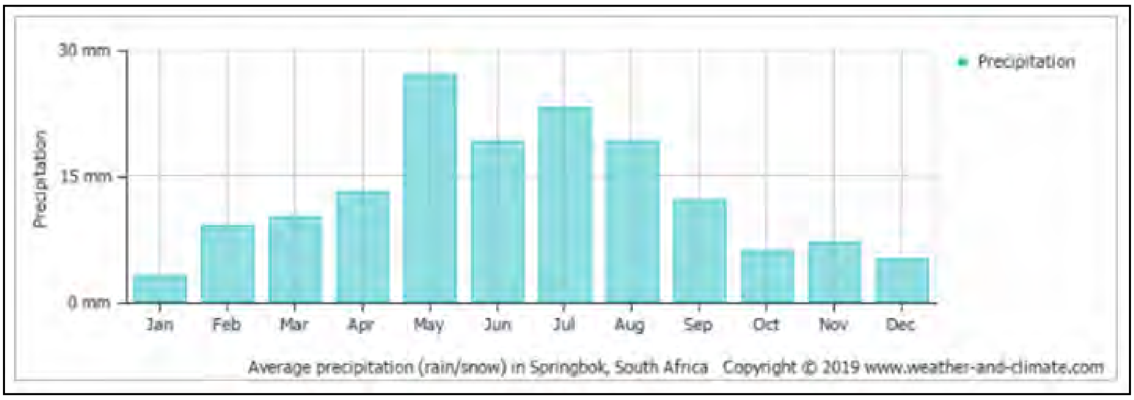

Figure 4: Precipitation

Steinkopf normally receives about 77mm of rain per year and because it receives most of its rainfall during winter it has a Mediterranean climate. It receives the lowest rainfall (3 mm) in January and the highest (23 mm) in June. Statistics recorded and sourced at the closest weather station

Springbok, to the site. The driest month is January, with 3 mm of rainfall. Most precipitation falls in June, with an average of 23 mm.

3.3.2 Temperature

The monthly distribution of average daily maximum temperatures, that the average midday temperatures for Steinkopf range from 17°C in July to 29.7°C in February. The region is the coldest during July when the mercury drops to 3.7°C on average during the night.

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	21.9	21.9	20.6	17.5	13.9	11.6	10.3	12	13.7	16.5	18.8	20.7
Min. Temperature (°C)	14.5	14.7	13.7	10.8	7.4	5.5	4.1	5.4	6.7	9.4	11.4	13.4
Max. Temperature (°C)	29.3	29.1	27.6	24.3	20.5	17.7	16.5	18.6	20.8	23.7	26.2	28.1
Avg. Temperature (°F)	71.4	71.4	69.1	63.5	57.0	52.9	50.5	53.6	56.7	61.7	65.8	69.3
Min. Temperature (°F)	58.1	58.5	56.7	51.4	45.3	41.9	39.4	41.7	44.1	48.9	52.5	56.1
Max. Temperature (°F)	84.7	84.4	81.7	75.7	68.9	63.9	61.7	65.5	69.4	74.7	79.2	82.6
Precipitation / Rainfall (mm)	3	5	9	15	19	23	21	19	7	8	4	7

Figure 5: Temperatures

3.4 VEGETATION

Steinkopf is a semi-arid, communal rangeland that is situated in the Northern Cape province of South Africa. Within Steinkopf livestock farming is the primary land use. In previous studies it was indicated that a relatively large number of poisonous plant species are found within these semi-arid rangelands and that the consumption of these poisonous plants by the livestock may be a contributing factor to the low livestock productivity within the area.

The site itself is covered by patches of grasslands of which some is used as agriculture land, and some Pachypodium namaquanum plants are present on site. Generally, the low vegetation is dominated by the flat cushions of rownanthus pseudoschlichtianus. Towards the west, a strong admixture of grasses, or mosaic elements of grassland, accompany the (flat) transition to SKs 6 Oograbies Plains Sandy Grassland.

3.5 GEOLOGY

The Namaquaorogenic belt in north-western South Africa (and Southern Namibia) is comprised of several terraces which are themselves divided into three sub-provinces:

- Gordonia,
- Richtersveld, and;
- Bushmanland sub-provinces.

The Bushmanland sub-province is includes the O'okiep and Garies terraces. The O'okiep District or terraine is underlain by granite gneiss and granite with remnants of metamorphosed supracrustal rocks, which are approximately late Mezoproterozoic in age (1210-1035 million years old). The assemblage was later intruded by the copper bearing Kokerberg Suite.

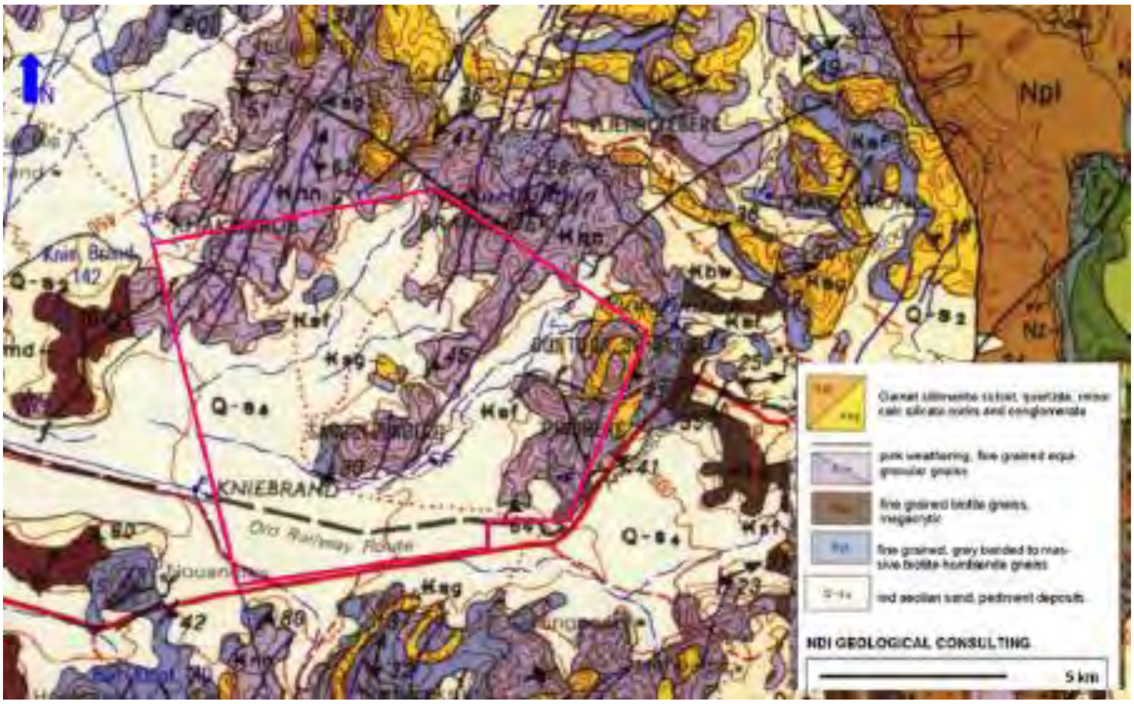

Figure 6: Geological Map

Recent work, specifically in Namibia, has incorporated the Kakamas and Areachap Terranes into the Gordonia Sub-province (e.g. Eglington, 2006; Moen and Toogood, 2007; Miller, 2008). The Gordonia Sub-province is separated from the Kaaien Terrane by the Brakbos Shear (Coward and Potgieter, 1983; Stowe, 1983, 1986; Thomas et al., 1994a). The Boven Rugzeer Shear is proposed to separate the Kakamas from the Areachap Terrane (Harris, 1992). The Kakamas Terrane is generally considered to be composed of high-grade supracrustal gneisses, charnokites and granites with the late stage NNW- trending Neusberg Shear-zone separating an arenite and calc-arenitesupracrustal succession in the east from high-grade metapelite and biotite-garnet paragneisses in the west (e.g. Van Bever Donker, 1980; Moen, 1988; Botha et al., 1976, Thomas et al., 1994a). The Areachap Terrane represents a narrow, NNW-trending terrane comprised of 1300 Ma amphibolite-grade metabasic and intermediate supracrustal gneisses (Geringer et al., 1986, 1994, Cornell et al., 1990). The Areachap Terrane contains juvenile Mesoproterozoic crust, showing clear subduction-related signatures (Geringer et al., 1986, 1994; Cornell et al., 1992; Jacobs et al., 2008) that are interpreted to indicate a series of volcanic arcs (Geringer and Ludick, 1990).

The geology of the farm is underlain by Q-S4 (red Aeolian sand, pediment deposits), Kbw (as well as fine grained biotite gneiss, megacrytic in places), Knn (pink weathering, fine grained equigranular gneiss), Ksg (Garnet sillimanite schist, quartzite, minor calc silicate rocks and conglomerate) and Ksf (fine grained, grey banded to massive biotite-hornblende gneiss) these are amongst the rock types that constitute aggregate.

Awaiting Geotechnical report from client.

3.5.1 Drainage

The site drains from the east and the north easterly direction towards the south west with one unnamed non-perennial rivers starting at the mountain tops. It is joined by a secondary non-perennial river running from the East across the proposed site towards the south west. These rivers join, towards the south west, outside the boundaries of the site. These rivers do not contribute to any bigger river as they all seem to disappear in the sand valleys. Groundwater flow direction is expected to be in a south western direction. Groundwater gradient usually mimic the topography, and, in this case, the topographic elevation lowers towards the south west as indicated on the elevation map and also by the river course which start from the mountainous areas flowing towards the south west of the site.

3.6 DEMOGRAPHIC OVERVIEW

Table 3-1: Overview of key demographic indicators for NKM – Nama Khoi Municipality

ASPECT	TM	
	2001	2011
Unemployment rate (official)- % of economically active population	33.1	22.9
Youth unemployment rate (official)- % of economically active population 15-34	43.4	30.1
No schooling - % of population 20+	4.7	2.2
Higher Education - % of population 20+	6.6	7.9
Matric - % of population 20+	16.6	20

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

As indicated in Table 3-1, the population of the Nama Khoi Local Municipality (NKM) increased from 44 900 in 2001 to 47 041 in 2011 which represents an increase of ~ 0.48%. The town of Springbok is the administrative centre for the NKM. Springbok is the most densely populated area (12 790 in 2011), is close to the N7, and functions as the sub-regional centre for administrative, commercial and higher-order social facilities.

The sizes of the NKM household size have decreased from 3.6 to 3.4 in 2011 census. The statistics indicate that the household sizes have decreased however there is a stabilisation in the working 15-64 age group, staying at the same percentage and a decrease in the young 0 -14 age group. A slight increase is also shown in the elderly 65+ age group.

The majority of the population in the NKM in 2011 was Coloureds (88.1%), followed by White (6.6%), Black African (4.2%), Indian/Asian (0.5%) and Other (0.8%) (Census 2011). The dominant language spoken is Afrikaans (93.2%), followed by English and IsiXhosa (1%), Setswana and Sesotho (0.6%) and Sign Language (0.3%).

The dependency ratio in NKM decreased from 52.5 to 49.4. The decrease represents a positive socio-economic improvement, indicating that there are a decreasing number of people dependent the economically active 15-64 age group. The age dependency ratio is the ratio of dependents, people younger than 15 or older than 64, to the working, age population, those ages 15-64. Even though the dependency ratio has decreased there was a slight increase in the elderly age group 65 + (8.2%) that may indicate that more people are reliable on government grant payments.

In terms of percentage of formal dwellings, the number of formal dwellings in NKM increased from 88.4% in 2001 to 94.7% in 2011. This represents a positive socio- economic movement for the NKM especially taking into account the agricultural activity improvements. The figure still reflects the challenges faced by the NKM associated with the influx of workers and job seekers to the area. This figure also indicates that there is likely to be a housing backlog in NKM.

3.6.1 Employment

The official unemployment rate in NKM decreased for the ten-year period between 2001 and 2011. In NKM the rate declined from 33.1% to 22.9%, a decrease of 10.2%. Youth unemployment in the NKM also declined over the same period. Youth unemployment in the NKM area decreased from 43.4% to 30.1%.

These statistics may indicate the successful job opportunities created /available in the surrounding area and new and upcoming agricultural activities. There are 16 016 economically active (employed or unemployed but looking for work) population in the municipality, 22,9% are unemployed. Of the 7 216 economically active youth (15 – 34 years) in the municipality, 30, 1% are unemployed in the NKM area.

3.6.2 Household income

Based on the data from the 2011 Census, 9.5 % of the population of the NKM have no formal income, 2.5% earn between 1 and R 4 800, 5% earn between R 4 801 and R 9 600 per annum, 17.4% between R 9 601 and 19 600 per annum, 20.8% between R 19 601 and R 38 200 per annum, 18.3% between R 38 201 and R 76 400 per annum, 13.2% between R 76 401 and R 153 800 per annum, 8.2% between R 153 801 and R 307 600 per annum and 3.9% between R 307 601 and R 614 400 per annum. (Census 2011).

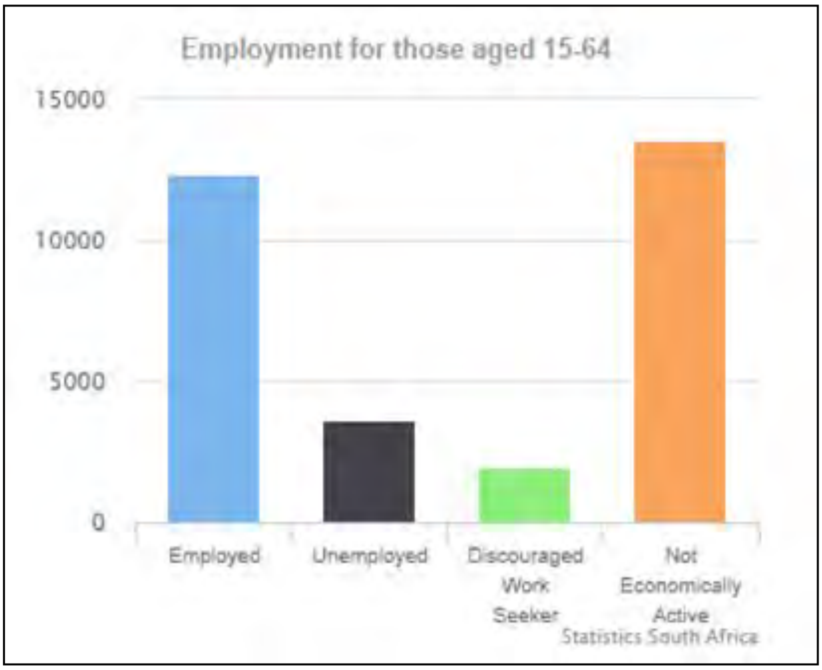

Figure 7: Employment Figures

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

These figures are likely to be linked to the influx of job seekers to the area and the inability of all of them to secure work. This is also likely to result in an increasing number of individuals and households who are likely to be dependent on social grants.

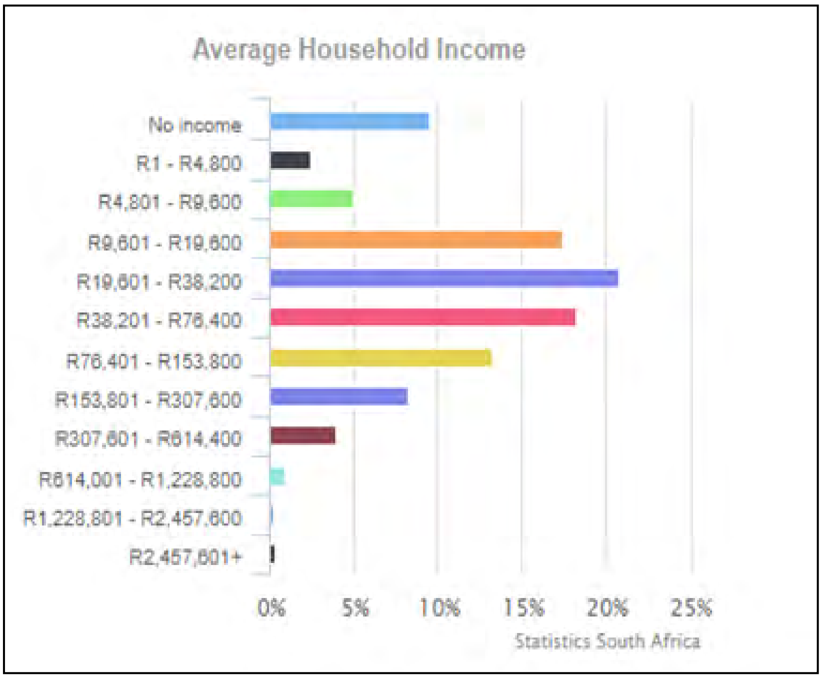

Figure 8: Average Household Income

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

The low-income levels also result in reduced spending in the local economy and less tax and rates revenue for the district and local municipality.

3.6.3 Education

The education levels at Nama Khoi local municipal level also improved, with the percentage of the population over 20 years of age, with no schooling in NKM the decrease was from 4.7% to 2.2%. The percentage of the population over the age of 20 with matric also increased in NKM, from 16.6% to 20%. However, despite this increase the figure for NKM are still below the national (28.4%) levels in 2011. The figure for the NKM is also below the provincial level (22.7%).

3.6.4 Municipal services

As indicated in Table 2, the municipal service levels in NKM most have improved over the period 2001 to 2011, but the sewer services show a slight decrease over the same period.

This still represents a socio-economic improvement. The service levels in the NKM are significantly higher than both the national and provincial averages. The national averages for each of the relevant indicators are 57% (access to flush toilet), 62% (weekly waste removal), 46.3% (piped water inside dwelling) and 84.7% for electricity. This indicates a good and stable growth in the NKM service provider sector.

Table 3-2: Overview of access to basic services in the TM

Municipal Services	JM	
	2001	2011
% households with access to flush toilet	64.7	63.5
% households with weekly municipal refuse removal	86.4	89.4
% households with piped water inside dwelling	61.2	74.9
% households which uses electricity for lighting	85.8	93.7

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

There are 13 193 households in the municipality, with an average household size of 3,4 persons per household. 74,9% of households have access to piped water inside dwelling/institution, 21,0% of households have access to piped water inside yard.

3.6.5 Population Figures

The name Nama Khoi means people first. The Nama Khoi Local Municipality is situated on the north-western side of the Northern Cape Province in the Namakwa District. It is one of the six municipalities that make up the district. Nama and Khoisan people occupied this area for hundreds of years. The town of Springbok is the administrative centre. Mining used to form the backbone of the economy, with tourism being seen as the new frontier for economic development with a municipal area of 17 990km^2.

Table 3-3: Beneficiaries 2011		
Suburb Benefiting	Total Benefiting Population	Total No. Of Households Benefiting
Bullettrap	415	119
Carolusberg	1 336	405
Concordia	4 988	1 425
Goodhouse	171	71
Kleinzee	728	383
Komaggas	3 116	842
Kotzehoop	467	180
Nababeep	5 374	1 414
Nama Khoi NU	2 909	1 212
Okiep	6 304	1 751
Springbok	12 790	3 553
Steinkopf	7 842	2 064
Vioolsdrift	599	250
Total	47 039	13 669

Source: Compiled from StatsSA Census 2011 Municipal Fact Sheet

The municipality incorporates the towns of Bulletrap, Carolusberg, Concordia, Kleinzee, Komaggas, Nababeep, O'Kiep, Springbok, Steinkopf and strives to deliver basic services to its community by ensuring that there is water, sanitation and electricity. The population figures for the Nama Khoi Local Municipality are depicted in Table 3-3

Table 3-4: Anticipated Population by 2020		
Suburb Benefiting	Total Benefiting Population	Total No. Of Households Benefiting
Bullettrap	433	124
Carolusberg	1 394	422
Concordia	5 203	1 487
Goodhouse	187	78
Kleinzee	759	399
Komaggas	3 250	878

Kotzehoop	487	187
Nababeep	5 606	1 475
Nama Khoi NU	3 034	1 264
Okiep	6 576	1 827
Springbok	13 341	3 706
Steinkopf	8 180	2 153
Vioolsdrift	625	260
Total	49 075	14 260

Nama Khoi Local Municipality has increased from 44 900 people in 2001 to 47 041 people in 2011 (Census 2011) at an average growth rate of 0.48% per annum. Based on these figures the anticipated population in 2020 is displayed in Table 3-4

4. TERMS OF REFERENCE

G3T Consult CC was appointed by Maxim Planning Solutions on the 18 February 2020 for the compilation of Technical Service report for the Bulk Civil and Electrical Services for the development of 1500 low cost/ subsidized residential erven towards the Southern side of Steinkopf with in the Nama Khoi Local Municipality. The proposed development will consist of the following:

- Residential Zone I — 1500 Erven
- Business — 6 Erven
- Church — 6 Erven
- Creche — 3 Erven
- School — 1 Erf
- Sports Field — 1 Erf
- Municipal — 1 Erf
- Park — 11 Erven
- Transport Zone II (Public Streets) — 23.7573ha

5. INFORMATION

5.1 Information Obtained:

5.1.1 Existing Population Figures

As indicated previously in this report, the existing population figures for the town of Steinkopf where obtained from extrapolated figures based on the outcomes of senses 2011. These extrapolated figures may be summarised as follows:

- No. of Households: 2153
- Population per Household: 3.8
- Total Population: 8180

However, it must also be noted that at present, there are an additional 500 registered erven under development, located to the south-west of the township. These erven will thus also be included with in the existing population figures at an anticipated population per erf of 3.8 people. From this the existing population figures will be as follows:

- No. of Households: 2653
- Population per Household: 3.8
- Total Population: 10081

5.1.2 Town planning Zoning

Draft layout plan received from Maxim Planning Solutions on Tuesday 9th June 2020 (Accredited Town and Regional Planners) *(Annexure A)*

5.1.3 Flood line information

The 1:100 flood depicted on the layouts received from Maxim Planning Solutions.

5.1.4 Sewer: Existing municipal infrastructure

Information regarding the existing municipal infrastructure was obtained from the local authorities. Information obtained included the following:

- Horizontal alignments and pipe diameters of the existing municipal sewer network.
- Sizes of existing municipal oxidation ponds (WTW).
- No vertical alignments of the existing municipal sewer network could be obtained.

5.1.5 Water: Existing municipal infrastructure

Information regarding the existing municipal infrastructure was obtained from the local authorities and Department of Water and Sanitation (DWS). Information obtained included the following:

- Horizontal alignments and pipe diameters of the existing municipal water network.
- Size of existing Trunk Main to reservoir.
- Size of existing municipal reservoir.
- Size of existing bulk water connection from the Sedibeng Bulk Water Main. It must be noted that despite inquiries to Sedibeng Water, no further details regarding this connection (i.e. licenced capacities; available pressures; e.c.t.) are forthcoming.

5.1.6 Geological investigation

No information received regarding a Geotechnical Investigation.

5.1.7 Cadastral and Topographic survey

No Information received regarding the Topographical survey

6. TECHNICAL DESIGN PARAMETERS AND STANDARDS

The design criteria and specifications as contained in this report are based on the following:

- Guidelines for the Provision of Engineering Services and Amenities in Residential Township Development, 1994 as amended (a.k.a. the "Blue Book").
- Guidelines for Human Settlement Planning and Designs as published by the CSIR and will also refer to the local municipality's guidelines and standards (a.k.a. the "Red Book").
- Water Institute of South Africa; Manual on the Design of Small Sewage Works; First Edition 1988

Furthermore, the design criteria will be in line with design criteria for developing areas, as defined in the "red Book" as follows:

"Developing areas are considered to be those areas where the level of service to be installed may be subject to future upgrade to a higher level."

In addition, it is recommended that the design population per erf for low income group developments be reduced from the specified 7 people/ erf to 5,5 people/ erf, due to the current average size of a household being 3,8 people. A figure of 5,5 represents an average between the existing approximate 4 people per erf and the design standard of 7 people per erf. This figure will provide a relative safety factor for evaluation of the existing infrastructure in the event of slightly higher population densities, while preventing over estimation of the proposed population. The existing capacity of bulk municipal infrastructure will be evaluated in accordance to the population figures as extrapolated from figures obtained from the 2011 senses, as represented in *table 4: Anticipated Population by 2020*, in conjunction with design standards as mentioned above.

Proposed amendments and additions to bulk infrastructure will be designed to accommodate all requirements for developments of this nature, as well as existing developments where applicable. The services will be according to accepted engineering specifications and principles as well as acceptable environmental requirements and standards

7. SEWER

7.1 Proposed Design Criteria: Sewer Infrastructure

Table 7-1: Sewer Gravitational Network: Developing Areas: Proposed Design Criteria		
Parameter	Element	Guideline
1. Design Capita per Dwelling Unit	Residential Zone I: Low Income: Proposed Erven (Assumed)	5.5 people
	Residential Zone I: Low Income: Existing Erven (Census 2011)	3.8 people
2. Design Effluent Generation	Residential Zone I: Low Income	65 ℓ/capita/day
3. Sewer gradients	Maximum (all diameters)	1:60
	Minimum 110mm Ø	1:120
	Minimum 160mm Ø	1:200
4. Flow Velocity	Minimum (all diameters; self-cleansing)	0.7 m/s
	Maximum (all diameters)	1.2 m/s
5. Dry weather Peak Factor (PF)	Design Peak	1.8
6. Wet weather Peak	Design Peak	15% additional to Dry Weather Peak Flow
7. Pipe Location	All Areas	Road reserve – 1.5 m from roads edge
8. Pipe Materials	All pipe diameters	uPVC Class 34
9. Pipe Size	Minimum diameter	160mm Ø
10. Cover to Pipes	Minimum: Road reserves	1,000 mm
	Other Areas	800 mm

7.2 Existing Municipal Infrastructure

A desk top study was done to confirm the status quo of the bulk and gravitational sewer system for Steinkopf, and may be summarized as follows:

- Waterborne sewer gravitational network of varying pipe diameters, draining effluent from all parts of the existing township to a 300mm Ø asbestos cement (AC) outfall main that conveys effluent to the wastewater treatment works.

- Anaerobic-Aerobic pond Wastewater Treatment Works (WTW) system.

The 300mm Ø bulk main originates from a position approximately 200 m north of the site of the proposed develop, on the grounds of the community sports and recreational facility. The bulk main drains effluent southward across the western portion of the site toward the WTW. The 300mm Ø bulk main is installed at a level below natural ground level for the majority of its length, however the last 340m toward the WTW is situated at a level above the natural ground supported by concrete pedestals. Of this portion of the pipeline, approximately 240m is situated on the site of the proposed development.

The waste water treatment works is situated approximately 150m south west of the proposed development, and consists of 2 anaerobic ponds (primary and secondary) with a water surface area of 1596 m^2 each, as well as 11 primary and secondary aerobic ponds with a total water surface area of 45200 m^2.

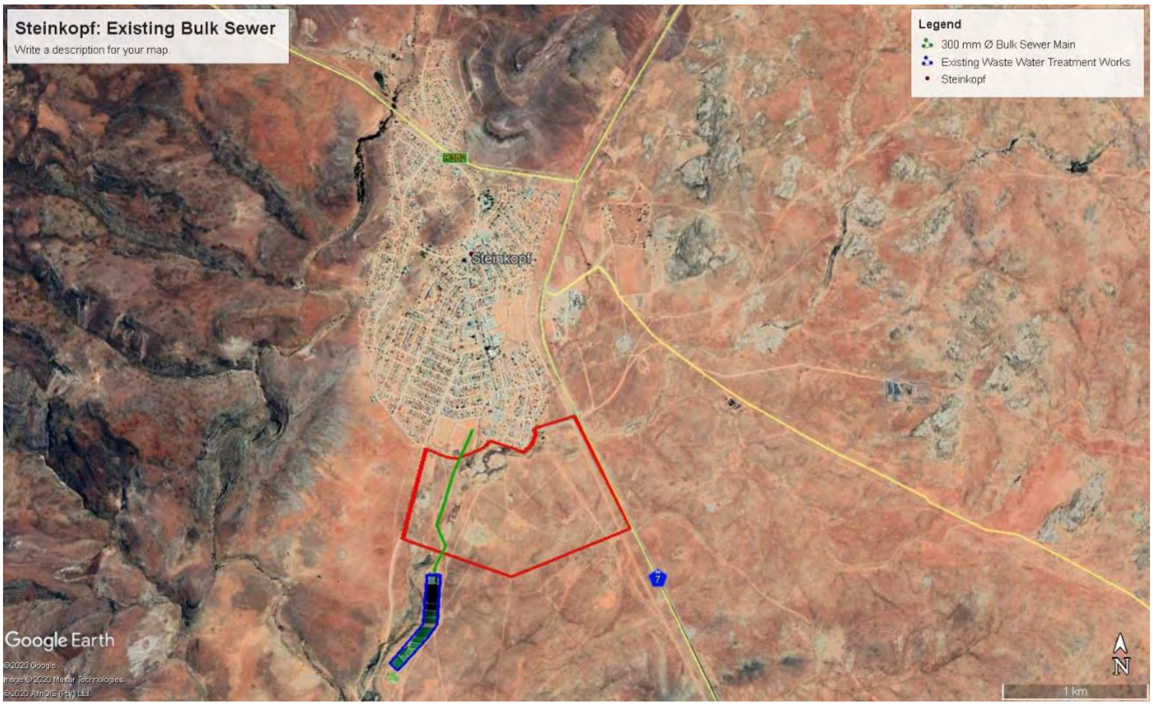

Figure 9: Existing Bulk Sewer Infrastructure

In order to perform a comprehensive evaluation of the bulk infrastructures suitability to serve the current demand as well as the proposed future demand, a logical process must be followed, and may be summarized as:

- Determination of existing demand.
- Determination of proposed additional demand.
- Determination of existing maximum capacity of bulk infrastructure.
- Determination of reserve capacity of bulk infrastructure with relation to current demand.
- Evaluation of bulk services reserve capacity with relation to the proposed additional demand.

7.3 Existing Total Effluent Generation

The existing peak flow will be based on figures and peak factors as obtained from *Guidelines for Human Settlement Planning and Designs* as set out in Table 7-1, in conjunction with the estimated population for the year 2020.

7.3.1 Average Dry Weather Flow (ADWF):

The total Average Dry Weather Flow (ADWF) for the estimated existing population for 2020' as depicted in the table below, amounts to 541.920m³/day (6.27ℓ/s).

Table 7-2: Average Dry Weather Flow: Existing Population

Description	Capacity	Unit factor (no of people)	m³/day
Residential Zone I: Low Income	65.0 ℓ/capita/day	10081	655.265
TOTAL			655.265

7.3.2 Peak Dry Weather Flow (PDWF):

The estimated existing population served is 8180 people. With reference to Figure 10 below the Dry Weather Peak Factor (DWPF) will be approximately 1,8.

From the above, the total Peak Dry Weather Flow for the existing population served will be as follows:

- (ADWF from table 4.2.1) x (DWPF) = (PDWF).
- 655.265m³/day x 1.8 = 1179.477m³/day (13.65ℓ/s).

7.3.3 Peak Wet Weather Flow (PWWF):

Taking into account storm water infiltration rate of 15%, thus the Peak Wet Weather Flow (PWWF) amounts to the following:

- (PDWF) x 1.15 = (PWWF)
- 1179.477m³/day x 1.15 = 1356.400m³/day (15.70**ℓ/s**).

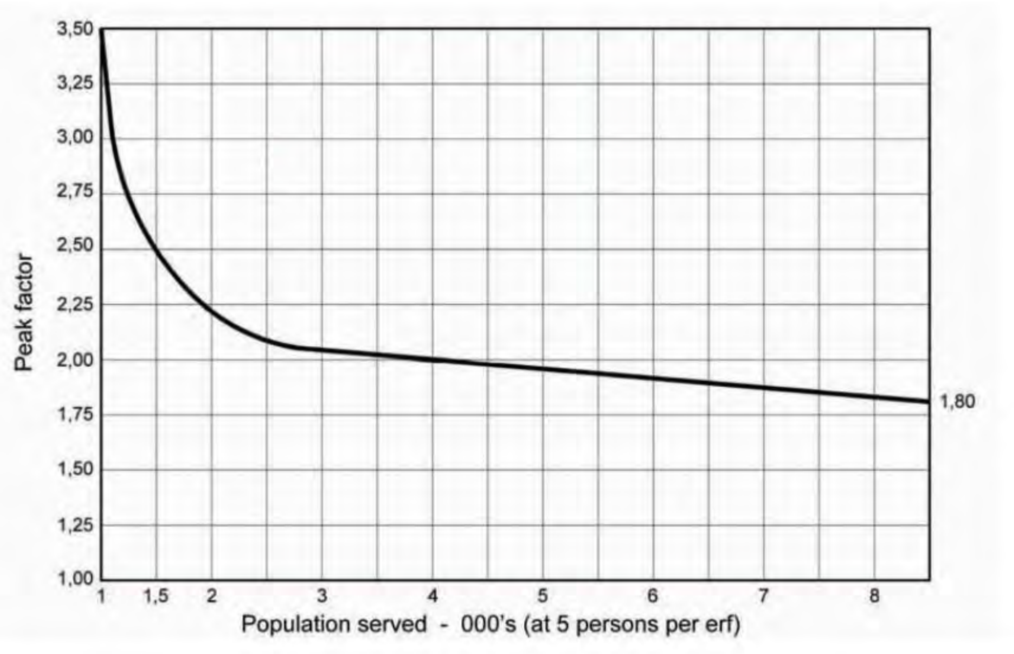

Figure 10: Peak Factors

7.4 Proposed Additional Effluent Generation

The proposed peak flow will be based on figures and peak factors as obtained from *Guidelines for Human Settlement Planning and Designs* as set out in Table 5, in conjunction with the estimated population for proposed development as set out below:

- (No. of proposed erven) x (capita/ erf) = (Estimated Population)
- 1500 erven x 5.5 people/erf = 8250 people

7.4.1 Average Dry Weather Flow (ADWF):

The total Average Dry Weather Flow (ADWF) for the estimated additional population as depicted in the Table 7 amounts to 536.250m³/day (6.21ℓ/s).

Table 7-3: Average Dry Weather Flow: Proposed Population			
Description	Capacity	Unit factor (no of people)	m³/day
Residential Zone I: Low Income	65.0 ℓ/capita/day	8250	536.250
TOTAL			536.250

7.4.2 Peak Dry Weather Flow (PDWF):

The estimated additional population served is 8250 people. With reference to Figure 10, the Dry Weather Peak Factor (DWPF) will be approximately 1,8.

From the above, the total Peak Dry Weather Flow for the proposed additional population will be as follows:

- (ADWF from table 4.3.1) x (DWPF) = (PDWF).
- 536.250m^3/day x 1.8 = 965.250m^3/day (11.17ℓ/s).

7.4.3 Peak Wet Weather Flow (PWWF):

Taking into account storm water infiltration rate of 15%, thus the Peak Wet Weather Flow (PWWF) amounts to the following:

- (PDWF) x 1.15 = (PWWF)
- 965.250m^3/day x 1.15 = 1110.038m^3/day (12.85ℓ/s).

7.5 Maximum Capacity of the Existing Bulk Sewer Infrastructure:

7.5.1 300 mm Ø Bulk Main:

In order to determine the full flow (maximum) capacity of the existing 300 mm Ø bulk main, one must consider the formula:

- Q = V x A
- Where:
- Q = Flow in m^3/s
- V = Velocity of flow in m/s
- A = Area of flow in m^2

However, to maintain a non-pressurised gravitational system, a free water surface must be maintained within the bulk main. To this end, full flow (Q) is considered to be 80% of the absolute maximum capacity of the bulk main, thus flow area is considered to be 80% of total pipe cross sectional area.

Considering the above, assuming a minimum self-cleansing velocity (V) = 0.7m/s at full flow, the following:

- Q = V x (A x 0.8)
- Q = (0.7 m/s) x [((Π/4) x 0.3^2) x 0.8] m^2
- Q = 0.040m^3/s

Thus, the total estimated maximum capacity of the bulk main is $0.40m^3/s$ (40.0 ℓ/s). When applied over a 24-hour period, the total volume of effluent at PWWF = $3456m^3/day$.

From the above, if dry weather and wet weather peak factors are applied in reverse, the maximum ADWF may be derived as follows:

- (PWWF) / (1.8 x 1.15) = ADWF
- ($3456.0m^3/day$)/(1.8 x 1.15) = $1669.57m^3/day$ (19.32 ℓ/s)

Therefore, assuming a demand of 65 ℓ/capita/day, the total capacity of the bulk main may be expressed as a total maximum population as follows:

- (ADWF)/(65 ℓ/capita/day) = Total Maximum Population
- ($1669.57m^3/day$/(65 ℓ/capita/day) = 25686 people

7.5.2 Wastewater Treatment Works

In order to determine the maximum capacity of the WTW, it must be considered in two parts, namely in relation to the two major components:

- The Anaerobic ponds.

  and

- The Aerobic ponds.

These two components will be evaluated separately, with a final judgement as to the total maximum capacity for the WTW as a hole to be set at the lowest resultant capacity.

7.5.3 Anaerobic Ponds:

As stated before, the WTW are equipped with 2 anaerobic ponds of 1596 m^2 of water surface area each. These ponds function on a duty cycle bases, thus one pond is responsible for the complete total inflow at any given time.

From the above, the total maximum capacity of the anaerobic ponds will be the maximum capacity of a single pond.

There are a number of minimum standards that govern the design capacities of an anaerobic pond, such as loading rates; retention times; and depth of ponds. These standards are as follows:

- Loading Rates:
  - 8 persons/m^3/day
  - or, 0.4 kg BOD/m^3/day
  - or, 0.85 kg COD/m^3/day
  - The lesser will apply.

- Retention Time:
  - No Less than 12 hours of PDWF
- Depth:
  - Minimum = 3m
  - Maximum = 4m

Furthermore, the applicable typical characteristics of domestic sewage are defined as follows:

- Biological Oxygen Demand (BOD) = 350 to 400mg/ℓ
- Chemical Oxygen Demand (COD) = 700 to 850mg/ℓ

Taking the aforementioned criteria into consideration, the maximum capacity of the anaerobic ponds may be determined using the following assumptions:

- Depth of pond = 3 m
- Retention time = 12 hours
- BOD of sewerage = 400mg/ℓ
- COD of sewerage= 850mg/ℓ

For the following:

- Capacity in accordance to loading rates:
  - Persons/day = (3366 m^3) x (8 ppl/ m^3 / day) = 26928 people
- Biological Oxygen Demand (BOD):
  - Total BOD = (3366m^3) x (0.4kg/m^3/day) = 1346.4kg/day
- Thus, assuming sewage strength of 400mg/ℓ
  - Total PDWF = (Total BOD in mg)/400mg/ℓ
  - Total PDWF = (1'346’400’000 mg)/400mg/ℓ
  - Total PDWF = 3’366’000 ℓ/day
- Assuming DWPF of 1.8
  - Total ADWF = (PDWF)/18
  - Total ADWF = (3’366’000ℓ/day)/18
  - Total ADWF = 1’870’000ℓ/day
  - Assuming 65ℓ/capita/day

  - Total persons = (ADWT)/(65ℓ/capita/day)
  - Total persons = (1’870’000 ℓ/day)/(65ℓ/capita/day)
  - Total persons = 28769 people

- COD of sewerage= 850mg/ℓ

  - Total COD = (3366m³) x (0.85 kg/m³/day) = 2861.1kg/day
  - Thus, assuming sewage strength of 850mg/ℓ
    - Total PDWF = (Total COD in mg)/850mg/ℓ
    - Total PDWF = (2861’100’000 mg)/850mg/ℓ
    - Total PDWF = 3’366’000 ℓ / day
  - Assuming DWPF of 1.8
    - Total ADWF = (PDWF)/18
    - Total ADWF = (3’366’000ℓ/day)/18
    - Total ADWF = 1’870’000ℓ/day
  - Assuming 65ℓ/capita/day
    - Total persons = (ADWT)/(65ℓ/capita/day)
    - Total persons = (1’870’000ℓ/day)/(65ℓ/capita/day)
    - Total persons = 28769 people

- Therefore, total maximum capacity in accordance to lauding rates = 26928 people

- Capacity in accordance to retention time:

  - Total PDWF = (3336 m³)/(12hours x 60 x60)
  - Total PDWF = 0.077m³/s = 6’652’800ℓ/day
  - Assuming DWPF of 1.8
    - Total ADWF = (PDWF)/18
    - Total ADWF = (6’652’800ℓ/day)/1.8
    - Total ADWF = 3’696’000ℓ/day
  - Assuming 65ℓ/capita/day
    - Total persons = (ADWT)/(65ℓ/capita/day)
    - Total persons = (3’696’000ℓ/day)/(65ℓ/capita/day)
    - Total persons = 56861 people

- Therefore, total maximum capacity in accordance to retention time = 56861 people

From the above calculations, the maximum capacity will be the least value derived, thus the maximum capacity of the anaerobic ponds will be approximately 26928 people.

7.5.4 Aerobic Ponds:

As stated before, the WTW are equipped with 11 aerobic ponds of total water surface area of 45200m^2. These ponds function in series and are responsible for the total retention period of 40 days required for the biological processes to occur.

From the above, the total maximum capacity of the aerobic ponds will be the total maximum capacity of all ponds.

There are a number of minimum standards that govern the design capacities of aerobic ponds, such as loading rates; retention times; and depth of ponds. These standards are as follows:

- Loading Rates:
  - or, 135 kg BOD/ha/day
- Retention Time:
  - No Less than 40 days of ADWF
- Depth:
  - Minimum = 1.2 m
  - Maximum = 1.5 m

Furthermore, the applicable typical characteristics of domestic sewage are defined as follows:

- Biological Oxygen Demand (BOD) = 350 to 400mg/ℓ
- Chemical Oxygen Demand (COD) = 700 to 850mg/ℓ

Taking the aforementioned criteria into consideration, the maximum capacity of the aerobic ponds may be determined using the following assumptions:

- Depth of pond = 1.2 m
- Retention time = 40 days
- BOD of sewerage = 400mg/ℓ

For the following:

- Capacity in accordance to loading rates:
  - BOD:
- Total BOD = (4.52 ha) x (135 kg BOD/ha/day) = 610.20kg/day
- Thus, assuming sewage strength of 400mg/ℓ

- Total ADWF = (Total BOD in mg/day)/(400mg/ℓ)
- Total ADWF = (610’200’000 mg/day)/(400mg/ℓ)
- Total ADWF = 1’525’500ℓ/day

- Assuming 65ℓ/capita/day
  - Total persons = (ADWF)/(65ℓ/capita/day)
  - Total persons = (1’525’500ℓ/day)/(65ℓ/capita/day)
  - Total persons = 23469 people

- Capacity in accordance to retention time:
  - Total ADWF = (50270 m^3) / (40 days x 24 x 60 x60)
  - Total ADWF = 0.015 m^3 / s = 1’296’000ℓ/day

  - o Assuming 65ℓ/capita/day
    - Total persons = (ADWF)/(65ℓ/capita/day)
    - Total persons = (1’296’000ℓ/day)/(65ℓ/capita/day)
    - Total persons = 19938 people

From the above calculations, the maximum capacity will be the least value derived, thus the maximum capacity of the aerobic ponds will be approximately 19938 people.

7.6 Evaluation of Capacity of Bulk Infrastructure:

The maximum capacity for the bulk infrastructure may be summarised as indicated in Column 1 of Table 8 in the form of the total population that may be served. The population that may be served for the WTW is the least amount across all components of the WTW, thus 19938 people.

Table 7-4: Summery of Bulk Infrastructure Capacity.

Bulk Infrastructure	Maximum Effective Capacity (people)	Current Capacity Served (people)	Reserve Capacity (people)	Proposed Additional Capacity (people)	Remainder (people)
300 mm Ø pipeline	25686	10081	15605	8250	7355
WTW	19938	10081	9857	8250	1607

It can be seen that the 300 mm Ø bulk sewer main and the WTW has sufficient capacity to serve the addition of a further 8250 people (1500 erven at 5.5 people/erf), with a residual capacity of 7355 and 1607people for the bulk pipeline and WTW respectively.

7.7 Recommendations for Bulk Infrastructure:

It is recommended that all parts of the proposed new development be drained to the existing Wastewater Treatment Works, via the 300 mm Ø bulk sewer main, as there is sufficient capacity to accommodate the new development

Based on the limited information received we anticipate that a small pump station (Lifting Station) with a short section of rising main (300m) will be required to accommodate a portion of the development situated to the north as it is evident that there is a low lying area.

7.8 Costing of Proposed Bulk Water Infrastructure:

To be determined once a Town Planning Layout and topographical survey has been received.

Table 7-5: Estimated Cost for Bulk Sewer Infrastructure			
Item	Description	Amount	
A	Bulk Sewer Pump Station	R	1 400 000,00
B	90mmØ Rising Main (300m)	R	270 000,00
Sub Total		R	1 670 000,00
Contingencies (10%)		R	167 000,00
Sub Total		R	1 837 000,00
Professional Fees		R	367 400,00
Sub Total		R	2 204 400,00
VAT (15%)		R	330 660,00
Total		R	2 535 060,00

8. WATER

8.1 Proposed Design Criteria: Water Infrastructure

Table 8-1: Water Distribution Network: Developing Areas: Proposed Design Criteria		
Parameter	Element	Guideline
1. Design Capita per Dwelling Unit	Residential Zone I: Low Income: Proposed Erven (Assumed)	5.5 people
	Residential Zone I: Low Income: Existing Erven (Census 2011)	3.8 people
2. Average Annual Daily	Residential Zone I: Low Income	80 ℓ/capita/day

Table 8-1: Water Distribution Network: Developing Areas: Proposed Design Criteria

Parameter	Element	Guideline
Demand		
3. Pressure	Maximum (Static) Minimum: Trunk Mains Minimum: Reticulation Mains	90 m (9.0 bar) 25 m (2.5 bar) 10 m (1.0 bar)
4. Flow Velocity	Minimum (all diameters Maximum (all diameters)	0.6 m/s 1.2 m/s
5. Peak Factor (PF)	Instantaneous Peak (Developing) Seasonal Peak (Developing) Daily Peak (developing)	4 x AADD 1.5 x AADD 2.4 x AADD
6. Pipe Location	All Areas	Road reserve – 2.0 m from roads edge
7. Pipe Materials	All pipe diameters	uPVC Class 09
8. Cover to Pipes	Minimum: Road reserves Other Areas	1,000 mm 800 mm

8.1.1 Existing Municipal Infrastructure

A desk top study was done to confirm the status quo of the Steinkopf bulk water and water distribution system, and may be summarised as follows:

- 160 mm Ø metered connection to the Sedibeng bulk water main.
- 160 mm Ø Dedicated trunk main to the water storage reservoir.
- 1.885 Mℓ Concrete reservoir.
- Gravity fed water distribution network of varying pipe diameters.

Steinkopf is supplied with treated potable water via a 160 mm Ø connection to the existing Sedibeng bulk water main situated adjacent to the N7 national road, east of the town. A dedicated 160 mm Ø trunk main of approximately 1.8 km long conveys the potable water to an existing 1.885 Mℓ concrete reservoir, situated on the mountain north of the town. From here water is distributed via a gravity fed water distribution network to all parts of the town. This distribution network consists of pipes of varying diameter, predominantly 75 to 100 mm Ø.

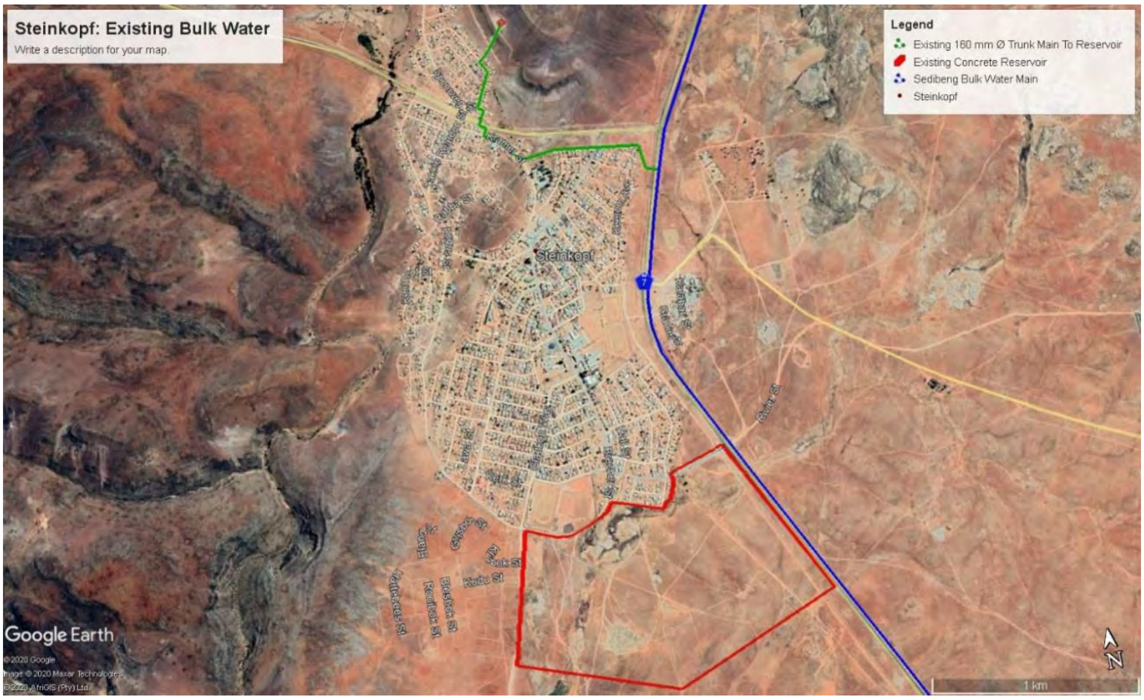

Figure 11: Existing Bulk Water Infrastructure

In order to perform a comprehensive evaluation of the bulk infrastructure's suitability to serve the current demand as well as the proposed future demand, a logical process must be followed, and may be summarized as:

- Determination of existing demand.
- Determination of proposed additional demand.
- Determination of existing maximum capacity of bulk infrastructure.
- Determination of reserve capacity of bulk infrastructure with relation to current demand.
- Evaluation of bulk service's reserve capacity with relation to the proposed additional demand.

8.2 Existing Total Water Demand

The existing total water demand will be based on figures and peak factors as obtained from *Guidelines for Human Settlement Planning and Designs* as set out in Table 8-1, in conjunction with the estimated population for the year 2020.

8.2.1 Annual Average Daily Demand (AADD):

The total Annual Average Daily Demand (AADD) for the estimated existing population for 2020 as depicted in Table 8-2 below, amounts to 654.400m³/day (7.57ℓ/s).

Table 8-2: Annual Average Daily Demand: Existing Population			
Description	Capacity	Unit factor (no of people)	m³/day
Residential Zone I: Low Income	80.0 ℓ/capita/day	10081	806.480
TOTAL			806.480

8.2.2 Instantaneous Peak Demand (IPD):

The Instantaneous Peak Factor (IPF) for high density (urban environments) developing areas complete with house connections is 4 times AADD, as seen in Table 8-3 below.

Table 8-3: Peak Factors: Developing Areas - Unrestricted Flow Systems #				
Type of Domestic Supply	Summer Peak Factor	Daily Peak Factor	Instantaneous Peak #	
			Low Density	High Density
House Connection	1,5	2,4	3,6-4,0	4,0 Minimum
Yard Connection	1,35	2,6	3,5-4,0	4,0 Minimum
Street Tap/Standpipe	1,2	3,0	3,0-3,6	4,0 Minimum
Yard Tanks	-	-	See Note	See Note

From the above, the total Instantaneous Peak Demand (IPD) for the existing population served will be as follows:

- (AADD from Table 8-3) x (IPF) = (IPD).
- 806.480m³/day x 4 = 3225.920m³/day (37.33ℓ/s).

8.2.3 Seasonal Peak Demand (SPD):

Taking into account for seasonal increase during wormer months, the seasonal peak factor (SPF) as indicated in Table 8-3 is 1.5. Thus the Seasonal Peak Demand (SPD) amounts to the following:

- (AADD) x 1.5 = (SPD)
- 806.480m³/day x 1.5 = 1209.720m³/day (14.00 ℓ/s)

8.2.4 Daily Peak Demand (DPD):

Taking into account for daily increase in demand during peak periods, the daily peak factor (DPF) as indicated in Table 8-3 is 2.4. Thus, the Daily Peak Demand (SPD) amounts to the following:

- (AADD) x 2.4 = (DPD)

- 806.480m³/day x 2.4 = 1935.552m³/day (22.40 ℓ/s)

8.3 Proposed Additional Total Water Demand

The proposed additional peak flow will be based on figures and peak factors as obtained from *Guidelines for Human Settlement Planning and Designs* as set out in Table 8-1, in conjunction with the estimated population for proposed development as set out below:

- (No. of proposed erven) x (capita/ erf) = (Estimated Population)
- 1500 erven x 5.5 people/erf = 8250 people

8.3.1 Annual Average Daily Demand (AADD):

The Annual Average Daily Demand (AADD) for the estimated proposed population as depicted in Table 8-4 amounts to 660.000m³/day (7.64ℓ/s).

Table 8-4: Annual Average Daily Demand: Additional Population			
Description	Capacity	Unit factor (no of people)	m³/day
Residential Zone I: Low Income	80.0 ℓ/capita/day	8250	660.000
TOTAL			660.000

8.3.2 Instantaneous Peak Demand (IPD):

The Instantaneous Peak Factor (IPF) for high density (urban environments) developing areas complete with house connections is 4 times AADD, as seen in Table 8-3. From the above, the total Instantaneous Peak Demand (IPD) for the additional population served will be as follows:

- (AADD from table 5.3.1) x (IPF) = (IPD).
- 660.000m³/day x 4 = 2640.000m³/day (30.56ℓ/s).

8.3.3 Seasonal Peak Demand (SPD):

Taking into account for seasonal increase during wormer months, the seasonal peak factor (SPF) as indicated in Table 8-3 is 1.5. Thus, the Seasonal Peak Demand (SPD) amounts to the following:

- (AADD) x 1.5 = (SPD)
- 660.000m³/day x 1.5 = 990.000m³/day (11.46ℓ/s)

8.3.4 Daily Peak Demand (DPD):

Taking into account for daily increase in demand during peak periods, the daily peak factor (DPF) as indicated in Table 8-3 is 2.4. Thus, the Daily Peak Demand (SPD) amounts to the following:

- (AADD) x 2.4 = (DPD)
- 660.000m^3/day x 2.4 = 1584.000 m^3/day (18.33 ℓ/s)

8.4 Maximum Capacity of Bulk Water Infrastructure:

8.4.1 160 mm Ø Trunk Main:

In order to determine the maximum capacity of the existing 160 mm Ø trunk main to the existing reservoir, one must consider the formula:

- Q = V x A
    - o Where:
        - Q = Flow in m^3/s
        - v = Velocity of flow in m/s
        - A = Area of flow in m^2

Considering the above, assuming a maximum velocity of 1.2m/s to maintain a maximum discharge at minimum frictional losses, the following:

- Q = V x A
- Q = (1.2 m/s) x ((Π/4) x 0.16^2) m^2
- Q = 0.0241m^3/s

Thus, the total estimated maximum capacity of the trunk main is 0.024m^3/s (24.1 ℓ/s). Taking into consideration the design standard of trunk mains to a reservoir, this capacity must be equal to the seasonal peak demand (AADD x 1.5) of the population served. Thus, the above discharge taken over a 24-hour period may be taken as the maximum seasonal peak demand (SPD) that can be served by the existing 160 mm Ø trunk main, namely 2084.610m^3/day.

From the above, if the seasonal peak factor is applied in reverse, the maximum AADD may be derived as follows:

- (SPD)/(1.5) = AADD
- (2084.610m^3/day)/(1.5) = 1389.740m^3/day (16.0 ℓ/s)

Therefore, assuming a demand of 80 ℓ/capita/day, the total maximum capacity of the trunk main may be expressed as a total maximum population as follows:

- (AADD) / (80 ℓ/capita/day) = Total Maximum Population
- (1389.740m^3/day)/(80 ℓ/capita/day) = 17372 people

8.4.2 Existing Concrete Reservoir:

As stated previously, the capacity of the existing concrete reservoir is 1.885 Mℓ, thus 1885m³. The existing capacity is representative of two components of storage, namely domestic demand and fire demand.

As the fire demand is a fixed volume of water required to serve development as a whole, irrespective of population served, based on a fire risk rating and standards as defined by the Red Book, only the domestic demand component may be used as measure of the maximum capacity that the reservoir may serve.

To the end of determining the maximum domestic capacity of the existing reservoir, the required fire demand for the existing township must first be determined.

Considering the existing township composition of mainly residential erven interspersed with commercial and institutional properties, and the apparent lack of congested business districts, the fire risk rating may be assumed to be Moderate Risk. Moderate Risk is defined by the Red Book as follows:

"Areas where the risk of fire and the spread of fire is moderate, such as industrial areas, areas zoned general residential with a floor space ratio of less than 1.0, where buildings are not more than three storeys in height, and commercial areas normally occurring in residential districts where buildings are not more than three storeys in height.

From the above, the requirements for fire demand may defined according to Table 8-5and Table 8-6 below and summarised as follows:

Table 8-5: Design fire flow

FIRE-RISK CATEGORY	MINIMUM DESIGN FIRE FLOW(l/min)	MAXIMUM NUMBER OF HYDRANTS DISCHARGING SIMULTANEOUSLY
High-risk	12000	All hydrants within a radius of 270 m of the fire
Moderate-risk	6000	
Low-risk – Group 1	900	1
Low-risk – Group 2	500	1
Low-risk – Group 3	350	
Low-risk – Group 4	N/A	N/A

Table 8-6: Duration of fire flow	
FIRE-RISK CATEGORY	DURATION OF DESIGN FIRE FLOW(h)
High-risk	6
Moderate-risk	4
Low-risk – Group 1	2
Low-risk – Group 2	1
Low-risk – Group 3	1
Low-risk – Group 4	N/A

- Minimum Fire Flow: 6000ℓ/min
- Minimum Fire Duration: 4 hours

Considering the above, the total capacity required for fire demand is as follows:

- (Min Fire Flow) x (Min Fire Duration) = (Min Fire Demand)
- (6000ℓ) x (4 hours x 60min) = 1440.000m³

Thus, the capacity available to the reservoir for domestic demand:

- (Total Capacity) – (Fire Demand) = (Domestic Demand)
- 1885.000 m³ - 1440.000 m³ = 445m³

Therefore, assuming a demand of 80ℓ/capita/day, the total maximum capacity of the reservoir may be expressed as a total maximum population as follows:

- (Domestic Demand)/(80ℓ/capita/day) = Total Maximum Population
- (445 m³)/(80ℓ/capita/day) = 5563 people

8.5 Evaluation of Capacity of Bulk Infrastructure:

The maximum capacity for the bulk infrastructure may be summarised as indicated in Column 1 in Table 8-7 in the form of the total population that may be served.

From the Table 8-7 it can be seen that the current bulk services for Steinkopf does not contain sufficient capacity to serve the addition of a further 8250 people (1500 erven at 5.5 people/erf), with a resultant negative deficit when the additional populations is applied to the reserve capacity.

Table 8-7: Summary of Bulk Infrastructure Capacity					
Bulk Infrastructure	Maximum Effective Capacity (people)	Current Capacity Served (people)	Reserve Capacity (people)	Proposed Additional Capacity (people)	Remainder (people)
160 mm Ø Bulk Water Connection and Trunk Main	17280	10081	7199	8250	-1051
Reservoir	5563	10081	-4518	8250	-12768

It must be noted that in the case of the reservoir the capacity available for domestic use, as a result of the reserved volume of water for fire demand, is insufficient to serve the current domestic demand within a single day. However, if the fire demand is ignored, the reservoir capacity increases to an estimated 11781 people for a period of 48 hours. This situation however does not fall in line with the accepted standards for water storage. Furthermore, the reservoir will still not contain sufficient capacity to serve both the existing population and the additional erven, with a resultant negative deficit of 6550 people.

With regards to the bulk water connection to the Sedibeng line, as stated previously little to no information is forthcoming, thus no evaluation can be made at this time. However, in light of telecoms with Ms A Botes of Sedibeng Water Springbok Region, applications for additional capacity and changes to the current connection may be considered.

Considering the existing 160 mm trunk main, the resultant negative deficit as seen in Table 15 is indicative of insufficient capacity to serve the total volume of additional water. It must be noted that the negative deficit is relatively small (1051 people). This may be offset by increasing the allowed velocity within the trunk main by approximately 0.1m/s to 1.3m/s. This increase will have an impact on the operational properties in the form of greater friction loss but will allow the accommodation of the 1051 shortfall within the existing infrastructure. Considering the lack of information in this regard (i.e. available pressure), this may result in too great a head loss within the pipeline, with no water reaching the reservoir as a result

8.6 Recommendations for Bulk Infrastructure:

Considering Table 8-7above, the following recommendations:

- Upgrade existing connection to Sedibeng water main.
    - Upgrade existing trunk main to site of reservoir.
    - New concrete reservoir to serve the proposed development.
    - New bulk main to proposed development.

The above recommendations are discussed in detail below.

8.6.1 Existing Connection to Sedibeng Water Main

It is recommended that an application be submitted to Sedibeng Water for the upgrading of the existing 160 mm Ø connection to a 200 mm Ø connection.

8.6.2 Existing Trunk Main to Reservoir

It is recommended that the 160 mm Ø existing trunk main be upgraded to a 200 mm Ø uPVC class 16 pipeline. This upgraded pipeline will follow the same rout of the existing 160 mm Ø pipeline at an estimated length of 1.8 kms.

8.6.3 Proposed Concrete Reservoir:

As stated previously the existing reservoir does not contain sufficient capacity to serve the additional proposed erven. Thus, the necessity exists to increase the available storage capacity

Thus, it is recommended that a new reservoir to serve the proposed development be constructed in position at the site of the existing reservoir.

The capacity of the new reservoir will be 48 hours of the AADD of the negative population deficit assuming no fire demand in the existing reservoir, thus 6550 people:

From the above, the required domestic demand may be derived as follows:

- (6550 people) x (80 ℓ/capita/day) = (524.00 m^3/day)
- Thus, Domestic Capacity of the reservoir for 45 storage as follows:
- (524.000 m^3/day) x (2 days) = 1048.000 m^3/day

Additionally a fixed reserve capacity for fire demand must be provided based on the fire risk category for the total development served (i.e. existing plus proposed) To this end the fire risk category must be defined with relation to the development composition and definitions as set out in the Red Book.

Considering the proposed development composition of the proposed development as low income single residential, the fire risk category may be defined as Low Risk Group 3:

"Residential areas (residential zone 1) where the gross floor area of dwellings, including outbuildings, is generally likely to be less than 100 m^2 but more than 55 m^2. This includes low cost housing schemes where the gross floor area of dwellings, including outbuildings and allowing for extensions by owner, would not generally exceed 100 m^2. (Red Book: Ch. 09; Pg. 33 - 34)

The overall fire risk for the town of Steinkopf is Moderate Risk. The requirements for fire demand may be defined according to Table 13 and Table 14.

- Minimum Fire Flow: 6000 ℓ/min
- Minimum Fire Duration: 4 hours
- Total Fire Demand 1440.000 m^3

The total capacity of the proposed reservoir must be set at:

- (Domestic Demand) + (Fire Demand) = (Total Capacity)
- 1048.000m^3 + 1440.000 m^3 = 2455.000m^3

Therefore, the capacity for the new reservoir is proposed to be 2.5 M ℓ.

In addition, due to the existing elevation difference between the site of the reservoirs and the lowest point of the proposed development of approximately 113m (11.3 bar), it is not foreseen that the addition of an elevated tower will be required. However, it must be noted that, during the detail design phase of the proposed development, the inclusion of pressure relief measures should be investigated in the event of static pressures in excess of 90 m (9.0 bar).

8.6.4 New Bulk Main to Proposed Development:

It is proposed that a new trunk main to serve the proposed development be installed from the site of the new and existing reservoir, within the road reserve of the existing municipal road network, to the north-west corner of the proposed development. The new bulk main will be sized to serve the total domestic demand for the town of Steinkopf, including the proposed 1500 erven.

From the Red Book the bulk man must be sized to accommodate the IPD for the population served. The size of the bulk main may be derived as follows:

- (18331 people) x (80 ℓ/capita/day) x 4 = 5865.920 m^3/day
- Therefore IPD = 5865.920 m^3/day = 0.069 m^3/s = Q

From the above, considering Q = V x A at maximum velocity (V) = 1.2 m/s

- A = Q/V
- $((\pi/4) \times Ø^2)\ m^2 = (0.069\ m^3/s) / (1.2\ m/s)$
- $0.785\ Ø^2 = 0.0575\ m$
- $Ø = \sqrt{(0.0575\ m / 0.785)}$
- Ø = 0.270 m

The required pipe diameter is minimum 270 mm Ø, however, considering the standard pipe diameters for uPVC pipes, the most suitable diameter will be a 250 mm Ø to 315 mm Ø pipe.

In light of the above it is recommended that the proposed bulk main to the proposed development will be a 250 mm Ø uPVC Class 16 main.

8.6.5 Summary of Recommendations

- The recommendations for the bulk water infrastructure may be summarised as follows:
- Upgrade existing connection to Sedibeng pipeline to 200mmØ.
- Upgrade existing 1.8km trunk main to reservoir site to 200mmØ uPVC Class 16.
- New 2.5 Mℓ concrete reservoir at site of existing reservoir.
- New 250 mm Ø bulk water main to site of the proposed development approximately 2.990kms in length.

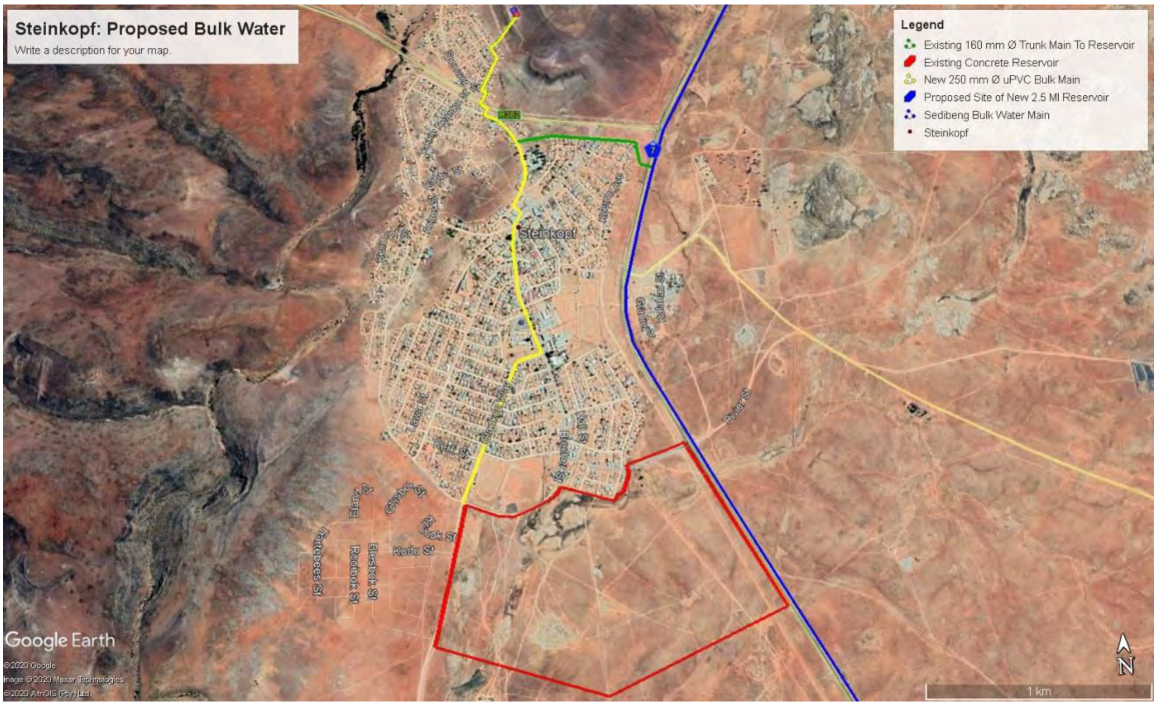

Figure 12: Proposed Bulk Water Infrastructure

8.7 Costing of Proposed Bulk Water Infrastructure:

Table 8-8: Costing of Proposed Bulk Water Infrastructure		
Item	Description	Amount
A	200mm Ø Bulk Supply Line from Sedibeng Water Line (1800m)	R 2,700,000.00
B	2.5Mℓ Concrete Reservoir	R 14,500,000.00
C	250mm Ø Bulk Supply Line to Proposed Development (2990m)	R 4,485,000.00
Sub Total		R 21,685,000.00
Contingencies (10%)		R 2,168,500.00

Table 8-8: Costing of Proposed Bulk Water Infrastructure		
Item	Description	Amount
Sub Total		R 23,853,500.00
Professional Fees		R 4,293,630.00
Sub Total		R 28,147,130.00
VAT (15%)		R 4,222,069.50
Total		R 32,369,199.50

9. ROADS

9.1 Existing Municipal Infrastructure:

Currently Steinkopf has two main point of access from the N7 national road with one arterial road linking these two points of access, one in the north-east and one in the south-east. The arterial road linking the two points of access is a surfaced road, while the remainder of the municipal roads' infrastructure is gravel roads.

9.2 Access to the Proposed Development:

Currently the site of the proposed development is bordered by existing municipal roads infrastructure to the north and west, as well as the N7 national rout to the east.

It is recommended that access to the proposed development be provided from the existing roads network situated to north and west of the proposed development.

It is, however not recommended to provide access to the site via the N7 national rout, as this entails a lengthy application process to the national roads authority (SANRAL), stringent conditions for approval, as well as a costly designs to adhere to the said conditions.

10. STORM WATER

10.1 Storm Water Management

The traditional design of storm water drainage systems has been to collect and convey storm water runoff as rapidly as possible to a suitable location where it can be discharged. We are also more conscious of the quality of the environment and the impact that uncontrolled increases in runoff can have on landowners.

The objective of a storm water management plan should be to manage the storm water resources of the collective watersheds to:

- Prevent flood damage.
- Preserve the natural and beneficial functions of the natural drainage system.

- Preserve and enhance storm water quality.

The collection and concentration of storm water will be kept to an absolute minimum so as not to impact negatively on any natural watercourse.

10.2 Existing Municipal Infrastructure:

Currently Steinkopf has no existing formal storm water infrastructure, with all storm water draining at surface within the existing roads infrastructure toward the natural watercourses.

10.3 Proposed Bulk Infrastructure:

Currently there is a non-perennial stream traversing the site of the proposed development, from north-east to south-west, with all portions of the proposed site draining toward this stream.

It is proposed that all portions of the proposed development be drained at surface, within the proposed roads network, toward and discharged into the above-mentioned stream.

10.4 Costing of Proposed Bulk Water Infrastructure:

No provision has been made for Bulk Storm Water infrastructure as provision should be made for drifts and paved sections under the development of internal roads and storm water.

11. SUMMARY OF PROPOSED BULK INFRASTRUCTURE

To be determined once a Town Planning Layout and topographical survey has been received.

Table 11-1: Estimated Cost for Bulk Infrastructure			
Item	Description	Amount	
A	PROPOSED BULK SEWER INFRASTRUCTURE	R	2,204,400.00
B	PROPOSED BULK WATER INFRASTRUCTURE	R	28,147,130.00
Sub Total		R	30,351,530.00
VAT (15%)		R	4,552,729.50
Total		R	34,904,259.50

12. REFERENCES

- *Department of Statistics South Africa Census 2011 Municipal Fact Sheet. Nama Khoi Municipality Draft Integrated Development Plan 2018/2019.*
- *Rednax Investment Pty Ltd EIA submission to Department of Mineral Resources Republic of South Africa.*

- *Guidelines for the Provision of Engineering Services and Amenities in Residential Township Development, 1994 as amended (a.k.a. the "Blue Book").*
- *Guidelines for Human Settlement Planning and Designs as published by the CSIR and will also refer to the local municipality's guidelines and standards (a.k.a. the "Red Book").*
- *Water Institute of South Africa; Manual on the Design of Small Sewage Works; First Edition 1988*

13. CONCLUSION

We trust this will enable you to make the necessary decisions. MVD Kalahari will gladly assist with additional information should the need arise.

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BD BENSLEY *(Pr Tech Eng)*
MVD Kalahari
Consulting Engineers and Town Planners
Level 2 B-BBEE Contributor
/bb/2985-003-QR-Steinkopf Civil Services Investigation & Report

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G3T CONSULT CC

ANNEXURES

ANNEXURE A:
TOWN PLANNING LAYOUT

DRAFT LAYOUT PLAN :

PROPOSED TOWNSHIP STEINKOPF (1500)

ON A PORTION OF THE REMAINING EXTENT OF ERF 2048, STEINKOPF

LEGEND

Land Use		Number of Erven	Area in Ha
Residential (min. 260m²)		1500	43.5723ha
Business		6	1.1375ha
Church		6	0.6747ha
Creche		3	0.2789ha
School		1	2.4479ha
Sports Field		1	1.2847ha
Municipal		1	0.2065ha
Park		11	49.4834ha
Street			23.7573ha
TOTAL		1529	123.0452ha

Scale 1 : 5 500

Nama Khoi
Local Municipality

BARZANi
DEVELOPMENT

COGHSTA
Department of Co-operative Governance, Human Settlements and Traditional Affairs of the Northern Cape

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