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FICKSBURG PORT OF ENTRY: SITE CLEARANCE AND DEVELOPMENT OF STRUCTURAL PLAN
CIVIL ENGINEERING REPORT: DETAILED PLANNING

Prepared for:	**Prepared by:**
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Abbreviations

L/s	-	Litres per second
Mℓ /day	-	Mega litres per day
kℓ/day	-	Kilo Litres per day
kℓ	-	Kilo Litres
PSC	-	Project Steering Committee
WC	-	Water Committee
IDP	-	Infrastructure Development Plan
DWS	-	Department of Water and Sanitation
RWS	-	Regional Water Scheme
StatsSA	-	Statistics South Africa
m3	-	cubic metre
AADD	-	Average Annual Daily Demand
VIP toilet	-	Ventilated Improved Pit toilet
MAP	-	Mean Annual Precipitation
ADWF	-	Average Dry Weather Flow

1 Executive summary

Ficksburg port of entry is situated in Ficksburg town, GPS coordinates: 28°52'57.10"S 28°16'42.88"E. Ficksburg port of entry experience high volume of people moving between South Africa and Lesotho. During festive seasons the port of entry experiences long queues due to inadequate infrastructure and thereby causing inefficiency. The department intents to improve the operational efficiency by providing adequate roads, security check points, staff accommodation, parking bays. The bulk services required for the upgrade are summarised below;

- 250kl portable water storage
- 750kl fire fight water storage
- Sewer and Water reticulation network and connections
- Road network upgrading
- Storm water management

The bulk services are estimated to cost **R 256 672 510.28** inclusive of VAT, contingencies, escalation, specialist services and professional fees.

2 INTRODUCTION

Ficksburg port of entry is a border post linking South Africa and Lesotho. The port of entry is to be upgraded to have adequate offices, parking bays, residential accommodation, lanes and security checks. The upgrade intent to equip the port of entry with adequate infrastructure to deliver on its obligations efficiently

This report outlines the engineering services needed for the Port of entry, i.e. roads, water, sewer, platforms and electricity.

3 SITE DESCRIPTION

Ficksburg port of entry is situated in Ficksburg town at corner main street and Bloem Street. The area is administered by Setsoto Local Municipality, under the Thabo Mofutsanyane District Municipality. GPS coordinates of site are 28°52'57.97"S 27°53'18.97"E. The locality map is presented on the image below.

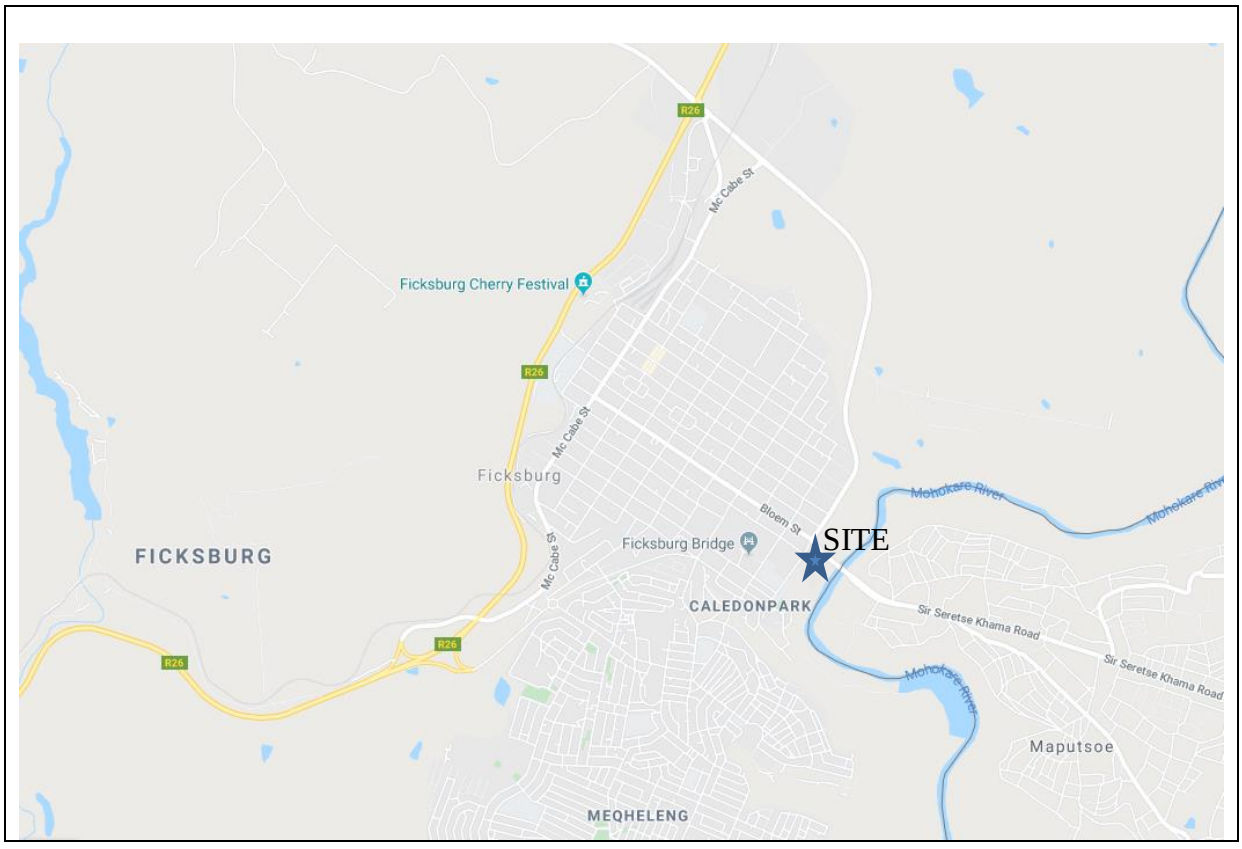

Figure 1: Locality plan

4 LAND USES

The port of entry is proposed to be upgraded as follows;

	BUILDINGS	AREA
	LIGHT VEHICLES LESS THAN 2 TONS	
1	MAIN ADMIN BUILDING	1922m²
2	INSPECTION BUILDING (ARRIVALS)	233m²
3	INSPECTION BUILDING (DEPARTURES)	221m²
	HEAVY VEHICLES MORE THAN 2 TONS/ FREIGHT	
4	MAIN ADMIN BUILDING	1117m²
5	INSPECTION BUILDING (ARRIVALS)	620m²
6	INSPECTION BUILDING (DEPARTURES)	620m²
	PEDESTRIANS, TAXIS AND BUSES	
7	MAIN ADMIN BUILDING	1666m²
8	INSPECTION BUILDING (ARRIVALS)	245m²
9	INSPECTION BUILDING (DEPARTURES)	245m²
	SUPPORT SERVICE BUILDINGS	
10	WASTE	
11	CONFISCATED GOODS	
12	INCINERATOR	70m²
13	WORKSHOP	
14	OFFICES	
15	AGRICULTURE/ SAPS DOGS KENNELS	436m²
16	FIRE & RESCUE	
17	WEIGH BRIDGE	
18	TOILETS	30m²
19	TAXI RANK	

Table 1 Land use

The proposed and use image is shown in figure 2 on the next page.

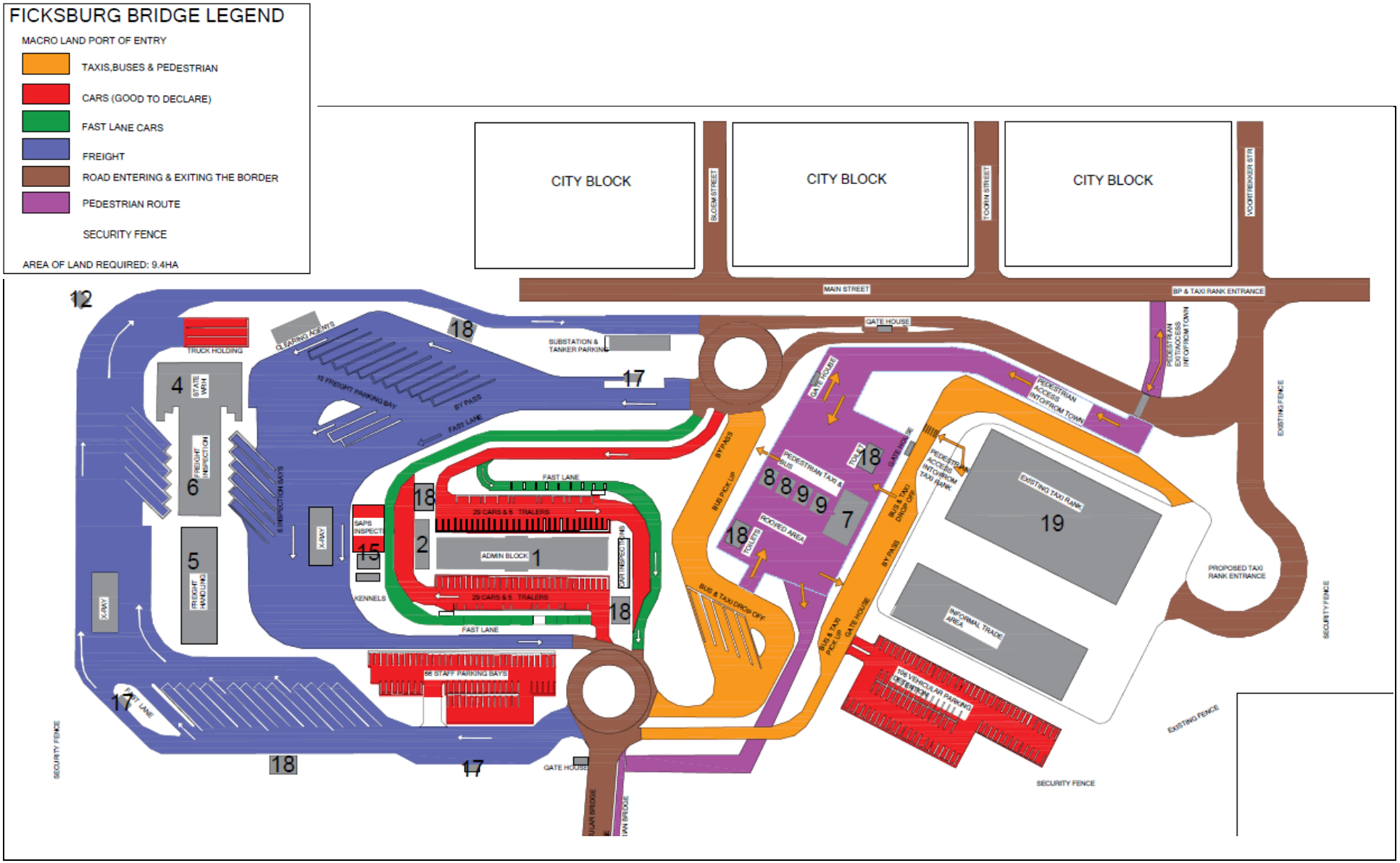

Figure 2: Proposed land use

5 TOPOGRAPHY AND ACCESS

The slope analysis is shown in Figure 3 below. The site is 49% flat (green), 34% hilly (yellow) and 17% steep (red). The slopes allow for building and roads development with medium site earthworks.

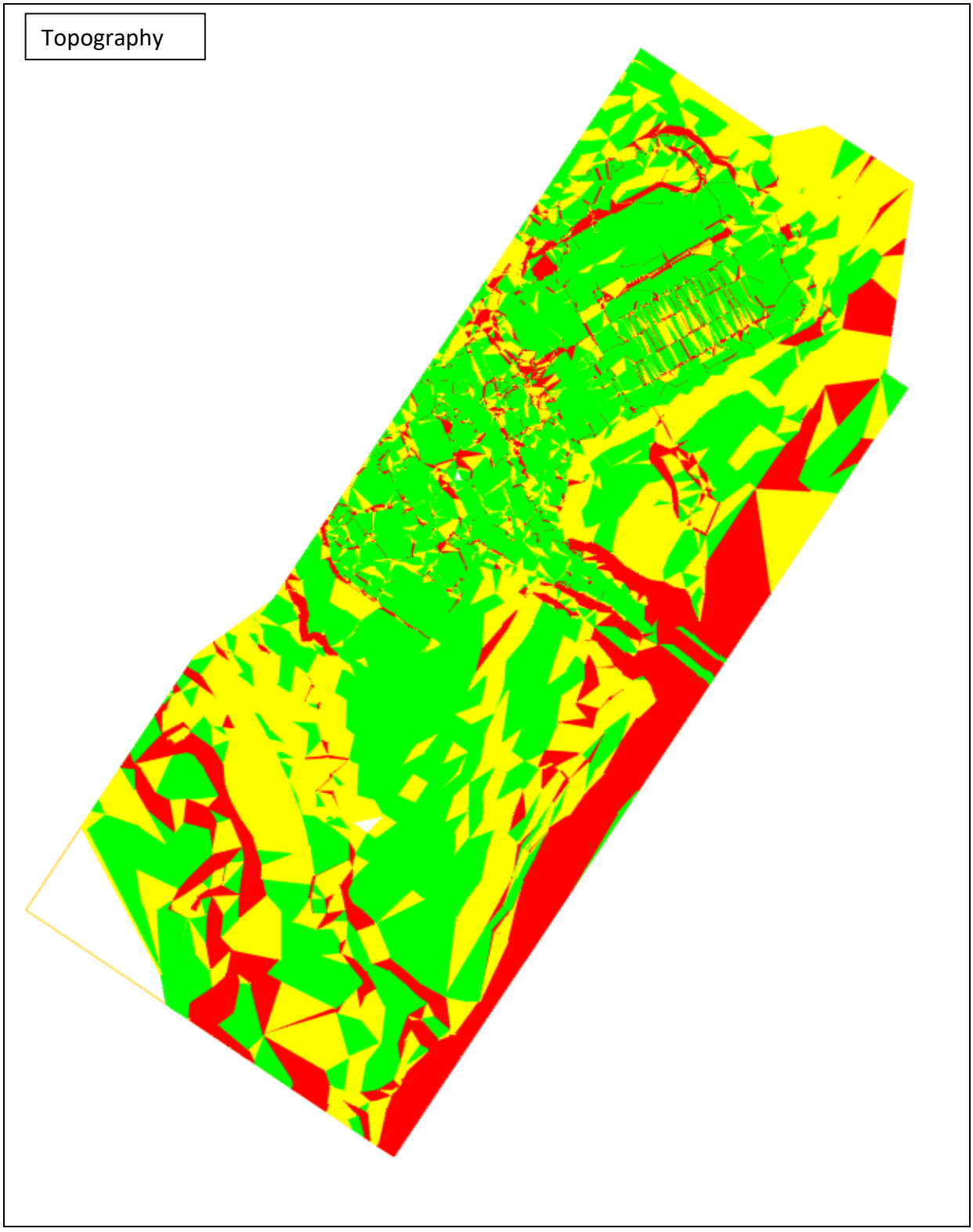

Figure 3 Topography

The existing development can be accessed by Bloem Street Main street linked to Road R26 local, access road linking the RAL road D1897. See the figures below.

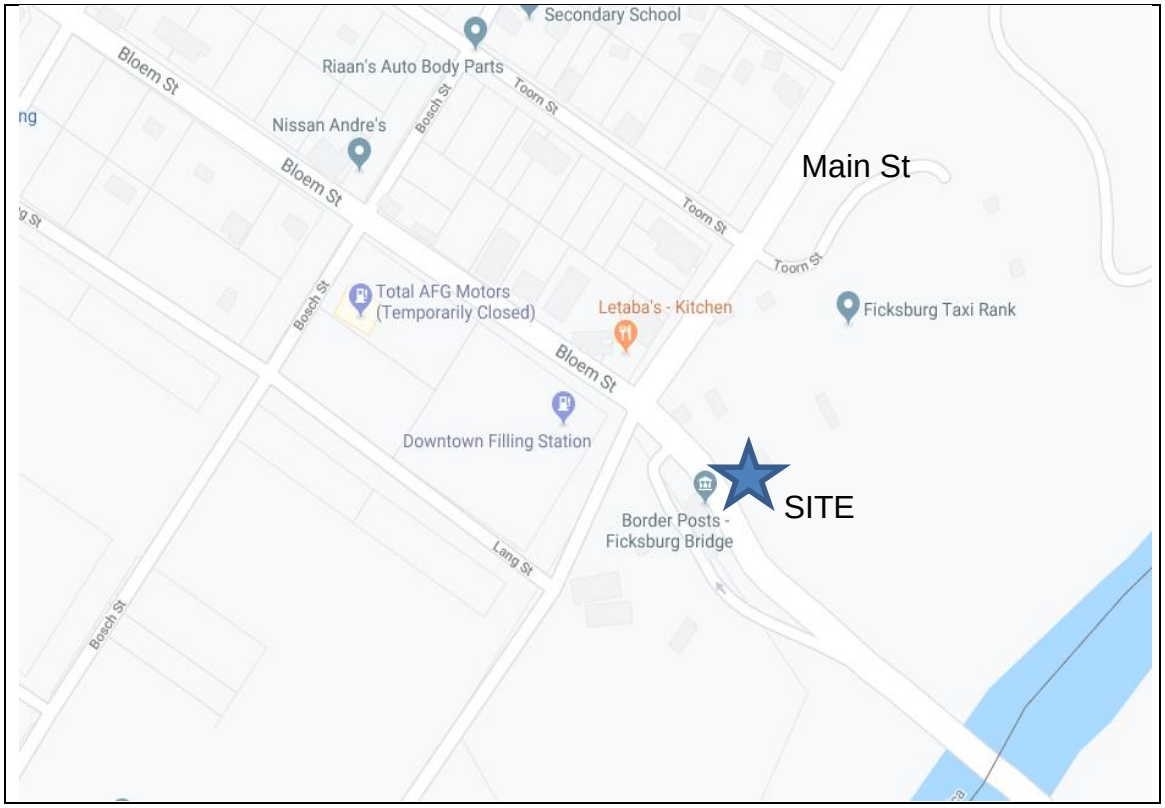

Figure 4 Roads

The port of entry internal road is mainly paved with concrete. The road is shown on the figure below.

Figure 5 Internal road

6 WATER SERVICE

6.1 Water source

The Ficksburg Water Treatment Works with a design capacity of 16.5 Mega litres per day, receive raw water for purification from the Caledon River and Meulspruit Dam.

Raw water is abstracted from the Caledon River via an inlet tower and pumped to the treatment works. Raw water from Meulspruit dam is pumped to a balancing dam on the slopes of the Imperani Mountain from where it gravitates through two pipelines with a length of approximately 7km to the Water Treatment Plant.

The final treated water is then pumped to the 2 Northern Reservoirs with a total capacity of 6.7 Mega litres and the 2 Meqheleng reservoirs with a total capacity of 7.1 Mega litres. From the reservoirs, the water flow into the distribution network for community use. Ficksburg Water Treatment Works supply potable water to 51,568 residents currently.

Figure 6 Water Source

Figure 7 Clarifiers at Ficksburg water treatment plant

6.2 Storage Tanks

Ficksburg port of entry has a 20kℓ standby ground steel tank. The tank is installed to supply the port of entry with water during interrupted water supply from the municipality.

The 20kℓ steel tank and the booster pump are shown in figure 8 and 9 respectively.

Figure 8: Standby 20kℓ storage tank

6.3 Inline Booster Pump

A pressure booster pump is installed on the outlet pipeline of the standby steel tank. The pump is designed to supply the port of entry with the required minimum pressure. The booster pump is shown in figure 8 below.

Figure 9: Inline booster pump

6.4 Water Reticulation

The port of entry is reticulated with uPVC and HDPE pipes.

The water reticulation is described below.

- Water reticulation to existing buildings.
- Fire hydrants.

6.5 Water design criteria

The water design criterion to be used is listed in the table below. The water demands and fire flow were adopted from document titled: *The Neighbourhood Planning and Design Guide, Creating Sustainable Human Settlements, developed by, Department of Human Settlements, Published by the South African Government, ISBN: 978-0-6399283-2-6 © 2019, Version 1.1. Printed July 2019*

Item	Design element	Criteria
i.	Average Annual Daily Demand (AADD), for residential 1	0.6kℓ/c/day
ii.	Average Annual Daily Demand (AADD), for residential 2	0.6kℓ/c/day
iii.	Average Annual Daily Demand (AADD), for business	400ℓ/100m2
iv.	Average Annual Daily Demand (AADD), for park	12.5-15kℓ/hectare
v.	Average Annual Daily Demand (AADD), for Municipal	400ℓ/100m2
vi.	Average Annual Daily Demand (AADD), for Institutional	400ℓ/100m2
vii.	Gross Average Annual Daily Demand (GAADD)	Allow 10% losses
viii.	Daily Instantaneous Peak Factor (DIPF)	1.5
ix.	Design Peak Flow Rate (DPFR) for domestic flows.	25ℓ/s
x.	Maximum static head	90m
xi.	Minimum residual head under conditions of domestic peak flow	10m
xii.	Maximum linear flow velocity under conditions of domestic peak flow	3m/s
xiii.	Pipe type	uPVC
xiv.	Minimum pipe class	9
xv.	Fire flow at any one hydrant under the conditions of domestic peak flows (one hydrant at a time)	15 ℓ/s
xvi.	Minimum residual head (fire plus domestic peak flow)	25m
xvii.	Maximum linear flow velocity under conditions of fire-fighting	3m/s
xviii.	DWS storage reservoirs sizing criteria: 48 Hrs x AADD Pumped from One Source 36 Hrs x AADD Pumped from Multiple Sources 24 Hrs x AADD Gravity Source	

Table 2 The water design criteria

6.6 Water demands

The estimated water demand for the township is shown in table below.

As per the table below, the water demand calculations indicate that the port of entry will require 990.5kℓ/d AADD and 1 089.6kℓ/d Gross Average Annual Daily Demand.

Table 3 Township water demand

Land Use	No. of Erven	Area (m^2)	Unit flow	Described demand applied	Demand	
LIGHT VEHICLES LESS THAN 2 TONS						
MAIN ADMIN BUILDING	1	1 922.0	400	ℓ/100m^2	7.7	kℓ/d
INSPECTION BUILDING (ARRIVALS)	1	233.0	400	ℓ/100m^2	0.9	kℓ/d
INSPECTION BUILDING (DEPARTURES)	1	221.0	400	ℓ/100m^2	0.9	kℓ/d
HEAVY VEHICLES MORE THAN 2 TONS/ FREIGHT						
MAIN ADMIN BUILDING	1	1 117.0	400	ℓ/100m^2	4.5	kℓ/d
INSPECTION BUILDING (ARRIVALS)	1	620.0	400	ℓ/100m^2	2.5	kℓ/d
INSPECTION BUILDING (DEPARTURES)	1	620.0	400	ℓ/100m^2	2.5	kℓ/d
PEDESTRIANS, TAXIS AND BUSES						
MAIN ADMIN BUILDING	1	1 666.0	400	ℓ/100m^2	6.7	kℓ/d
INSPECTION BUILDING (ARRIVALS)	1	245.0	400	ℓ/100m^2	1.0	kℓ/d
INSPECTION BUILDING (DEPARTURES)	1	245.0	400	ℓ/100m^2	1.0	kℓ/d
SUPPORT SERVICE BUIDINGS						
INCINERATOR	1	70	400	ℓ/100m^2	0.3	kℓ/d
AGRICULTURE/ SAPS DOGS KENNELS	1	436	400	ℓ/100m^2	1.7	kℓ/d
TOILETS	15 716	30	60	ℓ/c/d	943.0	kℓ/d
TAXI RANK	1	6 000	300	ℓ/100m^2	18.0	kℓ/d

Totals	10	6 959				
Sub-total Average Annual Daily Demand (AADD)					990.5	kℓ/d
Gross Average Annual Daily Demand (GAADD) (added 10%)					1 089.6	kℓ/d
Peak Water Flow (Summer Peak Factor)			**1.5**	**peak factor**	**1 634.4**	kℓ/d
Peak Water Flow (Summer Peak Factor)			**1.5**	**peak factor**	**18.9**	**ℓ/s**

Table 4 The water demands

The proposed development has an AADD water demand of 990.5kℓ/d.

The point of entry receives water supply from the municipality.

It is proposed that the development have a backup water storage that can last 6hours in case of a disruption to the municipal water supply.

Therefore, backup water storage = 6hrs x (990.5kℓ) / 24hrs = 248kℓ

= <u>say 250kℓ</u>

The Fire flow calculations are presented on the table below.

RISK CLASSIFICATION	Total Fire Flow (l/s)	Duration of Fire flow (h)	Total Fire Flow (l/s)	Required Fire Flow Storage	
Moderate risk 1: Industrial, business, high rise flats ≥ four storeys	50	4	50	720.0	kℓ/d

Table 5 Fire flow demands

The new development will require 720kℓ fire water storage onsite. Fire flow pipelines should be designed to the capacity of 50ℓ/s.

7 SEWER SERVICE

7.1 EXISTING WASTE WATER TREATMENT WORKS

The Ficksburg town has a waste water is treated pant located east of Maqheleng township, accessed via Visser street. The Plant's GPS coordinates are 28°53'28.71"S 27°53'46.75"E.
.

Figure 10 Ficksburg waste water treatment plant.

7.2 Bulk sewer

Sewer flows gravitate to the last manhole situated at a lower elevation, and then gravitate to a sump with a submersible pump. It is then pumped from the sump to a municipal manhole. The sewer then gravitates from the municipal sewer connection manhole to Ficksburg waste water treatment plant.

The design guidelines were adopted from the CSIR document titled: Guidelines for Human settlement planning and design volume 2, Reprint 2005. The proposed development sewer flow calculations are presented upon finalising the cadastral layout plan

LAND USE	*SITE*	Area (m^2)	*Average daily flow per unit*		*Sewer Return*	*Sewer Flow*	
LIGHT VEHICLES LESS THAN 2 TONS							
MAIN ADMIN BUILDING	1	1 922.0	400	ℓ/100m^2	85%	7	kℓ/d
INSPECTION BUILDING (ARRIVALS)	1	233.0	400	ℓ/100m^2	85%	1	kℓ/d
INSPECTION BUILDING (DEPARTURES)	1	221.0	400	ℓ/100m^2	85%	1	kℓ/d
HEAVY VEHICLES MORE THAN 2 TONS/ FREIGHT							
MAIN ADMIN BUILDING	1	1 117.0	400	ℓ/100m^2	85%	4	kℓ/d
INSPECTION BUILDING (ARRIVALS)	1	620.0	400	ℓ/100m^2	85%	2	kℓ/d
INSPECTION BUILDING (DEPARTURES)	1	620.0	400	ℓ/100m^2	85%	2	kℓ/d
PEDESTRIANS, TAXIS AND BUSES							
MAIN ADMIN BUILDING	1	1 666.0	400	ℓ/100m^2	85%	6	kℓ/d
INSPECTION BUILDING (ARRIVALS)	1	245.0	400	ℓ/100m^2	85%	1	kℓ/d
INSPECTION BUILDING (DEPARTURES)	1	245.0	400	ℓ/100m^2	85%	1	kℓ/d
SUPPORT SERVICE BUIDINGS							
INCINERATOR	1	70	400	ℓ/100m^2	85%	0	kℓ/d
AGRICULTURE/ SAPS DOGS KENNELS	1	436	400	ℓ/100m^2	85%	1	kℓ/d
TOILETS	15 716	30	60	ℓ/c/d	85%	801.5	kℓ/d
TAXI RANK	1	6 000	300	ℓ/100m^2	85%	15	kℓ/d
Sub-total Sewer ADWF						**842**	**kℓ/d**
15% Extraneous flow						126.29	kℓ/d
Total Sewer						968.25	kℓ/d
Sewer Flow						11.21	ℓ/s
Peak Factor						2.5	
Peak Sewer Flow						**2 420.63**	**kℓ/d**
Peak Sewer Flow						**28.02**	**ℓ/s**

Table 6 Sewer design flow

The new development will have a sewer ADWF of 842kℓ a peak sewer flow of 2,420.63kℓ/d

7.3 Sewer reticulation

- New reticulation pipelines must be constructed to supply the buildings and toilets.

8 Electricity

There is an existing electrical infrastructure around the area which is fed from Ficksburg sub-station. The feeder name is D-feeder 11Kv.The capacity of sub-station is 2x40MVA/11kv.There is an existing 315kva/11kv Minisub that is connecting from metering point to the generator room. The network is control by the Municipality (Setsoto Local Municipality)

9 TOWNSHIP ROADS

The road infrastructure to service the township will be the standards of the Red Book, TMH, TRH books and the local municipality.
Main access to the township is to be gained through existing bounding road.
An application to connect the township to the existing road has to be approved by road authorities prior to construction.

9.1 Classification of roads

Description	Class no.	Function	Reserve width	Roadway width	Length (km)
Access Road	5d	Access from existing bounding road	16m	7.4m	1.95
Internal Service Road	5f	Internal Road	13	6m	1.45
Internal Service Road	5f	Internal Road	10	6m	8.01

Table 7 Classification of roads

9.2 Geometric Design Standards

Design speed	60km/h
Minimum centre line radii	50m
Minimum gradient	0.5%
Favoured maximum gradient	10%
Maximum grade/grade length	12.5% over 70m
Maximum K-value : Crest	16
: Sag	16

Table 8 Class 5d – Access road

Design speed	30km/h
Minimum centre line radii	30m
Minimum gradient	0.5%
Favoured maximum gradient	12%
Maximum grade/grade length	16% over 50m
Maximum K-value : Crest	6
: Sag	8

Table 9 Class 5f – Internal roads

9.3 Pavement Design

The proposed pavement designs are based on anticipated traffic volumes and ground conditions, a detailed pavement design will require a geotechnical centreline investigation report.

The table below shows the proposed pavement design for the development.

Design	Description
Pavement	50mm Premix Asphalt / 80mm Paving blocks / Concrete
Base	150mm Thick commercially graded gravel G1 material compacted to Minimum of 88% of apparent relative density.
Subbase	300mm Thick natural gravel stabilised with Cement to create C3 material compacted to 97% of Mod AASHTO
Upper Selected Layer	150mm Thick Natural gravel G7 material compacted to 97% of Mod AASHTO Density.
Lower Selected Layer	150mm Thick Natural gravel G7 material compacted to 97% of Mod AASHTO Density.
Roadbed & Fill (where required)	150mm Thick layers compacted to 90% of Mod AASHTO Density. Minimum CBR= 3 at 90% of Mod AASHTO Density- G9

Table 10 Proposed pavement design

10 Stormwater Drainage

The stormwater will drain on according to the slope of the natural ground.

10.1 Stormwater systems

The terrain will be drained by V-drains or channelling of stormwater on the road surface to the natural low point. The stormwater will then flow over the veld to the stream. Stormwater discharge control will be applied in order to reduce the damaging effect of the increase in runoff due to densification.

10.2 Hydrology

The hydrological data used in the design of the stormwater drainage system is shown in the table below.

Hydrological Data	
a) Flood return period	1: 2 years for storm water pipe system. 1: 5 years for the combined storm water Pipe and road systems
b) Average yearly rainfall	755mm
c) Minimum time of concentration and run	As per Local Municipality Guidelines

d) Design Method	Rational method

Table 11 Hydrological data

10.3 Design Standards

The table below lists the standards to be used in the design of the stormwater drainage system:

Design Element	Specification
a) Minimum pipe size	600 concrete
b) Minimum pipe gradient	0.67%
c) Storm water details	Local Municipal Standard Details

Table 12 Stormwater design standard

11 SOLID WASTE

A regional landfill situated nearest is used to dispose solid waste. The local municipality is responsible for connecting and disposing the solid waste.

The Neighbourhood Planning and Design Guide, Creating Sustainable Human Settlements, developed by, Department of Human Settlements, Published by the South African Government, ISBN: 978-0-6399283-2-6 © 2019, Version 1.1. Printed July 2019.

The solid waste generation range from 0, 41 kg per capita per day in the poor areas, to 1.29 kg per capita per day.

People are anticipated to spend less than 8 hours in the port of entry and thus the 0.41kg/c/d was adopted. Solid waste will be generated by the development.

- Solid waste = 0.41kg/per person/day or (0.41kgx365 days)
- Waste generated per day = 0.41x 15716 = 6445 kg = 6.445t
- Waste generated per annum = 6445x365/1000 =2352t

12 COST ESTIMATES

The total cost estimates excluding building works and electrical cost is presented in table 13 on the next page. It is estimated that the bulk infrastructure will cost **R256 672 510.28** inclusive of VAT, contingency, escalation, specialist services and professional fees.

Item	Description	Unit	Qty	Rate	Amount (R)
1	Preliminary and General	Sum			16 368 600.00
1.1	**ROAD INFRASTRUCTURE**				
1.2	Internal road	km	10.0	11 500 000.00	115 000 000.00
1.3	Stormwater 900 diameter pipe	m	7000	1 200.00	8 400 000.00
1.4	**Sub-Total A**				**139 768 600.00**
2.0	**WATER INFRASTRUCTURE**				
2.1	250kL Elevated steel tank	no	1	750 000.00	750 000.00
2.2	750KL Elevated steel tank for fire	no	1	3 500 000.00	3 500 000.00
2.3	**Water reticutation pipe network:**				
2.3.1	75mm dia uPVC class 9 pipe	m	550	450.00	247 500.00
2.3.2	90mm dia uPVC class 9 pipe	m	600	480.00	288 000.00
2.3.3	110mm dia uPVC class 9 pipe	m	1500	520.00	780 000.00
2.3.4	160mm dia uPVC class 9 pipe	m	500	600.00	300 000.00
2.3.5	200mm dia uPVC class 9 pipe	m	300	620.00	186 000.00
2.3.6	250mm dia uPVC class 9 pipe	m	2350	650.00	1 527 500.00
2.3.7	315mm dia uPVC class 9 pipe	m	400	1 000.00	400 000.00
2.3.8	Fire hydrants	no	15	18 000.00	270 000.00
2.3.9	Water connections	no	22	6 000.00	132 000.00
	Sub-Total B				**8 381 000.00**
2.4	**SEWER INFRASTRUCTURE**				
2.4.1	Sewer reticutation:				
2.4.2	160mm dia uPVC class 34 pipe	m	1800	900.00	1 620 000.00
2.4.3	200mm dia uPVC class 34 pipe	m	350	920.00	322 000.00
2.4.4	250mm dia uPVC class 34 pipe	m	300	940.00	282 000.00
2.4.5	160mm dia uPVC class 9 pipe	m	1500	600.00	900 000.00
2.4.6	Sewer pumpstation	sum	1	1 500 000.00	1 500 000.00
	Sub-Total C				**4 624 000.00**

Item	Description	Unit	Qty	Rate	Amount (R)
	Sub-Total A + B + C				**152 773 600.00**
2.5.1	Survey and pegging	sum	1	350 000.00	350 000.00
2.5.2	Geotech	sum	1	180 000.00	180 000.00
2.5.3	Professional fees and disbursements	%	1	14%	21 388 304.00
2.5.4	Environmental Impact Assessment	sum	1	500 000.00	500 000.00
2.5.5	OHS monitoring	Month	36	150 000.00	5 400 000.00
2.5.6	Social consultation	Month	36	130 000.00	4 680 000.00
2.5.7	Environmental monitoring	Month	36	130 000.00	4 680 000.00
	Sub-Total (D)				**37 178 304.00**
	Sub-Total (D) = (B) + (C)				**189 951 904.00**
	Contingencies			10%	**18 995 190.40**
	Escalation	%		7.5%	**14 246 392.80**
	Total				**223 193 487.20**
	VAT	%		15%	33 479 023.08
	GRAND TOTAL				**256 672 510.28**

Table 13 Cost estimates

13 Conclusion

The proposed development will contribute towards improving migration and trade between South Africa and Lesotho.

ANNEXURES