Prepared for :

STEVE TSHWETE LOCAL MUNICIPALITY

ANALYSIS REPORT

MIDDELBURG TOWN – STORMWATER MASTERPLAN

Prepared by :

NKP Consulting Engineers (Pty) Ltd

Consulting Civil, Structural Engineers & Project Managers

Co. Reg Nr: 2003/013254/07

Portion 76, The Rest Road	13 Olyfberg Street ;Aerorand
P.O. Box 11	Middelburg 1050
Nelspruit, 1200	
Tel no.: 087 285 7788	Tel: 082 859 3483
Fax no.: 086 554 6578	Fax: 086 554 6578
e-mail:info@nkpsa.co.za	**e-mail**:info@nkpsa.co.za

DATE: August 2017

STORMWATER MASTERPLAN - MIDDELBURG

I N D E X

ATTACHMENTS:

- **DATA VOLUMES 1 – 14**

- **DRAWINGS 17-NKP339 – GML 01 UP TO 17-NKP339GML 016**

Abbreviations used in this report are:

STLM	Steve Tshwete Local Municipality
AR	Analysis Report
SG	Surveyor General
SRO	Stormwater Runoff

APPROVAL OF REPORT

Compiled by : **NKP Consulting Engineers (Pty) Ltd.**

Approved by : *C.J. Potgieter (Pr. Eng.)*

Signature : ……………………………………

Date : ……………………………………

Client : **Steve Tshwete Local Municipality**

Approved by : ……………………………………..

Signature : ……………………………………..

Date : ……………………………………

STEVE TSHWETE LOCAL MUNICIPALITY
ANALYSIS REPORT
STORMWATER MASTERPLAN - MIDDELBURG

1.   INTRODUCTION

This report was compiled by NKP Consulting Engineers for our client; Steve Tshwete Local Municipality (STLM). NKP Consulting Engineers was appointed as Civil Engineering Professional Service Providers for the draft of a stormwater masterplan for the Middelburg town area.

The town has been split into the following portions and drawings issued for them separately to make referencing easier due to the fact that it is such a large area.

Drawings have been plotted to a scale of 1:5000.

- NKP339_GML01 (Aerorand North)
- NKP339_GML02 (Aerorand South)
- NKP339_GML03 (Middelburg Central)
- NKP339_GML04 (Middelburg Central 2)
- NKP339_GML05 (Golfsig)
- NKP339_GML06 (Dennesig)
- NKP339_GML07 (Industrial)
- NKP339_GML08 (Kanonkop)
- NKP339_GML09 (Groenkol)
- NKP339_GML10 (Mineralia)
- NKP339_GML011-GML013 (Aerorand South – Mall & Industrial)
- NKP339_GML14 (Nasaret & Ext. 63 & 64)
- NKP339_GML15 (Rockdale)
- NKP339_GML16 (Hlalamnandi & Ext. 34,35 & 36)

2.   PROJECT SCOPE

The project scope entails the following:

- Preliminary pipe sizing
- Indication of existing and proposed new kerb inlets and stormwater outlets, including the connecting piping
- Indication of major runoff areas
- Proposed stormwater for areas still to be developed

For a detailed indication of the stormwater infrastructure, refer to the attached drawings:

- NKP339 – GML 01 up to NKP339 – GML 016

Also refer to the attached Data Volumes containing hydrological analyses as well as pipe data for each of the mentioned areas.

3.   ASSUMPTIONS FOR ANALYSES AND RECOMMENDATION TO CLIENT

For the analysis of the existing infrastructure, as-built layouts were supplied by the client. It was found that the information on these layouts were outdated and not accurate.

Many newly developed areas, like Ext. 63 & 64, did not have any town planning data indicated on the drawings hence information had to be sourced where possible. The accuracy of these town planning layouts, should be confirmed by the client.

Where newly proposed developments were indicated, NKP conducted a preliminary design of kerb inlet positions and pipe sizes for major stormwater systems to allow the client to estimate the required stormwater infrastructure in these areas.

It should be noted that many of the new developments have only been zoned and no roads layouts were available. Thus, provision was made for connecting points to existing and new stormwater infrastructure capable of servicing these areas.

The onus will fall on the client to extend these connection points towards the minor stormwater systems, but note that the major systems proposed have been sized to accommodate the stormwater runoff generated in these areas.

The analysis methodology used to calculate the stormwater runoff generated in Middelburg town, is the obtained by use of the rational method and implemented with design software. (Utility Programs for Drainage; Developed by Sinotech and coded by Prof. SJ van Vuuren and Mr M van Dijk)

The rational method is used for determining peak flow from small to medium catchment areas (<15km²). This was achieved by dividing the bigger catchment areas, as shown on the attached drawings into smaller areas spanning from one kerb inlet to the next. The data for these areas are indicated in the accompanying data volumes.

The mathematical basis of the rational method is encompassed within the following formula:

$$Q = 0.278\, C \times I \times A$$

Where: *Q is the peak flow in m¾s*
                 C is the runoff coefficient for the specific catchment area
                 I is the rainfall intensity in mm/hour
                 A is the area of the catchment in km²
                 0.278 is a conversion factor to change units to m¾s

- *A flood recurrence interval of 1:5 years was adopted as specified in the Guidelines for Human Settlement Planning and Design.*

- *The Annual Average Rainfall for Middelburg was adopted as 620mm per year and the rainfall intensity was determined from this along with the length of the longest watercourse per catchment area as well as the slope of the terrain.*

- The following C-values were used during the analysis process. Where catchment areas consisted of composite elements, the c-value was interpolated to provide an accurate representation of the land use of the catchment area.

Run-off coefficient factors

Component	Classification	Rural (C1) Mean annual rainfall (mm)		
		< 600	600 - 900	> 900
Surface slope	Vleis and pans (<3%)	0.01	0.03	0.05
	Flat areas (3 to 10%)	0.08	0.08	0.11
	Hilly (10 to 30%)	0.12	0.16	0.20
	Steep areas (>30%)	0.22	0.26	0.30
Permeability	Very permeable	0.03	0.04	0.05
	Permeable	0.06	0.08	0.10
	Semi permeable	0.12	0.16	0.20
	Impermeable	0.21	0.26	0.30
Vegetation	Thick bush and plantation	0.03	0.04	0.05
	Light bush and farm lands	0.07	0.11	0.15
	Grasslands	0.17	0.21	0.25
	No vegetation	0.26	0.28	0.30

Urban (C2)	
Lawns	
Sandy, flat (<2%)	0.05 - 0.10
Sandy, steep (>7%)	0.15 - 0.20
Heavy soil, flat (<2%)	0.13 - 0.17
Heavy soil, steep (>7%)	0.25 - 0.35
Residential areas	
Houses	0.30 - 0.50
Flats	0.50 - 0.70
Industry	
Light industry	0.50 - 0.80
Heavy industry	0.60 - 0.90
Business	
City centre	0.70 - 0.95
Suburban	0.50 - 0.70
Streets	0.70 - 0.95
Maximum flood	1.00

Adjustment factors for the influence of initial saturation

	Adjustment factors for value of C1					
Return period	100	50	20	10	5	2
Factor (Ft) for steep and impermeable catchments	1.00	0.95	0.90	0.85	0.80	0.75
Factor (Ft) for flat and permeable catchments	1.00	0.83	0.67	0.60	0.55	0.50

6

- *The slope of the terrain was determined from surveyed contours supplied by the client.*

- *The minimum pipe size required from kerb inlet to kerb inlet was determined by assuming a pipe slope equal to the slope of the terrain, but not with a slope less than 1:100.*

- *For effective maintenance, it is proposed that no stormwater pipes be installed at a gradient of less than 1:50. This ensures self-cleaning of the system during heavy rainfall by removal of excess silt in the pipes.*

- *It is also proposed and has been implemented as such in this masterplan, that no pipes smaller than 6000mm be installed. This allows for easier maintenance during dry periods.*

- *It is important to note that the masterplan should not be used to install pipes as if it serves as a final design. A proper site survey should be conducted and the longitudinal section of the road, the actual achievable pipe slope and the final kerb inlet positions, should be confirmed by a professional Engineers during a detail design, pending the aforementioned.*

- *It is proposed that STLM implement a maintenance plan that allows by process of rotation, the cleaning and inspection of all kerb inlets annually. All kerb inlets have been labelled to assist the client with this process. Obtaining a GPS coordinate at each kerb inlet, as well as a depth, could be used to update the masterplan and ensure accurate records.*

- *The spreadsheets for pipe calculation contained in the data volumes, will be made available to the client electronically, which can then be modified to determine optimal pipe sizes pending accurate pipe slopes.*

- *The calculations for pipe capacity is done by combining Manning's equation with the continuity equation and yields the following:*

$$Q = \frac{A}{n} \times R^2 \times \frac{2}{3} \sqrt{S}$$

Where: **Q is the capacity flow in m³/s**
A is the cross-sectional area of the pipe in m²
n is Manning's coefficient (0.012 for concrete pipes)
R is the hydraulic radius in meters (Assume pipe to be 80% full)
S is the slope in m/m

For ease of reference, a table indicating the most common pipe sizes and slopes used, is attached below as well as in the data volumes.

Pipe Slope (1:)	Pipe Capacity (m³/s)							
	450	600	750	900	1050	1200	1350	1500
10	0.955	2.056	3.728	6.062	9.144	13.06	17.87	23.67
20	0.675	1.454	2.636	4.287	6.466	9.232	12.64	16.74
30	0.551	1.187	2.152	3.5	5.279	7.537	10.32	13.67
40	0.477	1.028	1.864	3.031	4.572	6.528	8.936	11.84
50	0.427	0.92	1.667	2.711	4.089	5.839	7.993	10.59
60	0.39	0.839	1.522	2.475	3.733	5.33	7.297	9.664
70	0.361	0.777	1.409	2.291	3.456	4.934	6.755	8.947
80	0.338	0.727	1.318	2.143	3.233	4.616	6.319	8.369
90	0.318	0.685	1.243	2.021	3.048	4.352	5.957	7.89
100	0.302	0.65	1.179	1.917	2.892	4.129	5.652	7.485

The attached data volumes contain the hydrological analyses and pipe data. For ease of reference, the major catchment areas have been colour coded on the drawings, as well as on the data sheets. This will allow the client to locate the numbered pipes quicker and determine the recommended pipe size, kerb inlet position and distinguish between existing and proposed new pipelines and kerb inlets.

The drawings should be read in conjunction with the pipe data tables and can be used at the client's own prerogative though it is recommended that for efficient and accurate installation of stormwater systems in Middelburg Town, the masterplan be made available to a professional Engineer for the appointment of a surveyor, to assess the actual pipe slopes of existing pipes and surface contours of proposed new developments.

The following design standards and recommendations should be adhered to:

- A 1:5 years flood return period, minor storms for residential areas.
- Maximum runoff velocity along road edge is 3m/s
- Minimum gradient of road edge channels is 0,4%
- 600mm diameter (minimum pipe size.) Pipes to be Class 50D and in the case of road crossings where cover is limited, a Class 100D.
- 1:50 minimum pipe grade.
- A minimum cover of 600mm in the road reserve and 1000mm in the roadway.