SASELAMANI PROPOSED TOWNSHIP

STORMWATER MANAGEMENT PLAN

May 2020, Draft

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1. Introduction

The Saselamani township establishment entails the proposed formalisation and proclamation of the Saselamani CBD on the remainder of Tshikundu's location Farm 262 MT and the remainder of Portion 1 of Tshikundu's location farm 262 MT.

The proposed township will have 1833 stands.

The extent of the township site is 566Hactares in area with a perimeter of 13km, and is shown in the figure below.

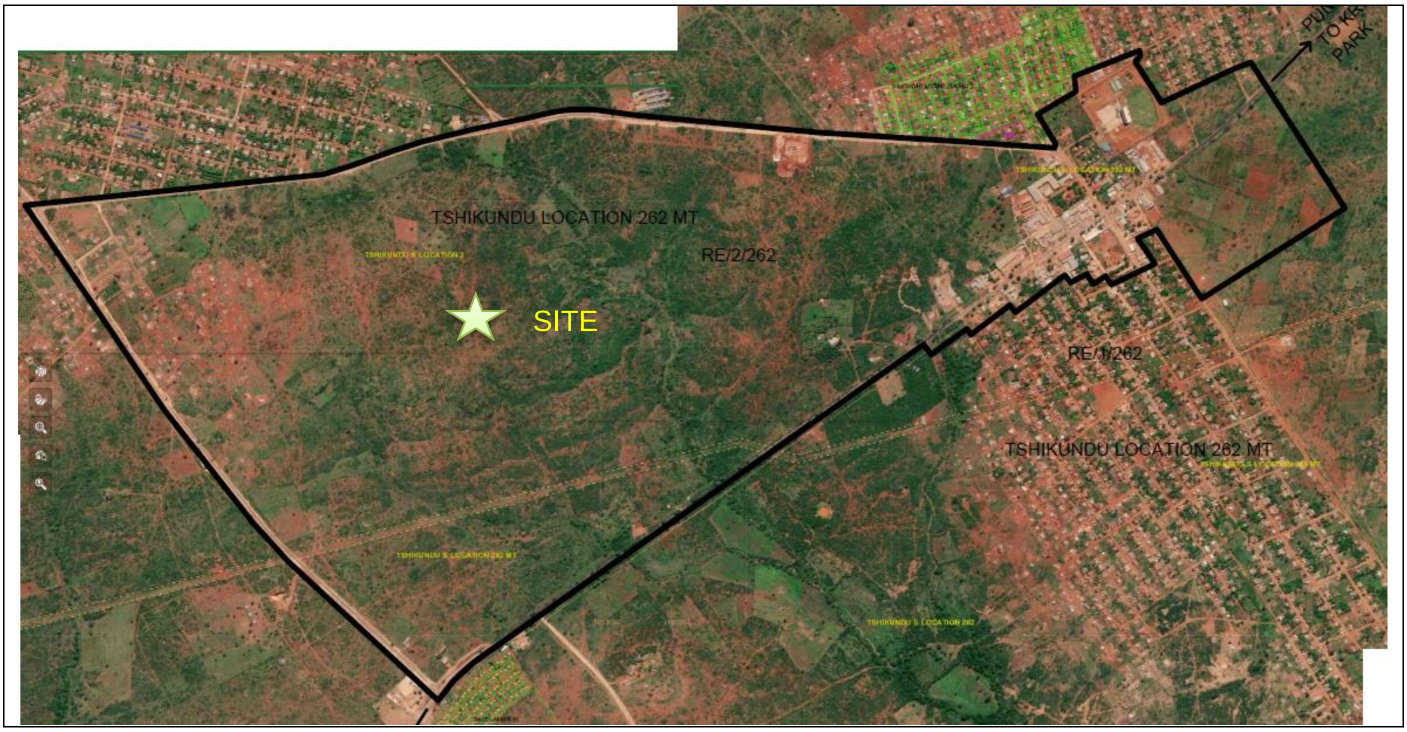

Figure 1 Extent of the township site

The site is largely undeveloped virgin bush land, save for the Salema business centre, new SASA offices, a cemetery, and some developing homesteads on the north western corner area.

The site will be developed into the categories shown in the figures below.

LAND USE

ZONING	LAND USE DESCRIPTION	NO, OF RESIDENTIAL OPPORTUNITIES	AREA (HA)	%
RESIDENTIAL	RESIDENTIAL	1624	201.80	39.31
BUSINESS	BUSINESS PURPOSES	102	65.95	13.19
INSTITUTIONAL	COMMUNITY FACILITIES	34	41.45	2.54
PUBLIC OPEN SPACE	PUBLIC OPEN SPACE\ RECREATIONAL FACILITIES	6	34.47	3.66
URBAN AGRICULTURE	AGRICULTURAL PURPOSES	35	82.92	28.99
MUNICIPAL PURPOSES	OFFICES	5	7.97	7.97
RESIDENTIAL 3	GUEST HOUSES	11	26.45	0.29
LIGHT INDUSTRY	WAREHOUSES / SERVICE INDUSTRY	18	17.20	0.29
ROAD			85.99	12.01
TOTAL		1833	563.64	100

Figure 2 Proposed land use

Figure 3 Proposed site development

2. Locality

Saselamani is situated 50km north of Thohoyandou along the road R524. The area is administered by Collins Chabane Local Municipality, under the Vhembe District Municipality, Limpopo Province, South Africa. GPS coordinates of site are 22°49'56.78"S 30°51'20.83"E.

The locality map is presented on the figures below.

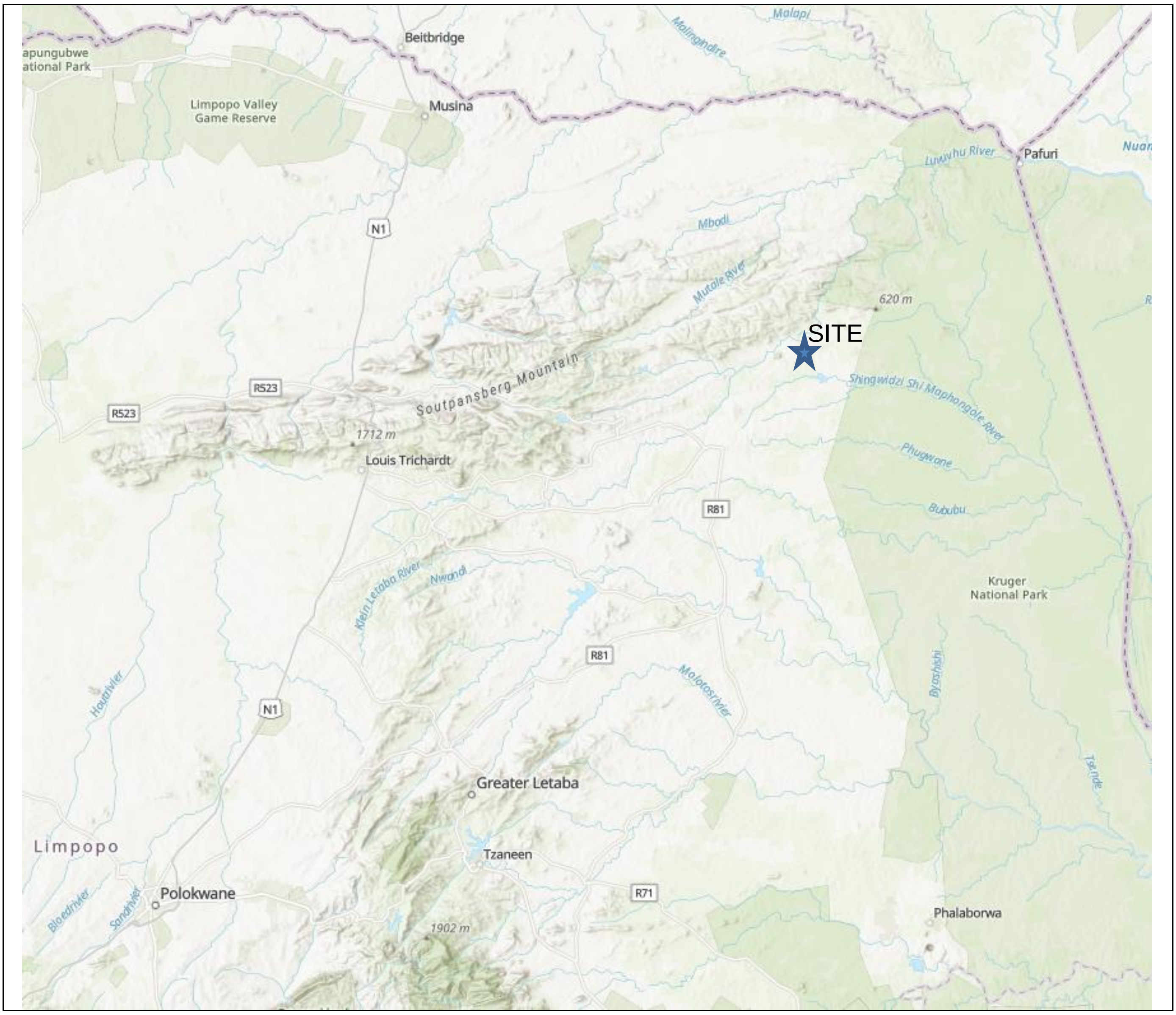

Figure 4 Locality plan

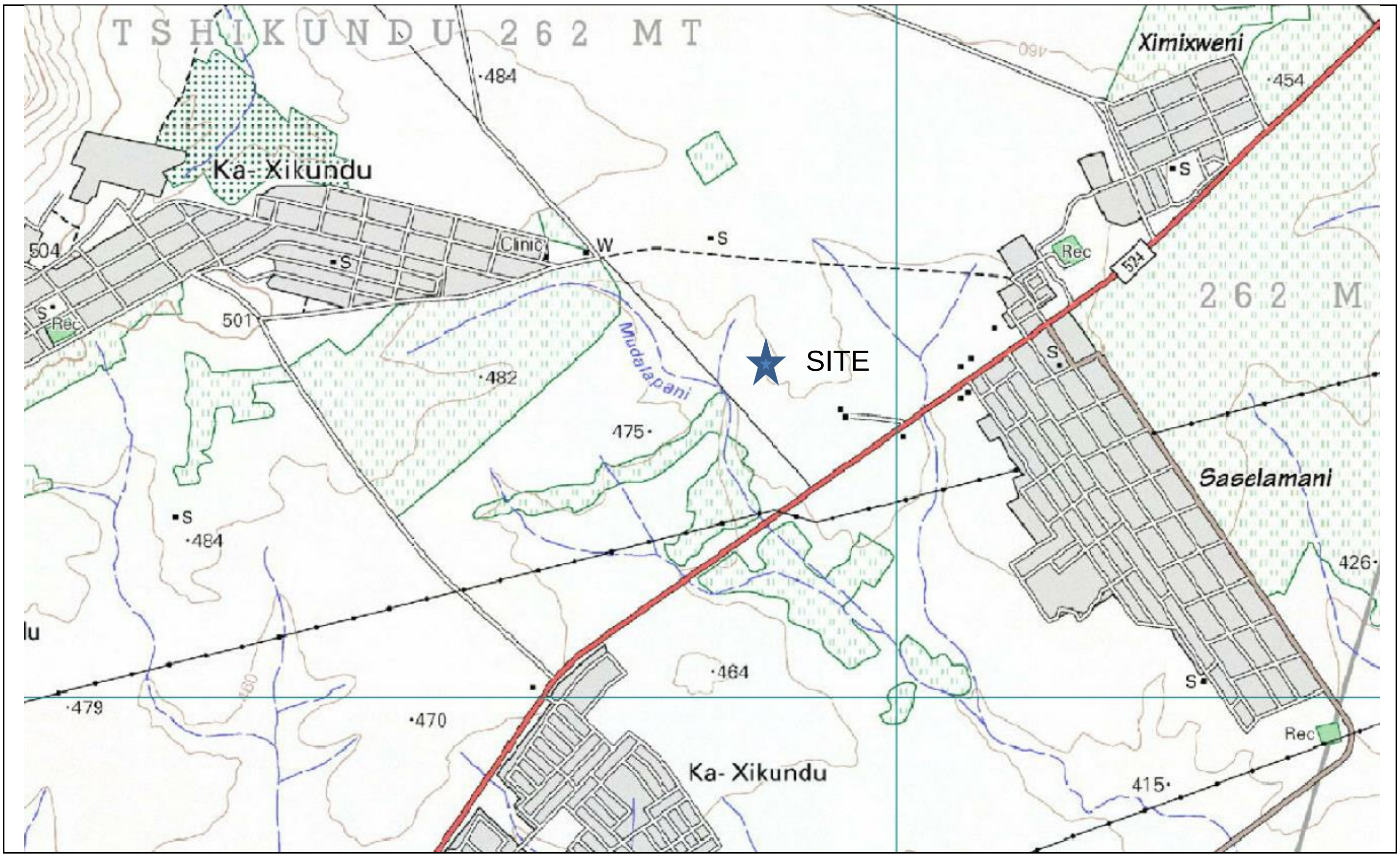

Figure 5 Site for development

3. The purpose

The purpose of this stormwater management plan for the proposed township is as follows:

- To provide a safety plan for residents and properties against potential damage from stormwater and floods.
- To minimise negative impact on flora and fauna of the site.
- To minimise soil erosion.
- The protection of downstream water courses and communities.
- The conservation of water resources in the catchment and minimising pollution and siltation.

4. Development impact

The proposed development of the largely virgin bush land will result in the following:

- Increase of bare areas through deforestation,
- Increase in hardened areas,
- Reduced infiltration areas,
- Reduced evapo-transpiration potential,
- An increase in surface runoff,
- An increase in runoff speed,
- An increase in peak flow rates in the rivers / streams.

5. Development impact mitigation

There needs to be a plan to deliberately reduce the unintended negative impact on the environment from the development.
The fundamental issues to be taken into cognisance are listed below:

- Utilisation of effective localised stormwater management practices.
- Making sure that wetlands operate well with minimum disturbance.
- The conservation of existing natural water courses against erosion, pollution and retain runoff.
- Maintenance of subsoil infiltration.
- Maintaining indigenous vegetation cover along stream banks.
- Stabilisation of stream banks.
- Installation of pollution traps in the streams.
- Use of onsite rainfall attenuation.
- Use of reducing runoff by in-catchment and onsite evaporation and evapo-transpiration.
- Reduction of localised flood risk by using appropriate design standards for culvert and stormwater attenuation infrastructure.
- Attenuation of post-development flood peaks to match pre-development flood peaks. The attenuation levels to be for 1:10 and 1:50 return periods.

6. Main risks

The stormwater main risks are erosion and actual flooding of the site.

Topsoil and alluvial sands are highly erodible and are a threat to the stability of natural land masses. Erosion occurs very quickly on steep slopes leading to the development of dongas and undermining built structures.

Also, a damaged watercourse is impacted by erosion onsite and adjacent properties. Eroded sediment will also be deposited on the downstream dam and wetlands. The cost of erosion repairs can be very high.

The scour velocities for earth materials are listed in the table below.

Earth Material	Maximum velocity (m/s)
Fine sand	0.6
Loam	0.9
Clay	1.2
Gravel	1.5
Soft shale	1.8
Hard shale	2.4
Hard rock	4.5

Table 1 Soil scour velocities

The proposed township development would reduce the rainfall infiltration and increase the stormwater runoff flow and velocity. Hence, there will be an increase to downstream flood damage risk, unless adequate attenuation of runoff flow is done in the watercourses and even onsite.

The design of the major stormwater system must address this increased runoff as much as possible. The post-development flood risks are to be no greater than those of the pre-development flood risks.

The 1:50 return period runoff flows of the pre-development and post-development phases will be used to determine the attenuation required.

7. Stormwater system

The stormwater system is divided into minor and major systems.

The *major stormwater system* is made up of all natural watercourses, i.e. rivers, streams, dams, springs, and wet lands. Stormwater detention dams, and other infrastructure constructed to control stormwater also form part of the major system. Also, roads and their accompanying drainage structures are also part of the major stormwater system, if together they result in a significant diversion of stormwater runoff from its natural overland flow path.

The *minor stormwater system* is made up of any means provided to accommodate stormwater runoff within local sites and road reserves and convey the runoff to the major stormwater system. Channels, small watercourses, berms, gutters, conduits, infiltration infrastructure, road verges form part of the minor system.

Land use	Design flood recurrence interval
Residential	1:1 to 1:5 or more in informal areas to ensure sufficient space to convey runoff
Institutional (e.g. schools)	1:2 to 1:5
General commercial and industrial	1:5
High-value central business district	1:5 to 1:10

Table 2 Flood frequencies for minor system planning

Concentration of stormwater runoff should be avoided as it may result in scouring of the environment. The watercourses and the built stormwater infrastructure must be well maintained and made clear of debris, pollution and other foreign matter.

- The stormwater system for the development must strive for the following:
- Avoid concentration of stormwater runoff, especially were the soil is easily erodible.
- Implement stormwater attenuation, where possible, to reduce the stormwater flows.
- Keep adequate ground cover to stormwater infrastructure to reduce erosion from wind, water, and traffic.
- Keep the stormwater infrastructure well maintained.
- Prevent the pollution of stormwater by suspended solids and dissolved solids.
- Build works to trap sediments at appropriate sections.
- Reduce soil erosion by building protective works.
- Avoid circumstances where natural and or built slopes may become saturated and unstable.

8. Stormwater management strategy

The stormwater management strategy for the development must be implemented by property owners and developers. The strategy is listed as follows:

- Deforestration must be done with caution, as it may lead to soil erosion potential.
- Outside landscaping and re-grassing must be done just after building works are practically completed.
- Approval of detailed plans for prevention of water soil erosion before the start of site works onsite.
- The design of buildings and local site must avoid the concentration of stormwater. There may be a need to provide onsite stormwater attenuation to bring the runoff flow to pre-development levels.
- The building sites must control soil erosion and avoid eroded material from being scoured off-site.
- There should be a minimisation of site earthworks. Soil embankments must be protected from erosion.
- The local onsite stormwater system must be constructed before building works commence, i.e. detention ponds, swales, berms, and soil fences. The stormwater control works must be then monitored in operation.
- There should be no stormwater ponding next to buildings.

9. Catchment areas

There are nine sub-catchments that were delineated, viz;

- C1.1 sub-catchment
- C1.2 sub-catchment
- C1.3 sub-catchment
- C2.1 sub-catchment
- C2.2 sub-catchment
- C2.3 sub-catchment
- C3.1 sub-catchment
- C3.2 sub-catchment
- C3.3 sub-catchment

The catchment areas are within the Luvuvhu and Letaba Water Management Area.
The drainage sub-catchments were delineated for the site.

The sub-catchments information is listed in the table below.

Catchment Site	Catchment area (km^2)	Remark	Quaternary catchment
C1.1	1.370	Sub-catchment	B90B
C1.2	0.203	Sub-catchment	B90B
C1.3	0.308	Sub-catchment	B90B
C2.1	2.440	Sub-catchment	B90B
C2.2	0.326	Sub-catchment	B90B
C2.3	0.629	Sub-catchment	B90B
C3.1	0.942	Sub-catchment	B90B
C3.2	0.449	Sub-catchment	B90B
C3.3	0.340	Sub-catchment	B90B

Table 3: Catchment area

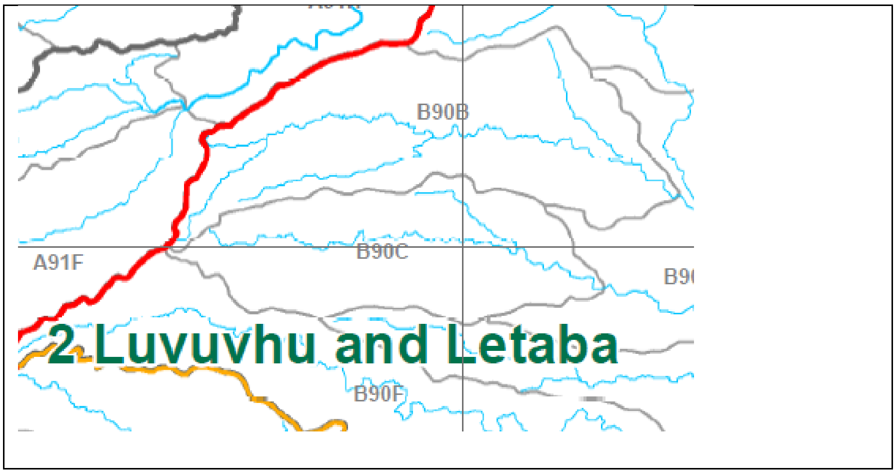

Figure 6 Quaternary catchments

The catchment areas were determined from the surveyor general 1:50,000 map contours, ortho photos and topographical survey. The site topographic survey was also done by Theo, a surveyor appointed by the Client, utilising a drone for the output of 1m contours. The coordinate system on the survey was UTM 36S and projected to Hartebeesthoek94 / Lo31.
See the figures below.

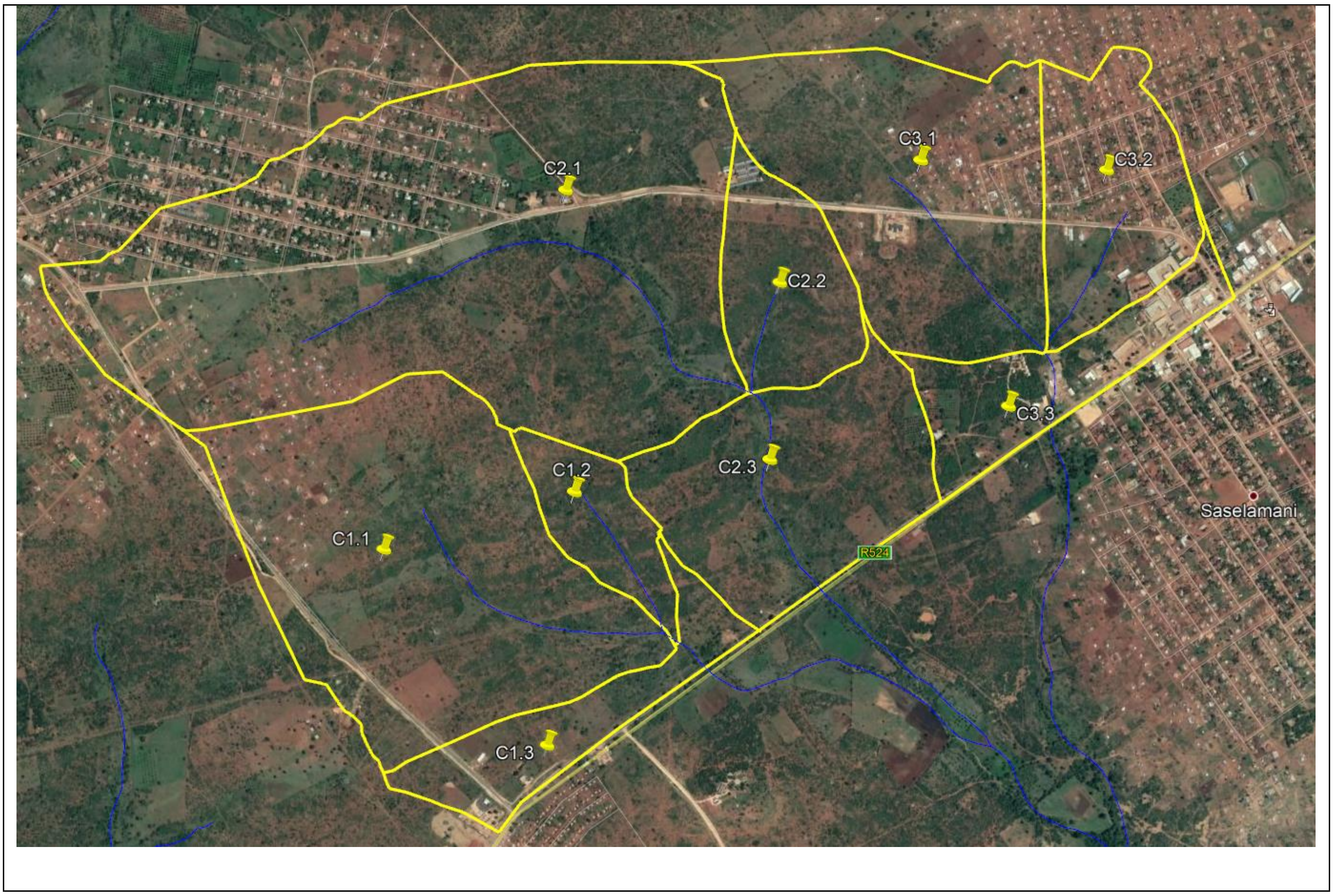

Figure 7 Sub-catchments (yellow line boundaries)

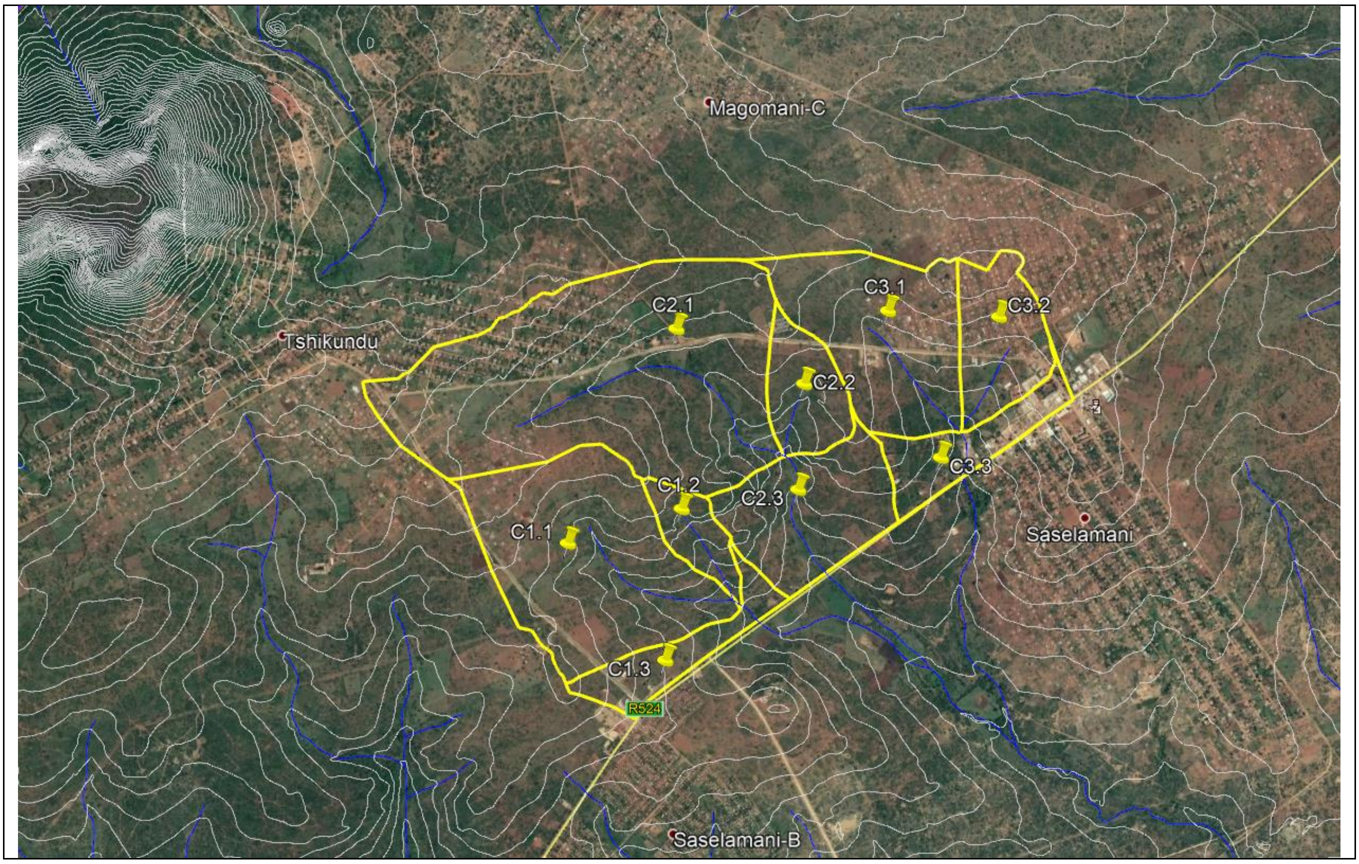

Figure 8 Sub-catchments delineation (yellow line boundaries)

10. Methodology

The first part of modelling was done for a series of storms with a return period of 1:100 and different durations falling over the catchment.
Storms with durations of 1, 1.5, 2, 4, 6, 8, 10, 12, 16, 20 and 24hour were synthesised using procedures to estimate design rainfall in South Africa developed by J.C. Smithers and R.E. Schulze, working under the Water Research Commission through a project entitled "Rainfall Statistics for Design Flood Estimation in South Africa" (WRC Project KS/1060).

The synthesis was done for the following return periods:
1:2 / 1:5 / 1:20 / 1:50 / 1:100

The Rational, Alternative Rational, Standard Design Flood (SDF), Unit Hydrograph, Empirical method and Statistical methods, were used to calculate the 1:100 return period storm event flow.

Secondly, the flood line was determined through utilising the river analysis program HEC-RAS. The methods described in the 6th edition of the SANRAL Drainage Manual (2013) were used to determine the flood peaks.

11. Catchment characteristics

The overall catchment topography ranges from flat light bush and cultivated land to a very small hilly terrain. The topographic elevation ranges from 438m to 503m above sea level.

The Mean Annual Precipitation (MAP) of the catchment was determined from weather stations gridded from in the vicinity of the site.

The MAP for the catchment is estimated to be 501mm.

Station Name	Station Number	Distance from site (km)	Mean Annual Rainfall (mm)	Years of record
Boltman	0724361_W	16.1	595	49
Gooldville Hospitaal	0766863_A	32.4	1077	37
Punda Milia	0768011_W	33.2	589	70
Shangoni	0724790_W	34.6	539	41
Sibasa	0766837_W	34.6	928	87
Palmaryville	0766779_W	41.0	811	92

Table 4 Rainfall data

The soil structure in the area is mainly sandy grey soil. The land use of the area includes residential, and subsistence agriculture mainly.
The area has a very dry subtropical climate, specifically a humid subtropical climate, with long hot and rainy summers and short cool and dry winters.

The area has about 40 days where thunder is heard, thus showing a large amount of convective rainfall activity.


Figure 9 Stream / River onsite

There is no river gauging station on the catchment.
The catchment characteristics are listed in the tables below.

	Rural	Urban	Lakes	
Characteristic	Distribution	Distribution	Distribution	Total
Catchment	%	%	%	(%)
C1.1	100%	0%	0%	100.0%
C1.2	100%	0%	0%	100.0%
C1.3	100%	0%	0%	100.0%
C2.1	100%	0%	0%	100.0%
C2.2	100%	0%	0%	100.0%
C2.3	100%	0%	0%	100.0%
C3.1	100%	0%	0%	100.0%
C3.2	90%	10%	0%	100.0%
C3.3	62%	38%	0%	100.0%

Table 5 Characteristic (pre-development)

	Rural	Urban	Lakes	
Characteristic	Distribution	Distribution	Distribution	Total
Catchment	%	%	%	(%)
C1.1	17%	83%	0%	100.0%
C1.2	7%	93%	0%	100.0%
C1.3	57%	43%	0%	100.0%
C2.1	67%	33%	0%	100.0%
C2.2	21%	79%	0%	100.0%
C2.3	44%	56%	0%	100.0%
C3.1	66%	34%	0%	100.0%
C3.2	43%	57%	0%	100.0%
C3.3	46%	54%	0%	100.0%

Table 6 Characteristic (post-development)

	Lakes and pans (<3%)	Flat area (3 to 10%)	Hilly (10 to 30%)	Steep areas (>30%)	
Rural area - Surface slope	Distribution	Distribution	Distribution	Distribution	Total
Catchment	(%)	(%)	(%)	(%)	(%)
C1.1	39%	60%	1%	0%	100.0%
C1.2	15%	81%	4%	0%	100.0%
C1.3	53%	47%	0%	0%	100.0%
C2.1	49%	51%	0%	0%	100.0%
C2.2	27%	71%	2%	0%	100.0%
C2.3	30%	64%	6%	0%	100.0%
C3.1	53%	47%	0%	0%	100.0%
C3.2	44%	56%	0%	0%	100.0%
C3.3	56%	44%	0%	0%	100.0%

Table 7 Rural area - Surface slope

	Very permeable	Permeable	Semi-permeable	Impermeable	
Rural area - Permeability	**Distribution**	**Distribution**	**Distribution**	**Distribution**	**Total**
Catchment	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
C1.1	11%	70%	17%	2%	100.0%
C1.2	11%	70%	17%	2%	100.0%
C1.3	11%	70%	17%	2%	100.0%
C2.1	11%	70%	17%	2%	100.0%
C2.2	11%	70%	17%	2%	100.0%
C2.3	11%	70%	17%	2%	100.0%
C3.1	11%	70%	17%	2%	100.0%
C3.2	11%	70%	17%	2%	100.0%
C3.3	11%	70%	17%	2%	100.0%

Table 8 Rural area – Permeability

	Thick bush & forests	Light bush & cultivated land	Grasslands	Bare	
Rural area - Vegetation	**Distribution**	**Distribution**	**Distribution**	**Distribution**	**Total**
Catchment					**(%)**
C1.1	48%	40%	8%	4%	100.0%
C1.2	72%	22%	4%	2%	100.0%
C1.3	22%	68%	1%	9%	100.0%
C2.1	41%	32%	16%	11%	100.0%
C2.2	68%	12%	8%	12%	100.0%
C2.3	70%	24%	4%	2%	100.0%
C3.1	41%	26%	24%	9%	100.0%
C3.2	7%	21%	56%	16%	100.0%
C3.3	53%	34%	10%	3%	100.0%

Table 9 Rural area – Vegetation (pre-development)

	Thick bush & forests	Light bush & cultivated land	Grasslands	Bare	
Rural area - Vegetation	**Distribution**	**Distribution**	**Distribution**	**Distribution**	**Total**
Catchment					**(%)**
C1.1	5%	35%	8%	52%	100.0%
C1.2	6%	15%	4%	75%	100.0%
C1.3	12%	40%	1%	47%	100.0%
C2.1	18%	20%	9%	53%	100.0%
C2.2	23%	8%	9%	60%	100.0%
C2.3	50%	16%	4%	30%	100.0%
C3.1	35%	15%	18%	32%	100.0%
C3.2	3%	15%	30%	52%	100.0%
C3.3	25%	15%	5%	55%	100.0%

Table 10 Rural area – Vegetation (post-development)

	Catchments Distribution (%)								
Urban	**C1.1**	**C1.2**	**C1.3**	**C2.1**	**C2.2**	**C2.3**	**C3.1**	**C3.2**	**C3.3**
Lawns									
Sandy, flat	0	0	0	0	0	0	0	0	0
Sandy, steep	0	0	0	0	0	0	0	0	0
Heavy soil, flat	0	0	0	0	0	0	0	0	0
Heavy soil, steep	0	0	0	0	0	0	0	0	0
Residential areas									
Houses	0	0	0	0	0	0	0	0	0
Flats	0	0	0	0	0	0	0	0	0
Industry									
Light industry	0	0	0	0	0	0	0	0	0
Heavy industry	0	0	0	0	0	0	0	0	0
Business									
City centre	0	0	0	0	0	0	0	0	0
Suburban	0	0	0	0	0	0	0	75%	75%
Streets	0	0	0	0	0	0	0	75%	75%
Maximum flood	0	0	0	0	0	0	0	0	
Total	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**	**100%**

Table 11 Urban (pre-development)

	Catchments Distribution (%)								
Urban	**C1.1**	**C1.2**	**C1.3**	**C2.1**	**C2.2**	**C2.3**	**C3.1**	**C3.2**	**C3.3**
Lawns									
Sandy, flat	43%	46%	11%	41%	45%	39%	43%	35%	24%
Sandy, steep	1%	1%	0%	1%	1%	1%	1%	1%	1%
Heavy soil, flat	11%	11%	3%	10%	11%	10%	11%	9%	6%
Heavy soil, steep	0%	0%	0%	0%	0%	0%	0%	0%	0%
Residential areas									
Houses	36%	39%	9%	35%	39%	34%	37%	30%	0
Flats	0	0	0	0	0	0	0	0	0
Industry									
Light industry	0	0	0	0	0	0	0	0	0
Heavy industry	0	0	0	0	0	0	0	0	0
Business									
City centre	0	0	0	0	0	0	0	0	0
Suburban	7%	2%	58%	10%	3%	12%	6%	19%	52%
Streets	2%	1%	19%	3%	1%	4%	2%	6%	17%
Maximum flood	0	0	0	0	0	0	0	0	0
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 12 Urban (post-development)

	Run-off factor			
	Rural (C_R)	**Urban (C_U)**	**Lakes (C_L)**	**Combined (C)**
Catchment				
C1.1	0.177	0	0	**0.177**
C1.2	0.174	0	0	**0.174**
C1.3	0.183	0	0	**0.183**
C2.1	0.196	0	0	**0.196**
C2.2	0.191	0	0	**0.191**
C2.3	0.168	0	0	**0.168**
C3.1	0.198	0	0	**0.198**
C3.2	0.262	0.763	0	**0.312**
C3.3	0.166	0.763	0	**0.393**

Table 13 Run-off factor (pre-development)

	Run-off factor			
	Rural (C_R)	**Urban (C_U)**	**Lakes (C_L)**	**Combined (C)**
Catchment				
C1.1	0.286	0.312	0	**0.307**
C1.2	0.339	0.285	0	**0.289**
C1.3	0.259	0.648	0	**0.426**
C2.1	0.278	0.334	0	**0.296**
C2.2	0.301	0.291	0	**0.293**
C2.3	0.230	0.350	0	**0.297**
C3.1	0.238	0.310	0	**0.263**
C3.2	0.306	0.392	0	**0.355**
C3.3	0.271	0.562	0	**0.428**

Table 14 Run-off factor (post-development)

Catchment	Catchment Area (km^2)	Longest water course (km)	Distance to centroid of catchment area (km)	Height difference 1085 method (m)	Height difference equal area method (m)	Veld type region	Days thunder was heard (No.)	Area Dolomite (%)	Mean Annual Precipitation (mm)	SDF Basin no. (No.)	Kovács region
C1.1	1.370	2.03	0.95	38.2	43.34	8	40	0	501	3	K6
C1.2	0.203	1.00	0.524	28.5	33.49	8	40	0	501	3	K6
C1.3	0.308	1.25	0.5	25.7	31.59	8	40	0	501	3	K6
C2.1	2.440	2.95	1.333	36.4	51.47	8	40	0	501	3	K6
C2.2	0.326	0.98	0.41	24.3	30.91	8	40	0	501	3	K6
C2.3	0.629	1.08	0.273	24.0	30.72	8	40	0	501	3	K6
C3.1	0.942	1.72	0.78	27.4	31.88	8	40	0	501	3	K6
C3.2	0.449	1.09	0.553	19.8	25.08	8	40	0	501	3	K6
C3.3	0.340	1.04	0.12	17.3	24.85	8	40	0	501	3	K6

Table 15 Hydrological input

Catchment Site	Catchment area (km^2)	Longest water course, L (km)	Height difference along 10-85 slope (m)	Average slope S_{av} (m/m)	Time of concentration, Tc (hours)	% Slope	MAP (mm)	Run-off factor C	Distance to centroid (km)	Height difference on equal area slope (m)
C1.1	1.370	2.032	38.2	0.02509083	0.47323618	2.51%	501	0.177	0.95	43.34
C1.2	0.203	1.003	28.5	0.03790481	0.234386358	3.79%	501	0.174	0.524	33.49
C1.3	0.308	1.251	25.7	0.02738279	0.314949112	2.74%	501	0.183	0.5	31.59
C2.1	2.440	2.948	36.4	0.01646270	0.741182834	1.65%	501	0.196	1.333	51.47
C2.2	0.326	0.982	24.3	0.03301244	0.243241146	3.30%	501	0.191	0.41	30.91
C2.3	0.629	1.079	24.0	0.02970798	0.27239182	2.97%	501	0.168	0.273	30.72
C3.1	0.942	1.721	27.4	0.02124894	0.443804615	2.12%	501	0.198	0.78	31.88
C3.2	0.449	1.093	19.8	0.02420387	0.297684301	2.42%	501	0.312	0.553	25.08
C3.3	0.340	1.039	17.3	0.02217648	0.296059185	2.22%	501	0.393	0.12	24.85

Table 16 Catchment characteristics (pre-development)

Catchment Site	Catchment area (km^2)	Longest water course, L (km)	Height difference along 10-85 slope (m)	Average slope S_{av} (m/m)	Time of concentration, Tc (hours)	% Slope	MAP (mm)	Run-off factor C	Distance to centroid (km)	Height difference on equal area slope (m)
C1.1	1.370	2.032	38.2	0.02509083	0.47323618	2.51%	501	0.307	0.95	43.34
C1.2	0.203	1.003	28.5	0.03790481	0.234386358	3.79%	501	0.289	0.524	33.49
C1.3	0.308	1.251	25.7	0.02738279	0.314949112	2.74%	501	0.426	0.5	31.59
C2.1	2.440	2.948	36.4	0.01646270	0.741182834	1.65%	501	0.296	1.333	51.47
C2.2	0.326	0.982	24.3	0.03301244	0.243241146	3.30%	501	0.293	0.41	30.91
C2.3	0.629	1.079	24.0	0.02970798	0.27239182	2.97%	501	0.297	0.273	30.72
C3.1	0.942	1.721	27.4	0.02124894	0.443804615	2.12%	501	0.263	0.78	31.88
C3.2	0.449	1.093	19.8	0.02420387	0.297684301	2.42%	501	0.355	0.553	25.08
C3.3	0.340	1.039	17.3	0.02217648	0.296059185	2.22%	501	0.428	0.12	24.85

Table 17 Catchment characteristics (post-development)

	Rational method						Alternative rational method					
Return	1:2	1:5	1:10	1:20	1:50	1:100	1:2	1:5	1:10	1:20	1:50	1:100
Catchment												
C1.1	2.057	2.985	4.012	5.242	7.186	9.301	2.661	4.788	6.654	8.705	11.5	13.95
C1.2	0.428	0.622	0.837	1.094	1.5	1.943	0.593	1.068	1.484	1.941	2.566	3.112
C1.3	0.595	0.864	1.162	1.519	2.083	2.698	0.798	1.435	1.995	2.61	3.449	4.183
C2.1	3.051	4.428	5.95	7.771	10.65	13.78	3.852	6.931	9.633	12.6	16.65	20.2
C2.2	0.745	1.081	1.454	1.9	2.606	3.376	1.027	1.848	2.569	3.36	4.441	5.386
C2.3	1.2	1.743	2.343	3.061	4.198	5.435	1.635	2.942	4.089	5.349	7.068	8.573
C3.1	1.639	2.38	3.199	4.181	5.733	7.422	2.13	3.834	5.328	6.97	9.211	11.17
C3.2	1.644	2.343	3.096	3.985	5.389	6.891	2.218	3.915	5.349	6.891	8.979	10.75
C3.3	1.815	2.505	3.214	4.022	5.297	6.604	2.218	3.915	5.349	6.891	8.979	10.75

Table 18 Estimated stormwater flow (m^3/s) (pre-development)

	Rational method						Alternative rational method					
Return	1:2	1:5	1:10	1:20	1:50	1:100	1:2	1:5	1:10	1:20	1:50	1:100
Catchment												
C1.1	4.562	6.26	7.983	9.929	13	16.11	5.902	10.04	13.24	16.49	20.81	24.17
C1.2	0.93	1.272	1.616	2.004	2.615	3.231	1.289	2.183	2.867	3.557	4.472	5.174
C1.3	1.69	2.344	3.022	3.798	5.025	6.292	2.265	3.894	5.188	6.527	8.319	9.754
C2.1	5.185	7.318	9.588	12.24	16.42	20.84	6.546	11.46	15.52	19.84	25.68	30.55
C2.2	1.441	1.984	2.539	3.169	4.164	5.179	1.988	3.391	4.486	5.605	7.094	8.263
C2.3	2.584	3.582	4.615	5.798	7.665	9.591	3.519	6.048	8.055	10.13	12.91	15.13
C3.1	2.463	3.47	4.54	5.787	7.757	9.835	3.201	5.59	7.56	9.648	12.46	14.8
C3.2	2.096	2.911	3.757	4.728	6.263	7.85	2.826	4.865	6.491	8.177	10.43	12.25
C3.3	1.962	2.713	3.487	4.369	5.764	7.196	2.648	4.537	6.026	7.559	9.606	11.23

Table 19 Estimated stormwater flow (m^3/s) (post-development)

12. Conclusion

13. References

- Smithers J.C. and Schulze R.E. (2002): Drainage rainfall and flood estimation in South Africa, WRC project KS/1060.

- The South African National Roads Agency Limited (2013): Drainage manual, 6th Edition.

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ANNEXURES

ANNEXURE 1 DRAWINGS