

Description of catchment: Sibaya Node 6 **Calculated by:**
Element Description: Area 10 Pre Development **Date:** Monday, 11 November 2019
Project Number: 2019_0173 **Source:** SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,058569	km ²
Water path (overland)	L ₁ =	0,2	km
Average slope:	H _{L1} =	103,000	m
	H _{L2} =	88,000	m
Overland	L ₁ =	0,2	km
	S _{avg1} =	0,075	m/m
Area dolomite	D=	0%	

Longest water path	L=	0,52	km
Water path (water course)	L ₂ =	0,32	km
Average slope:	H _{0,85L} =	88,000	m
	H _{0,10L} =	61,000	m
Watercourse	0.75L=	0,24	km
	S _{avg2} =	0,1125	m/m

Area distribution factors (α + β + γ = 1)					
Rural	Urban	Lakes	α	β	γ
			1	0	0

0,177

RURAL								URBAN			
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)			VEGETATION C _v (%)			USE			
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	30%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	5%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets	0%	0,95
Total (100)	100%	0,178	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	0%	0,0

Rural coefficient C₁= 0,413

Urban coefficient C₂= 0,00

Return period	2	5	10	20	50	100	200
F _i	1	1	1	1	1	1	1
C	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Adjusted C ₁	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Total C	0,41	0,41	0,41	0,41	0,41	0,41	0,41

RAINFALL:

T_c (overland flow)

$$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r =	0,4
T _c =	0,34

V = 0,1634 m/s
(0.2 - 0.5m/s)

Values for r	
Paved areas	0,02
Clean soil	0,1
Sparse Grass	0,3
Moderate Grass	0,4
Thick Bush	0,8

T_c (channel flow)

$$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T_c = 0,0640

V = 1,3889 m/s
(0.8 - 1.3m/s)

T_c = 0,4050

Storm duration 24,3 min

Dolomite reduction (D _i)	
Steep (>30%)	0,5
Hilly (10 -30%)	0,35
Flat (3 - 10%)	0,2
Vlei's & Pans (<3%)	0,1

Average annual rainfall: 1018 mm / annum

Rainfall region: Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,369	0,553	0,697	0,853	0,892	1,088	1,291	1,519
Peak flow (l/s)	369	553	697	853	892	1088	1291	1519

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 10 Post Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,058569 km ²	Longest water path	L=	0,52 km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L ₁ =	0,2 km				Rural	Urban	Lakes			
Average slope:	H _{L1} =	103,000 m	Water path (water course)	L ₂ =	0,32 km	α=	0,28	β=	0,72	γ=	0
Overland	H _{L2} =	88,000 m	Average slope:	H _{0,85L} =	88,000 m	0,177					
	L ₁ =	0,2 km	Watercourse	H _{0,10L} =	61,000 m						
	S _{avg1} =	0,075 m/m		0,75L=	0,24 km						
Area dolomite	D=	0%		S _{avg2} =	0,1125 m/m						

RURAL						URBAN					
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE					
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	30%	0,18
Flat areas	30%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	20%	0,6
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	5%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets and roofs	50%	0,95
Total (100)	100%	0,178	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	100%	0,6

Rural coefficient C ₁ =	0,413	Urban coefficient C ₂ =	0,65
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Adjusted C ₁	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Total C	0,58	0,58	0,58	0,58	0,58	0,58	0,58

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4 T _c = 0,34	V = 0,1634 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0,02</td></tr> <tr><td>Clean soil</td><td>0,1</td></tr> <tr><td>Sparse Grass</td><td>0,3</td></tr> <tr><td>Moderate Grass</td><td>0,4</td></tr> <tr><td>Thick Bush</td><td>0,8</td></tr> </table>	Values for r		Paved areas	0,02	Clean soil	0,1	Sparse Grass	0,3	Moderate Grass	0,4	Thick Bush	0,8
Values for r																
Paved areas	0,02															
Clean soil	0,1															
Sparse Grass	0,3															
Moderate Grass	0,4															
Thick Bush	0,8															

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0640	V = 1,3889 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D_i)</th></tr> <tr><td>Steep (>30%)</td><td>0,5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0,35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0,2</td></tr> <tr><td>Vlei's & Pans (<3%)</td><td>0,1</td></tr> </table>	Dolomite reduction (D _i)		Steep (>30%)	0,5	Hilly (10 -30%)	0,35	Flat (3 - 10%)	0,2	Vlei's & Pans (<3%)	0,1
Dolomite reduction (D _i)														
Steep (>30%)	0,5													
Hilly (10 -30%)	0,35													
Flat (3 - 10%)	0,2													
Vlei's & Pans (<3%)	0,1													
		T _c = 0,4050												
		Storm duration 24,3 min												

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,522	0,781	0,985	1,206	1,261	1,538	1,824	2,146
Peak flow (l/s)	522	781	985	1206	1261	1538	1824	2146

Description of catchment:
Element Description:
Project Number:

Sibaya Node 6
 Area 11 Pre Development
 2019_0173

Calculated by:
Date:
Source:

Monday, 11 November 2019
 SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,0917	km ²
Water path (overland)	L ₁ =	0,2	km
Average slope:	H _{L1} =	92,000	m
	H _{L2} =	65,500	m
Overland	L ₁ =	0,2	km
	S _{avg1} =	0,1325	m/m
Area dolomite	D=	0%	

Longest water path	L=	0,315	km
Water path (water course)	L ₂ =	0,115	km
Average slope:	H _{0,85L} =	65,500	m
	H _{0,10L} =	57,000	m
Watercourse	0.75L=	0,08625	km
	S _{avg2} =	0,0985507	m/m

Area distribution factors (α + β + γ = 1)					
Rural	Urban	Lakes			
α=	1	β=	0	γ=	0

0,116

RURAL								URBAN			
SLOPE		SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE			
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	30%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	5%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets	0%	0,95
Total (100)	100%	0,178	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	0%	0,0

Rural coefficient C₁= 0,413

Urban coefficient C₂= 0,00

Return period	2	5	10	20	50	100	200
F _i	1	1	1	1	1	1	1
C	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Adjusted C ₁	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Total C	0,41	0,41	0,41	0,41	0,41	0,41	0,41

RAINFALL:

T_c (overland flow)

$$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r =	0,4
T _c =	0,2977

V = 0,1866 m/s
(0.2 - 0.5m/s)

Values for r	
Paved areas	0,02
Clean soil	0,1
Sparse Grass	0,3
Moderate Grass	0,4
Thick Bush	0,8

T_c (channel flow)

$$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T _c =	0,0310
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V = 1,0305 m/s
(0.8 - 1.3m/s)

T _c =	0,4050
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Storm duration 24,3 min

Dolomite reduction (D _i)	
Steep (>30%)	0,5
Hilly (10 -30%)	0,35
Flat (3 - 10%)	0,2
Vlei's & Pans (<3%)	0,1

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,578	0,866	1,091	1,336	1,397	1,704	2,021	2,378
Peak flow (l/s)	578	866	1091	1336	1397	1704	2021	2378

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 11 Post Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,0917 km ²	Longest water path	L=	0,315 km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L ₁ =	0,2 km				Rural	Urban	Lakes			
Average slope:	H _{L1} =	92,000 m	Water path (water course)	L ₂ =	0,115 km	α=	0,00	β=	1,00	γ=	0
Overland	H _{L2} =	65,500 m	Average slope:	H _{0,85L} =	65,500 m	0,116					
	L ₁ =	0,2 km	Watercourse	H _{0,10L} =	57,000 m						
	S _{avg1} =	0,1325 m/m		0,75L=	0,08625 km						
Area dolomite	D=	0%		S _{avg2} =	0,0985507 m/m						

RURAL						URBAN					
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE					
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	30%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	100%	0,6
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	5%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets and roofs	0%	0,95
Total (100)	100%	0,178	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	100%	0,6

Rural coefficient C ₁ =	0,413	Urban coefficient C ₂ =	0,60
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Adjusted C ₁	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Total C	0,60	0,60	0,60	0,60	0,60	0,60	0,60

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4 T _c = 0,2977	V = 0,1866 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0,02</td></tr> <tr><td>Clean soil</td><td>0,1</td></tr> <tr><td>Sparse Grass</td><td>0,3</td></tr> <tr><td>Moderate Grass</td><td>0,4</td></tr> <tr><td>Thick Bush</td><td>0,8</td></tr> </table>	Values for r		Paved areas	0,02	Clean soil	0,1	Sparse Grass	0,3	Moderate Grass	0,4	Thick Bush	0,8
Values for r																
Paved areas	0,02															
Clean soil	0,1															
Sparse Grass	0,3															
Moderate Grass	0,4															
Thick Bush	0,8															

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0310 T _c = 0,4050	V = 1,0305 m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D_i)</th></tr> <tr><td>Steep (>30%)</td><td>0,5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0,35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0,2</td></tr> <tr><td>Vlei's & Pans (<3%)</td><td>0,1</td></tr> </table>	Dolomite reduction (D _i)		Steep (>30%)	0,5	Hilly (10 -30%)	0,35	Flat (3 - 10%)	0,2	Vlei's & Pans (<3%)	0,1
Dolomite reduction (D _i)														
Steep (>30%)	0,5													
Hilly (10 -30%)	0,35													
Flat (3 - 10%)	0,2													
Vlei's & Pans (<3%)	0,1													

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Storm duration 24,3 min

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,839	1,258	1,586	1,941	2,030	2,476	2,937	3,454
Peak flow (l/s)	839	1258	1586	1941	2030	2476	2937	3454

Description of catchment:
Element Description:
Project Number:

Sibaya Node 6
 Area 12 Pre Development
 2019_0173

Calculated by:
Date:
Source:

Monday, 11 November 2019
 SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,009345	km ²
Water path (overland)	L ₁ =	0,06	km
Average slope:	H _{L1} =	73,000	m
	H _{L2} =	59,000	m
Overland	L ₁ =	0,06	km
	S _{avg1} =	0,233333333	m/m
Area dolomite	D=	0%	

Longest water path	L=	0,06	km
Water path (water course)	L ₂ =	0	km
Average slope:	H _{0,85L} =	0,000	m
	H _{0,10L} =	0,000	m
Watercourse	0.75L=	0	km
	S _{avg2} =	0	m/m

Area distribution factors (α + β + γ = 1)					
Rural		Urban		Lakes	
α=	1	β=	0	γ=	0

0,233

RURAL								URBAN			
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)				VEGETATION C _v (%)		USE			
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	20%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	15%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets	0%	0,95
Total (100)	100%	0,197	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	0%	0,0

Rural coefficient C₁= 0,432

Urban coefficient C₂= 0,00

Return period	2	5	10	20	50	100	200
F _i	1	1	1	1	1	1	1
C	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Adjusted C ₁	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Total C	0,43	0,43	0,43	0,43	0,43	0,43	0,43

RAINFALL:

T_c (overland flow)

$$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r =	0,4
T _c =	0,1487

V = 0,1121 m/s
 (0.2 - 0.5m/s)

Values for r	
Paved areas	0,02
Clean soil	0,1
Sparse Grass	0,3
Moderate Grass	0,4
Thick Bush	0,8

T_c (channel flow)

$$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T _c =	0,0000
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V = #DIV/0! m/s
 (0.8 - 1.3m/s)

Dolomite reduction (D _i)	
Steep (>30%)	0,5
Hilly (10 -30%)	0,35
Flat (3 - 10%)	0,2
Vlei's & Pans (<3%)	0,1

T _c =	0,4050
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Storm duration 24,3 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,062	0,092	0,116	0,142	0,149	0,182	0,215	0,253
Peak flow (l/s)	62	92	116	142	149	182	215	253

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 12 Post Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A= 0,009345 km ²	Longest water path	L= 0,06 km	Area distribution factors (α + β + γ = 1)		
Water path (overland)	L ₁ = 0,06 km	Water path (water course)	L ₂ = 0 km	Rural	Urban	Lakes
Average slope:	H _{L1} = 73,000 m	Average slope:	H _{0,85L} = 0,000 m	α= 0,00	β= 1,00	γ= 0
Overland	H _{L2} = 59,000 m	Watercourse	H _{0,10L} = 0,000 m	0,233		
	L ₁ = 0,06 km		0,75L= 0 km			
	S _{avg1} = 0,233333333 m/m		S _{avg2} = 0 m/m			
Area dolomite	D= 0%					

RURAL						URBAN	
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE	
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%
Flat areas	20%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%
Mountaneous	15%	0,3	Unpermeable	0%	0,3	No vegetation	0%
Total (100)	100%	0,197	Total (100)	100%	0,075	Total (100)	100%
							0,16
							1,0

Rural coefficient C ₁ =	0,432	Urban coefficient C ₂ =	0,95
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Adjusted C ₁	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Total C	0,95	0,95	0,95	0,95	0,95	0,95	0,95

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4	V = 0,1121 m/s (0.2 - 0.5m/s)	Values for r
		T _c = 0,1487		Paved areas 0,02
				Clean soil 0,1
				Sparse Grass 0,3
				Moderate Grass 0,4
				Thick Bush 0,8

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0000	V = #DIV/0! m/s (0.8 - 1.3m/s)	Dolomite reduction (D_i)
		T _c = 0,4050		Steep (>30%) 0,5
				Hilly (10 -30%) 0,35
				Flat (3 - 10%) 0,2
				Vlei's & Pans (<3%) 0,1
		Storm duration 24,3 min		

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,135	0,203	0,256	0,313	0,328	0,399	0,474	0,557
Peak flow (l/s)	135	203	256	313	328	399	474	557

Description of catchment:
Element Description:
Project Number:

Sibaya Node 6
 Area 13 Pre Development
 2019_0173

Calculated by:
Date:
Source:

Monday, 11 November 2019
 SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,008165	km ²
Water path (overland)	L ₁ =	0,07	km
Average slope:	H _{L1} =	70,000	m
	H _{L2} =	59,000	m
Overland	L ₁ =	0,07	km
	S _{avg1} =	0,157142857	m/m
Area dolomite	D=	0%	

Longest water path	L=	0,07	km
Water path (water course)	L ₂ =	0	km
Average slope:	H _{0,85L} =	0,000	m
	H _{0,10L} =	0,000	m
Watercourse	0.75L=	0	km
	S _{avg2} =	0	m/m

Area distribution factors (α + β + γ = 1)					
Rural		Urban		Lakes	
α=	1	β=	0	γ=	0

0,157

RURAL								URBAN			
SLOPE		SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE			
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	20%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	15%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets	0%	0,95
Total (100)	100%	0,197	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	0%	0,0

Rural coefficient C₁= 0,432

Urban coefficient C₂= 0,00

Return period	2	5	10	20	50	100	200
F _i	1	1	1	1	1	1	1
C	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Adjusted C ₁	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Total C	0,43	0,43	0,43	0,43	0,43	0,43	0,43

RAINFALL:

T_c (overland flow)

$$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r =	0,4
T _c =	0,1752

V = 0,111 m/s
(0.2 - 0.5m/s)

Values for r	
Paved areas	0,02
Clean soil	0,1
Sparse Grass	0,3
Moderate Grass	0,4
Thick Bush	0,8

T_c (channel flow)

$$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T _c =	0,0000
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V = #DIV/0! m/s
(0.8 - 1.3m/s)

T _c =	0,4050
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Storm duration 24,3 min

Dolomite reduction (D _i)	
Steep (>30%)	0,5
Hilly (10 -30%)	0,35
Flat (3 - 10%)	0,2
Vlei's & Pans (<3%)	0,1

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,054	0,081	0,102	0,124	0,130	0,159	0,188	0,221
Peak flow (l/s)	54	81	102	124	130	159	188	221

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 13 Post Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,008165	km ²	Longest water path	L=	0,07	km	Area distribution factors ($\alpha + \beta + \gamma = 1$)					
Water path (overland)	L ₁ =	0,07	km	Water path (water course)	L ₂ =	0	km	Rural	Urban	Lakes			
Average slope:	H _{L1} =	70,000	m	Average slope:	H _{0,85L} =	0,000	m	$\alpha=$	0,85	$\beta=$	0,15	$\gamma=$	0
Overland	H _{L2} =	59,000	m	Watercourse	H _{0,10L} =	0,000	m	0,157					
	L ₁ =	0,07	km		0,75L=	0	km						
	S _{avg1} =	0,157142857	m/m		S _{avg2} =	0	m/m						
Area dolomite	D=	0%											

RURAL								URBAN			
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)				VEGETATION C _v (%)		USE			
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	20%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	65%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	15%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets and roofs	100%	0,95
Total (100)	100%	0,197	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	100%	1,0

Rural coefficient C ₁ =	0,432	Urban coefficient C ₂ =	0,95
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Adjusted C ₁	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Total C	0,51	0,51	0,51	0,51	0,51	0,51	0,51

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{r L_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4 T _c = 0,1752	V = 0,111 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0,02</td></tr> <tr><td>Clean soil</td><td>0,1</td></tr> <tr><td>Sparse Grass</td><td>0,3</td></tr> <tr><td>Moderate Grass</td><td>0,4</td></tr> <tr><td>Thick Bush</td><td>0,8</td></tr> </table>	Values for r		Paved areas	0,02	Clean soil	0,1	Sparse Grass	0,3	Moderate Grass	0,4	Thick Bush	0,8
Values for r																
Paved areas	0,02															
Clean soil	0,1															
Sparse Grass	0,3															
Moderate Grass	0,4															
Thick Bush	0,8															

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0000 T _c = 0,4050	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D_i)</th></tr> <tr><td>Steep (>30%)</td><td>0,5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0,35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0,2</td></tr> <tr><td>Vlei's & Pans (<3%)</td><td>0,1</td></tr> </table>	Dolomite reduction (D _i)		Steep (>30%)	0,5	Hilly (10 -30%)	0,35	Flat (3 - 10%)	0,2	Vlei's & Pans (<3%)	0,1
Dolomite reduction (D _i)														
Steep (>30%)	0,5													
Hilly (10 -30%)	0,35													
Flat (3 - 10%)	0,2													
Vlei's & Pans (<3%)	0,1													
Average annual rainfall:	1018 mm / annum	Storm duration	24,3 min											
Rainfall region:	Summer													

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,063	0,095	0,120	0,147	0,154	0,187	0,222	0,261
Peak flow (l/s)	63	95	120	147	154	187	222	261

Description of catchment:
Element Description:
Project Number:

Sibaya Node 6
 Area 14 Pre Development
 2019_0173

Calculated by:
Date:
Source:

Monday, 11 November 2019
 SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,038518	km ²
Water path (overland)	L ₁ =	0,2	km
Average slope:	H _{L1} =	86,000	m
	H _{L2} =	63,000	m
Overland	L ₁ =	0,2	km
	S _{avg1} =	0,115	m/m
Area dolomite	D=	0%	

Longest water path	L=	0,22	km
Water path (water course)	L ₂ =	0,02	km
Average slope:	H _{0,85L} =	63,000	m
	H _{0,10L} =	60,000	m
Watercourse	0.75L=	0,015	km
	S _{avg2} =	0,2	m/m

Area distribution factors (α + β + γ = 1)					
Rural	Urban	Lakes			
α=	β=	γ=			
1	0	0			

0,106

RURAL								URBAN			
SLOPE SLOPE C _S (%)		PERMEABILITY C _p (%)			VEGETATION C _v (%)			USE			
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	20%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	75%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	5%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets	0%	0,95
Total (100)	100%	0,187	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	0%	0,0

Rural coefficient C₁= 0,422

Urban coefficient C₂= 0,00

Return period	2	5	10	20	50	100	200
F _i	1	1	1	1	1	1	1
C	0,42	0,42	0,42	0,42	0,42	0,42	0,42
Adjusted C ₁	0,42	0,42	0,42	0,42	0,42	0,42	0,42
Total C	0,42	0,42	0,42	0,42	0,42	0,42	0,42

RAINFALL:

T_c (overland flow)

$$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r =	0,4
T _c =	0,3077

V = 0,1806 m/s
(0.2 - 0.5m/s)

Values for r	
Paved areas	0,02
Clean soil	0,1
Sparse Grass	0,3
Moderate Grass	0,4
Thick Bush	0,8

T_c (channel flow)

$$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T _c =	0,0060
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V = 0,9259 m/s
(0.8 - 1.3m/s)

T _c =	0,4050
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Storm duration 24,3 min

Dolomite reduction (D _i)	
Steep (>30%)	0,5
Hilly (10 -30%)	0,35
Flat (3 - 10%)	0,2
Vlei's & Pans (<3%)	0,1

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,248	0,372	0,468	0,573	0,600	0,731	0,868	1,020
Peak flow (l/s)	248	372	468	573	600	731	868	1020

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 14 Post Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A= 0,038518 km ²	Longest water path	L= 0,22 km	Area distribution factors (α + β + γ = 1)		
Water path (overland)	L ₁ = 0,2 km			Rural	Urban	Lakes
Average slope:	H _{L1} = 86,000 m	Water path (water course)	L ₂ = 0,02 km	α= 0,00	β= 1,00	γ= 0
Overland	H _{L2} = 63,000 m	Average slope:	H _{0,85L} = 63,000 m	0,106		
	L ₁ = 0,2 km	Watercourse	H _{0,10L} = 60,000 m			
	S _{avg1} = 0,115 m/m		0,75L= 0,015 km			
Area dolomite	D= 0%		S _{avg2} = 0,2 m/m			

RURAL						URBAN	
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE	
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%
Flat areas	20%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%
Hilly areas	75%	0,2	Semi-permeable	0%	0,2	Grasveld	10%
Mountaneous	5%	0,3	Unpermeable	0%	0,3	No vegetation	0%
Total (100)	100%	0,187	Total (100)	100%	0,075	Total (100)	100%
							0,16
						Total (100)	100%
							1,0

Rural coefficient C ₁ =	0,422	Urban coefficient C ₂ =	0,95
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,42	0,42	0,42	0,42	0,42	0,42	0,42
Adjusted C ₁	0,42	0,42	0,42	0,42	0,42	0,42	0,42
Total C	0,95	0,95	0,95	0,95	0,95	0,95	0,95

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4	V = 0,1806 m/s (0.2 - 0.5m/s)	Values for r
		T _c = 0,3077		Paved areas 0,02
				Clean soil 0,1
				Sparse Grass 0,3
				Moderate Grass 0,4
				Thick Bush 0,8

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0060	V = 0,9259 m/s (0.8 - 1.3m/s)	Dolomite reduction (D_i)
				Steep (>30%) 0,5
				Hilly (10 -30%) 0,35
				Flat (3 - 10%) 0,2
				Vlei's & Pans (<3%) 0,1

Storm duration 24,3 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,558	0,836	1,054	1,291	1,350	1,647	1,953	2,297
Peak flow (l/s)	558	836	1054	1291	1350	1647	1953	2297

Description of catchment:
Element Description:
Project Number:

Sibaya Node 6
 Area 15 Pre Development
 2019_0173

Calculated by:
Date:
Source:

Monday, 11 November 2019
 SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,004887	km ²
Water path (overland)	L ₁ =	0,078	km
Average slope:	H _{L1} =	68,000	m
	H _{L2} =	58,000	m
Overland	L ₁ =	0,078	km
	S _{avg1} =	0,128205128	m/m
Area dolomite	D=	0%	

Longest water path	L=	0,078	km
Water path (water course)	L ₂ =	0	km
Average slope:	H _{0,85L} =	0,000	m
	H _{0,10L} =	0,000	m
Watercourse	0.75L=	0	km
	S _{avg2} =	0	m/m

Area distribution factors (α + β + γ = 1)					
Rural		Urban		Lakes	
α=	1	β=	0	γ=	0

0,128

RURAL								URBAN					
SLOPE SLOPE C _s (%)				PERMEABILITY C _p (%)				VEGETATION C _v (%)				USE	
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18		
Flat areas	10%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6		
Hilly areas	90%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85		
Mountaneous	0%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets	0%	0,95		
Total (100)	100%	0,191	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	0%	0,0		

Rural coefficient C₁= 0,426

Urban coefficient C₂= 0,00

Return period	2	5	10	20	50	100	200
F _i	1	1	1	1	1	1	1
C	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Adjusted C ₁	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Total C	0,43	0,43	0,43	0,43	0,43	0,43	0,43

RAINFALL:

T_c (overland flow)

$$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$$

r =	0,4
T _c =	0,1932

V = 0,1121 m/s
 (0.2 - 0.5m/s)

Values for r

Paved areas	0,02
Clean soil	0,1
Sparse Grass	0,3
Moderate Grass	0,4
Thick Bush	0,8

T_c (channel flow)

$$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$$

T _c =	0,0000
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V = #DIV/0! m/s
 (0.8 - 1.3m/s)

T _c =	0,4050
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Storm duration 24,3 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Dolomite reduction (D _i)	
Steep (>30%)	0,5
Hilly (10 -30%)	0,35
Flat (3 - 10%)	0,2
Vlei's & Pans (<3%)	0,1

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,032	0,048	0,060	0,073	0,077	0,094	0,111	0,131
Peak flow (l/s)	32	48	60	73	77	94	111	131

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 15 Post Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,004887 km ²	Longest water path	L=	0,078 km	Area distribution factors (α + β + γ = 1)	
Water path (overland)	L ₁ =	0,078 km					
Average slope:	H _{L1} =	68,000 m	Water path (water course)	L ₂ =	0 km	Rural	
Overland	H _{L2} =	58,000 m	Average slope:	H _{0,85L} =	0,000 m	Urban	
	L ₁ =	0,078 km	Watercourse	H _{0,10L} =	0,000 m	Lakes	
	S _{avg1} =	0,128205128 m/m		0,75L=	0 km	α=	
Area dolomite	D=	0%	S _{avg2} =	0 m/m	β=	0,85	
						γ=	0

RURAL						URBAN					
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE					
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	10%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	90%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	0%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets and roofs	100%	0,95
Total (100)	100%	0,191	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	100%	1,0

Rural coefficient C ₁ =	0,426	Urban coefficient C ₂ =	0,95
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Adjusted C ₁	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Total C	0,50	0,50	0,50	0,50	0,50	0,50	0,50

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{rL_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4	V = 0,1121 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0,02</td></tr> <tr><td>Clean soil</td><td>0,1</td></tr> <tr><td>Sparse Grass</td><td>0,3</td></tr> <tr><td>Moderate Grass</td><td>0,4</td></tr> <tr><td>Thick Bush</td><td>0,8</td></tr> </table>	Values for r		Paved areas	0,02	Clean soil	0,1	Sparse Grass	0,3	Moderate Grass	0,4	Thick Bush	0,8
Values for r																
Paved areas	0,02															
Clean soil	0,1															
Sparse Grass	0,3															
Moderate Grass	0,4															
Thick Bush	0,8															
		T _c = 0,1932														

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0000	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D_i)</th></tr> <tr><td>Steep (>30%)</td><td>0,5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0,35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0,2</td></tr> <tr><td>Vlei's & Pans (<3%)</td><td>0,1</td></tr> </table>	Dolomite reduction (D _i)		Steep (>30%)	0,5	Hilly (10 -30%)	0,35	Flat (3 - 10%)	0,2	Vlei's & Pans (<3%)	0,1
Dolomite reduction (D _i)														
Steep (>30%)	0,5													
Hilly (10 -30%)	0,35													
Flat (3 - 10%)	0,2													
Vlei's & Pans (<3%)	0,1													
		T _c = 0,4050												

Storm duration 24,3 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,038	0,056	0,071	0,087	0,091	0,111	0,132	0,155
Peak flow (l/s)	38	56	71	87	91	111	132	155

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 19 Pre Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,00577 km ²	Longest water path	L=	0,057 km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L ₁ =	0,057 km				Rural	Urban	Lakes			
Average slope:	H _{L1} =	68,500 m	Water path (water course)	L ₂ =	0 km	α=	1,00	β=	0,00	γ=	0
Overland	H _{L2} =	60,500 m	Average slope:	H _{0,85L} =	0,000 m	0,14					
	L ₁ =	0,057 km	Watercourse	H _{0,10L} =	0,000 m						
	S _{avg1} =	0,140350877 m/m		0,75L=	0 km						
Area dolomite	D=	0%		S _{avg2} =	0 m/m						

RURAL						URBAN					
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE					
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	30%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	70%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	0%	0,85
Mountaneous	0%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets and roofs	100%	0,95
Total (100)	100%	0,173	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	100%	1,0

Rural coefficient C ₁ =	0,408	Urban coefficient C ₂ =	0,95
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Adjusted C ₁	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Total C	0,41	0,41	0,41	0,41	0,41	0,41	0,41

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{r L_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4 T _c = 0,1634	V = 0,0969 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0,02</td></tr> <tr><td>Clean soil</td><td>0,1</td></tr> <tr><td>Sparse Grass</td><td>0,3</td></tr> <tr><td>Moderate Grass</td><td>0,4</td></tr> <tr><td>Thick Bush</td><td>0,8</td></tr> </table>	Values for r		Paved areas	0,02	Clean soil	0,1	Sparse Grass	0,3	Moderate Grass	0,4	Thick Bush	0,8
Values for r																
Paved areas	0,02															
Clean soil	0,1															
Sparse Grass	0,3															
Moderate Grass	0,4															
Thick Bush	0,8															

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0000	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D_i)</th></tr> <tr><td>Steep (>30%)</td><td>0,5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0,35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0,2</td></tr> <tr><td>Vlei's & Pans (<3%)</td><td>0,1</td></tr> </table>	Dolomite reduction (D _i)		Steep (>30%)	0,5	Hilly (10 -30%)	0,35	Flat (3 - 10%)	0,2	Vlei's & Pans (<3%)	0,1
Dolomite reduction (D _i)														
Steep (>30%)	0,5													
Hilly (10 -30%)	0,35													
Flat (3 - 10%)	0,2													
Vlei's & Pans (<3%)	0,1													
		T _c = 0,4050												
		Storm duration 24,3 min												

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,036	0,054	0,068	0,083	0,087	0,106	0,126	0,148
Peak flow (l/s)	36	54	68	83	87	106	126	148

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Area 19 Post Development	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,00577 km ²	Longest water path	L=	0,057 km	Area distribution factors (α + β + γ = 1)					
Water path (overland)	L ₁ =	0,057 km				Rural	Urban	Lakes			
Average slope:	H _{L1} =	68,500 m	Water path (water course)	L ₂ =	0 km	α=	0,00	β=	1,00	γ=	0
Overland	H _{L2} =	60,500 m	Average slope:	H _{0,85L} =	0,000 m	0,14					
	L ₁ =	0,057 km	Watercourse	H _{0,10L} =	0,000 m						
	S _{avg1} =	0,140350877 m/m		0,75L=	0 km						
Area dolomite	D=	0%		S _{avg2} =	0 m/m						

RURAL						URBAN					
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)		VEGETATION C _v (%)		USE					
Lakes and pans	0%	0,05	Very permeable	50%	0,05	Thick bush & plantations	0%	0,05	Lawns & Parks	0%	0,18
Flat areas	30%	0,11	Permeable	50%	0,1	Light bush & cultivated areas	90%	0,15	Residential	0%	0,6
Hilly areas	70%	0,2	Semi-permeable	0%	0,2	Grasveld	10%	0,25	City / Industrial	100%	0,85
Mountaneous	0%	0,3	Unpermeable	0%	0,3	No vegetation	0%	0,3	Streets and roofs	0%	0,95
Total (100)	100%	0,173	Total (100)	100%	0,075	Total (100)	100%	0,16	Total (100)	100%	0,9

Rural coefficient C ₁ =	0,408	Urban coefficient C ₂ =	0,85
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Adjusted C ₁	0,41	0,41	0,41	0,41	0,41	0,41	0,41
Total C	0,85	0,85	0,85	0,85	0,85	0,85	0,85

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{r L_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,4 T _c = 0,1634	V = 0,0969 m/s (0.2 - 0.5m/s)	<table border="1"> <tr><th colspan="2">Values for r</th></tr> <tr><td>Paved areas</td><td>0,02</td></tr> <tr><td>Clean soil</td><td>0,1</td></tr> <tr><td>Sparse Grass</td><td>0,3</td></tr> <tr><td>Moderate Grass</td><td>0,4</td></tr> <tr><td>Thick Bush</td><td>0,8</td></tr> </table>	Values for r		Paved areas	0,02	Clean soil	0,1	Sparse Grass	0,3	Moderate Grass	0,4	Thick Bush	0,8
Values for r																
Paved areas	0,02															
Clean soil	0,1															
Sparse Grass	0,3															
Moderate Grass	0,4															
Thick Bush	0,8															

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0000	V = #DIV/0! m/s (0.8 - 1.3m/s)	<table border="1"> <tr><th colspan="2">Dolomite reduction (D_i)</th></tr> <tr><td>Steep (>30%)</td><td>0,5</td></tr> <tr><td>Hilly (10 -30%)</td><td>0,35</td></tr> <tr><td>Flat (3 - 10%)</td><td>0,2</td></tr> <tr><td>Vlei's & Pans (<3%)</td><td>0,1</td></tr> </table>	Dolomite reduction (D _i)		Steep (>30%)	0,5	Hilly (10 -30%)	0,35	Flat (3 - 10%)	0,2	Vlei's & Pans (<3%)	0,1
Dolomite reduction (D _i)														
Steep (>30%)	0,5													
Hilly (10 -30%)	0,35													
Flat (3 - 10%)	0,2													
Vlei's & Pans (<3%)	0,1													
		T _c = 0,4050												
		Storm duration 24,3 min												

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,075	0,112	0,141	0,173	0,181	0,221	0,262	0,308
Peak flow (l/s)	75	112	141	173	181	221	262	308

Description of catchment:	Sibaya Node 6	Calculated by:	
Element Description:	Wetland 3	Date:	Monday, 11 November 2019
Project Number:	2019_0173	Source:	SANRAL, 2007

PHYSICAL PROPERTIES OF CATCHMENT:

Area of catchment:	A=	0,043	km ²	Longest water path	L=	0,356	km	Area distribution factors ($\alpha + \beta + \gamma = 1$)					
Water path (overland)	L ₁ =	0,076	km						Rural	Urban	Lakes		
Average slope:	H _{L1} =	64,000	m	Water path (water course)	L ₂ =	0,28	km	$\alpha=$	1,00	$\beta=$	0,00	$\gamma=$	0
Overland	H _{L2} =	58,000	m	Average slope:	H _{0,85L} =	58,000	m	0,182					
	L ₁ =	0,076	km	Watercourse	H _{0,10L} =	51,000	m						
	S _{avg1} =	0,078947368	m/m		0,75L=	0,21	km						
Area dolomite	D=	0%			S _{avg2} =	0,03333333	m/m						

RURAL								URBAN			
SLOPE SLOPE C _s (%)		PERMEABILITY C _p (%)				VEGETATION C _v (%)		USE			
Lakes and pans	30%	0,05	Very permeable	0%	0,05	Thick bush & plantations	50%	0,05	Lawns & Parks	100%	0,3
Flat areas	50%	0,11	Permeable	10%	0,1	Light bush & cultivated areas	30%	0,15	Residential	0%	0,6
Hilly areas	20%	0,2	Semi-permeable	60%	0,2	Grasveld	20%	0,25	City / Industrial	0%	0,85
Mountaneous	0%	0,3	Unpermeable	30%	0,3	No vegetation	0%	0,3	Streets and roofs	0%	0,95
Total (100)	100%	0,11	Total (100)	100%	0,22	Total (100)	100%	0,12	Total (100)	100%	0,3

Rural coefficient C ₁ =	0,450	Urban coefficient C ₂ =	0,30
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Return period	2	5	10	20	50	100	200
F _t	1	1	1	1	1	1	1
C	0,45	0,45	0,45	0,45	0,45	0,45	0,45
Adjusted C ₁	0,45	0,45	0,45	0,45	0,45	0,45	0,45
Total C	0,45	0,45	0,45	0,45	0,45	0,45	0,45

RAINFALL:

T _c (overland flow)	$T_c = 0.604 \times \left(\frac{r L_1}{S_{avg1}^{0.5}} \right)^{0.467}$	r = 0,8	V = 0,0714 m/s (0.2 - 0.5m/s)	Values for r
		T _c = 0,2955		Paved areas 0,02
				Clean soil 0,1
				Sparse Grass 0,3
				Moderate Grass 0,4
				Thick Bush 0,8

T _c (channel flow)	$T_c = \left(\frac{0.87 \times L_2^2}{1000 S_{avg2}} \right)^{0.385}$	T _c = 0,0920	V = 0,8454 m/s (0.8 - 1.3m/s)	Dolomite reduction (D_i)
				Steep (>30%) 0,5
				Hilly (10 -30%) 0,35
				Flat (3 - 10%) 0,2
				Vlei's & Pans (<3%) 0,1

Storm duration 24,3 min

Average annual rainfall:	1018 mm / annum
Rainfall region:	Summer

Return period	2	5	10	20	50	100	200
Point rainfall (mm)	22,24	33,33	42,02	51,43	65,61	77,82	91,53
Point intensity I (mm/h)	54,9	82,3	103,7	127,0	162,0	192,1	226,0
Area reduction factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average intensity I (mm/hr)	54,9	82,3	103,7	127,0	162,0	192,1	226,0

PEAK FLOW:

Return period	2	5	10	20	25	50	100	200
Peak flow (m ³ /s)	0,295	0,442	0,558	0,683	0,714	0,871	1,033	1,215
Peak flow (l/s)	295	442	558	683	714	871	1033	1215