Caculation sheet description: Surface flood retention and peak discharge

Caculation type (if applicable): SCS, Rational and SDF

Date of calculations:24-03-2025Calculations done by:Des Fourie

Calculation summary:

Surface flood retention and peak discharge

Calculation method	Flood Retention (m³) - V	Peak Discharge (m³/s) - Q
SCS	13495	2.5
Rational	8355.00	1.51
SDF	8083	2.1

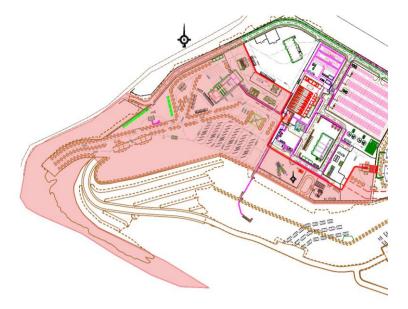
Conclusion:

The flood retention volume for the purpose of design will be based on the rational method. Peak discharge for the purpose of design will also be based on the Rational method. The design may improve on this minimum storage requirement as subsequent revisions to the design may be effected.

Abbreviation	calculate flood retention volume and po Item description	Unit of mea	asure Source	Input value
Q _p	Peak discharge	m³/s	Calculated	p
∢ p /	Catchment volume	m³	Calculated	
\ \	Catchment area	km²	Measured	0.114366
2	Stormflow depth	mm	Calculated	01211000
vent	Storm event	years	Guidalatea	01:50
L	Catchment lag time	hours	Calculated	02.00
_	Hydraulic length of catchment along main channel	km	Measured	0.539
- S	Potential Maximum Soil Water Retention/Infiltratio		Calculated	0.000
CN	Curve number	N/A	Chart	91.7
,	Average catchment slope	%	Calculated	
\RF	Areal reduction factor	%	Calculated	
c	Time of concentraction	hours	Calculated	
C	Roughness coefficient	N/A	Tabulated with recommended values	0.3
o _d	Runoff potential	mm	Chart	140
	Initial abstraction	mm	Calculated from S, based on curve number	23
a S (Slope)	Based on Invert levels set for the design	m/m	Measured	N/A
V (Stope)	Contour interval	m	Measured	10
•	Contour interval		ricusurcu	10
upporting inf	in:			
upporting iiii	Surface description	on	Recommended value of r	
	Paved areas		0,02	
	Clean compacted soil, n		0,1	
	Sparse grass over fairly rou Medium grass cov		0,3	
	Thick grass cove SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil	Conservation Se	0,4 0,8 ervice based techniques for the estimation of design flood volur fless than 30 % has been adapted for South African conditions	
Average catch	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen	Conservation Se	0,8 ervice based techniques for the estimation of design flood volur	
	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmer Water Research Commission	Conservation Se	0,8 ervice based techniques for the estimation of design flood volur	by the
/	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmer Water Research Commission	Conservation Sents with slopes o	0,8 ervice based techniques for the estimation of design flood volur of less than 30 % has been adapted for South African conditions	by the
Potential Maxi	Thick grass cove SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmer Water Research Commission Iment slope is calculated to be:	Conservation Sents with slopes o	0,8 ervice based techniques for the estimation of design flood volur of less than 30 % has been adapted for South African conditions Invert levels set out in drawing - Reference 09160001E-	by the
/ Potential Maxi	Thick grass cove SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmer Water Research Commission Iment slope is calculated to be:	Conservation Sents with slopes o	0,8 ervice based techniques for the estimation of design flood volur of less than 30 % has been adapted for South African conditions	by the
/ Potential Maxi S	Thick grass cove SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmer Water Research Commission Iment slope is calculated to be:	Conservation Sents with slopes o	0,8 ervice based techniques for the estimation of design flood volur of less than 30 % has been adapted for South African conditions Invert levels set out in drawing - Reference 09160001E-	by the
/ Potential Maxi S Stormflow dep	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission ment slope is calculated to be: imum Soil Water Retention is calculated to be:	Conservation Sents with slopes o	0,8 ervice based techniques for the estimation of design flood volur of less than 30 % has been adapted for South African conditions Invert levels set out in drawing - Reference 09160001E-	by the
Potential Maxi S Stormflow dep Q	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission ment slope is calculated to be: imum Soil Water Retention is calculated to be:	Conservation Sents with slopes o	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions $Invert \ levels \ set \ out \ in \ drawing - Reference \ 09160001E-$ $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$	by the
Potential Maxi S Stormflow dep Q Aereal reducti	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission Imment slope is calculated to be: Immum Soil Water Retention is calculated to be: Into the calculated to be: Into the calculated to be: Into factor is calculat	Conservation Sents with slopes o	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions $Invert \ levels \ set \ out \ in \ drawing - Reference \ 09160001E-$ $S = \frac{25400}{CN} - 254$	by the
Potential Maxi S Stormflow dep Q Aereal reducti	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission Imment slope is calculated to be: Immum Soil Water Retention is calculated to be: Into the calculated to be: Into factor is ca	Conservation Sents with slopes of 0.3 % 23 mm 118 mm 20.2 %	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO $ARF = (99000 - 12800 \ln A + 9830 \ln I)^{A4}$ Where: ARF = (99000 - 12800 \ln A + 9830 \ln I)^{A4} Where: ARF = (99 000 - 12800 \ln A + 9830 \ln I)^{A4} Where: Are considered for the condition of the 100 Act of of the 10	by the
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Potential Maxi S Stormflow dep Q Aereal reducti ARF Fime of Conce	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission Imment slope is calculated to be: In this calculated to be:	Conservation Sents with slopes of 0.3 % 23 mm 118 mm 20.2 %	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 09160001E- $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO. ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ Widness: ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ Videous Acceleration for India (Policy Conditions) (1 = Time of concentrations formed) (1 = Time of	by the
Potential Maxi Solormflow dep Q Aereal reducti ARF Time of Conce	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission Imment slope is calculated to be: In this calculated to be:	Conservation Sents with slopes of 0.3 % 23 mm 118 mm 20.2 %	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO $ARF = (99000 - 12800 \ln A + 9830 \ln I)^{A4}$ Where: ARF = (99000 - 12800 \ln A + 9830 \ln I)^{A4} Where: ARF = (99 000 - 12800 \ln A + 9830 \ln I)^{A4} Where: Are considered for the condition of the 100 Act of of the 10	by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Time of Conce T _c Catchment vo	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission Imment slope is calculated to be: In this calculated to be:	Conservation Sents with slopes of 0.3 % 23 mm 118 mm 20.2 %	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 09160001E- $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO. ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ Widness: ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ Videous Acceleration for India (Policy Conditions) (1 = Time of concentrations formed) (1 = Time of	by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Fime of Conce	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission Imment slope is calculated to be: In this calculated to be:	Conservation Sents with slopes of 0.3 % 23 mm 118 mm 20.2 %	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 09160001E- $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO. ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ Widness: ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ Videous Acceleration for India (Policy Conditions) (1 = Time of concentrations formed) (1 = Time of	by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Fime of Conce Tc Catchment vo	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil and peak discharge from relatively small catchmen Water Research Commission Imment slope is calculated to be: In this calculated to be:	Conservation Sents with slopes of 0.3 % 23 mm 118 mm 20.2 % 1 hr	ervice based techniques for the estimation of design flood volum of less than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 09160001E- $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO. ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ Widness: ARF = (99.000 - 12.800InA + 9.830InI) ⁶⁴ To cathematic and principle (and principle) 1 = Time of concentration (principle) 1 = Time of concentration (principle) 0.4667 $T_C = 0.604 \left(\frac{rL}{S0.5}\right)^{0.4667}$ $V = Q \times A$	by the

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The stormwater/dirty water drain and catchment area information is as follows:



Drain fall	1.465 m
Drain invert end	1191.911
Drain invert start	1193.376
Drain length	539.5 m
Catchment area	114366 m ²

 Drain fall
 1.465 m
 0.3%

 Drain cross section
 1.5m wide and 0.75m deep at start

Terrace fall to drain 1 in 100

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1:368

Abbreviation	Item description	Unit of measure	Source	Input value
Qp	Peak discharge	m³/s	Calculated	
V	Catchment volume	m³	Calculated	
Α	Catchment area	km²	Measured	0.114366
L	Hydraulic length of catchment along main channel	km	Measured	0.539
Event	Storm event	years		01:50
I	Rainfall Intensity	mm/hour	SAICE Chart 2	50
Тс	Time of concentraction	minutes	Calculated	
r	Roughness coefficient	N/A	Tabulated with recommended values	0.3
С	Runoff factor	N/A	Chart	0.95
S (SANRAL)	Average slope of the overland path	m/m	Measured	0.003
Time of Concentr	ation is calculated to be:			
Тс	6:	1 minutes	$T_c = 0.604 \left(\frac{rL}{S^{0.5}}\right)^{0.467}$	
Catchment volun	ne			
V	8355.00) m ³	$V = Q \times 3Tc \times 60/2$	
Peak discharge is	calculated to be:			
Q _p	1.5	1 m³/s	Q = CIA/3.6	

In order to calculate flood retention volume and peak discharge, the following will be utilized for the SDF method:

VDDI CAIQI	tion I	tem desc	cription					Unit of mea	sure	Source				Input valu
Q _t	F	Peak disc	harge				1	m³/s		Calcula	ted			
V	(Catchmei	nt volume				1	m³		Calcula	ted			
Α	(Catchmei	nt area				I	km²		Measured				0.11436
MAP	1	Mean ann	ual precipi	tation			1	mm		Struan S	AWS			550
Event	5	Storm eve	ent				\	years						01:50
L	H	Hydraulic	length of c	atchment	along m	ain chanı	-	km		Measure	ed			0.539
Sav (SANF	RAL) A	Average slope of the overland path				1	m/m		Measure	ed			0.003	
Pt.T	É	Point precipication depth				1	mm		Calcula	ted				
lt		Rainfall in	=	·			1	mm/hr		Calcula	ted			
ARF	A	Areal redu	uction facto	r			(%		Calcula	ted			
T _c	1	Time of co	oncentracti	on			ŀ	hours		Calcula	ted			
C _t	F	Runoff co	efficient				ı	N/A		Calcula	ted			
r			s coefficie	nt				N/A				ecomme	nded values	0.3
ľ		поивппес	3 COCITICIO					14/71		rabatate	Zu Witi i	ccomme	naca valacs	0.0
Supportin	ng info):	Called	Table 3B	.1: Infor	mation r	required	l for the cal	culati	on of the	SDF			
	•		Basin	SAWS	SATI	'S site	M	R	C ₂	C100	MAP	MAE		
				number	100000	and the second	(mm)	(days)	(%)	(%)	(mm)	(mm)		
			1	546 204	Str	uan	56	30	10	40	550	1800		
					TABL	E 8: RE1	TURN F	PERIOD FA	ACTO	DRS				7
	Т	· =	2		5	10		20		50		100	200	
	Y-	т =	0	0.	84	1.2	8	1.64		2.05		2.33	2.58	
													'	
Time of C	oncer	ntration i	s calculate	ed to be:								205		
T _c							0.392 l	hrs		$T_c = \left(\frac{0}{10}\right)$	$.87L^2$	0.385		
										$r_c = \sqrt{10}$	$000S_{av}$			
Rainfall in	ntensi	ity is calc	culated to b	e (based o	on modi	fied Her	schfield	d equation)						
$P_{t,T}$					Rainfall intensity is calculated to be (based on modified Herschfield equation): $P_{t,T} = 1.13(0.41 + 0.64lnT)(-0.11 + 0.27lnt)(0.79M^{0.69}R^{0.2})$									
						,	0.085				•		(0.11) 0.27 0.0	,
Aereal reduction factor is calculated to be:											`	ĺ	(0.21 0.2700	,
Aereal red	ductio	n factor	is calculat	ed to be:		,	0.685 1							,
Aereal red ARF	ductio	n factor	is calculat	ed to be:		,	117			ARF = (90 00 Where:	00 — 12 800ln.	A + 9 830lnt) ^{0.4}		
	ductio	on factor	is calculat	ed to be:		,				ARF = (90 00	10 - 12 800lm. tion factor (%)			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
ARF			is calculat			,				ARF = (90 00 Where: ARF - Areal reduction A= Catchment are	10 - 12 800lm. tion factor (%)	A + 9 830lnt) ^{0.4}		
ARF						,				ARF = (90 00 Where: ARF = Areal reduce A* Catchment and t = Time of conce	tion factor (%) to a (km²) ntration (min)	A + 9 830Int) ^{0,4} May not exc	coed 100	
ARF Runoff co						,	117			ARF = (90 00 Where: ARF = Areal reduce A* Catchment and t = Time of conce	tion factor (%) to a (km²) ntration (min)	A + 9 830Int) ^{0,4} May not exc		
ARF Runoff co	effici	ent is cal		be:		,	117			ARF = (90 00 Where: ARF = Areal reduce A* Catchment and t = Time of conce	tion factor (%) to a (km²) ntration (min)	A + 9 830Int) ^{0,4} May not exc	coed 100	
ARF Runoff co	effici	ent is cal	lculated to	be:			117	%		ARF = (90 00 Where: ARF = Areal reduce A* Catchment and t = Time of conce	tion factor (%) to a (km²) ntration (min)	A + 9 830Int) ^{0,4} May not exc	coed 100	
ARF Runoff co	effici	ent is cal	lculated to	be:			117 ⁹ 0.364	%		ARF = (90 00 Where: ARF = Areal reduce A* Catchment and t = Time of conce	tion factor (%) to a (km²) ntration (min)	A + 9 830Int) ^{0,4} May not exc	coed 100	
Runoff co Ct Catchme	effici	ent is cal ume is ca	lculated to	be: o be:			117 ⁹ 0.364	%		$\begin{aligned} & \text{ARF} = (900\text{ M}) \\ & \text{Where:} \\ & \text{A8F} = \text{Areal reduce} \\ & \text{A-Catchment are } \\ & \text{t= Time of conce} \end{aligned}$	10 – 12 800 lm. tion factor (%) as (km²) construction (min) $\frac{2}{2} = \frac{1}{2}$	A + 9 830Int) ^{0,4} May not exc	coed 100	
Runoff co Ct Catchme	effici	ent is cal ume is ca	lculated to	be: o be:			117 9 0.364 8083 I	%		$\begin{aligned} & \text{ARF} = (900\text{ M}) \\ & \text{Where:} \\ & \text{A8F} = \text{Areal reduce} \\ & \text{A-Catchment are } \\ & \text{t= Time of conce} \end{aligned}$	10 – 12 800 lm. tion factor (%) as (km²) construction (min) $\frac{2}{2} = \frac{1}{2}$	A + 9 830Int) ^{0,4} May not exc	coed 100	
Runoff co Ct Catchme V	effici	ent is cal ume is ca	lculated to	be: o be:			117 9 0.364 8083 I	% m³		ARF = (90 00 Where: ARF = Areal reduce A* Catchment and t = Time of conce	10 – 12 800 lm. tion factor (%) as (km²) construction (min) $\frac{2}{2} = \frac{1}{2}$	A + 9 830Int) ^{0,4} May not exc	coed 100	
Runoff co Ct Catchme V Rainfall in It	nt vol	ent is cal ume is ca ity is calc	lculated to	be: o be: oe:			117 9 0.364 8083 I	% m³		$\begin{aligned} & \text{ARF} = (900\text{ M}) \\ & \text{Where:} \\ & \text{A8F} = \text{Areal reduce} \\ & \text{A-Catchment are } \\ & \text{t= Time of conce} \end{aligned}$	10 – 12 800 lm. tion factor (%) as (km²) construction (min) $\frac{2}{2} = \frac{1}{2}$	A + 9 830Int) ^{0,4} May not exc	coed 100	
Runoff co Ct Catchmen V Rainfall in	nt vol	ent is cal ume is ca ity is calc	lculated to	be: o be: oe:			117 9 0.364 8083 I	m ³		$I_T = \frac{P_i}{T}$ $I_T = \frac{P_i}{T}$	10 – 12 800lm. tion factor (%) as (km²) arration (min) $\frac{2}{2}$ OO + $\left(\frac{2}{2}\right)$	$\frac{\mathbf{A} + 9830 \text{int})^{8.4}}{\text{May not ease}} \frac{\mathbf{Y}_{T}}{1!}$	coed 100	

Caculation sheet description: Slope Stability On Dams - Worst Case

Caculation type (if applicable):

Date of calculations:24-03-2025Calculations done by:Des Fourie

Conclusion/summary:

These calculations are applicable to settling-, return water- as well as pollution control dams. The slope stability analysis shows that an acceptable factor of safety have been achieved.

The planned geotechnical investigation is required to confirm these results.

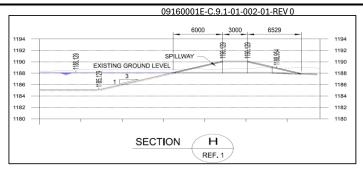
The source of assumptions for c and \emptyset values is a report referenced in detail in the WULA design report (Reference 13.10).

It may also be noted the South African Pavement Engineering Manual prredicts much higher shear and friction angles for the slopes under investigation as the construction materials will be a G5 imported product as defined in TRH 14: 1986

In order to do a slope stability design check, the following will be utilized:

Abbreviation	Item description	Unit of measure	Source	Input value
F	Safety factor	N/A	Calculation	
С	Cohesive strength of construction material	kN/m ²	Assumed from Table 3	5
ф	Friction angle	degrees/ ^o	Assumed	20
γ	Compacted density of construction material	kN/m ³	Assumed	19
N	Stability number	N/A	Read from chart (Fig 5.17)	
C _m	Cohesion value	kN/m ²	Calculation	
F _c	Factor of safety for cohesion only	N/A	Calculation	
Н	Height of constructed embankment	m	Drawings	2

Reference drawing:

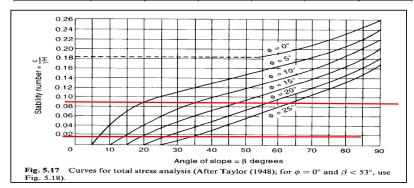


Reference table:

TABLE 3: PEAK STRENGTH PARAMETERS DERIVED FROM PREVIOUS TRIAXIAL AND SHEAR BOX TESTING, AND PARAMETERS FROM GEOTECHNICAL CHART

	Triaxial Testing on Similar Soils		Shear Box Simila		Strength Parameters from Geotechnical Chart	
Soil Description	Cohesion c' (kPa)	Friction angle ¢' (degrees)	Cohesion c' (kPa)	Friction angle o' (degrees)	Cohesion c' (kPa)	Friction angle o' (degrees)
Black slickensided clay (CH)	16 – 26	14 - 17	29 - 34.5	8.2 - 9	25 ± 10	22 ± 4
Highly weathered norite (SM)	-	-	4 - 5.5	38.4 - 38.9	0	34 ± 3

Reference chart:



Reference literature:

Elements of Soil Mechanics

Seventh Edition

G. N. Smith

MSc, PhD, CEng, MICE Formerly of Heriot-Watt University, Edinburgh

Ian G. N. Smith

BEng, PhD Napier University, Edinburgh

Formulae:

$$F = \frac{\textit{Shear Strength}}{\textit{Disturbing Shear}} \ \textit{i.e.F} = \frac{\textit{c} + \textit{\sigmatan}\emptyset}{\tau}$$

$$N = \frac{c}{\gamma H}$$

$$\tau = \frac{c}{F} + \frac{\sigma tan\emptyset}{F}$$

For an assumed F = 1.5, the following:

From formula, Ø has been calculated to be 13.6°. When utilizing Figure 5.17, a stability number of 0.017 is derived. From here c_{m} is

calculated and by calculating $F_{\text{\tiny c}}, 7.74$ is obtained, which is too high.

Formulas used:
$$\frac{tan\emptyset}{F}$$

$$c_m = N\gamma H$$

$$F_c = \frac{c}{c_m}$$

For an assumed F = 2, the following:

By using the same methodology as for F = 1.5, but with F = 2, \emptyset has been calculated to be 10.3°. A stability number of 0.082 is obtained from Figure 5.17. This results in F_c being calculated as 1.6 which is indicating the factor of safety cannot be 2.

For an assumed F = 1.52, the following:

Taking into account F = 1.5 and F = 2, a value of F = 1.52 was selected. A stability number of 0.084 is obtained from Figure 5.17. This results in F_c being calculated as 1.57. With F = 1.52 and F_c being 1.57, the safety factor is satisfactory.

This will result in a factor of safety for the slope, being 1.5.

Caculation sheet description: In-pit flood retention and peak discharge

Caculation type (if applicable): SCS, Rational and SDF

Date of calculations:24-03-2025Calculations done by:Des Fourie

Calculation summary:

Surface flood retention and peak discharge

Calculation method	Flood Retention (m³) - V	Peak Discharge (m³/s) - Q
SCS	40878	712
Rational	35114.31	11.55
SDF	13655	10.1

Conclusion:

The flood retention volume and peak discharge for the purpose of design will be based on the rational method. The SCS method is disregarded for peak discharge and flood retention.

Space is available in-pit to accommodate the flood retention predicted in the North East corner.

In order to calculate in-pit flood retention volume and peak discharge, the following will be utilized for the SCS method:

Abbreviation	Item description	Unit of measure	Source	Input value
Q_p	Peak discharge	m³/s	Calculated	
V	Catchment volume	m³	Calculated	
A	Catchment area	km²	Measured	0.297
Q	Stormflow depth	mm	Calculated	
T _L	Catchment lag time	hours	Calculated	
Event	Storm event	years		1:100
L Eastern Path	Hydraulic length of catchment in-pit	km	Measured	0.75
L Western Path	Hydraulic length of catchment in-pit	km	Measured	0.498
S	Potential Maximum Soil Water Retention/Infiltration	mm	Calculated	
CN	Curve number	N/A	Chart	91.7
у	Average catchment slope	%	Calculated	
ARF	Areal reduction factor	%	Calculated	
T _c	Time of concentraction	hours	Calculated	
r	Roughness coefficient	N/A	Tabulated with recommended values	0.3
P_d	Runoff potential	mm	Chart, Marikana for a 1:100-year storm	160
l _a	Initial abstraction	mm	Calculated from S, based on curve number	23
S (Slope - Eastern Path)	Based on Invert levels set for the design	m/m	Measured	0.0676
S (Slope - Western Path) Based on Invert levels set for the design	m/m	Measured	0.0723
N	Contour interval	m	Measured	10

Supporting info:

Surface description	Recommended value of r
Paved areas	0,02
Clean compacted soil, no stones	0,1
Sparse grass over fairly rough surface	0,3
Medium grass cover	0,4
Thick grass cover	0,8

SCS (Soil Conservation Service) - SA Method

The United States Department of Agriculture's Soil Conservation Service based techniques for the estimation of design flood volume and peak discharge from relatively small catchments with slopes of less than 30 % has been adapted for South African conditions by the Water Research Commission

Average catchment slope

The average slope value cannot be applied to a flow path length of 500 m, as the actual slope is much flatter and pit path length is longer (see contour and lengths measurements below):

 $Average\ catchment\ slope\ for\ entire\ catchment\ area,\ y(\%),\ may\ be\ determined\ from\ the\ following\ equation:$

$$y(\%) = \frac{(M)(N)(10)^{-4}}{A}$$

Where:

 $\label{eq:map} \textbf{M} = \textbf{Total length of all contour lines (m) within the catchment, according to the scale of the map}$

M 11945 m N = Contour interval (m) 10 m A = catchment area (km²) 0.297 km² y 40.2 %

 $The \ relevant \ slopes \ and \ path \ lengths \ for \ the \ Eastern \ and \ Western \ paths \ will \ be \ used \ for \ the \ purpose \ of \ calculations.$

Note that the catchment is largely in rock with thin soil cover, hence runoff can be assumed to be 100%, particularly as design for a 100 year return interval storm should assume days of light rain, sufficient to saturate the soil layer, before the 100 year storm hits. Ref: Prof Alexander article in SAICE journal ~ 2001. SEE ALSO Sanral Drainage Manual Table 3.8 and the note below it that recommends using C = 100% for 100 year return interval.

Average catchment slope is calculated to be:		
y, Eastern path	0.0676 m/m	Invert levels set out in drawing - Reference 09160001E-C.9.20-01-001-01
y, Western path	0.0723 m/m	
Potential Maximum Soil Water Retention is calculated t	o be:	
S	23 mm	$S = \frac{25400}{CN} - 254$
Stormflow depth is calculated to be:		
Q	137.5 mm	$Q = rac{(P_D - I_A)^2}{P_D - I_A + S}$ Predicad to PD
Aereal reduction factor is calculated to be:		
ARF	114.5 %	ARF = (90 000 - 12 800 lm + 9 830 lm) ⁶⁴ Where: A cladimate factor (c) A cladimate area (m) 1 = To m of concentration (min) 1 = To m of concentration (min)
Time of Concentration is calculated to be:		
T _c Eastern Path	0.563 hrs	$T_c = 0.604 \left(\frac{rL}{S^{0.5}}\right)^{0.467}$
T _c Western Path	0.5 hrs	$I_c = 0.604 \left(\frac{1}{S^{0.5}} \right)$

Reference email from Wayne Howroyd dated 21/05/2024

Catchment volume			
V Eastern Path	40878 m³	$V = Q \times A$	Highest T_c so only Eastern Path
			considered.
Catchment lag time is calculated to be:			
T _L Eastern Path	0.01 hrs	$L^{0.8}(S+25.4)^{0.7}$	Highest L so only Eastern Path
		$TL = \frac{L^{0.8}(S + 25.4)^{0.7}}{7069(y^{0.5})}$	considered.

T _L Eastern Path	0.01 hrs $TL = \frac{L^{0.8}(S + 25.4)^{0.7}}{7069(y^{0.5})}$	Highest L so only Eastern Path considered.
Peak discharge is calculated to be:		
Q_p	712 m³/s $Q_P = \frac{0.2083(A)(Q)}{1.83T_L}$	Highest TL so only Eastern path considered.
The stormwater and catchment area information is as follow	s:	
Contraction of the second		
The state of the s		
	The second of th	
	E Transfer	
4		
Contour interval (AMSL) m	Length (m)	
1180	3310	
1170	2845	
1160	2420	
1150	2000	
1142	1370	
38 m Elevation M 2	= 11945	

Abbreviation	ate in-pit flood retention volume and peak discha Item description	Unit of measure		Input value
	· · · · · · · · · · · · · · · · · · ·			input value
Q_p	Peak discharge	m³/s	Calculated	
V	Catchment volume	m³	Calculated	
Α	Catchment area	km²	Measured	0.297
Event	Storm event	years		1:100
L Eastern Path	Hydraulic length of catchment along main channel	km	Measured	0.75
L Western Path	Hydraulic length of catchment along main channel	km	Measured	0.498
l Eastern Path	Rainfall Intensity	mm/hour	SAICE Chart 2	140
I Western Path	Rainfall Intensity	mm/hour	SAICE Chart 2	142
T _c	Time of concentraction	minutes	Calculated	
r	Roughness coefficient	N/A	Tabulated with recommended values	0.3
С	Runoff factor	N/A	Chart	1
S (Slope - Eastern P	ath) Based on Invert levels set for the design	m/m	Measured	0.0676
S (Slope - Western I	Path Based on Invert levels set for the design	m/m	Measured	0.0723
Time of Concentra	tion is calculated to be:			
T _c Eastern Path	33.7	'8 minutes	$(rL)^{0.467}$	
T _c Western Path	2	5 minutes	$T_c = 0.604 \left(\frac{rL}{S^{0.5}}\right)^{0.467}$	
Catchment volume				
Volume Eastern pat	th 35114.3	1 m³	$V = Q \times 3T_c \times 60/2$	
Volume Western pa	ath 26358.7	75 m ³	Worst case scenario (Eastern path) wi	ll be used.
Peak discharge is d	calculated to be:			
Q _p Eastern path	11.5	55 m³/s	Q = CIA/3.6	
Q _p Western path	11.7	_{'2} m³/s	Worst case scenario (Eastern path) wi	ll be used.

In order to calculate in-pit flood retention volume and peak discharge, the following will be utilized for the SDF method:

	ation	Item descripti	on		Unit	of measure	Source		Input value
Qt		Peak discharge)		m³/s		Calculated		
V		Catchment vol	ume		m³		Calculated		
Α		Catchment are	a		km²	km ² Measured		0.297	
MAD		Mean annual p	recipitation (no	ting the reported v	alue		Ct CAVAG		550
MAP		for the site of 6	55 mm)		mm		Struan SAWS		550
Event		Storm event			years	;			1:100
L Easteri	n Path	Hydraulic leng	th of catchment	along main chani	nel km		Measured		0.75
L Wester	rn Path	Hydraulic leng	th of catchment	along main chan	nel km		Measured		0.498
S _{Eastern Pa}	th (SANRAL)	Average slope	of the overland	path	m/m		Measured		0.0676
$P_{t,T}$		Point precipica	ition depth		mm		Calculated		
lt		Rainfall intensi	ty		mm/	hr	Calculated		
ARF		Areal reduction	n factor		%		Calculated		
T _c		Time of concer	ntraction		hours	5	Calculated		
C_t		Runoff coeffici	ent		N/A		Calculated		
r		Roughness coe	efficient		N/A		Tabulated with re	ecommended va	lues 0.3
Support	ing info:			3.1: Information r					
		В	sAWS station	SAWS site	M (mm) (e	R C ₂ days) (%)	(%) (mm)	MAE (mm)	
			number 1 546 204	Struan	56	30 10	40 550	1800	
		-	TΔRI	E 8: RETURN P	ERIOD EAG	TORS			
	T =	2	5	10	20	50	100	200	
		0							
	Y _T =	U	0.84	1.28	1.64	2.05	2.33	2.58	
Time of	Concentratio	n is calculated t	o be:						
T _c					0.15 hrs		$(0.87L^2)^0$	0.385	
							$T_c = \left(\frac{0.87L^2}{1000S_{av}}\right)^c$		
							0-1	h concidered as	Nata :
Rainfall	intensity is ca						Only Eastern pat	ii considered as	this is worst case.
$P_{t,T}$	-	alculated to be (based on modi	fied Herschfield e	equation):		Only Eastern pat	ii considered as	tnis is worst case.
٠,.		alculated to be (based on modi	fied Herschfield e	equation): 15.977 mm				this is worst case. + $0.27 lnt)(0.79 M^{0.69} R^{0.2})$
		alculated to be (based on modi				$P_{t,T} = 1.13(0.41 + 1.13)$	- 0.64 <i>lnT</i>)(-0.11	
	eduction fact	alculated to be ($P_{t,T} = 1.13(0.41 + 1.13)$	- 0.64 <i>lnT</i>)(-0.11	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$
	eduction fact						$P_{t,T}=1.13(0.41+$ Only Eastern pat ARF = (90 000 - 12 800ln/ Where:	0.64lnT)(-0.11 h considered as	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$
Aereal r	eduction fact				15.977 mm		$P_{t,T} = 1.13(0.41 + 0.000)$ Only Eastern pat	- 0.64lnT)(-0.11 h considered as	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$
Aereal ro ARF			to be:		15.977 mm		$P_{t,T}=1.13(0.41+$ Only Eastern pat ARF = (90 000 - 12 800In/ Where: ABF = Areal reduction factor (%) A-Catchemet rate (Int')	0.64lnT)(-0.11 h considered as	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$
Aereal re		or is calculated	to be:		15.977 mm		$P_{t,T}=1.13(0.41+Only Eastern pat)$ ARF = (90 000 - 12 800lm). Where: ARF = Areal reduction factor (%) A-Catchment area (fm²) t = Time of concentration (min)	- 0.64lnT)(-0.11 h considered as 1+9830lnt) ^{8,4} May not exceed 100	+ 0.27lnt)(0.79M ^{0.69} R ^{0.2}) this is worst case.
Aereal ro ARF		or is calculated	to be:		15.977 mm 110 %		$P_{t,T}=1.13(0.41+$ Only Eastern pat ARF = (90 000 - 12 800In/ Where: ABF = Areal reduction factor (%) A-Catchemet rate (Int')	- 0.64lnT)(-0.11 h considered as 1+9830lnt) ^{8,4} May not exceed 100	+ 0.27lnt)(0.79M ^{0.69} R ^{0.2}) this is worst case.
Aereal re ARF Runoff c	coefficient is o	or is calculated	to be:		15.977 mm 110 %		$P_{t,T}=1.13(0.41+Only Eastern pat)$ ARF = (90 000 - 12 800lm). Where: ARF = Areal reduction factor (%) A-Catchment area (fm²) t = Time of concentration (min)	- 0.64lnT)(-0.11 h considered as 1+9830lnt) ^{8,4} May not exceed 100	+ 0.27lnt)(0.79M ^{0.69} R ^{0.2}) this is worst case.
Aereal re ARF Runoff c	coefficient is o	or is calculated calculated be	to be:	4	15.977 mm 110 %		$P_{t,T}=1.13(0.41+0.01)$ Only Eastern pat ARF = (90 000 - 12 800 Int.) Where the foliation factor (6) Are Catchement area (km²): 1 = Time of concentration (min) $C_T=\frac{C_2}{100}+\left(\frac{C_2}{2}\right)$	- 0.64 lnT)(-0.11 h considered as the parameter of the	+ 0.27lnt)(0.79M ^{0.69} R ^{0.2}) this is worst case.
Aereal re ARF Runoff c Ct	coefficient is o	or is calculated calculated be	to be:	4	110 % 0.4		$P_{t,T}=1.13(0.41+0.01)$ Only Eastern pat ARF = (90 000 - 12 800 Int.) Where the following factor (6) Are Catchement area (km²): 1 = Time of concentration (min) $C_T=\frac{C_2}{100}+\left(\frac{C_2}{2}\right)$	- 0.64 lnT)(-0.11 h considered as the parameter of the	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$ this is worst case.
Aereal ro ARF Runoff c C _t	coefficient is o	or is calculated calculated be	to be:	4	110 % 0.4		$P_{t,T}=1.13(0.41+Only Eastern pat)$ ANF = (90 000 - 12 800In) Where: A Catchment area (Bm²) 1 = Time of concentration (min) $C_T=\frac{C_2}{100}+\left(\frac{C_2}{2}\right)$ Only Eastern pat	- 0.64 lnT)(-0.11 h considered as the parameter of the	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$ this is worst case.
Aereal ro ARF Runoff c C _t	coefficient is o	or is calculated calculated to be	to be:	4	110 % 0.4		$P_{t,T}=1.13(0.41+Only Eastern pat)$ ANF = (90 000 - 12 800In) Where: A Catchment area (Bm²) 1 = Time of concentration (min) $C_T=\frac{C_2}{100}+\left(\frac{C_2}{2}\right)$ Only Eastern pat	- 0.64 lnT)(-0.11 h considered as the parameter of the	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$ this is worst case.
Aereal ro	coefficient is o	or is calculated calculated to be	to be:	4	110 % 0.4 13655 m³		$P_{t,T}=1.13(0.41+0.01)$ Only Eastern pat ARF = (90 000 - 12 800 Int.) Where the following factor (6) Are Catchement area (km²): 1 = Time of concentration (min) $C_T=\frac{C_2}{100}+\left(\frac{C_2}{2}\right)$	- 0.64 lnT)(-0.11 h considered as the parameter of the	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$ this is worst case.
Aereal ro ARF Runoff c C t Catchm V Rainfall I t	coefficient is one of the control of	or is calculated calculated to be	to be:	4	110 % 0.4 13655 m³		$P_{t,T}=1.13(0.41+Only Eastern pat)$ ANF = (90 000 - 12 800In) Where: A Catchment area (Bm²) 1 = Time of concentration (min) $C_T=\frac{C_2}{100}+\left(\frac{C_2}{2}\right)$ Only Eastern pat	- 0.64 lnT)(-0.11 h considered as the parameter of the	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$ this is worst case.
Aereal ro ARF Runoff c C t Catchm V Rainfall I _t	coefficient is one of the control of	or is calculated calculated to be calculated to be alculated to be:	to be:	4	110 % 0.4 13655 m³	hr	$P_{t,T} = 1.13(0.41 + Only Eastern pat)$ $ARF = (90 000 - 12 800 Int)$ $ARF = (90 000 - 12 800$	- 0.64 lnT)(-0.11 h considered as the parameter of the	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$ this is worst case.
Aereal ro	coefficient is one of the control of	or is calculated calculated to be calculated to be alculated to be:	to be:	4	110 % 0.4 13655 m ³	hr	$P_{t,T}=1.13(0.41+Only Eastern pat)$ ANF = (90 000 - 12 800In) Where: A Catchment area (Bm²) 1 = Time of concentration (min) $C_T=\frac{C_2}{100}+\left(\frac{C_2}{2}\right)$ Only Eastern pat	- 0.64 lnT)(-0.11 h considered as the parameter of the	$+ 0.27 lnt)(0.79 M^{0.69} R^{0.2})$ this is worst case.

Caculation sheet description: Spillway Design Check - Worst Case

Caculation type (if applicable):

Date of calculations:24-03-2025Calculations done by:Des Fourie

Conclusion:

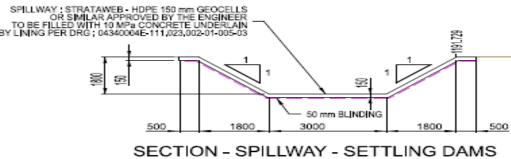
The spillway from the settling dams to the return water dam is the smallest of all spillways and subsequently has been utilized as worst case scenario. The spillway design shows that the spillway sizing for all spillways is thus adequate and that the discharge side of the spillway will accommodate a flow of less than 3m/s, which is adequate. The velocity on the downstream side of the spillway has been reviewed and is less than 3m/s, on condition a minimum slope of 1:55 is maintained. The drawings indicate a slope of less than 1:55 so the velocity will not present a degradation attack to the lining.

In order to do a spillway design check, the following will be utilized:

Abbreviation	Item description	Unit of measure	Source	Input value
L _e	Effective length/width of spillway	m	Drawings	3
h	Flood level above TOC	m	Drawings	1
C_d	Coefficient of discharge	N/A	Calculated	
h _e	Effective height of flow above spillway	m	Calculated	
Q	Peak discharge from 1:50 year storm event	m³/s	Calculated from 0916000C-01-CAL-0001	2.1
Q_A	Maximum allowable flow from spillway	m³/s	Calculate	
	Height from invert level on dam to top of spillway	m	Drawings	3
d _n	Normal depth of flow	m	Calculated	
В	Width of the spillway/channel	m	Drawings	3
S	Slope	N/A	Drawings	01:55
V _n	Normal velocity	m/s	Calculated	
g	Gravitational acceleration	m/s ²	N/A	9.81

Reference drawing:

09160001E-C.9.1-01-002-01-REV 0



SPILLWAY - SETTLING DAM SCALE 1: 100

Assumption:

Spillway is 3000mm wide and 1000mm high (vertically) in trapezoidal shape however rectangular shape has been used for calculations.

P = 3000mm Reference 09160001E-C.9.1-01-002-01-REV 0 Section C

Coefficient of discharge, $C_{d,}$ is calculated	ated to be:	
C_d	0.63	$C_d = 0.602 + \frac{0.083h}{P}$
		Rhebock formula in BS3680 Part 4A:1965
		Reference Fluid Mechanics for Civil Engineers by N.B. Webber 1971
Effective height of flow ,h _e , is calculat	ted to be:	
h_{e}	1.0012 m	$h_e = h + 0.0012$
Maximum allowable flow, Q_A , is calcu	lated to be:	
Q_{A}	5.6 m ³ /s	$Q_A = \frac{2}{3}\sqrt{2gC_d}L_eh_e^{\frac{3}{2}}$
Manning d_n value on spillway exit is ca	alculated to be:	
d _n	0.158 m	$Q_A = \frac{Bd_n}{n} \left[\frac{Bd_n}{B + 2d_n} \right]^{\frac{2}{3}} \sqrt{s}$
		Reference 0916000C-01-CAL-0001 Surface flood and peak
V _n is calculated to be:		
V_n	2.95 m/s	$V_n = \frac{Q_A}{B d_n}$
		Velocity <3m/s acceptable
Froude no is calculated to be:		
Froude no	2.37	$Froude\ No=rac{V_n}{\sqrt{g}d_n}$ Reference Fluid Mechanics for Civil Engineers by N.B. Webber 1971 Section 7.7 Scouring and silting p164
i		Supercritical flow maintained due to Froude no > 1

 Calculation sheet number:
 09160001C-01-CAL-0006

 Caculation sheet description:
 Subsoil Drain Loading

Caculation type (if applicable):

Date of calculations:24-03-2025Calculations done by:Des Fourie

Conclusion:

HDPE flexible slotted drainage pipe with smooth bore

Source https://tinyurl.com/3eh3x845

Loading, pipe and liner information

Liner

Width 110mm HDPE slotted pipe buried Trench 750mm wide x 750mm deep

Loading	Density	Depth/thickness	Width		Loading/m
Liner weight	2400kg/m ³	0.2m		0.75m	3.5kN/m
Weight of water	1000kg/m ³	4m		0.75m	29.4kN/m
Front End Loader Axle Loading	-	-		-	87kN/m
Soil pressure	1900kg/m ³	0.75m		0.75m	10.5kN/m
Total loading (worst case excl wa	ater)				101kN/m

The loading is specified for worst case scenario when a Front End Loader (FEL) will be cleaning out a dam. In this instance there will be no water loading. The total loading is well below the design resistance load of 150kN/m provided the bedding and filler material are correctly constructed as per CQA. A typical FEL such as a Bell 2606E has been used for the purpose of calculations.

Axle loading = (25576)(9.81)/2 = 125.9kN spread across axle width of 2.877m = 87kN/m.

Reference Buried Pipe Design by A.P. Moser and Steven Folkman, Third Edition McGraw Hill, 2008

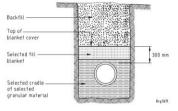
Pipe Strength Calculation based on the Moser and Spangler procedure

Subsoil Drain 110 mm Diameter

Fill Conditions 200 thick concrete liner plus water surcharge or Vehicle Loading

Negative Project Codition SANS 10102-1: 2013

Bedding Class d Figure 5 SANS 2001-DP1: 2011



Filtration Geotextile to encase the the pipe line

b) Backfilling over flexible pipeline

Table 1 - Loads on buried pipesSANS 10102-1: 2013LinerStatic LoadWater SurchargeStatic LoadFill LoadStatic Load

Vehicle Load Live

Fluid Pressure due to transient flow Live ignored as nominal

From Table 2 Property of soil SANS 10102-1

Area Moment of Inertia Section Properties = I
$$\frac{\pi(D^4 - d^4)}{64}$$

Stiffness Factor EI 25.1E+06 MPa

Ring stiffness = $\frac{EI}{r^3}$ 173.2 N/mm Pine stiffness = $\frac{F}{r}$ = 6.7 $\frac{EI}{r}$ 1160.3 kN/m

Tipe summess
$$-\frac{1}{\Delta y} = 0.7 \frac{1}{r^3}$$

0.083 Bedding angle 180° or 0.1 1.5 After RK Watkins

$$\Delta X = \frac{D_L K W_c r^3}{E I + 0.061 e r^4} \tag{3.4} \label{eq:deltaX}$$

where $D_L = \text{deflection lag factor}$ K = bedding constant

 W_c = Marston's load per unit length of pipe, lb/in

r = mean radius of pipe, in

 $E = \text{modulus of elasticity of pipe material, lb/in}^2$

I = moment of inertia of pipe wall per unit length, in4/in = in3

 $e = \text{modulus of passive resistance of sidefill, } lb/(in^2) (in)$

 ΔX = horizontal deflection or change in diameter, in

E' is recommended in SANS 10201-1 as

11 MPa refer reference above

The CQA will ensure that tis density is achieved

Proctor Density 97%

 W_c

101 kN/m

Refer loading above

Spangler's modified equation or the Iowa formula

$$\Delta X = \frac{D_L K W_c r^3}{E I + 0.061 E \gamma^3} \tag{3.5} \label{eq:deltaX}$$

 $\Delta \mathsf{X}$

0.087

The theory is defined in emprical units however the calculation has been carried out in metric units.

Therefore this deflection is acceptable

Calculation sheet number:09160001C-01-CAL-0007Caculation sheet description:Channel Flow on Surface

Caculation type (if applicable):

Date of calculations:24-03-2025Calculations done by:Des Fourie

Conclusion:

The Rational method was used to size the channel. The cross section and fall is adequate to carry the peak discharge. This will inherently apply to the silt trap entry and exit channels.

In order to do a channel flow design check, the following will be utilized:

Abbreviation	Item description	Unit of measur	e Source	Input value
L	Length of channel	m	Drawings	539
H _{0.10}	10% of average slope	m	Calculated as 10% of fall of channel	
H _{0.85}	85% of average slope	m	Calculated as 85% of fall of channel	
L _{0.10}	10% of channel length	m	Calculated as 10% of length of channel	
L _{0.85}	85% of channel length	m	Calculated as 85% of length of channel	
S _{av}	Slope	m/m	SDF worksheet	0.003
A	Cross sectional area of channel	m^2	Calculated from drawing	0.863
Р	Wetted perimeter of channel	m	Calculated from drawing	2.96
n	Roughness factor (Manning)	N/A	SANRAL Drainage manual	0.014
v	Velocity	m/s	Calculated	
r	Ratio of area to perimeter	N/A	Calculated	
Reference dra From drawings	v	09160001E-C.9	20-01-001-01	
	Channel width:	1500mm		
	Channel depth:	575 mm		
Velocity is cal	culated as follows:			
V		1.81 m/s	$v = \frac{1}{n}r^{\frac{2}{3}}.\frac{1}{s^{\frac{1}{2}}}$	
Peak discharg	e is calculated as follows:			
Q		1.56 m ³ /s	Q = v x A	
			With Rational method, Peak discharge was cal thus the channel size is sufficient.	culated to be 1.51 m³/s,

Caculation sheet description: Silt Trap Sizing

Caculation type (if applicable):

Date of calculations:24-03-2025Calculations done by:Des Fourie

Conclusion:

Two scenarios were run to confirm silt trap sizing; 1:50 year storm event as well as normal operations. In both instances it was confirmed that the silt trap capacity as per drawings is sufficient. One compartment would be sufficient herefor, however a second compartment is allowed to allow cleaning and simultaneous operation of silt trap with the associated drying pads which is discussed in the design report. It may however be noted that in a Jones and Wagener report A SOUTH AFRICAN CASE STUDY ON SEDIMENT CONTROL MEASURES

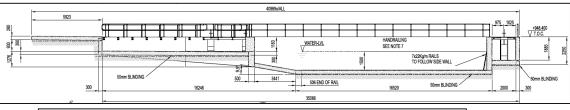
WITH THE USE OF SILT TRAPS IN THE COAL MINING INDUSTRY

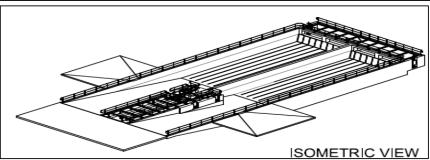
In order to do a silt trap sizing check, the following will be utilized:

Abbreviation	Item description	Unit of measure	Source	Input value
V	Silt trap compartment volume	m ³	Calculated from drawings	
Q _{storm}	Volume of sediment introduced in storm event	m³/hr	Calculated from Fig 2 in report and CAL-0001	
Q _{normal}	Volume of sediment introduced in normal operation	m ³ /hr	Calculated from Fig 2 in report and CAL-0001	
Q _{silt, retained}	Rate of silt retention in single compartment	m ³ /hr	Calculated	
V _{silt, retained}	Volume of silt retained in single compartment	m ³ /hr	Calculated	
t _{silt, cleaning}	Time interval between cleaning	hrs	Calculated	
V_L	Durand's limiting velocity	m/s	Calculated	
V _{s, storm}	Settling velocity in storm event	m/s	Calculated	
V _{s, normal}	Settling velocity in normal operation	m/s	Calculated	
Fl	Durand & Condolios Flow coefficient	N/A	Read off chart	0.6
g	Gravitational acceleration	m/s ²		9.81
D	Depth of flow	m		1.3
SG	Specific Gravity	N/A	Assumed	2.65
RD	Relative Density	t/m ³	Assumed	1.005
BD	Bulk Density	t/m ³	Assumed	1.65

Reference drawing:

09160001E-C.1-01-003-01





Assumptions &

In the event of a storm, all normal inflows of water into silt trap will remain in place.

parameters:

Storm: Sediment loading rate in a storm event 23.38 m³/hr with bulk density of 1.65t/m³

Normal: Sediment load relative density (RD) 1.005 t/m³ Normal: Sediment loading under normal operation 0.77 t/hr

Normal: Sediment loading under normal operation 0.47 m³/hr with bulk density of 1.65t/m³

80% of silt is retained in the silt trap (storm & normal operation)
20% of silt is carried over into settling dams (storm & normal operation)
Bulk density (BD)
1.65

Bulk density (BD) 1.65 t/m³ Specific gravity (SG) 2.65

Silt trap single compartment capacity is calculated as follows:

 Sloped area
 68.04 m³
 16.2mL x 1.5mH x 5.6mW (50%)

 Flat area
 138.60 m³
 16.5mL x 1.5mH x 5.6mW

Total V 206.64 m³

Total	linflow	in even	t of	a s	torm	is	ca	lcu	late	d as	fol	lows	; :

Storm event	7560 m ³ /hr
Service water tank	0.007 m ³ /hr
Potable water tank	0.007 m ³ /hr
Fire water tank	0.007 m ³ /hr
MG2 RWD	130 m ³ /hr
Fissure water	10 m ³ /hr

2.14 m ³ /s

Total inflow under normal operating conditions is calculated as follows:					
Service water tank	0.007 m ³ /hr				
Potable water tank	0.007 m ³ /hr				
Fire water tank	0.007 m ³ /hr				
MG2 RWD	130 m ³ /hr				
Fissure water	10 m ³ /hr				
Oil separator	14.4 m ³ /hr				
Total Q _{normal}	154.42 m ³ /hr	0.04 m ³ /s			

Volume of silt retained in silt trap in event of a storm is calculated as follows:

At 80% retention

 $Q_{\text{silt, retained}} \hspace{1cm} 18.70 \hspace{1mm} \text{m}^3/\text{hr} \hspace{1cm} 80\% \hspace{1mm} \text{of sediment loading}$

 $V_{\text{silt, retained}}$ 56.10 m³ For 3hr (3T_c) storm event, $V_{\text{silt, retained}}$

Volume of silt retained is less than volume of silt trap, so sufficient capacity is available in silt trap.

Cleaning intervals of silt trap under normal operations is calculated as follows:

At 80% retention

 $\begin{array}{ccc} Q_{\text{silt, retained}} & 0.37 \ \text{m}^3\text{/hr} & 80\% \ \text{of sediment loading} \\ t_{\text{silt, cleaning}} & 551.99 \ \text{hrs} & \text{Intervals between cleaning} \end{array}$

Durand's limiting velocity for settlement is calculated as follows:

 V_{L}

4.16 m/s

$$V_L = Fl \sqrt{\frac{2gD(SG - RD)}{RD}}$$

Actual settling velocity under storm event is calculated as follows:

 $V_{s, storm}$

0.29 m/s

This is lower than Durand's velocity, so settling will occur. Calculated on

cross sectional area for silt trap of 5.8mW x 1.3mH.

Actual settling velocity under normal operation is calculated as follows:

 $V_{s, normal}$

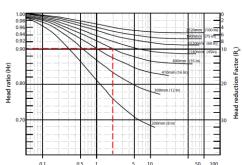
0.006 m/s

This is lower than Durand's velocity, so settling will occur. Calculated on

cross sectional area for silt trap of 5.8mW x 1.3mH.

Particle Sizing Assumptions

An example below being of a graph from the Hydraulic Institute Standard "12.1-12.6: Rotodynamic (Centrifugal) Slurry Pumps for Nomenclature, Definitions, Applications and Operation"



Information from HI Standards reproduced courtesy of Hydraulic Institute, Parsippany, NJ

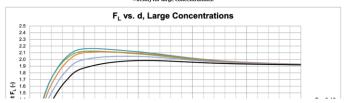
A d_{50} of

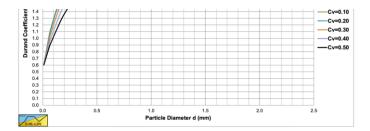
2 mm can be expected based on typical service water conditions as depicted in the chart shown in the Metso/Outotec slurry pumping manual Samples will taken once silt deposition has taken place to validate this assumption which will also confirm % of silt retained

F_L Sourced from the Durand and Condolios chart for Limiting Factor vs Particle size

Figure 6.4-23: Original Durand coefficient approximation according to equation (6.4-19) (D =0.5m) for large concentrations.

https://tinyurl.com/2s3uxx9d





Caculation sheet description: Settling Dam Sizing

Caculation type (if applicable):

Date of calculations:24-03-2025Calculations done by:Des Fourie

Conclusion:

Two scenarios were run to confirm settling dam sizing; 1:50 year storm event as well as normal operations. It is important to note that the inflow of water during a storm event would exceed the settling dams' capacity, however these dams are not designed for storm water catchment, only for the purpose of sediment settling. The PCD dam is sized to handle the volume of storm water required. Refer to 09160001C-01-CAL-0001. The comments in the summary with respect to the sediment load in the sil trap calculations 09160001C-01-CAL-

	ttling dam sizing check, the following will be utilized:	Unit of moo	curo Couros	Innutvolue
Abbreviation	Item description	m ³	sure Source	Input value
V	Silt trap compartment volume	m" m³/hr	Calculated from drawings	
Q _{storm}	Volume of sediment introduced in storm event		Calculated from Fig 2 in report and CAL-0001	
Q _{normal}	Volume of sediment introduced in normal operation	m³/hr	Calculated from Fig 2 in report and CAL-0001	
Q _{silt, retained}	Rate of silt retention in single compartment	m³/hr	Calculated	
V _{silt, retained}	Volume of silt retained in single compartment	m³/hr	Calculated	
t _{silt, cleaning}	Time interval between cleaning	hrs	Calculated	
SG	Specific Gravity	N/A	Assumed	2.65
RD	Relative Density	t/m³	Assumed	1.005
BD	Bulk Density	t/m ³	Assumed	1.65
Reference drawing	g:	09160001E-	·C.9.1-01-001-01	
Assumptions &	In the event of a storm, all normal inflows of water int	o settling dams	s will remain in place.	
parameters:	Storm: Sediment load relative density (RD)	_	1.005 t/m ³	
purumotors.	Storm: Sediment loading rate in a storm event		88.57 t/hr	
	Storm: Sediment loading rate in a storm event		23.38 m ³ /hr with bulk density of 1.65t/m ³	
	Normal: Sediment load relative density (RD)		1.005 t/m ³	
	Normal: Sediment loading under normal operation		0.77 t/hr	
	Normal: Sediment loading under normal operation		0.47 m ³ /hr with bulk density of 1.65t/m ³	
	80% of silt is retained in the silt trap (storm & normal	operation)		
1	20% of silt is carried over into settling dams (storm &		1.65 t/m ³	
	Bulk density (BD)		2.65	
	Specific gravity (SG)		2.65	
Volume of settling	dams calculated as follows:			
Settling dam North	1750.0	00 m ³		
Settling dam South				
Total V	3500.0	00 m ³		
Total inflow in ava	nt of a storm is calculated as follows:			
Storm event		60 m ³ /hr		
Service water tank		70 m ³ /hr		
)7 iii /iii)7 m³/hr		
Potable water tank				
Fire water tank)7 m ³ /hr		
MG2 RWD		30 m ³ /hr		
Fissure water		LO m ³ /hr		
Oil separator		.4 m ³ /hr	<u></u>	3, .
Total Q _{storm}	7714.4	12 m ³ /hr		2.14 m ³ /s
Total inflow under	normal operating conditions is calculated as follows:			
Service water tank	0.00)7 m ³ /hr		
Potable water tank	0.00)7 m ³ /hr		
Fire water tank	0.00)7 m³/hr		
MG2 RWD		30 m ³ /hr		
Fissure water		.0 m ³ /hr		
		.4 m ³ /hr		
	14.	_		0.04 m ³ /s
Oil separator Total Q _{normal}	154.4	12 m³/hr		0.04 11175
Total Q _{normal}				0.04 111 75
Total Q _{normal}	ined in settling dams in event of a storm is calculated			0.04 111 70
Total Q _{normal} Volume of silt reta At 20% carry over in	ined in settling dams in event of a storm is calculated nto silt traps	as follows:	2004 of godinant loading	0.04 1170
Total Q _{normal} Volume of silt reta At 20% carry over ir	ined in settling dams in event of a storm is calculated nto silt traps	as follows: 68 m ³ /hr	20% of sediment loading	0.04 1170
Total Q _{normal} Volume of silt reta At 20% carry over in	ined in settling dams in event of a storm is calculated into silt traps 4.6 14.0	as follows: 68 m ³ /hr	For 3hr (3Tc) storm event, $V_{\text{silt, retained}}$	0.04 / 0
Total Q _{normal} Volume of silt reta At 20% carry over ir Q _{silt, retaine}	ined in settling dams in event of a storm is calculated nto silt traps	as follows: 68 m ³ /hr	For 3hr (3Tc) storm event, $V_{\text{silt, retained}}$	0.04 1170
Total Q _{normal} Volume of silt reta At 20% carry over ii Q _{silt, retaine} V _{silt, retaine}	ined in settling dams in event of a storm is calculated into silt traps 4.6 14.0	as follows: 88 m³/hr 93 m³ dam, so suffici	For 3hr (3Tc) storm event, $V_{\text{silt, retained}}$	0.04 11176
Total Q _{normal} Volume of silt reta At 20% carry over ii Q _{silt, retaine} V _{silt, retaine}	ined in settling dams in event of a storm is calculated nto silt traps 4.6 Volume of silt retained is less than volume of settling of settling dams under normal operations is calculatento silt traps	as follows: 88 m³/hr 93 m³ dam, so sufficied as follows:	For 3hr (3Tc) storm event, $V_{\text{silt, retained}}$	0.04 11176
Total Q _{normal} Volume of silt reta At 20% carry over in Q _{silt, retaine} V _{silt, retaine}	ined in settling dams in event of a storm is calculated into silt traps 4.6 4.6 Volume of silt retained is less than volume of settling of settling dams under normal operations is calculated into silt traps	as follows: 88 m³/hr 93 m³ dam, so suffici	For 3hr (3Tc) storm event, $V_{\text{silt, retained}}$	~779days

Calculation sheet number:09160001C-01-CAL-0010Caculation sheet description:Return Water Dam Sizing

Caculation type (if applicable):

Date of calculations:24-03-2025Calculations done by:Des Fourie

Conclusion:

Two scenarios were run to confirm return water dam sizing; 1:50 year storm event as well as normal operations. It is important to note that the inflow of water during a storm event would exceed the return water dam's capacity, however this dam is not designed for storm water catchment, only for the purpose of service water storage. The PCD dam is sized to handle the volume of storm water required. Refer to 09160001C-01-CAL-0001.

In order to do a return water dam sizing check, the following will be utilized:

Abbreviation	Item description	Unit of measure	Source	Input value
/	Silt trap compartment volume	m ³	Calculated from drawings	
Q_{storm}	Volume of sediment introduced in storm event	m ³ /hr	Calculated from Fig 2 in report and CAL-0001	
Q _{normal}	Volume of sediment introduced in normal operation	m ³ /hr	Calculated from Fig 2 in report and CAL-0001	
SG	Specific Gravity	N/A	Assumed	2.65
RD	Relative Density	t/m ³	Assumed	1.005
BD	Bulk Density	t/m ³	Assumed	1.65
Reference drawing	g:	09160001E-C.9.1	1-01-001-01	
Assumptions &	In the event of a storm, all normal inflows of water into		•	
parameters:	All settlement of sediment has occurred in the silt trap	and settling dams v	with no carry over to the return water dam.	
Volume of return v	vater dam calculated as follows:			
Total V	4500.00	0 m ³		
Total inflow in ever	nt of a storm is calculated as follows:			
Storm event		O m ³ /hr		
Service water tank	0.007	7 m ³ /hr		
Potable water tank	0.00	7 m ³ /hr		
Fire water tank	0.00	7 m ³ /hr		
MG2 RWD	130	0 m ³ /hr		
Fissure water	10) m ³ /hr		
Oil separator	14	4 m ³ /hr	_	
Total Q _{storm}	7714.43	2 m³/hr		2.14 m³/s
			In the event of a storm the return water dam would	fill within 0.583 hours
			or 35minutes, provided the dam was empty in the	event of a flood event.
			All storm water overflow from the return water dan	*
			directly into the PCD. Refer to Figure 2 of the WUL	A design report.
Total inflow under	normal operating conditions is calculated as follows:			
Service water tank		7 m ³ /hr		
Potable water tank	*****	7 m ³ /hr		
Fire water tank		7 m ³ /hr		
MG2 RWD) m ³ /hr		
Fissure water		o m ³ /hr		
Oil separator		4 m ³ /hr		
Total Q _{normal}		2 m ³ /hr	-	0.04 m ³ /s
Cilormat	2011-1		At a rate of 154.4m ³ /hr, the return water dam will f	
			This water is however returned as service water as	Del Figure 2 Oi

Caculation sheet description: Surface flood retention and peak discharge

Caculation type (if applicable): SCS, Rational and SDF

Date of calculations:28-03-2025Calculations done by:Des Fourie

Calculation summary:

Surface flood retention and peak discharge

Calculation method	Flood Retention (m³) - V	Peak Discharge (m³/s) - Q
SCS	Discharge to Sterkstroom River	2.1
Rational	Discharge to Sterkstroom River	1.54
SDF	Discharge to Sterkstroom River	1.6

Conclusion:

Peak discharge for the purpose of design is based on the Rational method which aligns closely with the SDF method.

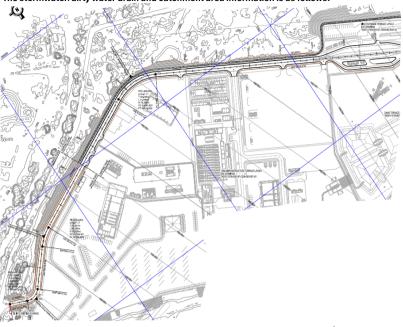
In accordance with the SANRAL drainage manual the roads are considered class 3, i.e. R3 Rural minor arterial or U3 Urban minor arterial.

Abbreviation	Item description	Unit of measur	e Source	Input value
Q_p	Peak discharge	m³/s	Calculated	
/	Catchment volume	m³	Calculated	
A	Catchment area	km²	Measured	0.100586
Q	Stormflow depth	mm	Calculated	0.120000
Event	Storm event	years	Sutsulated	1:10
r _L	Catchment lag time	hours	Calculated	1.10
'L 	Hydraulic length of catchment along main channel	km	Measured	0.785
- S	Potential Maximum Soil Water Retention/Infiltration	mm	Calculated	0.703
CN	Curve number	N/A	Chart	91.7
/	Average catchment slope	%	Calculated	31.7
ARF	Areal reduction factor	%	Calculated	
	Time of concentraction	hours	Calculated	
Γ _c				0.2
	Roughness coefficient	N/A	Tabulated with recommended values	0.3
P _d	Runoff potential	mm	Chart	90
a	Initial abstraction	mm	Calculated from S, based on curve number	23
S (Slope)	Based on Invert levels set for the design	m/m	Measured	N/A
N	Contour interval	m	Measured	10
Supporting inf		T.	Decommended value of v	
	Surface description Paved areas		Recommended value of r 0,02	
	Clean compacted soil, no s	tones	0,1	
	Sparse grass over fairly rough	surface	0,3	
	Medium grass cover			
			0,4	
	Thick grass cover SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Con		e based techniques for the estimation of design flood vo	
Average catch	Thick grass cover SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Corand peak discharge from relatively small catchments Water Research Commission		0,8 e based techniques for the estimation of design flood vo	
-	Thick grass cover SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Cor and peak discharge from relatively small catchments Water Research Commission ment slope is calculated to be:		0,8 e based techniques for the estimation of design flood vo	ons by the
-	Thick grass cover SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Cor and peak discharge from relatively small catchments Water Research Commission ment slope is calculated to be:	with slopes of les	0,8 e based techniques for the estimation of design flood vo s than 30 % has been adapted for South African condition	ons by the
y Potential Maxi	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Con and peak discharge from relatively small catchments Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be:	with slopes of less	e based techniques for the estimation of design flood vo s than 30 % has been adapted for South African condition Invert levels set out in drawing - Reference 0916000	ons by the
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y Potential Max i S	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Con and peak discharge from relatively small catchments Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be:	with slopes of less	e based techniques for the estimation of design flood vo s than 30 % has been adapted for South African condition Invert levels set out in drawing - Reference 0916000	ons by the
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Potential Maxi S Stormflow dep	Thick grass cover SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Con and peak discharge from relatively small catchments Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be:	with slopes of less	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 0916000: $S = \frac{25400}{CN} - 254$	ons by the
y Potential Maxi S Stormflow dep Q	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Con and peak discharge from relatively small catchments Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be: 23 oth is calculated to be: 69.5	with slopes of less 3 % 3 mm	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African condition. Invert levels set out in drawing - Reference 0916000: $S = \frac{25400}{CN} - 254$	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti	Thick grass cover SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Corand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be: 23 oth is calculated to be: 69.5	with slopes of less 3 % 3 mm 5 mm	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 0916000: $S = \frac{25400}{CN} - 254$	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti	Thick grass cover SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Corand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be: 23 oth is calculated to be: 69.5	with slopes of less 3 % 3 mm	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 0916000: $S = \frac{25400}{CN} - 254$ $q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be: 23 oth is calculated to be: 69.5 on factor is calculated to be:	with slopes of less 3 % 3 mm 5 mm	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African condition. Invert levels set out in drawing - Reference 0916000: $S = \frac{25400}{CN} - 254$ $q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO	ons by the
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Potential Maxi S Stormflow dep Q Aereal reducti ARF Time of Conce	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Con and peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 thus Soil Water Retention is calculated to be: 69.5 on factor is calculated to be: 120 intration is calculated to be: 0.8	with slopes of less 3 % 3 mm 5 mm	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions that the state of	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Time of Conce	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Corand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 imum Soil Water Retention is calculated to be: 69.5 on factor is calculated to be: 120 intration is calculated to be: 0.6	with slopes of less 3 % 3 mm 5 mm 0 %	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions and the second sec	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Time of Conce	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Con and peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 thus Soil Water Retention is calculated to be: 69.5 on factor is calculated to be: 120 intration is calculated to be: 0.8	with slopes of less 3 % 3 mm 5 mm 0 %	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions. Invert levels set out in drawing - Reference 09160000: $S = \frac{25400}{CN} - 254$ $Q = \frac{(P_D - I_A)^2}{P_D - I_A + S}$ Produced to PO $ARR = (99000 - 12000 \ln A + 9830 \ln A)^{64}$ Mayor and the position of the second of the position of the second o	ons by the
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Potential Maxi S Stormflow dep Q Aereal reducti ARF Time of Conce T _c Catchment vo	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 Imum Soil Water Retention is calculated to be: 69.5 on factor is calculated to be: 120 Intration is calculated to be: 0.8 United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: 4.3 Imum Soil Water Retention is calculated to be: 69.5 On factor is calculated to be: 0.8 United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: 1.3 Imum Soil Water Retention is calculated to be: 1.4 On factor is calculated to be: 1.5 On factor is calculated to be: 1.6 On factor is calculated to be:	with slopes of less 3 % 3 mm 5 mm 0 % 8 hr	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions at the second seco	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Time of Conce T _c Catchment vo	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 Imum Soil Water Retention is calculated to be: 69.5 on factor is calculated to be: 120 Intration is calculated to be: 0.8 United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: 4.3 Imum Soil Water Retention is calculated to be: 69.5 On factor is calculated to be: 0.8 United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: 1.3 Imum Soil Water Retention is calculated to be: 1.4 On factor is calculated to be: 1.5 On factor is calculated to be: 1.6 On factor is calculated to be:	with slopes of less 3 % 3 mm 5 mm 0 %	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions at the second seco	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Time of Conce T _c Catchment vo V Catchment lag	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 Imum Soil Water Retention is calculated to be: 69.5 on factor is calculated to be: 120 Intration is calculated to be: 0.8 United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: 23 On factor is calculated to be: 0.8 United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: 24 Discharge to Sterkstroom Rive gitime is calculated to be: 0.36	with slopes of less 3 % 3 mm 5 mm 0 % 8 hr	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions and the second sec	ons by the
Potential Maxi S Stormflow dep Q Aereal reducti ARF Fime of Conce Tc Catchment vo	SCS (Soil Conservation Service) - SA Method The United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: Water Research Commission ment slope is calculated to be: 1.3 Imum Soil Water Retention is calculated to be: 69.5 on factor is calculated to be: 120 Intration is calculated to be: 0.8 United States Department of Agriculture's Soil Conand peak discharge from relatively small catchments: (69.5) Imum Soil Water Retention is calculated to be: 1.3 On factor is calculated to be: 1.6 On factor is calculated to be: 0.8 United States Department of Agriculture's Soil Conand Peak discharge from relatively small catchments: 0.8 United States Department of Agriculture's Soil Conand Peak discharge from relatively small catchments: 1.3 On factor is calculated to be: 0.8 United States Department of Agriculture's Soil Conand Peak discharge from relatively small catchments: 0.8 On factor is calculated to be: 0.8	with slopes of less 3 % 3 mm 5 mm 0 % 8 hr	e based techniques for the estimation of design flood votes than 30 % has been adapted for South African conditions at the second seco	ons by the

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Reference drawing TM237-13105-S001-01-C009-101-0001-01

The stormwater/dirty water drain and catchment area information is as follows:



Catchment area	100586 m ²
Drain length	785 m
Drain invert start	1193.127
Drain invert end	1182.636
Drain fall	10.491 m

Drain fall
Drain cross section V Drain 2200 mm 1H/2V

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1:75

1.3 %

Abbreviation	Item description	Unit of measure	Source	Input value
Qp	Peak discharge	m³/s	Calculated	
V	Catchment volume	m³	Calculated	
Α	Catchment area	km²	Measured	0.100586
L	Hydraulic length of catchment along main channel	km	Measured	0.785
Event	Storm event	years		1:10
I	Rainfall Intensity	mm/hour	SAICE Chart 2	65
Тс	Time of concentraction	minutes	Calculated	
r	Roughness coefficient	N/A	Tabulated with recommended values	0.3
С	Runoff factor	N/A	Chart	0.85
S (SANRAL)	Average slope of the overland path	m/m	Measured	0.013
Time of Concentr	ration is calculated to be:			
Тс	4:	8 minutes	$T_c = 0.604 \left(\frac{rL}{S^{0.5}}\right)^{0.467}$	
Catchment volun	ne			
V	Discharge to Sterkstroom Rive	r m³	V = Q x 3Tc x 60/2	
Peak discharge is	calculated to be:			
Q_p	1.5	4 m³/s	Q = CIA/3.6	

In order to calculate flood retention volume and peak discharge, the following will be utilized for the SDF method:

	tion	Item desc	ription					Unit of mea	sure	Source				Input value
Q _t		Peak discharge				m³/s		Calcula	ted					
V		Catchment volume				m³		Calcula	ted					
A		Catchment area					km²		Measured				0.100586	
MAP		Mean annual precipitation					nm Struan SAWS						550	
Event		Storm event					,	years						1:10
L	Hydraulic length of catchment along main channel					nel	km		Measure	ed			0.785	
Sav (SANI	Sav (SANRAL) Average slope of the overland path						m/m		Measured				0.013	
Pt.T							mm		Calculated					
lt		Rainfall in	tensity					mm/hr		Calcula	ted			
ARF		Areal redu	ıction facto	r				%		Calcula	ted			
T _c		Time of co	ncentractio	on				hours		Calcula	ted			
C _t		Runoff co	efficient					N/A		Calcula	ted			
r			s coefficien	nt				N/A				ecommer	nded values	0.3
•										rabulati	-	20011111101		0.0
Supportir	ng inf	o:		Table 3B.	1: Info	mation 1	equire	d for the cal	culati	on of the	SDF			
			Basin	SAWS	SATI	'S site	M	R	C ₂	C100	MAP	MAE		
				number	1000		(mm)		(%)	(%)	(mm)	(mm)		
			1	546 204	Sti	uan	56	30	10	40	550	1800		
					TABL	E 8: RE1	URN	PERIOD FA	СТО	RS				1
	-	Т =	2	5	5	10		20		50		100	200	
	```	/ _T =	0	0.8	34	1.2	8	1.64		2.05		2.33	2.58	
													1	1
Time of C	Conce	entration is	s calculate	d to be:										
T _c							0.29	hrs		$T_c = \left(\frac{0}{10}\right)$	.87L ²	0.385		
										$r_c = \sqrt{10}$	$000S_{av}$			
Rainfall i	ntens	sity is calc	ulated to b	e (based o	n modi	fied Her	schfiel	d equation)						
$P_{t,T}$										D _ 1 1	2(0.41 4	$0.64 \ln T$	[-0.11 + 0.27lnt]	$(0.70M^{0.69}R^{0.2})$
						6	2.905	mm		$r_{t,T}-1.1$	3(0.41 7	0.041111 )(	0.11   0.27 0.00	)(0.7)14 11 )
						6	2.905	mm		$\Gamma_{t,T} = 1.1$	3(0.41 7	0.041111 )(	0.11   0.270.00	)(0.75M K )
Aereal re	ducti	on factor	is calculate	ed to be:		6	62.905	mm					0.22   0.27000	)(0.7514 K )
	ducti	on factor	is calculate	ed to be:		6	116.8			ARF = (90 00 Where:	90 – 12 800lr	nA + 9 830lnt) ^{0,4}		)(0.73FI K )
	ducti	on factor	is calculate	ed to be:		6				ARF = (90 00	00 — 12 800lr ction factor (%) ea (km²)			)(0.7 <i>7</i> 14 K )
ARF			is calculate			6				ARF = (90 00 Where: ARF = Areal reduc A= Catchment are	00 — 12 800lr ction factor (%) ea (km²)	nA + 9 830lnt) ^{0,4}		)(0.7 <i>51</i> 4 K )
ARF Runoff co						6				ARF = (90 00 Where: ARF = Areal redu Ar Catchment are t = Time of concer	00 — 12 800lr ction factor (%) ea (km²) ntration (min)	nA + 9 830Int) ^{0.4} May not exce	sed 100	)(0.7 <i>51</i> 4 K )
ARF						6	116.8			ARF = (90 00 Where: ARF = Areal redu Ar Catchment are t = Time of concer	00 — 12 800lr ction factor (%) ea (km²) ntration (min)	nA + 9 830Int) ^{0.4} May not exce		)(0.75M K )
ARF  Runoff co	oeffic	ient is cal		be:		6	116.8			ARF = (90 00 Where: ARF = Areal redu Ar Catchment are t = Time of concer	00 — 12 800lr ction factor (%) ea (km²) ntration (min)	nA + 9 830Int) ^{0.4} May not exce	sed 100	)(0.75M K )
ARF  Runoff co	oeffic	ient is cal	culated to	be:	ge to Ste		0.265	%		ARF = (90 00 Where: ARF = Areal redu Ar Catchment are t = Time of concer	00 — 12 800lr ction factor (%) ea (km²) ntration (min)	nA + 9 830Int) ^{0.4} May not exce	sed 100	)(0.75M K )
ARF  Runoff co	oeffic	ient is cal	culated to	be:	ge to Ste		0.265	%		ARF = (90 00 Where: ARF = Areal redu Ar Catchment are t = Time of concer	00 — 12 800lr ction factor (%) ea (km²) ntration (min)	nA + 9 830Int) ^{0.4} May not exce	sed 100	)(0.75M K )
Runoff co C _t Catchme V	oeffic ent vo	ient is cal	culated to	be: • be: • Discharg	ge to Ste		0.265	%		$\begin{array}{c} \text{ARF} = (90 \text{ oc}) \\ \text{Where:} \\ \text{ARF} = \text{Areal reduced} \\ \text{A-Catchment are} \\ \text{t= Time of conce} \\ \\ C_T = \frac{C}{1} \end{array}$	100 - 12 800 (h) ction factor (%) sa (km²) ntration (min) $\frac{2}{OO} + \left(\frac{2}{OO}\right)$	nA + 9 830Int) ^{0.4} May not exce	sed 100	)(0.75M K )
Runoff co Ct Catchme V	oeffic ent vo	ient is cal	culated to	be: • be: • Discharg	ge to Ste		0.265	%		$\begin{array}{c} \text{ARF} = (90 \text{ oc}) \\ \text{Where:} \\ \text{ARF} = \text{Areal reduced} \\ \text{A-Catchment are} \\ \text{t= Time of conce} \\ \\ C_T = \frac{C}{1} \end{array}$	100 - 12 800 (h) ction factor (%) sa (km²) ntration (min) $\frac{2}{OO} + \left(\frac{2}{OO}\right)$	nA + 9 830Int) ^{0.4} May not exce	sed 100	)(0.75M K )
Runoff co C _t Catchme V	oeffic ent vo	ient is cal	culated to	be: • be: • Discharg	ge to Ste		0.265	% m³		ARF = (90 00 Where: ARF = Areal redu Ar Catchment are t = Time of concer	100 - 12 800 (h) ction factor (%) sa (km²) ntration (min) $\frac{2}{OO} + \left(\frac{2}{OO}\right)$	nA + 9 830Int) ^{0.4} May not exce	sed 100	)(0.7514 K )
Runoff co C _t Catchme V Rainfall in	oefficent vo	ient is cal lume is ca	culated to	be: Discharg	ge to Ste		0.265	% m³		$\begin{array}{c} \text{ARF} = (90 \text{ oc}) \\ \text{Where:} \\ \text{ARF} = \text{Areal reduced} \\ \text{A-Catchment are} \\ \text{t= Time of conce} \\ \\ C_T = \frac{C}{1} \end{array}$	100 - 12 800 (h) ction factor (%) sa (km²) ntration (min) $\frac{2}{OO} + \left(\frac{2}{OO}\right)$	nA + 9 830Int) ^{0.4} May not exce	sed 100	(0.7514 K )
Runoff co Ct Catchme V Rainfall in	oefficent vo	ient is cal lume is ca	culated to alculated to	be: Discharg	ge to Ste		0.265 n River	% m³		$I_T = \frac{P_1}{T}$ $I_T = \frac{P_1}{T}$	100 - 12 800 (h) ction factor (%) sa (km²) ntration (min) $\frac{2}{OO} + \left(\frac{2}{OO}\right)$	$\frac{\mathbf{Y}_{\mathrm{T}}}{2,33} \left( \frac{\mathbf{C}}{10} \right)$	sed 100	)(0.7514 K )

Calculation sheet number:09160001C-01-CAL-0013Caculation sheet description:Channel Flow on Surface

Caculation type (if applicable):

Date of calculations:28-03-2025Calculations done by:Des Fourie

# **Conclusion:**

The Rational method was used to size the drain. The cross section and fall is adequate to carry the peak discharge.

# In order to do a channel flow design check, the following will be utilized:

Abbreviation	Item description	Unit of measure	Source	Input value
L	Length of channel	m	Drawings	0.785
H _{0.10}	10% of average slope	m	Calculated as 10% of fall of channel	
H _{0.85}	85% of average slope	m	Calculated as 85% of fall of channel	
L _{0.10}	10% of channel length	m	Calculated as 10% of length of channel	
L _{0.85}	85% of channel length	m	Calculated as 85% of length of channel	
S _{av}	Slope	m/m	SDF worksheet	0.013
Α	Cross sectional area of channel	m ²	Calculated from drawing	0.605
Р	Wetted perimeter of channel	m	Calculated from drawing	2.460
n	Roughness factor (Manning)	N/A	Drainage manual	0.014
v	Velocity	m/s	Calculated	
r	Ratio of area to perimeter	N/A	Calculated	
Reference dra	wing:	TM237-13105-S	001-01-C009-092-0003-01	
From drawings	:			
	Channel width:	2200	V Drain 1H:2V	
Velocity is cal	culated as follows:		1.0.1	
V		3.2 m/s	$v = -\frac{1}{n}r^{\frac{2}{3}}.s^{\frac{1}{2}}$	
Peak discharg	e is calculated as follows:			
Q		1.94 m ³ /s	Q = v x A With Rational method, Peak discharge was cald	culated to be 1.54m³/s, thu
			channel size is sufficient.	