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UNIVERSITY OF ESWATINI
FINAL EXAMINATION PAPER

PROGRAMMES: BSC AG ED3 AND AG EXTN 3

COURSE CODE: ABE301

TITLE OF PAPER: SOIL AND WATER CONSERVATION

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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SECTION A. COMPULSORY QUESTION

Question One

a. Using the Zimbabwean method, determine the recommended spacing between terraces constructed on highly erodible soils (4.0) with an average slope of 1.9^0. Express your answer in metres when: 1ft = 0.3048m. **8 marks**

b. If the length of the field is 8000m, estimate the peak run-off from the field when rain intensity is 110mm/hr and the runoff coefficient of the field is 0.031 using the rational formula (q = 0.0028CIA), and run-off volume (using the US. SCS (1972) for a 25year return period storm, given that the land use is a pasture with good hydrologic conditions, soil group C. **14 marks**

$$Q = \frac{(I - 0.2S)}{(I + 0.8S)}$$

c. Design a waterway (using Manning's formula) to convey the peak runoff at the flow velocity is 1.5m/s, allowing 20% for the freeboard. **18 marks**

$$V = \frac{R^{2/3} S^{1/2}}{n}$$

(40 Marks)

SECTION B. ANSWER ANY TWO QUESTIONS

Question two

a. Explain the importance of the following soil and water conservation measures highlighting the conditions where they are most applicable.

i. Tied ridges /10

ii. Bench terraces /10

20 marks

b. Briefly discus the limitations of mechanical soil conservation practices.

10 marks

(30 marks)

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Question three

a. Give five important factors considered to determine the amount of rain water to be harvested from a rooftop. **10 marks**

b. Describe four factors considered when determining the water demand for a household. **8 marks**

c. Calculate the yearly and monthly water demand for a family of eight people if the daily water requirement per person is 20liters and assuming zero demand fluctuations between months; **12 marks**

(30 marks)

Question four

a. Describe the influence of the following on soil erosion.

i. Soil bulk density /10

ii. Vegetation /10

iii. Soil additives /5

iv. Slope /5

(30 marks)

APPENDIX A

Land Use or Cover	Treatment or Practice	Hydrologic Condition	* Hydrologic Soil Group			
			A	B	C	D
Fallow	Straight row	-	77	86	91	94
Row Crops	Straight row	Poor	72	81	88	91
	Straight row	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	Contoured	Good	65	75	82	86
	Terraced	Poor	66	74	80	82
	Terraced	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
	Straight row	Good	63	75	83	87
	Contoured	Poor	63	74	82	85
	Contoured	Good	61	73	81	84
	Terraced	Poor	61	72	79	82
	Terraced	Good	59	70	78	81
Close seeded legumes or meadow	Straight row	Poor	66	77	85	89
	Straight row	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	Contoured	Good	55	69	78	83
	Terraced	Poor	63	73	80	83
	Terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	Contoured	Fair	25	59	75	83
	Contoured	Good	6	35	70	79

Table 2.3 : Runoff Curve Numbers for Hydrologic Soil Cover Complexes for Antecedent Rainfall Condition: II, and $I_a = 0.2S$

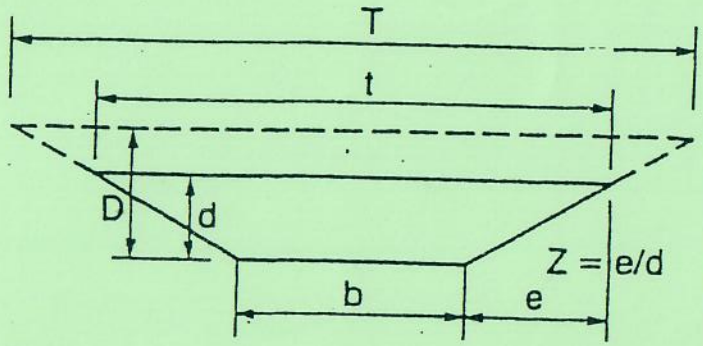
Table 2.3 (Continued)

Land Use or Cover	Treatment or Practice	Hydrologic Condition	* Hydrologic Soil Group A	B	C	D
Meadow (Permanent		Good	30	58	71	78
Woods		Poor	45	66	77	83
(Farm wood-lots)		Fair	36	60	73	79
		Good	25	55	70	77
		-	59	74	82	86
Right-of-way (hard surface		-	74	84	90	92

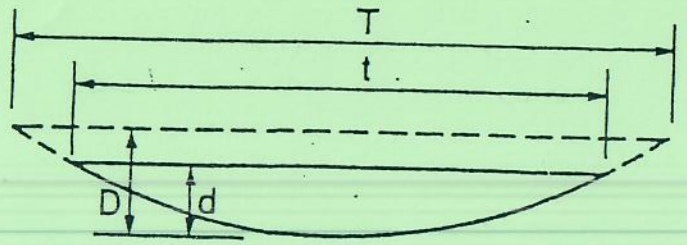
*Soil Group	Description	Final Infiltration rate (mm/h)
A	Lowest Runoff Potential. Includes deep sands with very little silt and clay. also deep, rapidly permeable loess.	8 - 12
B	Moderately Low Runoff Potential. Mostly sandy soils less deep than A, and loess less deep or less aggregated than A, but the group as a whole has above average infiltration after thorough wetting.	4 - 8
C	Moderately High Runoff Potential. Comprises shallow soils and soils containing considerable clay and colloids, though less that those of group D. The group has below average infiltration after pre-saturation.	1 - 4
D	Highest Runoff Potential. Includes mostly clays of high swelling percent, but the group also includes some shallow soils with nearly impermeable sub-horizons near the surface.	0 -1

Source: U.S. Soil Conservation Service, National Engineering Handbook, Hydrology, Section 4 (1972) and U.S. Dept. Agr. ARS 41 - 172 (1970). As Cited By Schwab et al (1981).

APPENDIX B



Area	$bd + Zd^2$
Wetted perimeter	$b + 2d\sqrt{1 + Z^2}$
Hydraulic radius	$\frac{bd + Zd^2}{b + 2d\sqrt{1 + Z^2}}$
Top width	$t = b + 2dZ$ $T = b + 2DZ$



Area	$\frac{2}{3}td$
Wetted perimeter	$t + \frac{8d^2}{3t}$
Hydraulic radius	$\frac{t^2d}{1{\cdot}5t^2 + 4d^2}$ (approx.) $\frac{2d}{3}$
Top width	$t = \frac{3a}{2d}$ $T = t(\frac{D}{d})^{\frac{1}{4}}$

Basic dimensions of common channel sections