The University of Melbourne

Faculty of Land and Food Resources

Semester 2, Assessment 2005

208-308 Irrigation and Water Management - Block

Date: Friday September 9, 2005

Time: 1.00 pm – 4.00 pm

Reading Time: 15 minutes

Examination Duration – 3 hours

This paper has 7 pages including this cover.

Data sheets are also provided.

Examination paper can be deposited in the Library.

Authorized Materials:

No materials are authorized

Instructions to Invigilators

Students will require script books only.

Instructions to students.

This paper contributes 50% of the total subject mark.

All questions are of equal value.

There are 15 questions.

You are to provide answers to all questions, no selection is provided.

1. The Living Murray initiative aims to provide 500 GL of water annually to improve river health and sustain wetlands at key points in the river system. List and describe how State and Federal Governments propose to access this water from the current water resources available. (10 marks)

2. A drainage diverter is proposing to pump effluent to a drainage system re-use sump to facilitate irrigation of a 2.5 ha woodlot. If the irrigator plans to apply 12 ML/ha/year of water containing 1,000 mg/l of salt determine the following system design characteristics:

   (a) the average annual volume of leachate collected if the leaching fraction is 15%

   (b) the average salinity of the leachate

   (c) the mass of salt applied annually to the woodlot. (10 marks)

3. List and describe two techniques for scheduling irrigation water applications through crop, soil or climatic monitoring and modeling. (10 marks)

4. What are the key water management issues facing the Murray Darling Basin, that are being addressed through strategies adopted by the Murray Darling Basin Commission? (10 marks)

5. The role of Wetlands in the Murray River catchment is often compared to the kidneys of the human body. What is the function of wetlands and why are so many resources being devoted to their maintenance? (10 marks)

6. An irrigator proposes to apply 1 m of water to a maize crop during the irrigation season. If the crop occupies 5 ha of land and the projected crop evapotranspiration is 600 mm determine the following:

   (a) the projected volume of runoff or deep percolation that will accrue if there is no rainfall.

   (b) the projected irrigation efficiency

   (c) the water use per hectare of production if the maize yield is projected to be 5 tonne/ha

   (d) if the projected volume of water needed remains the same but the allocation is reduced by 50%, what options does the irrigator have with the water available? (10 marks)

7. With the aid of diagrams, describe the impact on a waterway of the discharge of organic waste from an agricultural source in terms of:

   oxygen demand

   nitrogen

   energy

   organisms

   (10 marks)

8. A Murray Valley orchard is founded on sandy loam in a district where the average February evaporation is 210 mm. Allowing for a crop factor of 0.8, a soil field capacity of 150 mm/m and permanent wilting point of 40 mm/m determine the following:

   (a) the predicted monthly evapotranspiration

   (b) the projected irrigation interval assuming a root zone depth of 0.9 m and implementation of a policy to irrigate when 50% of available soil water is depleted.

   (c) The projected irrigation water depth assuming that the irrigation system efficiency is 70%

   (10 marks)

9. A dryland farmer in the Northern Mallee has recently connected to the regional piped domestic and stock water supply system. He has installed a tank 20 m above the proposed location of a trough and installed a 50 mm diameter galvanized iron pipe to connect the tank to the trough, a distance of 400 m.

(a) If a flow rate of 1.5 l/sec is measured, what is the likely pressure of water at the outlet to the trough?
(b) The farmer wants to relocate the trough a further 500 m away, if the same flow rate is needed and the trough elevation is unchanged, can it be done?
(c) How can the pressure of water at the trough outlet be increased?

(10 marks)

10. Reservoirs and weirs are major components of the Goulburn-Broken water management system. List and describe the functions that these facilities serve and also describe their impact on river health. (10 marks)

11. List the advantages and disadvantages of drip/miscrosprinkler irrigation systems for horticultural and agricultural applications.

(10 marks)

12. A channel of rectangular section 20 m wide and 0.3m deep is to be employed as a grassed waterway for soil erosion control. If the roughness coefficient is 0.03 and the channel slope is 0.08%, determine the following characteristics:

(a) The predicted velocity when the channel is flowing full.

(b) The potential for scour to occur if the waterway is bare and formed in silty sand.
(c) The flow rate when the channel is flowing full. (10 marks)

13. What are the key water quality concerns for the water resources of northern Victoria and what parameters are of concern for irrigation and stock and domestic consumption? (10 marks)

14. (a) What is blue green algae and how does it impact on the utilization of water for urban, irrigation or stock and domestic purposes?

(b) What strategies are being followed to reduce the impact of blue green algae blooms?

(10 marks)

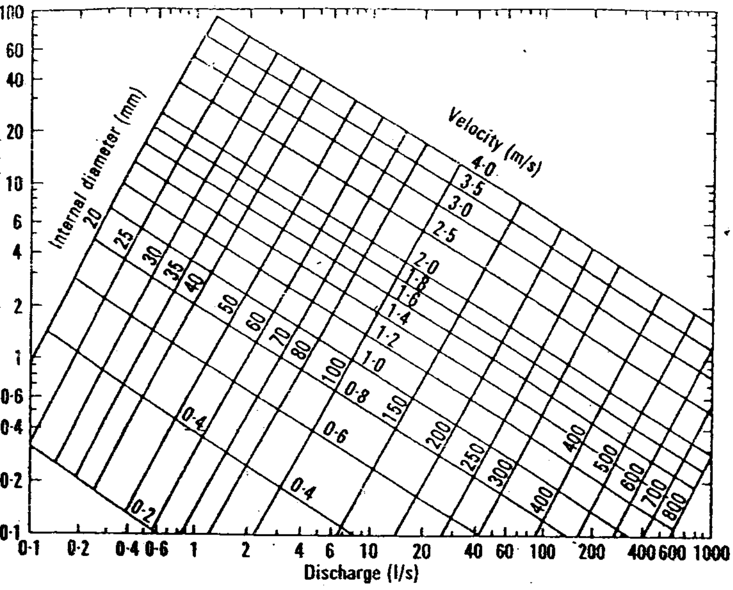
15. Describe the mechanism of either dryland on irrigation salinity and identify what measures are being taken to counter the threat of salinity to agricultural production and employment of water resources.

(10 marks)

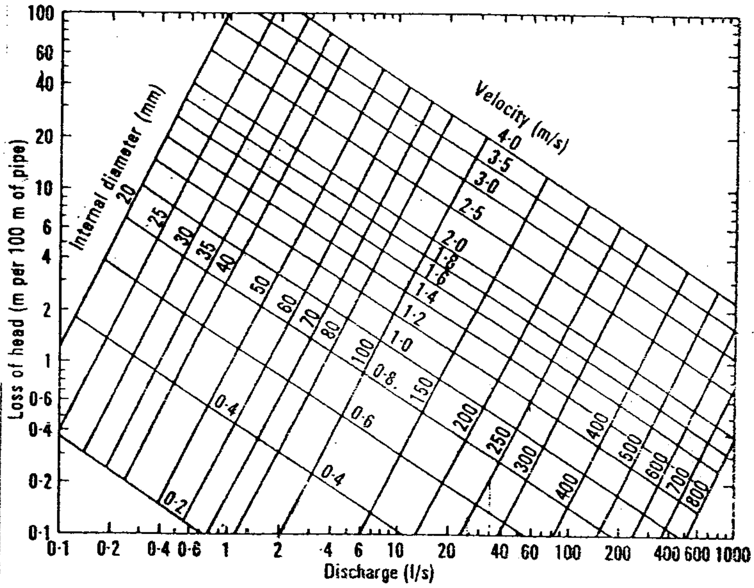
AGRICULTURAL ENGINEERING DEPARTMENT

HYDRAULICS SECTION

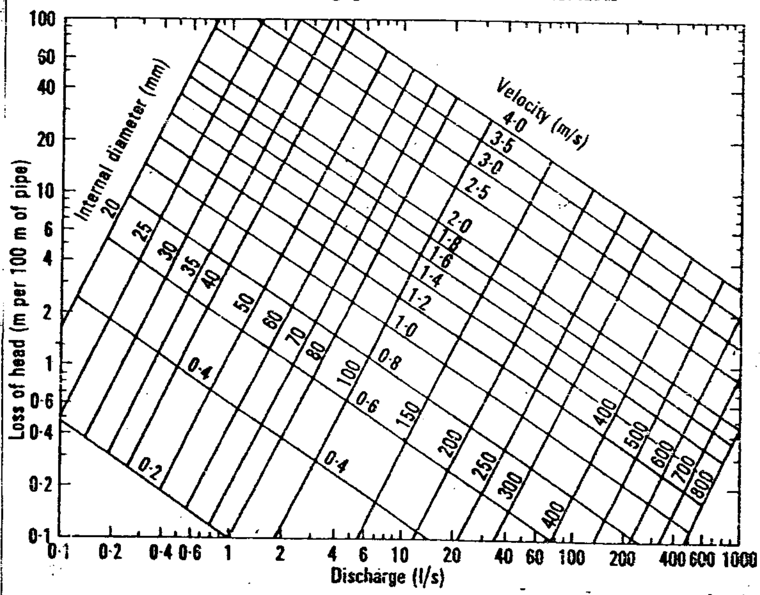
PIPE FLOW



Friction loss in pipes with low friction



Friction loss in pipes with medium friction



Friction loss in pipes with high friction

Approximate capacities of pipes of various sizes

Metric sizes (flow not exceeding 2 m/s)		English sizes (flow not exceeding 6 ft/s)	
iameter (mm)	Flow (l/s)	Diameter (in)	Flow (gall/min)
50	3	2	48
75	8	2½	75
100	15	3	110
125	20	4	200
150	35	5	300
175	50	6	450
200	60	8	800
225	80	10	1250
250	100	12	1700
300	150	18	3700

Head losses in pipe fittings

Pipe size (mm)	50 mm	75 mm	100 mm
	Length of straight pipe with similar head loss (m)		
bows and bends	1·25	1·75	3·0
junctions	3·0	4·5	6·0
ick couplers / mi-quick couplers	1·50	1·5	1·5

Roughness characteristics of pipes of various materials

Roughness category	Material				
	Plastic	Asbestos/ cement	Aluminium	Galvanized	Concrete
Low friction	No constriction at joints, for example, taper-fit or solvent-welded	With smooth joints	Permanent	New	-
Medium friction	Some constriction at joints, for example, butt-welded	-	Portable	-	Spun concrete with gasket joints
High friction	-	-	-	Old	(a) Precast with gasket joints (b) Cast *in situ*

Values of Manning's roughness coefficient *n*

(*a*) *Channels free from vegetation*	*n*
Uniform cross-section, regular alignment free from pebbles and vegetation, in fine sedimentary soils	0·016
Uniform cross-section, regular alignment, free from pebbles and vegetation, in stiff clay soils or hardpan	0·018
Uniform cross-section, regular alignment, few pebbles, little vegetation, in clay loam	0·020
Small variations in cross-section, fairly regular alignment, few stones, thin grass at edges, in sandy and clay soils, also newly cleaned, ploughed, and harrowed channels	0·0225
Irregular alignment, ripples on bottom, in gravelly soil or shale, with jagged banks or vegetation	0·025
Irregular section and alignment, scattered rocks and loose gravel on bottom, or considerable weeds on sloping banks, or in gravelly material up to 150 mm diameter	0·030
Eroded irregular channels, channels blasted in rock	0·030
(*b*) *Vegetated channels*	
Short grass (50-150 mm)	0·030-0·060
Medium grass (150-250 mm)	0·030-0·085
Long grass (250-600 mm)	0·040-0·150
(*c*) *Natural stream channels*	
Clean and straight	0·025-0·030
Winding, with pools and shoals	0·033-0·040
Very weedy, winding, and overgrown	0·075-0·150

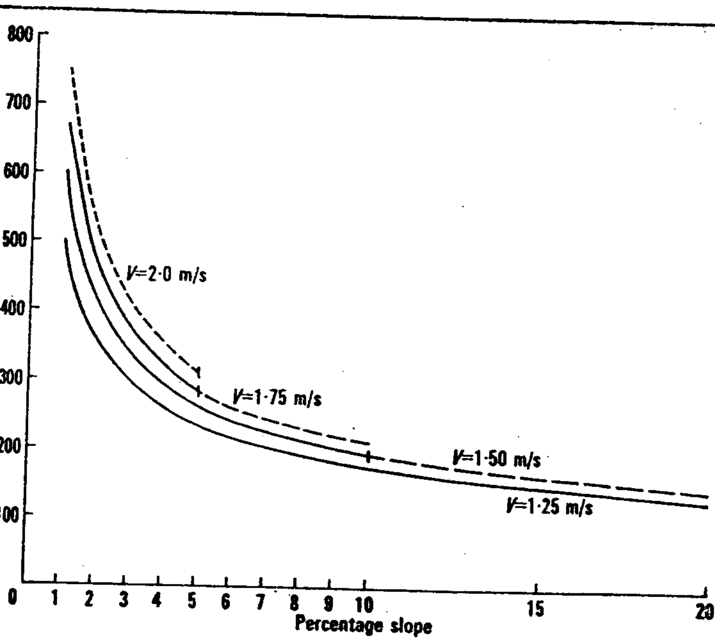
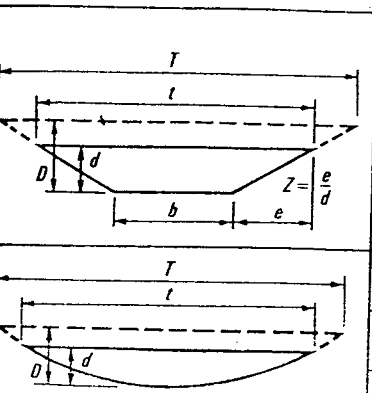


Chart for obtaining the design depth of shallow grassed ins and waterways. Dotted lines show values which should only be d on soils resistant to erosion.



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

Basic dimensions of common channel sections.

AGRICULTURAL ENGINEERING DEPARTMENT

HYDRAULICS SECTION

OPEN CHANNEL FLOW

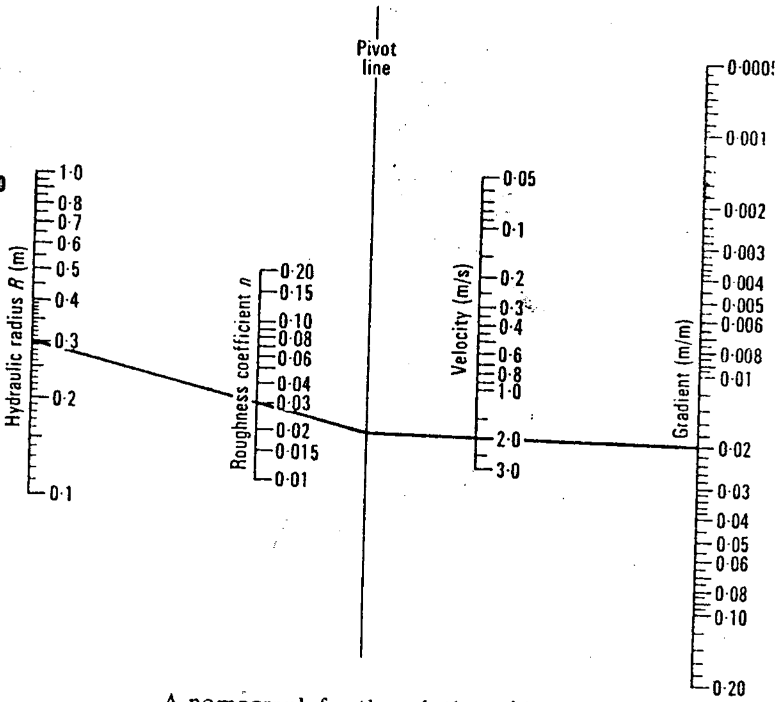
Maximum non-scouring velocities for open channels

Material	Maximum velocity on cover expected after two season					
	Bare		Medium grass cover		Very good grass cover	
	m/s	ft/s	m/s	ft/s	m/s	ft/
Very light silty sand	0·3	1·0	0·75	2·5	1·5	4·
Light loose sand	0·5	1·5	0·9	3·0	1·5	5·
Coarse sand	0·75	2·5	1·25	4·0	1·7	5·
Sandy soil	0·75	2·5	1·5	4·5	2·0	6·
Firm clay loam	1·0	3·5	1·7	5·5	2·3	7·
Stiff clay or stiff gravelly soil	1·5	4·5	1·8	6·0	2·5	8·
Coarse gravels	1·5	5·0	1·8	6·0	Unlikely to form very good grass cover	
Shale, hardpan, soft rock, etc.	1·8	6·0	2·1	7·0		
Hard cemented conglomerates	2·5	8·0	-	-	-	-

Intermediate values may be selected.

Design velocities for grass waterways (m/s)

	Slope 0-5 per cent	5-10 per cent	10 per cen
Soil resistant to erosion	2·0	1·75	1·50
Erodible soils	1·75	1·50	1·25



A nomograph for the solution of Manning's equation. If any three variables are known, the fourth can be found.
Example. Given $R = 0{\cdot}3$ m, $n = 0{\cdot}03$, gradient = 2 per cent or 0·02 m per m, find velocity V.
Solution. Join $R = 0{\cdot}3$ and $n = 0{\cdot}03$ and project to the pivot line. Join the point on the pivot line to gradient = 0·02. Intersection of the velocity scale gives $V = 2{\cdot}0$ m/s.