DIVERSION DESIGN

The design for capacity of diversions shall be based on Manning's formula for open channel flow and current related procedures and recommendations. Tables 1A and 1B 'Diversion Design', Engineering Field Manual, may be used for design of diversions. These tables show capacities in CFS and velocities in feet/second for diversions with various bottom widths, flow depths and side slopes for both C and D retardance.

To use these tables select from Table 1A the section -- side slopes, bottom width and flow depth -- for the grade on which diversion will be built, that will carry within velocity requirements, the required Q. Then using Table 1B, read the flow depth that will be required to carry this Q in the same section, but with a C retardance. Intermediate values of flow depths can be obtained by interpolation.

Normally diversions are vegetated and will be designed with D retardance for velocity and C retardance for capacity. When it is anticipated that vegetation will not be managed to maintain a retardance of C as a maximum, then the diversion shall be designed using Manning's formula B retardance and the proper velocity -- hydraulic radius relationships.

Where diversions are constructed to provide water control in connection with irrigated land, the area occupied by the diversion may be cropped. At certain periods, such diversions may function as bare channels. At other periods, these same diversions will function as channels having a high retardance. For the design of these diversions to provide for some safety against lower velocities when retardance is high, as well as higher velocities when retardance is low, the following procedure should be used:

PROCEDURE FOR DESIGN OF LOW GRADIENT DIVERSIONS
USED WITH IRRIGATION PRACTICES

Diversion Grade - %	Required Q - CFS	Procedure	
		C Retardance	Bare Channel (N = .025)
1. 0.2 or less	120 or less	Select channel from Table 1B that will carry the required Q. Use wider channels for Q over 40 CFS.	Channel will carry design Q at a maximum velocity of near 3 ft. per sec. This velocity will be safe except for non-cohesive ML and SM soils. 1/
	over 120	Special design.	Special design.
2. Over 0.2 - 0.3	80 or less	Select channel from table 1B that will carry the required Q. For Q over 30 CFS use wider channel.	Same as no. 1 above.

PROCEDURE FOR DESIGN OF LOW GRADIENT DIVERSIONS USED WITH IRRIGATION PRACTICES CONT'D.

Diversion Grade - %	Required Q - CFS	Procedure	
		C. Retardance	Bare Channel (N = .025)
3. Over 0.3 - 0.4	60 or less	Select channel from Table 1B that will carry the required Q. For Q over 20 CFS use wider channel.	Same as no. 1 above.
	Over 60	Special design.	Special design.
4. Over 0.4 - 0.5	40 or less	Select channel from Table 1B that will carry required Q. For Q over 20 CFS use wider channel.	Same as no. 1 above.
	Over 40	Special design.	Special design.
5. Over 0.5	All	Special design.	Special design.

1/ Diversions that may be required to function as bare channels and are to be constructed on light non-cohesive soils will require special design.

DIVERSIONS

MAXIMUM PERMISSIBLE VELOCITIES - FT/SEC

	Easily Eroded Soils	Erosion Resistant Soils
	Light looms, sands and loomy silts (non-plastic)	Heavy, clayey silts and clays (plastic)
Poor Channel Vegetation	2.5	3.5
Good Channel Vegetation	5.0	7.0

MAXIMUM PERMISSIBLE VELOCITIES

Common Classification			Maximum Safe Velocities
USDA	Unified		
	Description	Symbol	FT/SEC
Fine Sand, Loomy Sand (Very low in clay content)	Fine Sands Silty Sands	SW, SP SM	1.50 - 2.50
Sandy Loom (Low in clay content)	Silty Sands Sandy Silts	SM ML	1.75 - 2.50
Silt Loom (Low in clay content) Soils or Soil Materials from Brule	Sandy Silts	ML	2.00 - 3.00
Alluvial Silt, Very Fine Sandy Loom, Silt Loom (Low in clay content, high in silt content)	Sandy Silts	ML	2.00 - 3.50
Silt Loom, Silty Clay Loom (Low to moderately high in clay in surface, moderately high in clay in subsoil)	Sandy Silts Clayey Silts	ML CL	2.25 - 3.50
Alluvial Silt, Silty Clay Loom (Moderately high in clay in surface and subsoil)	Clayey Silts	ML, CL	3.00 - 5.00
Silty Clay, Clay (High in clay)	Silty Clay Clay	CH	3.75 - 5.00
Shale, Hardpan, Clay	Clay, Shale	CH	5.00 - 6.00

The lower velocities occurring when retardance is high may increase channel sillation and the maintenance required. This should be accepted by the farmer.

Tables 2A and 2B provide velocities and capacities for out-of-channel flows in diversions. Generally, for small diversions -- under 10 feet bottom width -- this out-of-channel flow can be neglected in design when land slope crossed is one percent or greater, and flow depths are less than 1.8 feet. For any given required Q -- greater flow depths, wider bottom widths, steeper side slopes and flatter land slopes -- all tend to increase out-of-channel flow.

Diversion Excavation Quantities

The tables "Channel Centerline Depth of Cut and Area of Excavation for Diversions with Cut-Fill Ratio 1.25:1", in the Engineering Field Manual, gives excavation area of the section in square feet, based on height of diversion and bottom width, for various channel and ridge slopes and land slopes. In using these tables, the figure used as Total Height of Diversion above channel will be obtained by adding to Flow Depth (from Table 1 or from special design) a freeboard of 0.3 foot to 0.5 foot.

The table also includes the channel centerline cut required to construct the section, using a balance factor (C/F) of 1.25. Therefore, in the construction of the diversion, it will not be necessary, under normal conditions, to provide for overfill providing the providing the excavation depth at centerline of channel as shown in table, is made.

The number of cubic yards of excavation will be determined by multiplying the area shown in table for pertinent land slope, by the length of diversion, or portion of diversion, in feet, and dividing by 27.

Yardage conversion chart for diversion, in Engineering Field Manual, may also be used to determine directly the number of cubic yards in diversion, after obtaining the area of excavation in square feet.

If design requirements dictate the use of a design height (total height of diversion above channel), side slopes, bottom width, or its use on a land slope not covered by these tables, the excavation quantity shall be determined from areas obtained after plotting the section as designed on land slope crossed, and using a balance factor (C/F) of 1.25.