

CHAPTER 7. CHANNEL PROTECTION

7.1 Open Channels

Open channels in subcritical flow (see Chapter 3) are generally designed as grass-lined channels. All channel bottoms shall be sodded. Channel side slopes which are flatter than 3:1 may be sodded or seeded. Channel side slopes between 3:1 and 2:1 shall be sodded. Channel side slopes of 2:1 or steeper shall be lined with concrete, riprap, brick, asphalt, or other erosion-resistant lining. Open channels carrying super-critical flow shall be lined with concrete on the bottom and on the side slopes to the full design depth plus 1 foot.

7.2 Culvert Headwalls

Culverts at collector streets, main arteries, and freeways shall be provided with concrete headwalls.

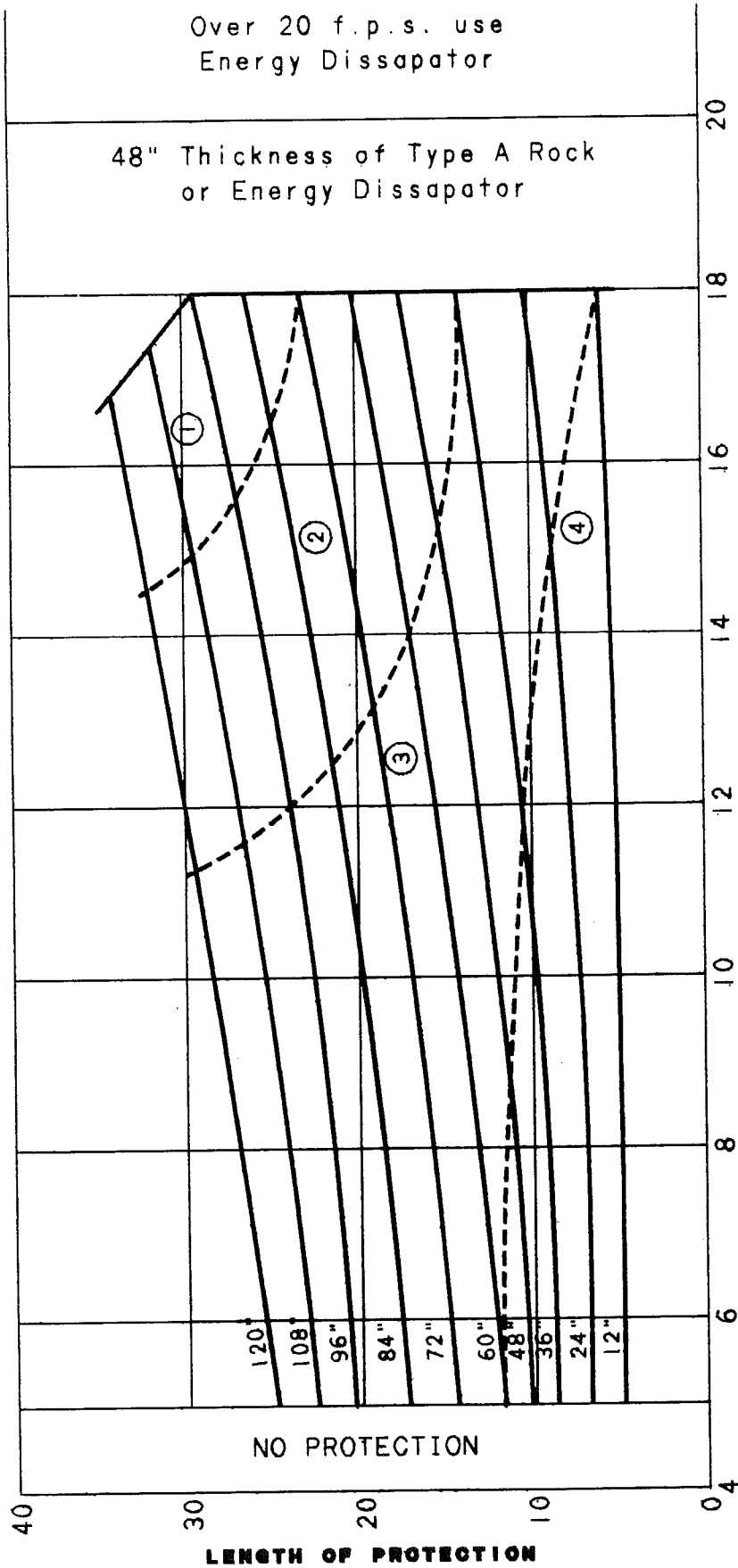
7.3 Energy Dissipation

Outfalls from storm sewers and culverts shall be designed to minimize erosion action on the channel at and downstream from the outfall. At all outfalls, rock protection shall be provided as given in Exhibit VII-1 (page 7-2).

7.4 Example - Energy Dissipation

Find the length and type of rock channel protection from a 48-inch concrete culvert, with an outfall velocity of 12 fps.

Step 1. Use Exhibit VII-1 (page 7-2) with culvert size of 48 inch and pipe outlet velocity of 12 fps and read that rock channel protection is required and shall consist of 12-inch rock, 30 inches deep, extending 13.5 feet below the outfall and be 8 feet wide.



LEGEND

ROCK TYPE	LEGEND
A	① 48" of 18" rock
A	② 36" of 18" rock
B	③ 30" of 12" rock
C	④ 18" of 6" rock

NOTES

Rock size (6", 12", 18") indicates the square opening on which 85% of the material by weight will be retained.

Minimum width of protection shall be twice the pipe diameter, with 4" being the very minimum.

(Where a stream bed will withstand the calculated velocity without erosion, no rock channel protection will be required)

**ROCK CHANNEL PROTECTION
AT CULVERT AND STORM SEWER OUTLETS**