



The standard precast concrete box section produced under Standards C789 and C850 is shown in Figure 1, and the standard sizes and wall thicknesses in Tables I and II. Generally, box culverts are designed with wing walls and a wing wall flare of 30-75 degrees as shown in Figure 2 encompass a majority of installations. The precast concrete box sections commonly have a tongue and groove joint configuration similar to precast concrete pipe. The entrance loss coefficient,  $k_e$ , is 0.2 for concrete pipe with the groove end projecting. The box section groove also provides basically a rounded crown edge and therefore, an entrance loss coefficient of 0.2 should apply.

Performance curves for the hydraulic design of the standard precast concrete box culvert are presented in Figures 3

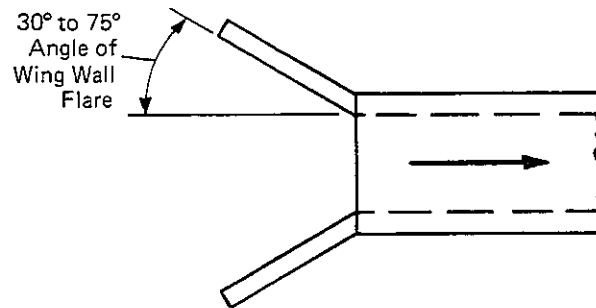
through 14. These curves correlate discharge-headwater depth and are based on nomographs included in Hydraulic Engineering Circular Number 5, Federal Highway Administration, with a recommended roughness coefficient of 0.012. The headwater depths for inlet-controlled flow are read directly from the performance curves. For outlet-controlled flow it is necessary to subtract the product of the culvert length and slope from the headwater depth.

A complete discussion of the hydraulics of culverts is presented in Design Data 8, Hydraulics of Culverts; 12-inch through 21-inch Diameter Pipe and specifics on the hydraulic properties of precast concrete box sections in Design Data 26, Hydraulic Capacity of Precast Concrete Boxes.

**TABLE II: Standard Thicknesses**

SPAN, Feet	$T_T$ , inches		$T_B$ , inches		$T_S$ , inches	
	C789	C850	C789	C850	C789	C850
3	4	7	4	6	4	4
4	5	7½	5	6	5	5
5	6	8	6	7	6	6
6	7	8	7	7	7	7
7	8	8	8	8	8	8
8	8	8	8	8	8	8
9	9	9	9	9	9	9
10	10	10	10	10	10	10
11	11	11	11	11	11	11
12	12	12	12	12	12	12

**FIGURE 2: Wing Wall Flare**



**EXAMPLE**

**Given:** A 400-foot long highway culvert is to be installed on a 1 percent slope. The culvert is limited to a maximum rise of 6 feet and is required to carry a flow of 200 cubic feet per second with an allowable headwater depth of 6 feet.

**Find:** Size of precast concrete box section required and type of control.

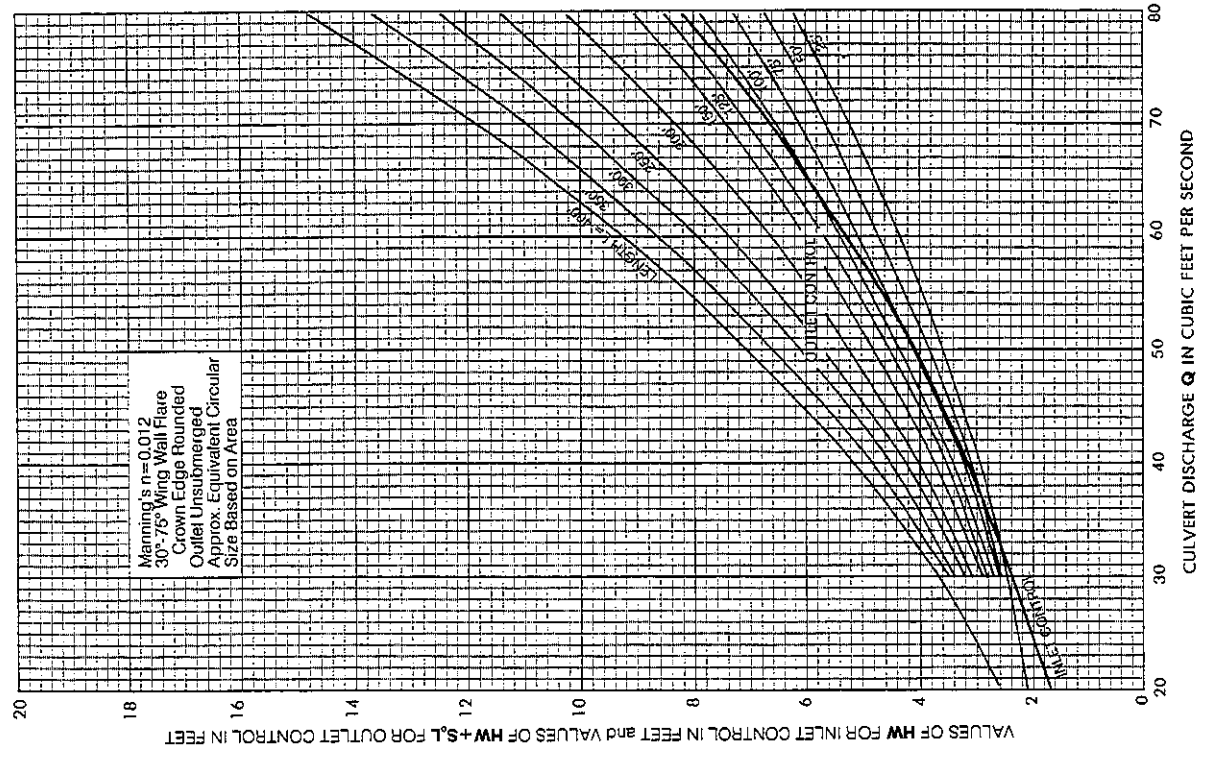
**Solution:** Enter Figure 12: 6 × 4-foot concrete box section, and project a vertical line from  $Q = 200$  to the inlet control curve and the outlet control curve for  $L = 400$  feet. Project horizontally to the vertical scale and read a headwater depth of 5.4 feet for inlet control and a

value of 6.6 feet for outlet control. To obtain outlet control headwater depth, subtract  $S_o \times L$  from the outlet control value:  $6.6 - (0.01 \times 400) = 2.6$  feet: Therefore inlet control governs.

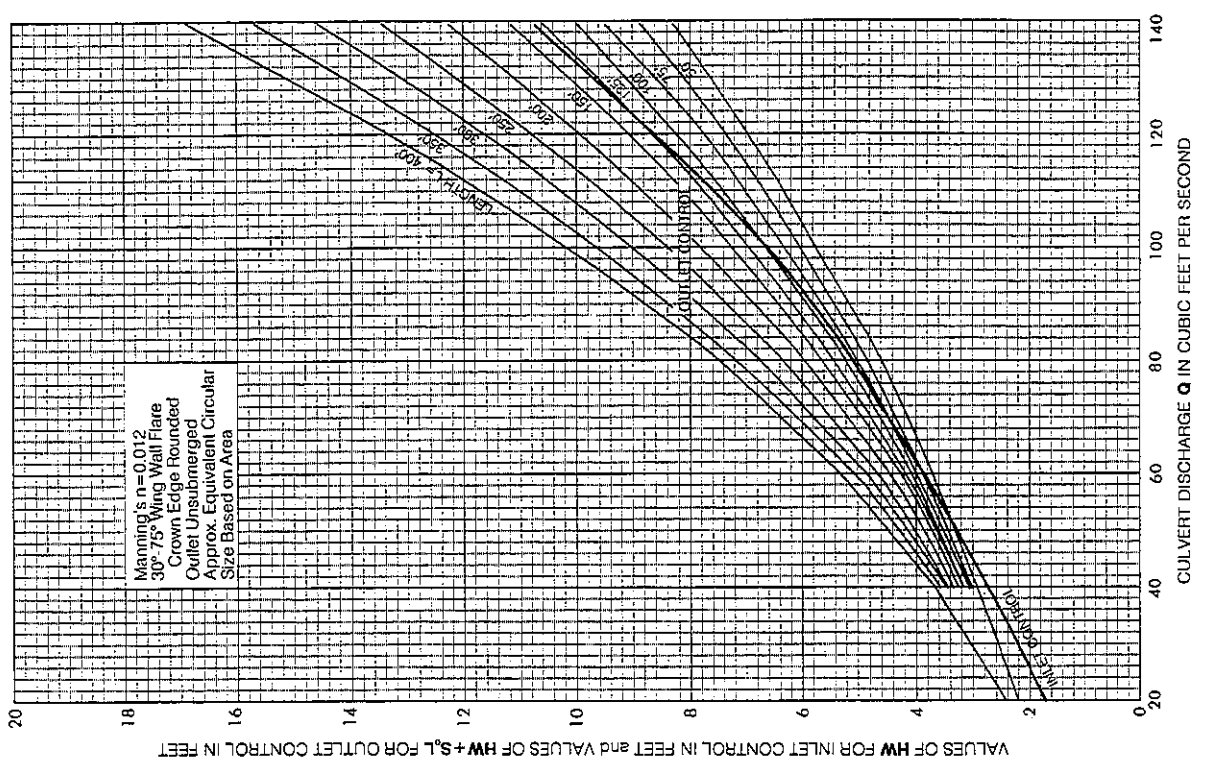
Entering Figure 10: 5 × 5-foot concrete box section and proceeding in a similar manner, read a headwater depth of 5.9 feet for inlet control and obtain 2.8 feet for the outlet control headwater depth with inlet control governing.

**Answer:** A 5 × 5-foot or a 6 × 4-foot precast concrete box section will carry the design discharge within the allowable headwater depth of 6 feet under inlet control.

**FIGURE 3: Culvert Capacity—3 x 2-foot Precast Box Section  
Equivalent 33-inch Circular**

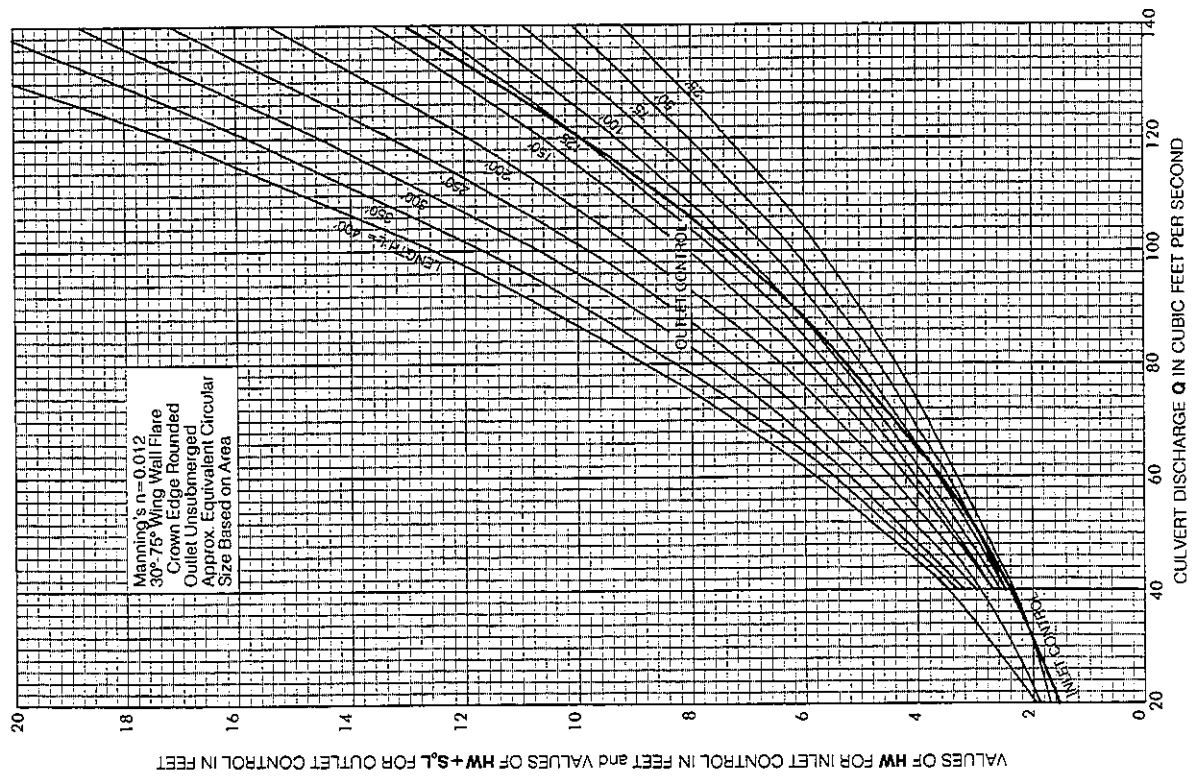


**FIGURE 4: Culvert Capacity—3 x 3-foot Precast Box Section  
Equivalent 39-inch Circular**

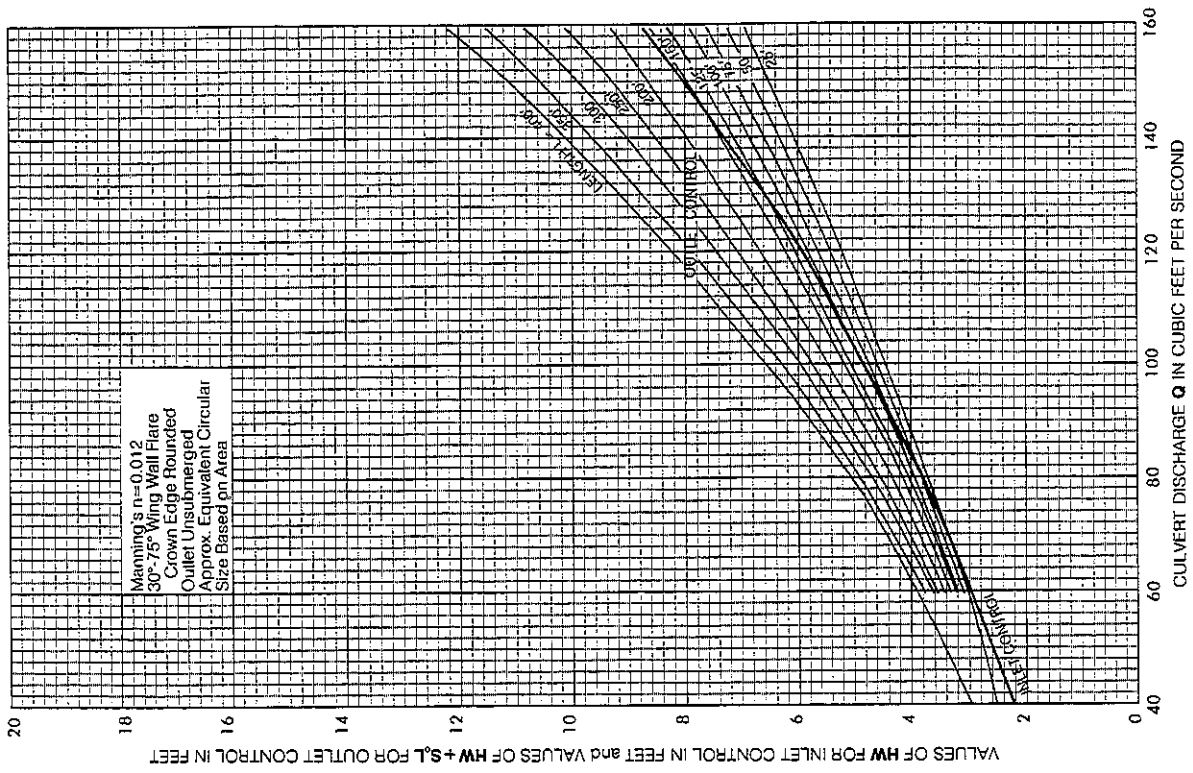


Interpolate for intermediate culvert lengths

**FIGURE 5: Culvert Capacity—4 x 2-foot Precast Box Section Equivalent 36-inch Circular**

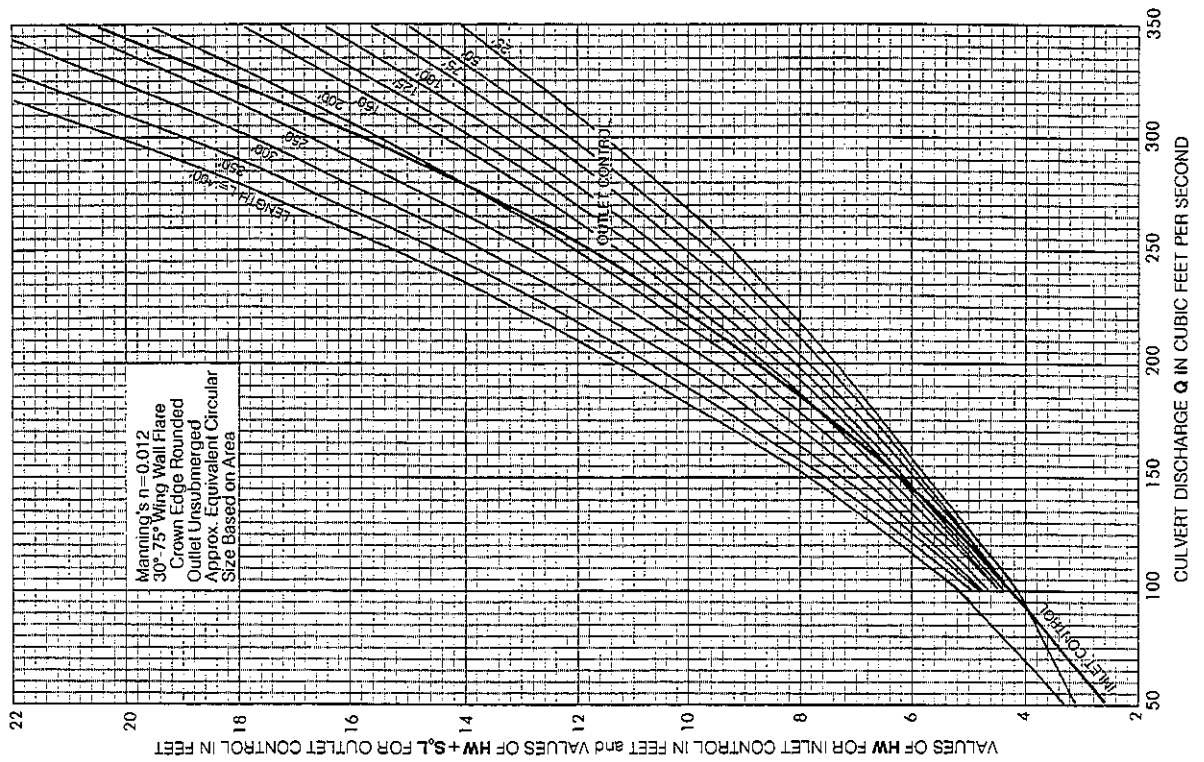


**FIGURE 6: Culvert Capacity—4 x 3-foot Precast Box Section Equivalent 42-inch Circular**

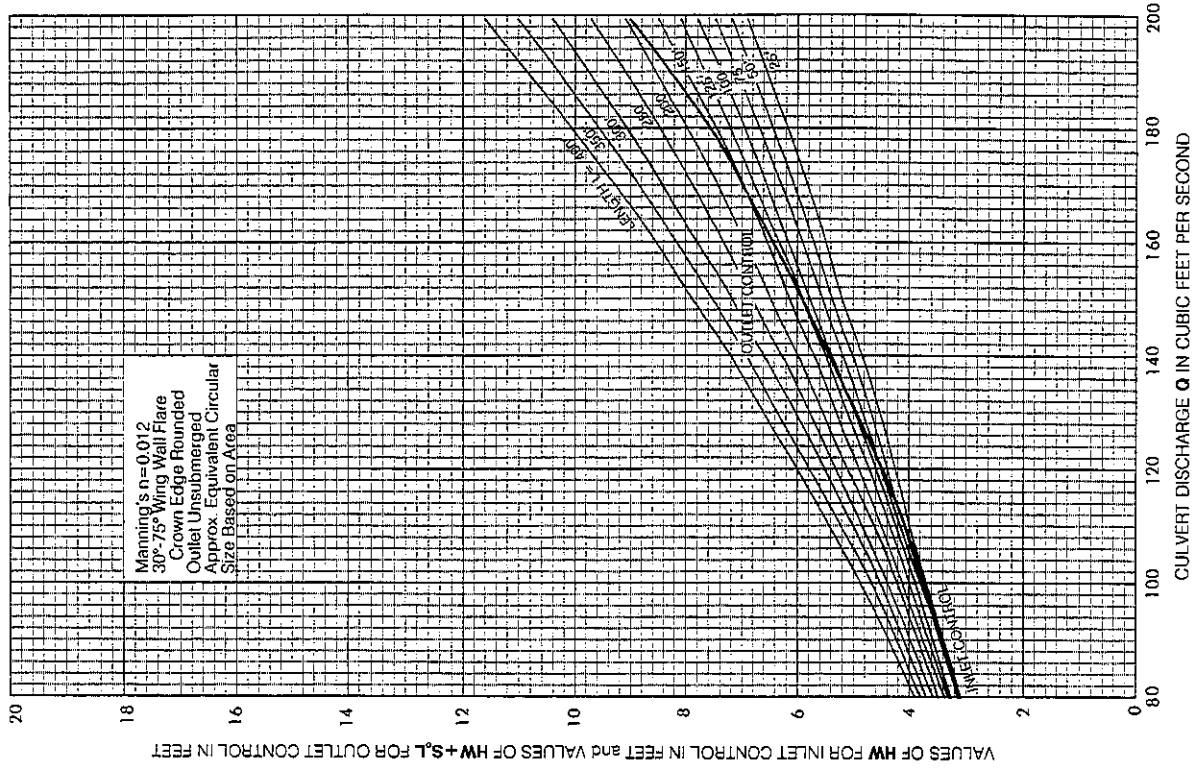


Interpolate for intermediate culvert lengths

**FIGURE 7: Culvert Capacity—4 x 4-foot Precast Box Section  
Equivalent 54-inch Circular**

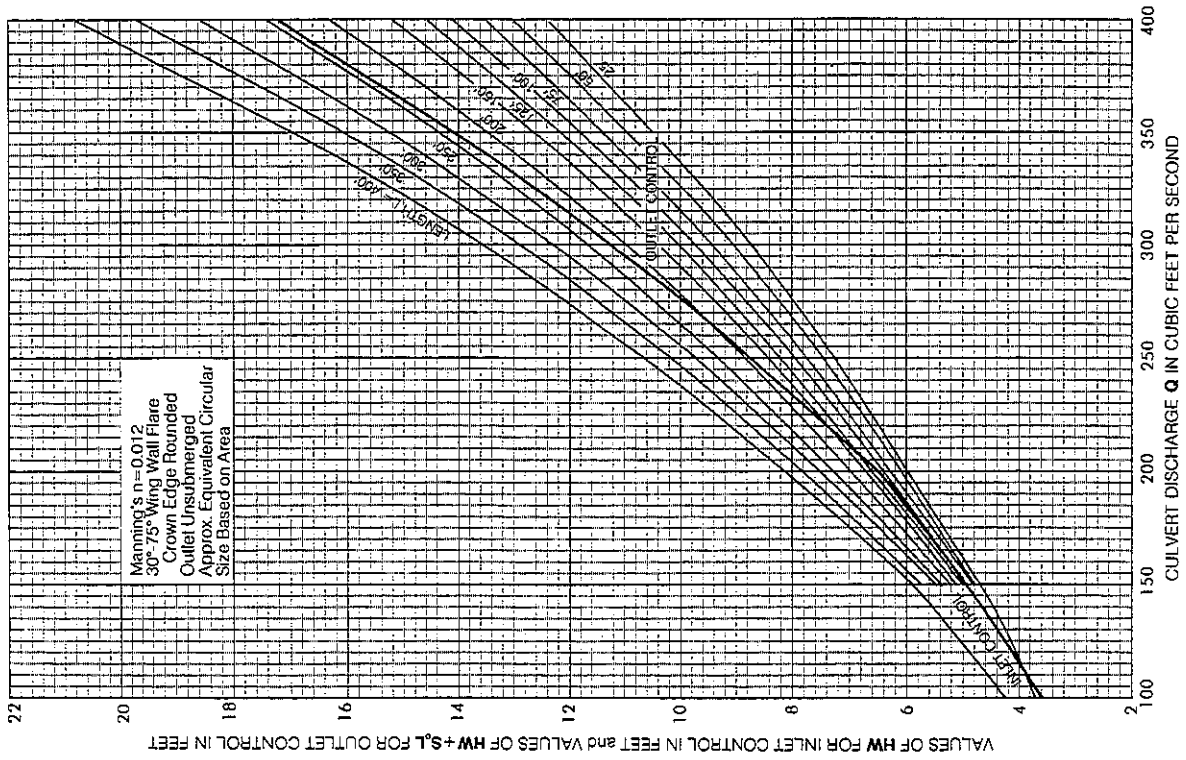


**FIGURE 8: Culvert Capacity—5 x 3-foot Precast Box Section  
Equivalent 48-inch Circular**

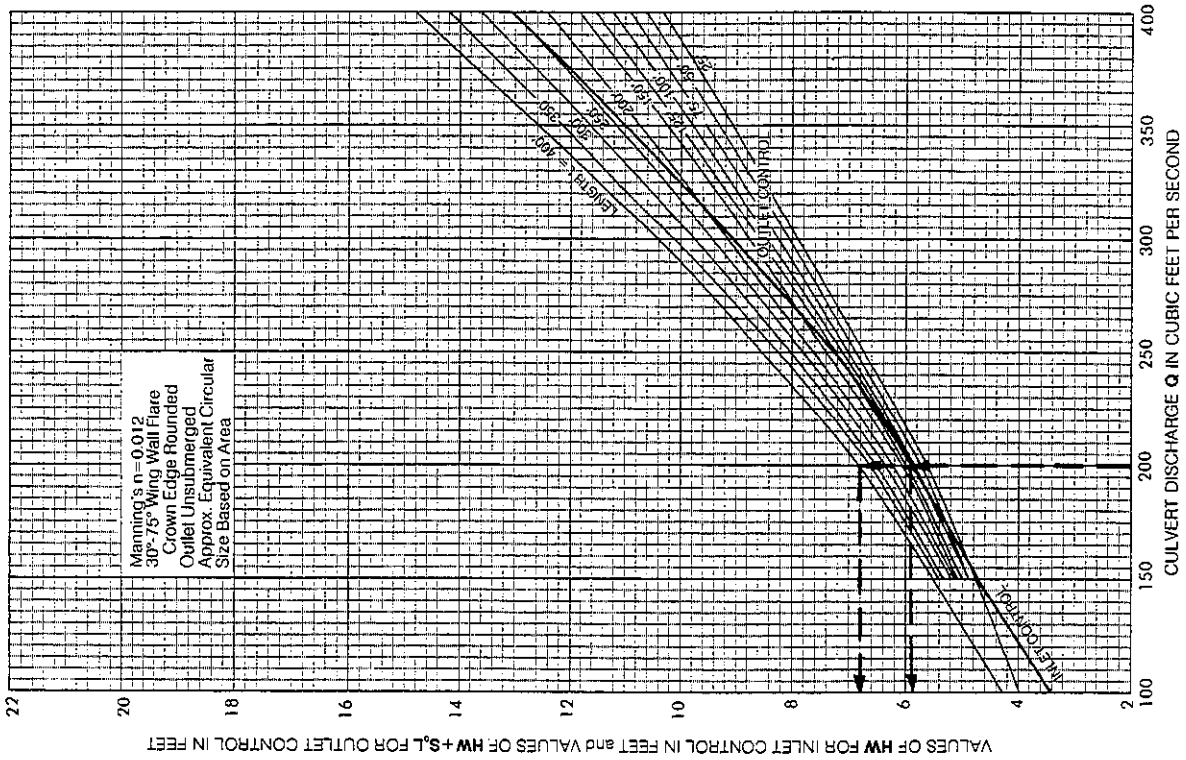


Interpolate for intermediate culvert lengths

**FIGURE 9: Culvert Capacity—5 x 4-foot Precast Box Section  
Equivalent 60-inch Circular**

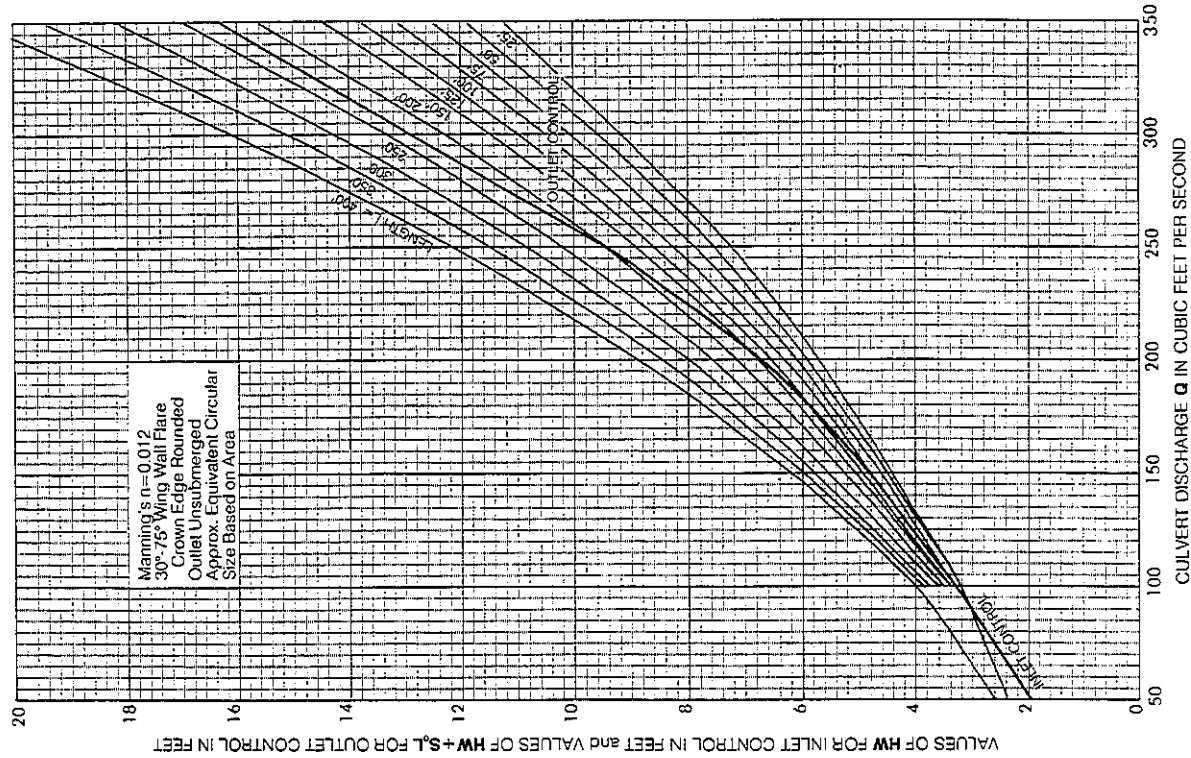


**FIGURE 10: Culvert Capacity 5 x 5-foot Precast Box Section  
Equivalent 66-inch Circular**

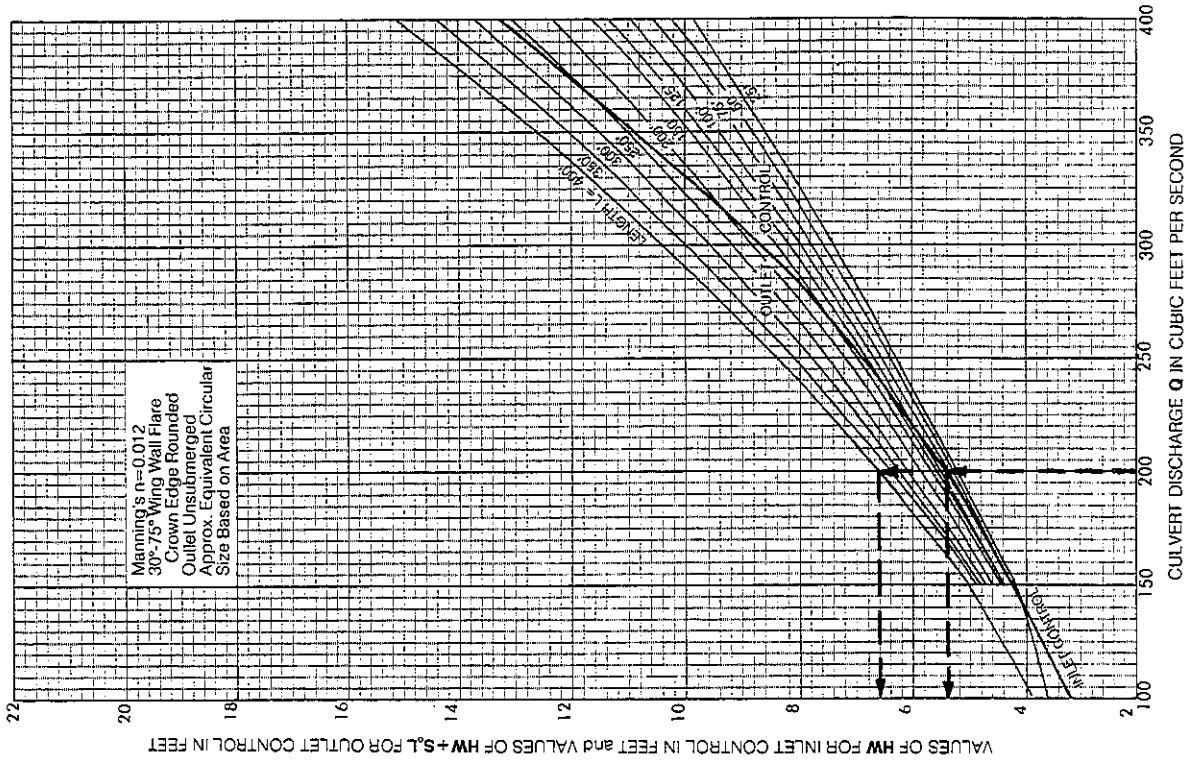


Interpolate for intermediate culvert lengths

**FIGURE 11: Culvert Capacity—6 x 3-foot Precast Box Section Equivalent 57-inch Circular**

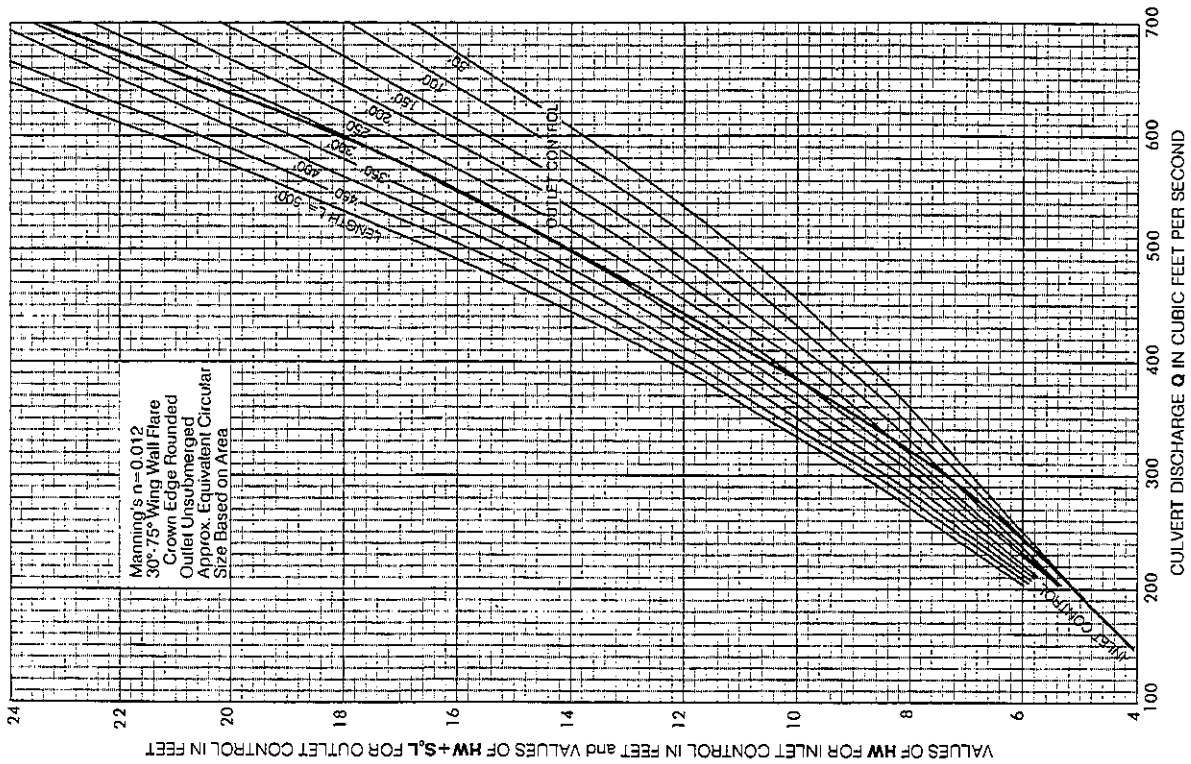


**FIGURE 12: Culvert Capacity—6 x 4-foot Precast Box Section Equivalent 66-inch Circular**

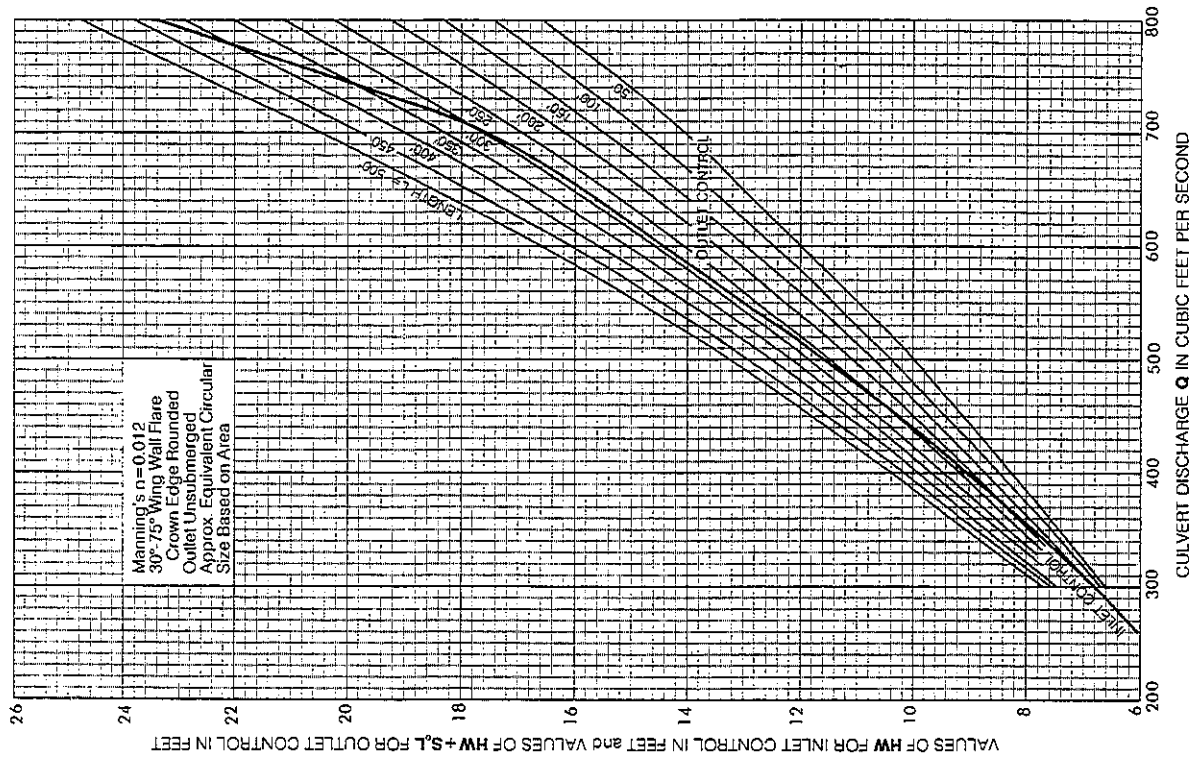


Interpolate for intermediate culvert lengths

**FIGURE 13: Culvert Capacity—6 x 5-foot Precast Box Section  
Equivalent 75-inch Circular**



**FIGURE 14: Culvert Capacity—6 x 6-foot Precast Box Section  
Equivalent 81-inch Circular**



Interpolate for intermediate culvert lengths