APPENDIX A – FIGURE AND DIAGRAMS

Figures

FIGURES FROM SECTION 2

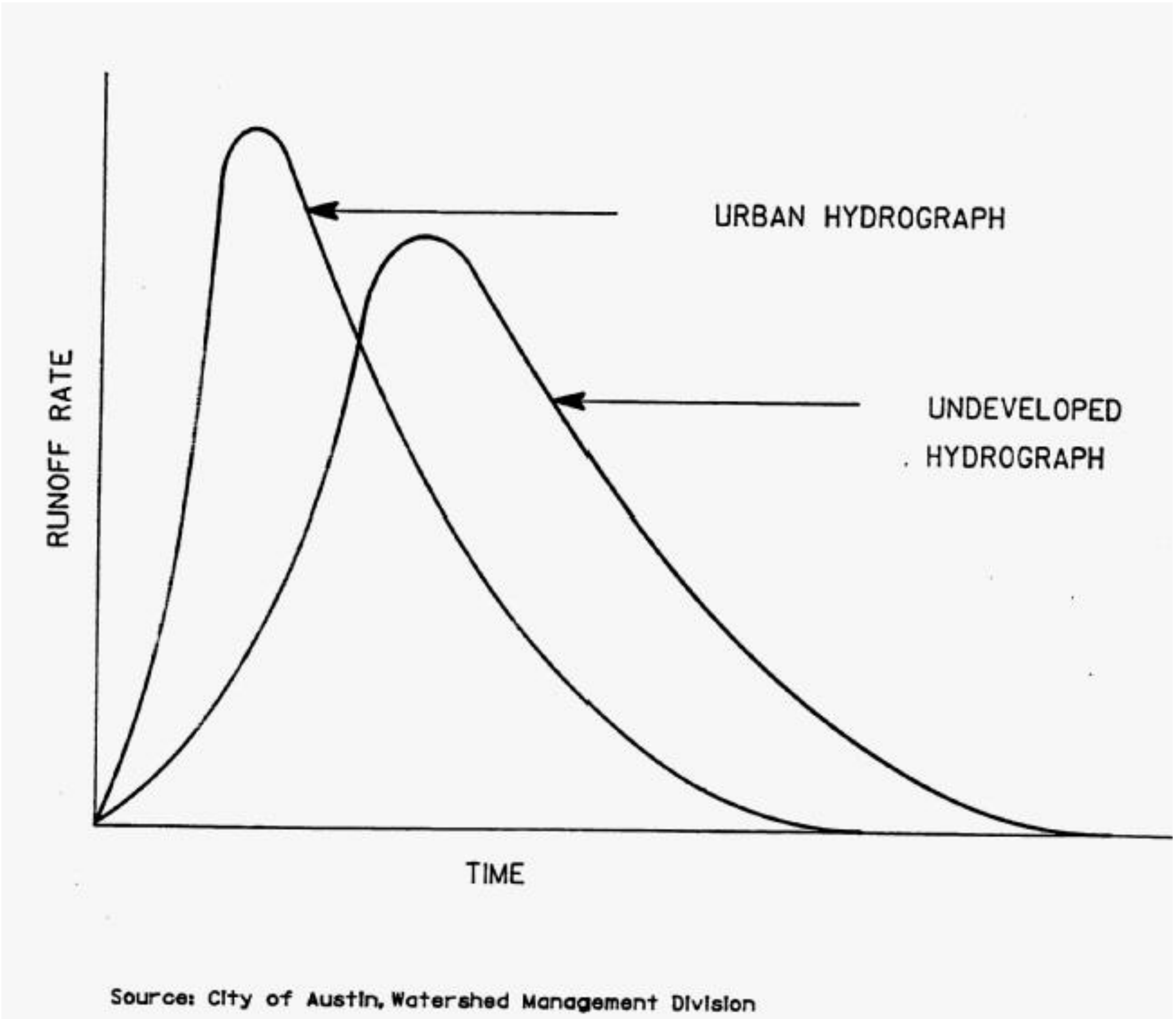


Figure 2-1: Effects of Urbanization on Flood Hydrograph

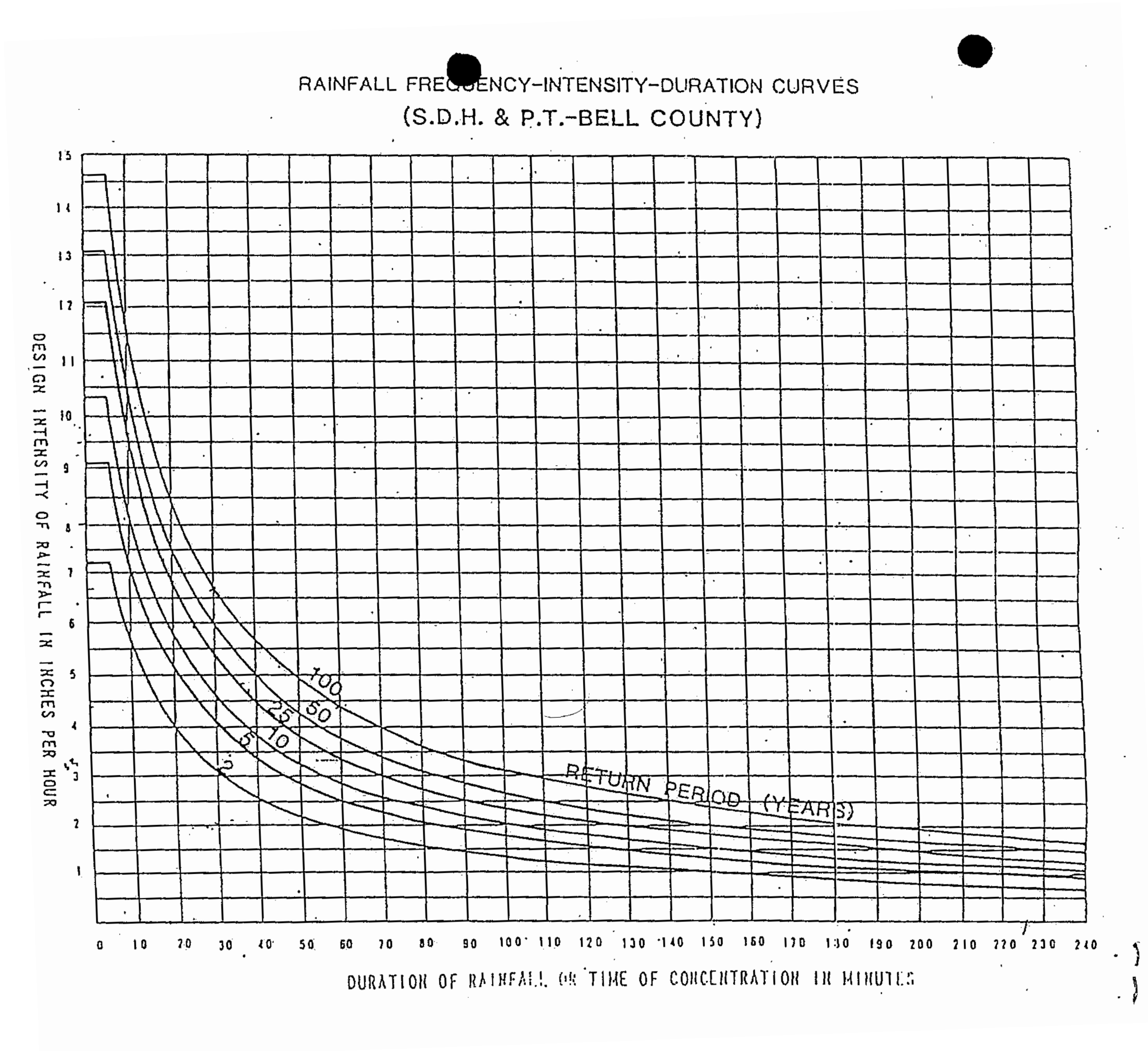


Figure 2-2: Intensity Duration Frequency Curve for Bell County, Texas

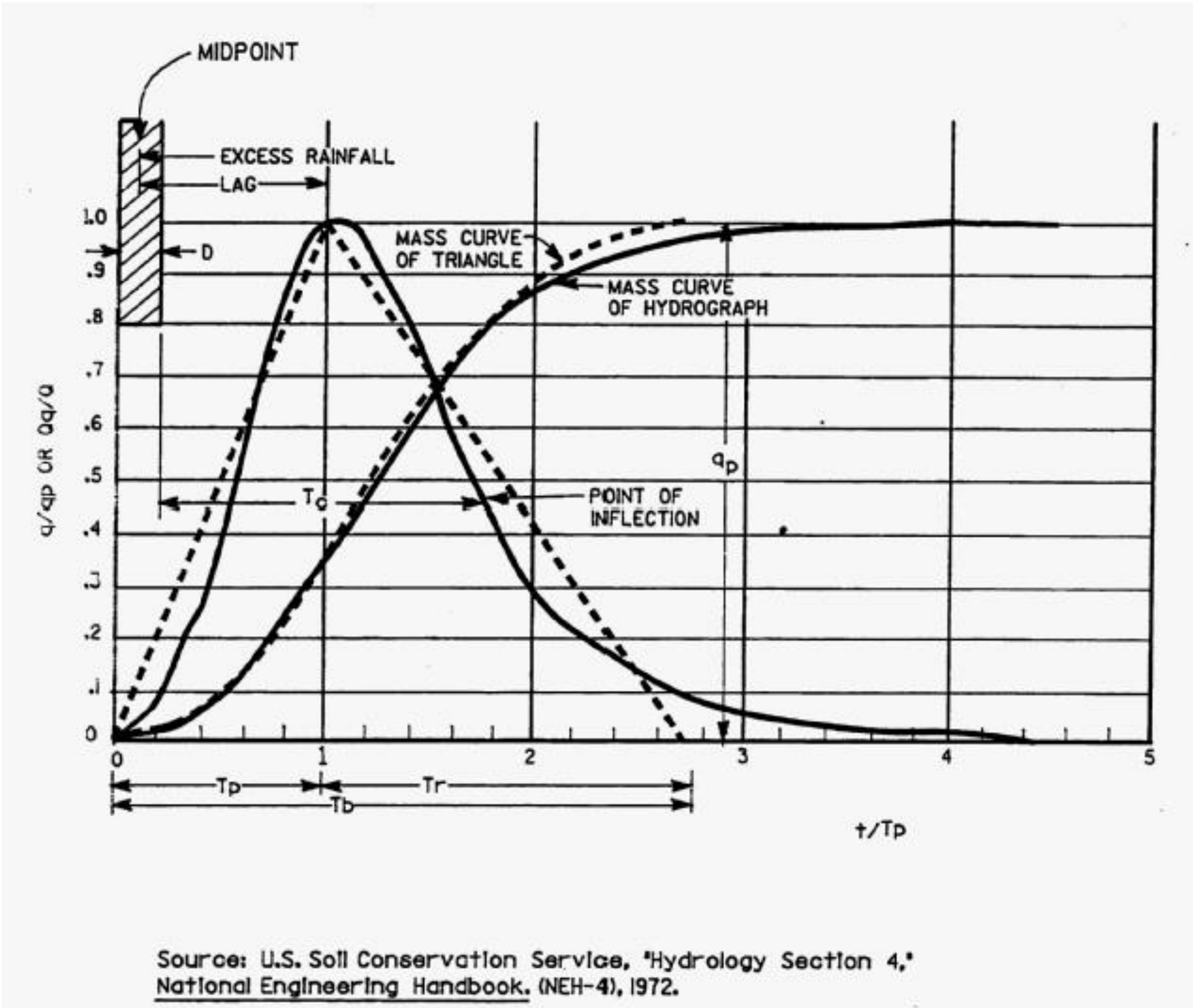
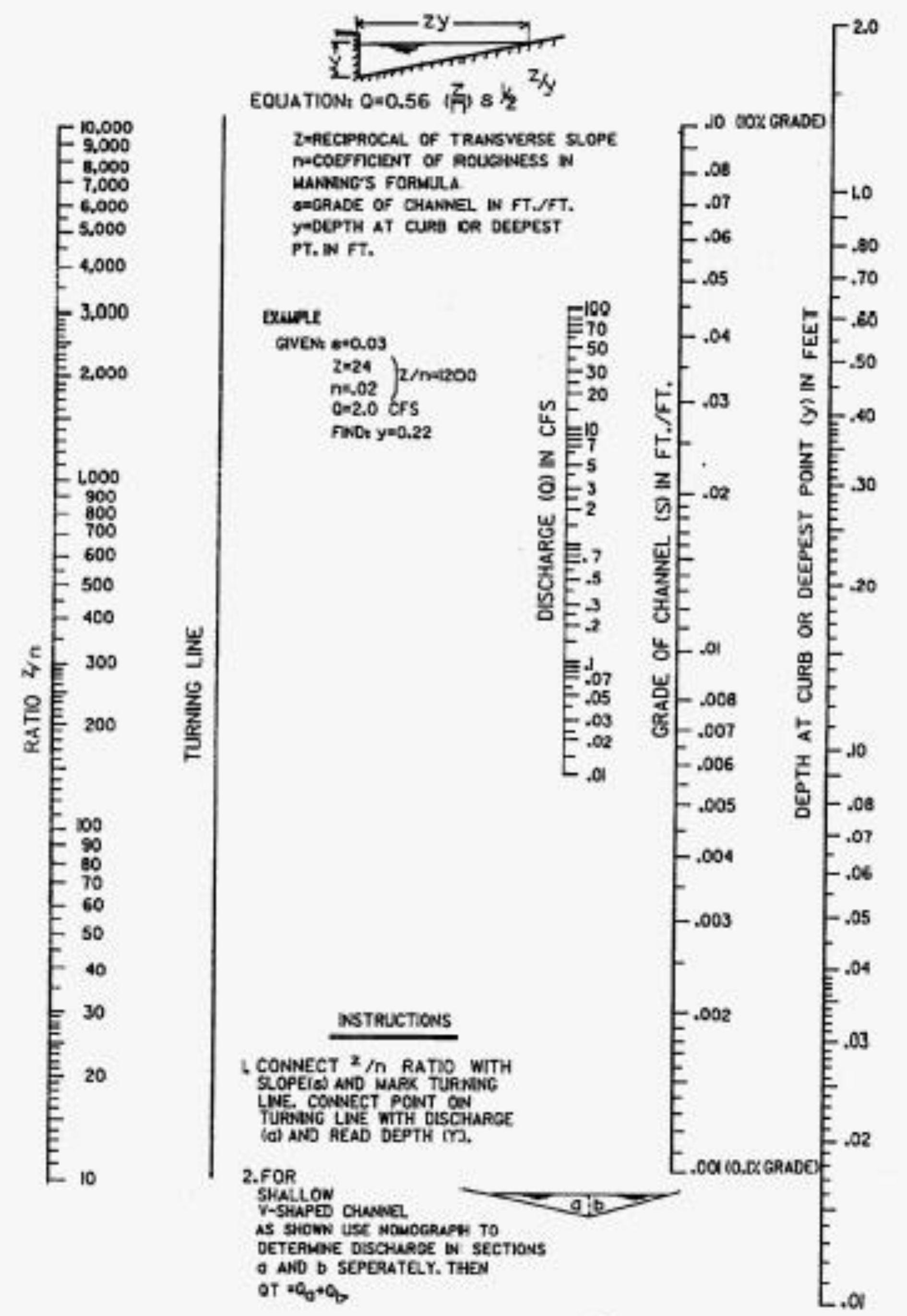


Figure 2-3: Dimensionless Curvilinear Unit Hydrograph and Equivalent Triangular Hydrograph



Source: City of Austin. Drainage Criteria Manual, Department of Public Works. Austin, Texas. January 1977.

Figure 3-1: Nomograph for Flow in Gutters

FIGURES FROM SECTION 4

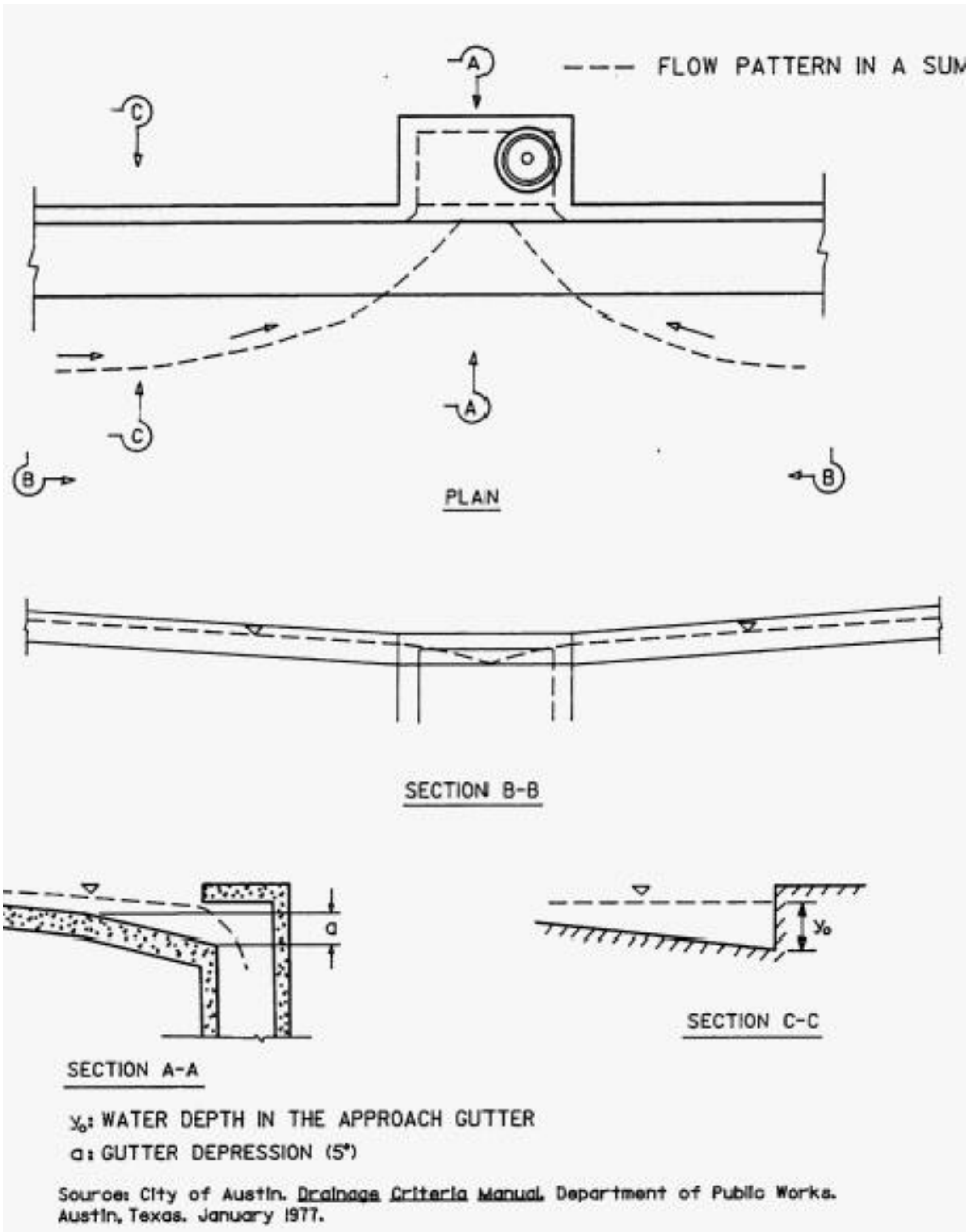


Figure 4-1: Curb Opening Inlet in a Sump (Type S-1)

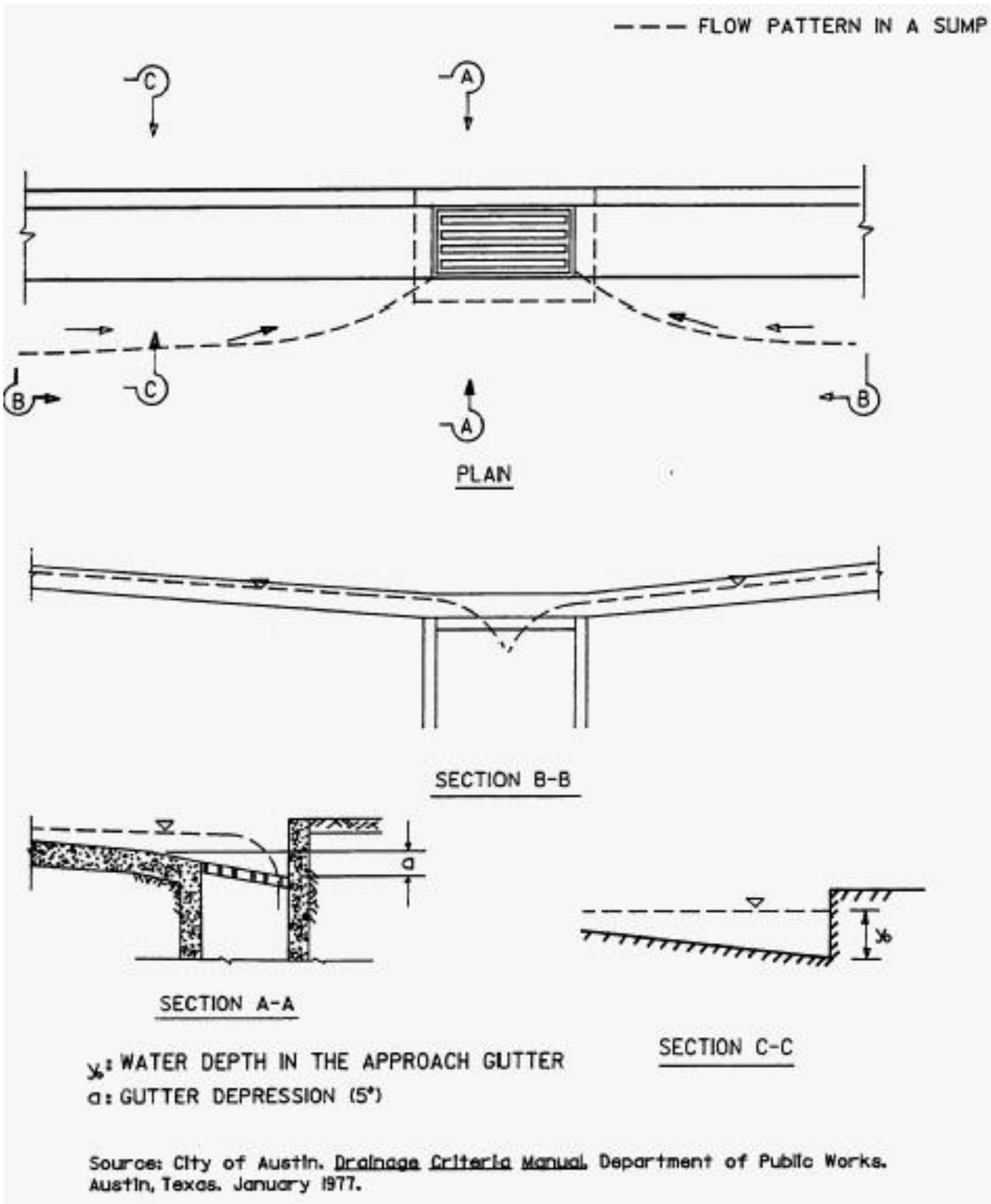


Figure 4-2: Grate Inlet in a Sump (Type S-2)

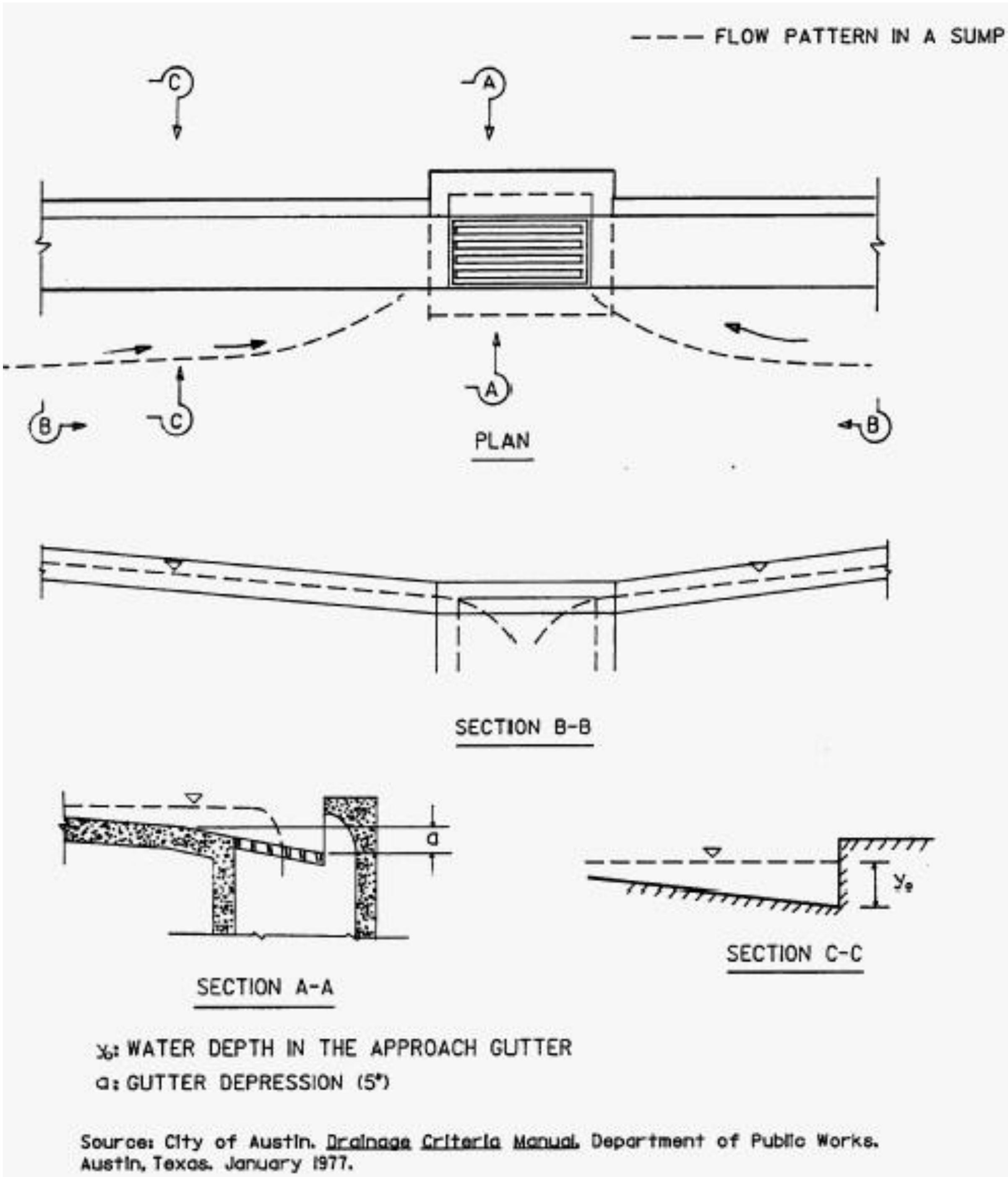


Figure 4-3: Combination Inlet in a Sump (Type S-3)

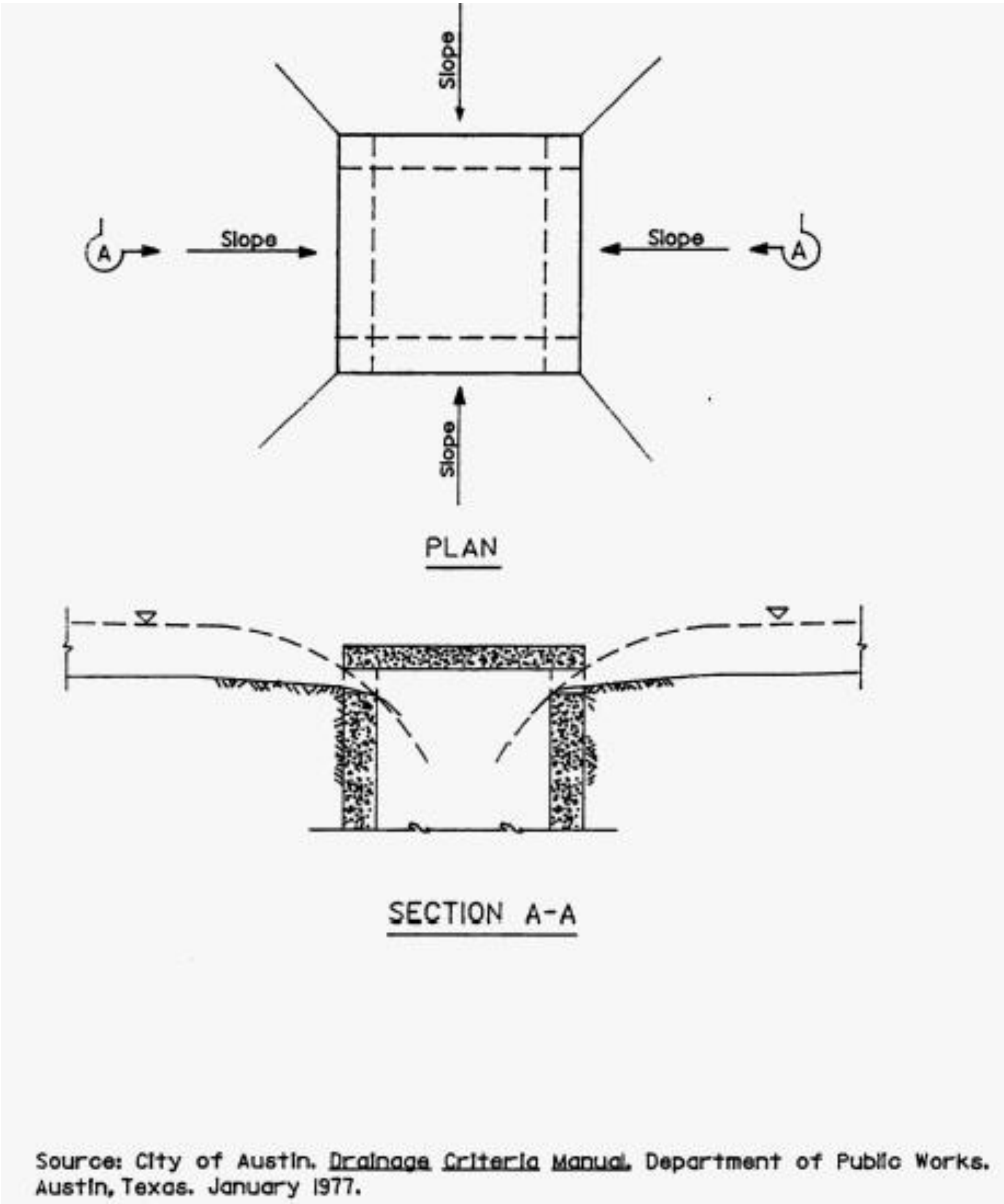


Figure 4-4: Area Inlet Without Grate (Type S-4)

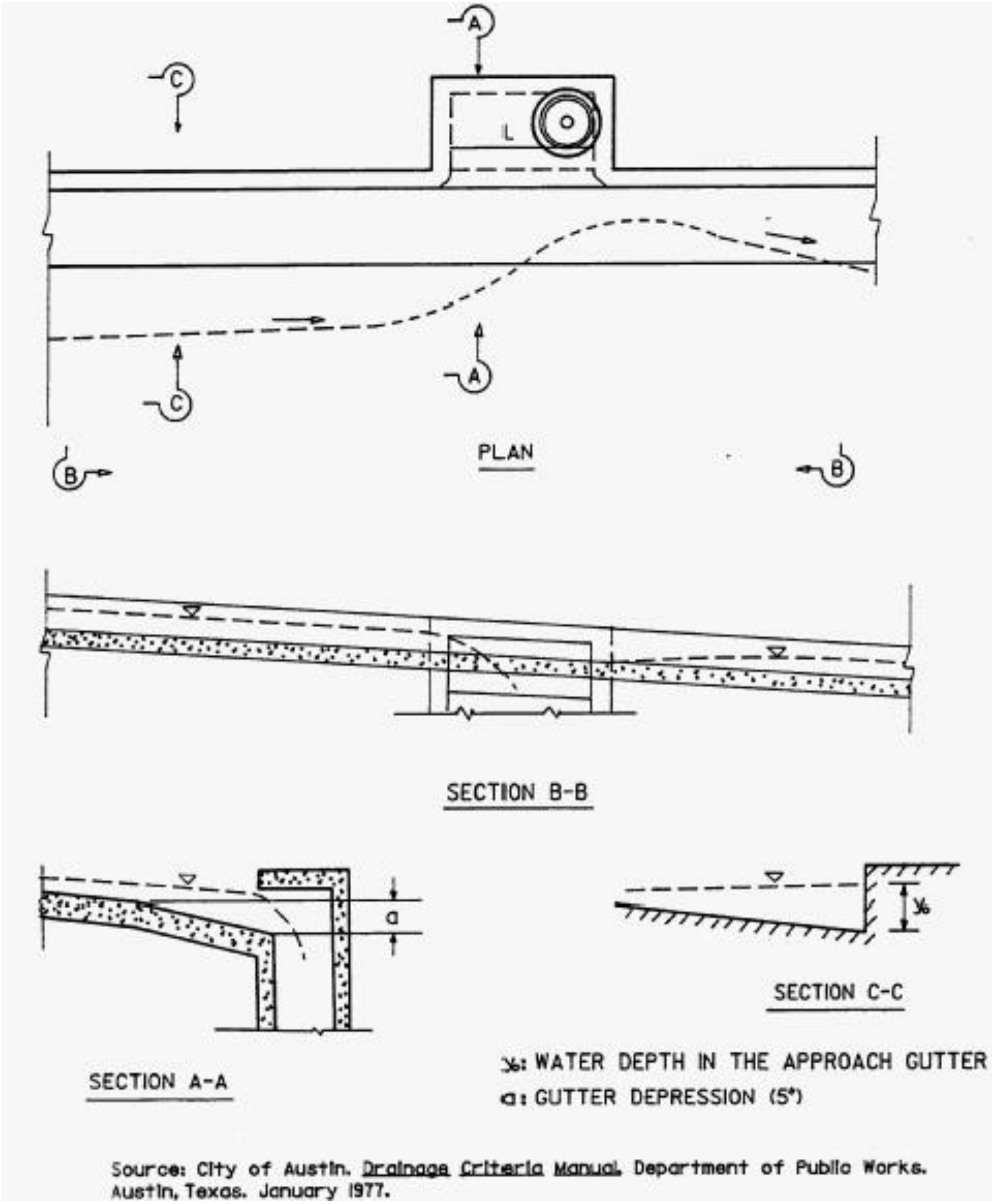
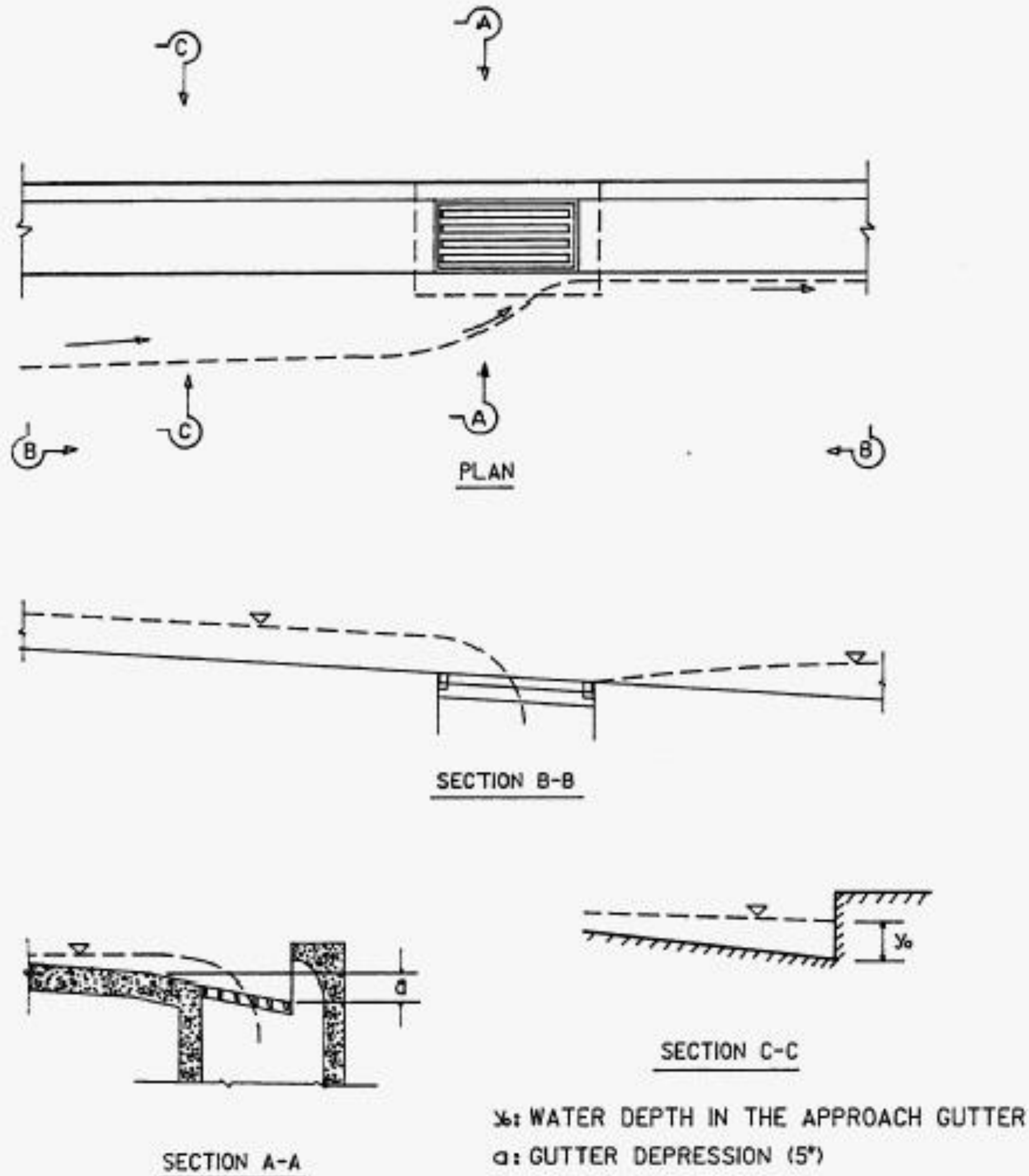


Figure 4-5: Curb Opening, Inlet on Grade (Type G-1)



Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 4-6: Grate, Inlet on Grade (Type G-2)

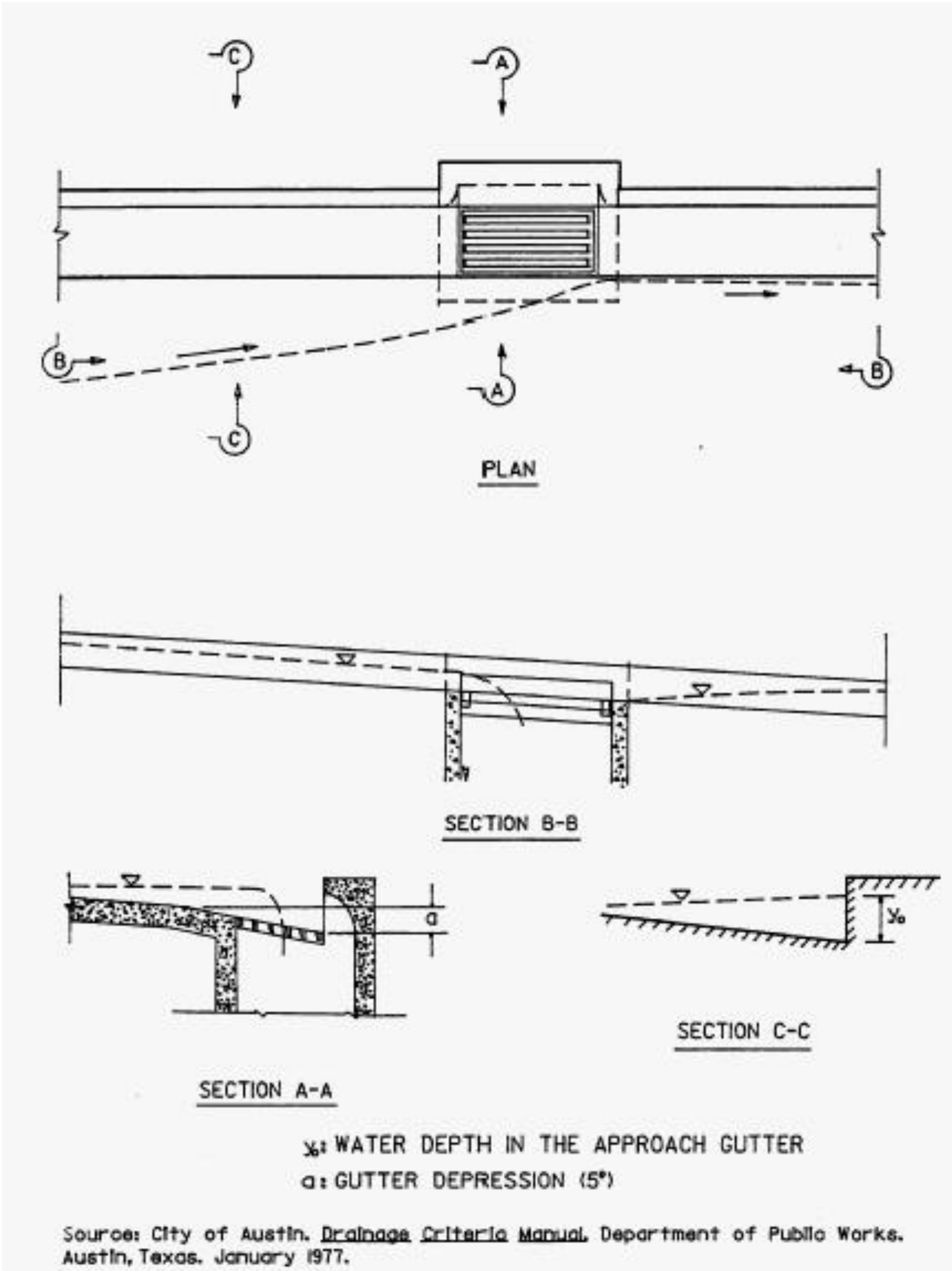
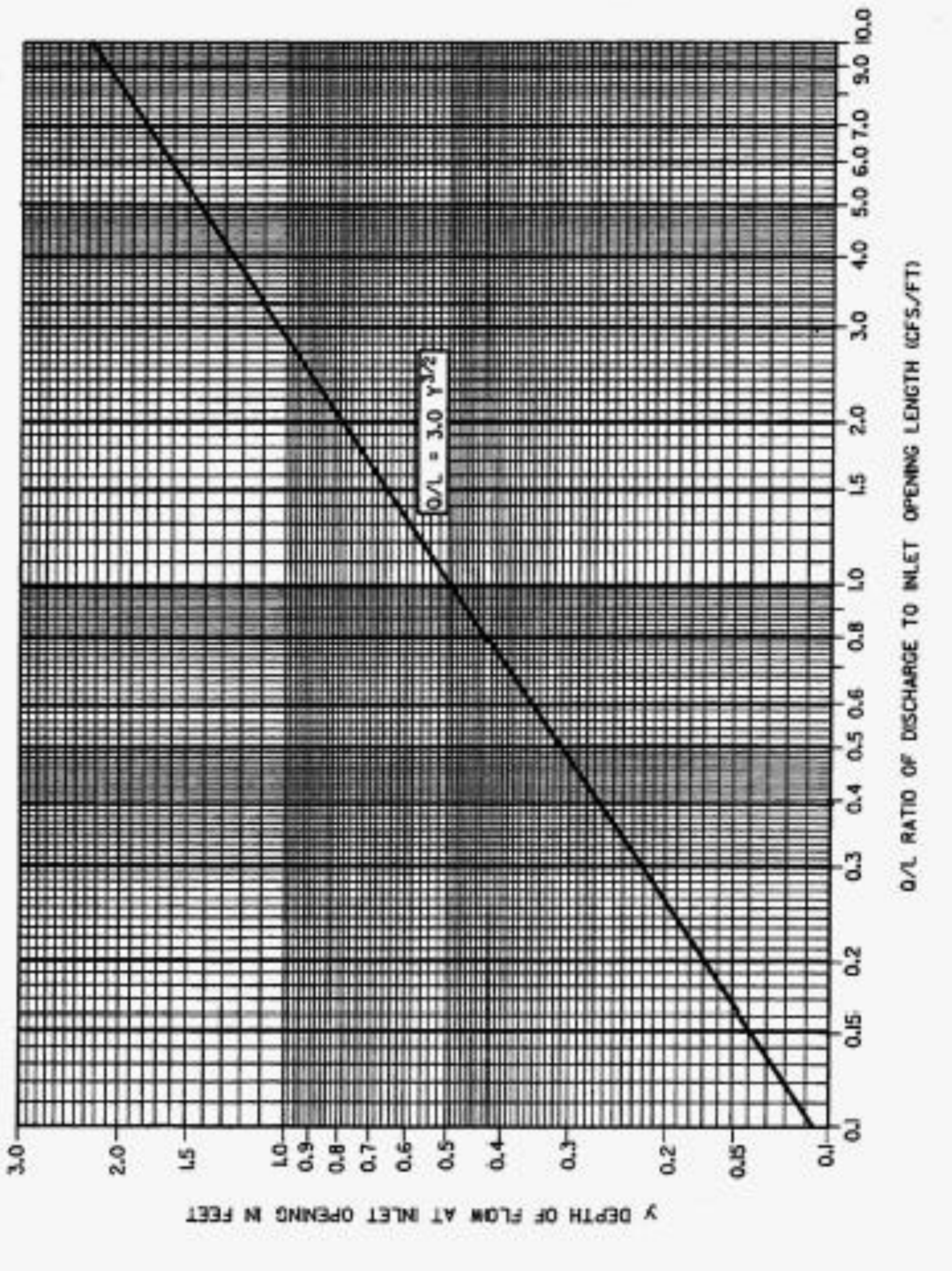
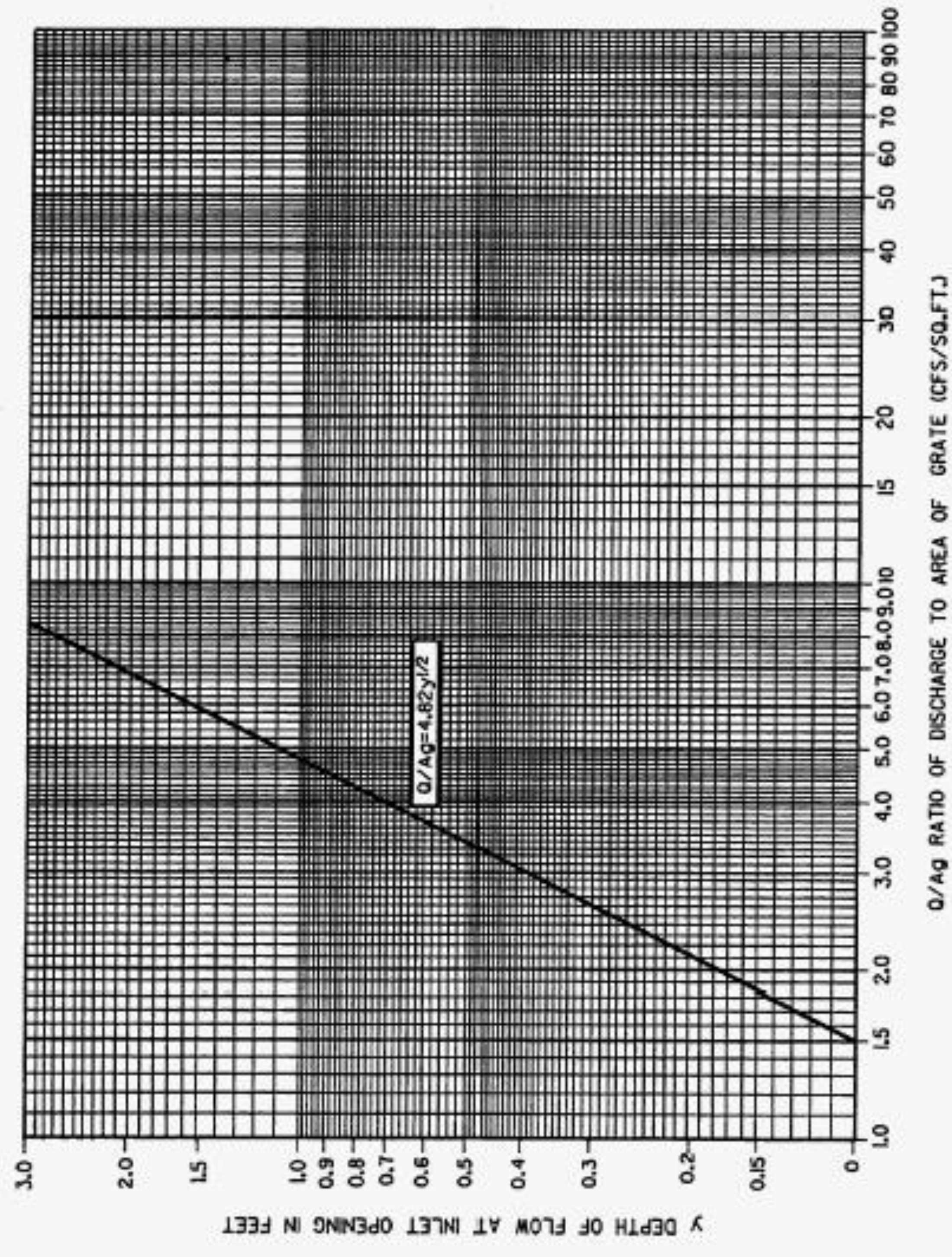


Figure 4-7: Combination Inlet on Grade (Type G-3)



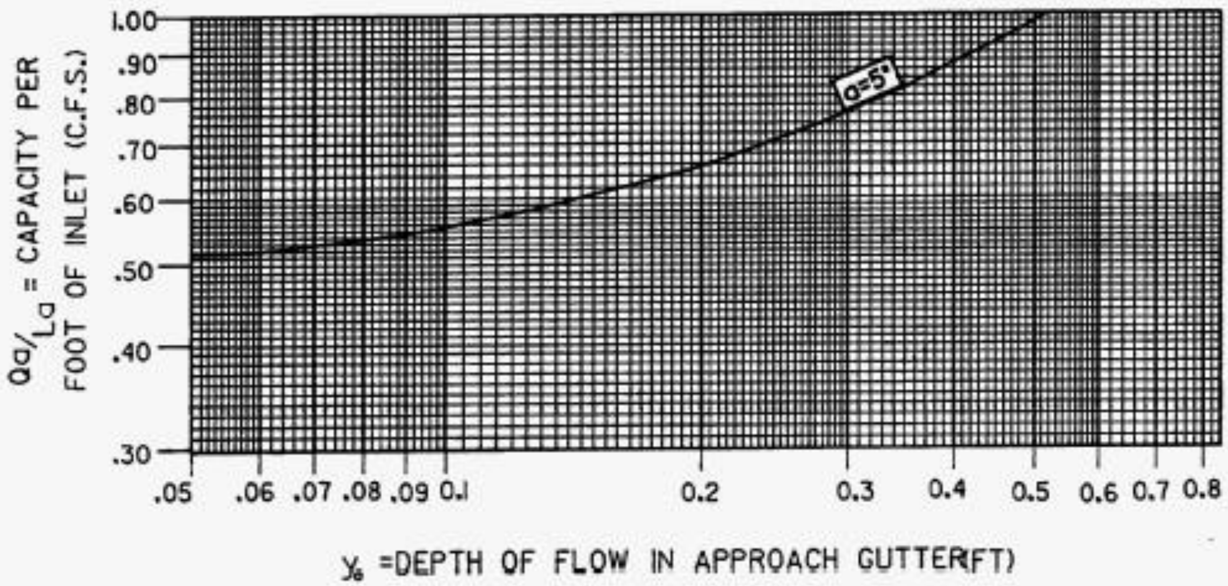
Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 4-8: Inlet Capacity for Type S-1 and S-3



Source: City of Austin. Drainage Criteria Manual, Department of Public Works. Austin, Texas. January 1977.

Figure 4-9: Inlet Capacity for Type S-2



$$Qa/La = 0.7 \left[\frac{1}{H_1 - H_2}\right] \left[(H_1)^{5/2} - (H_2)^{5/2}\right]$$

$H_1 = a + y_0$

$H_2 = a =$ GUTTER DEPRESSION

Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 4-10: Capacity for Inlets on Grade

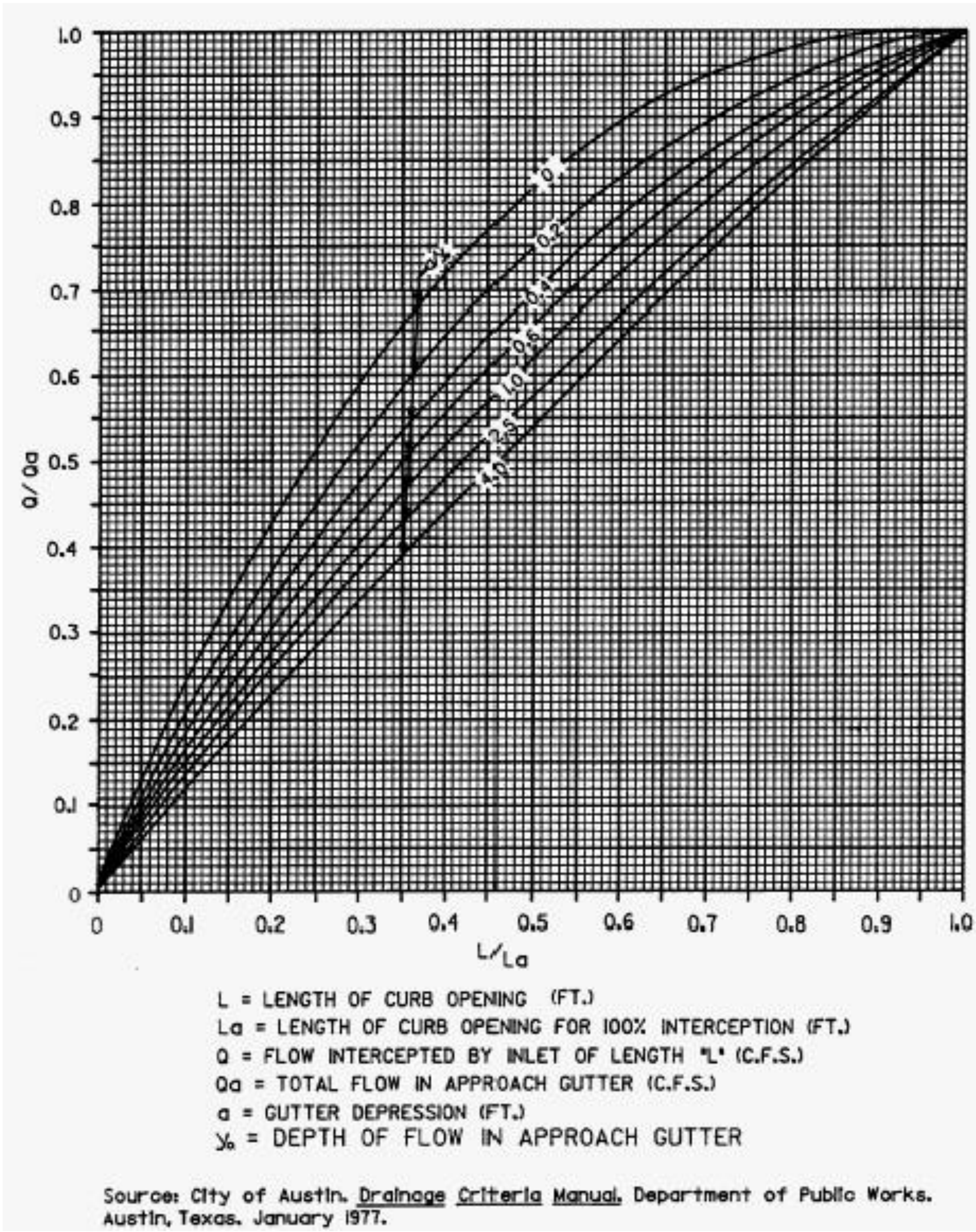
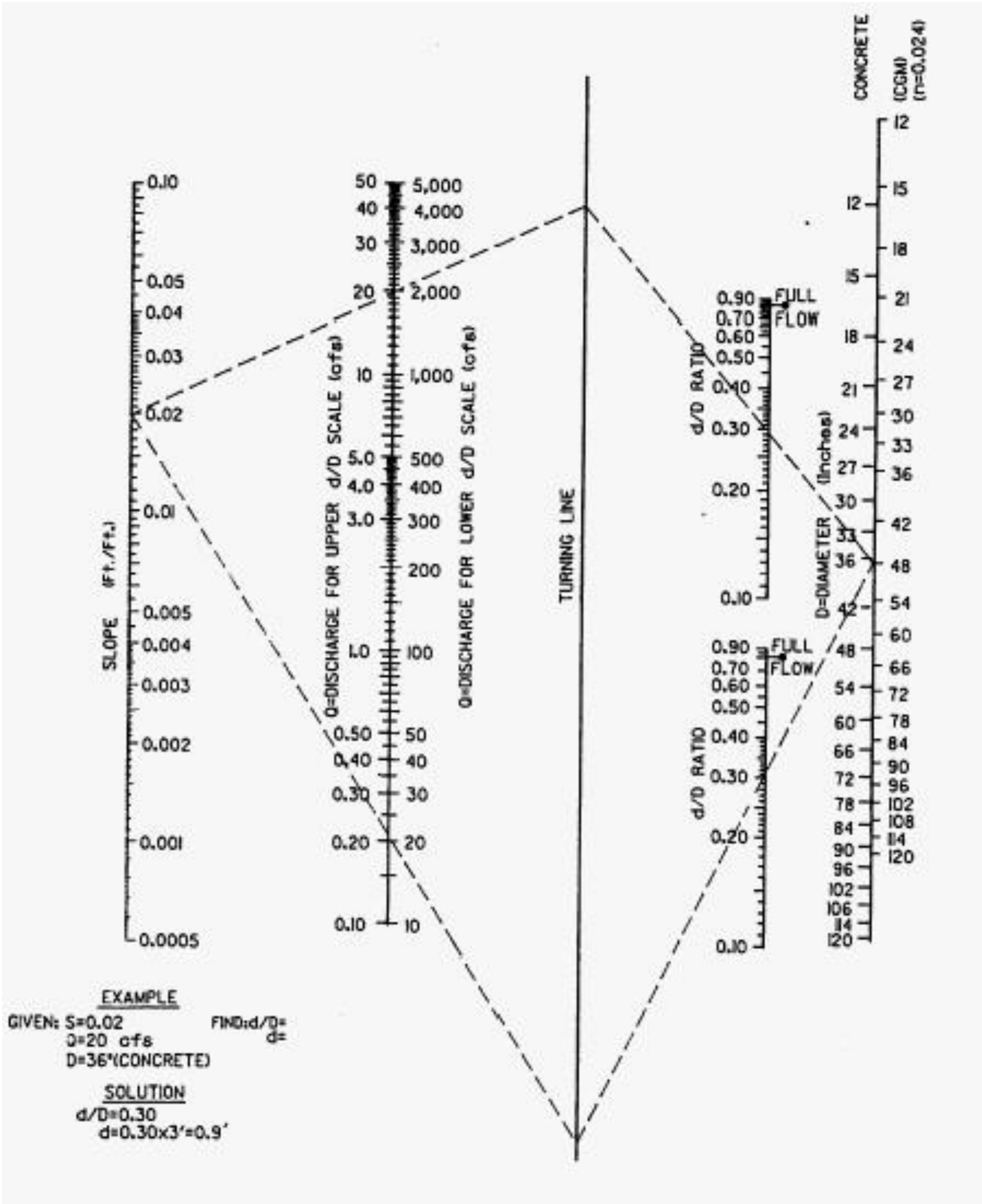
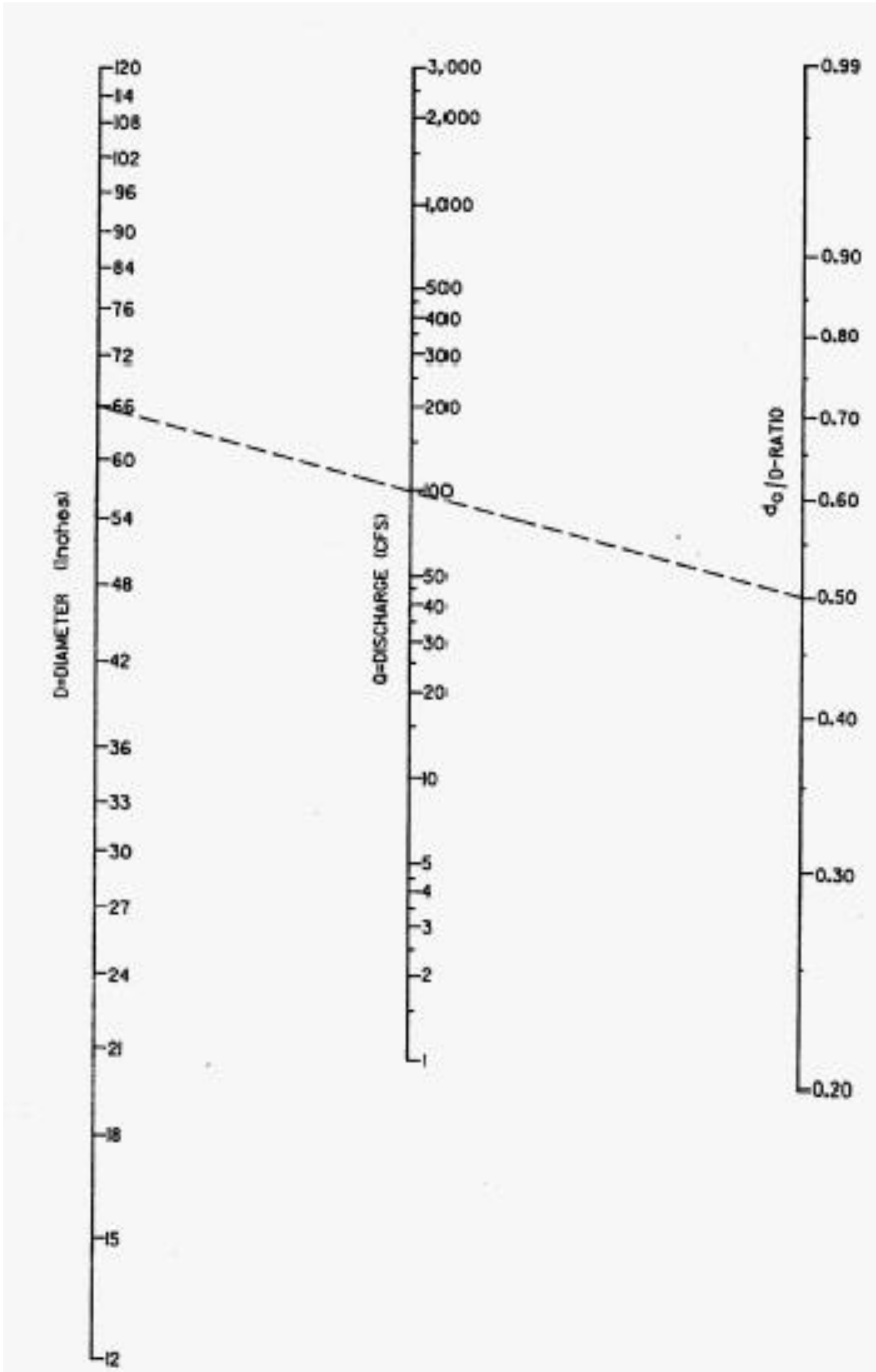


Figure 4-11: Ratio of Intercepted to Total Flow for Inlets on Grade



Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 5-1: Uniform Flow for Pipe Culverts



Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 5-2: Critical Depth of Flow for Circular Conduits

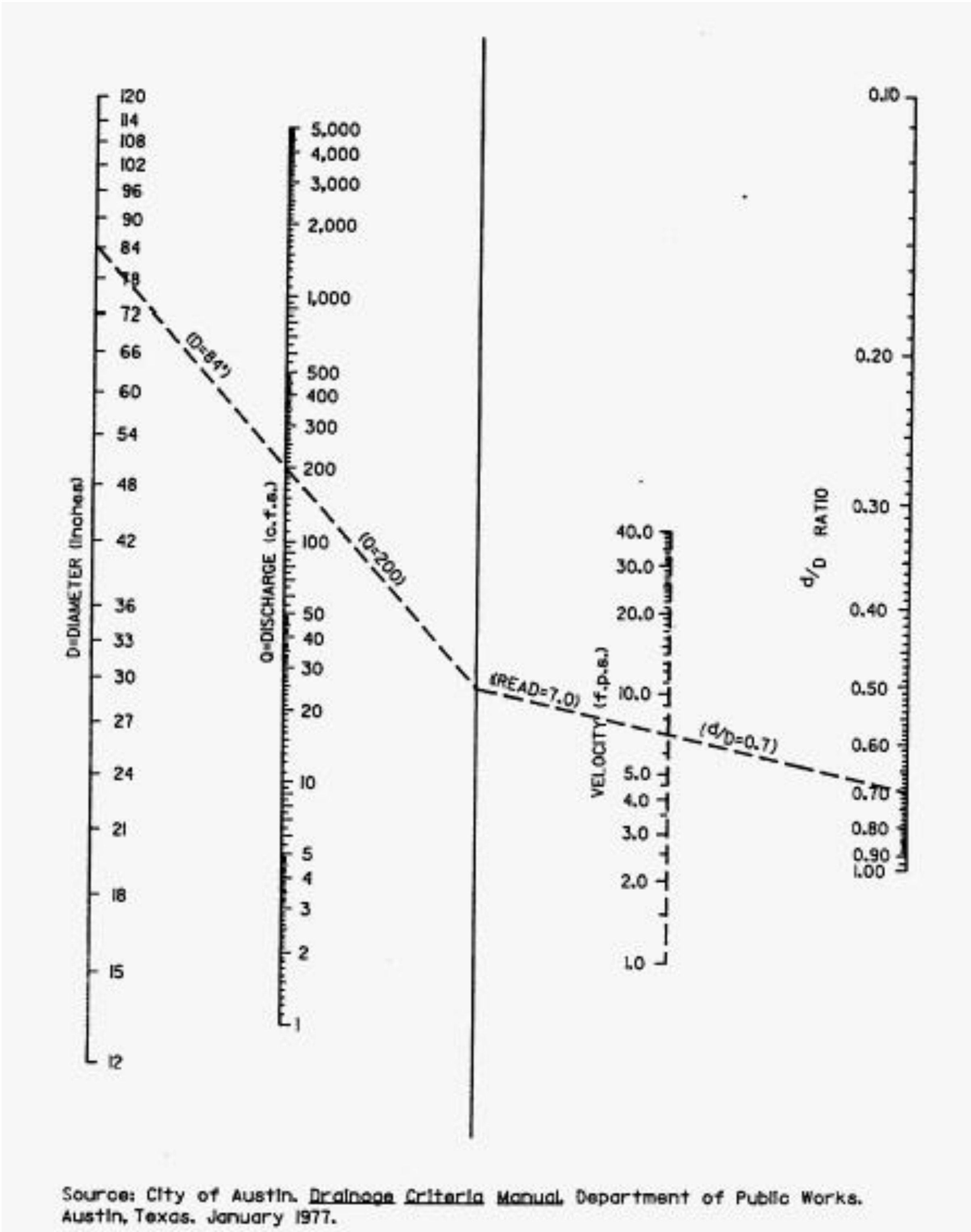
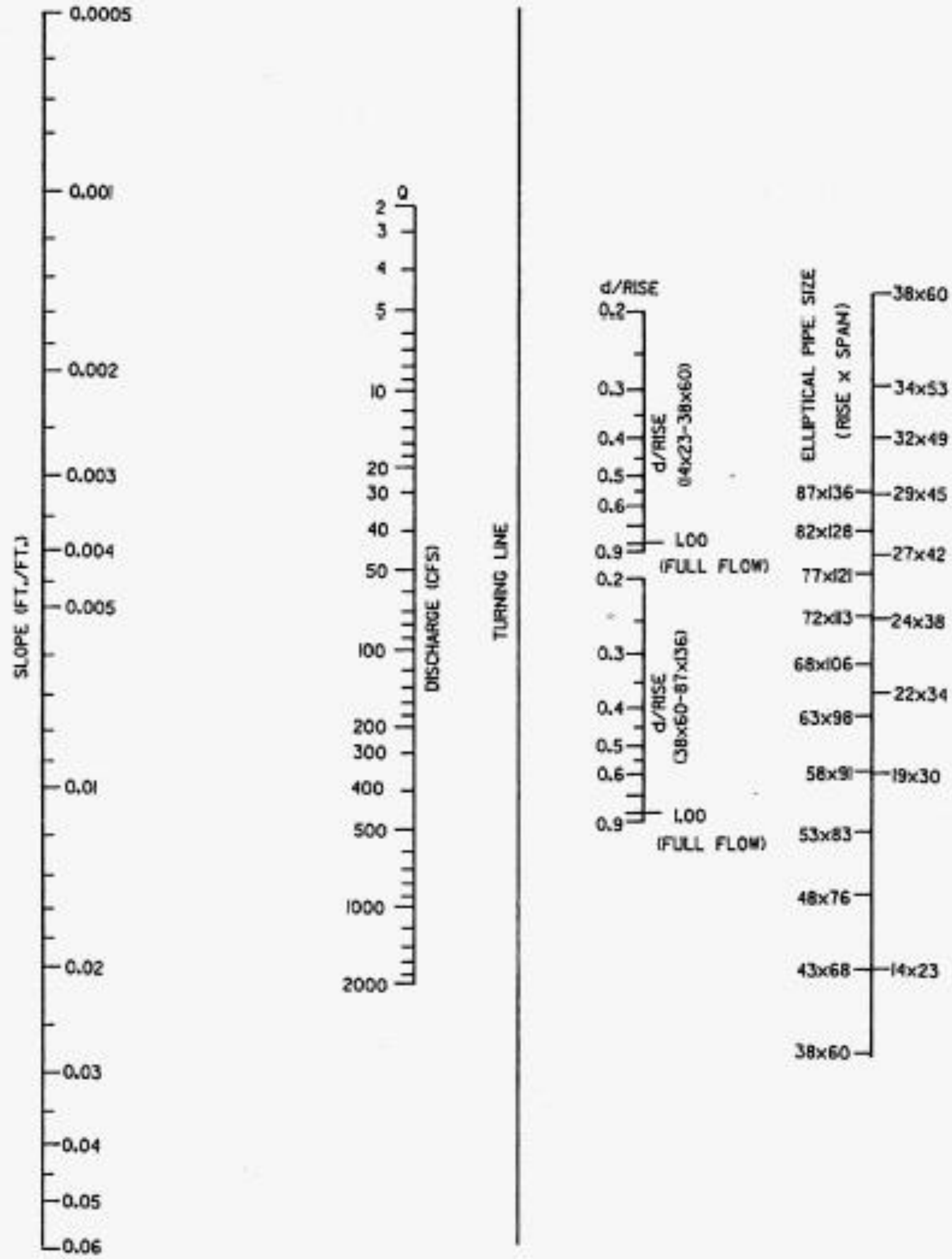
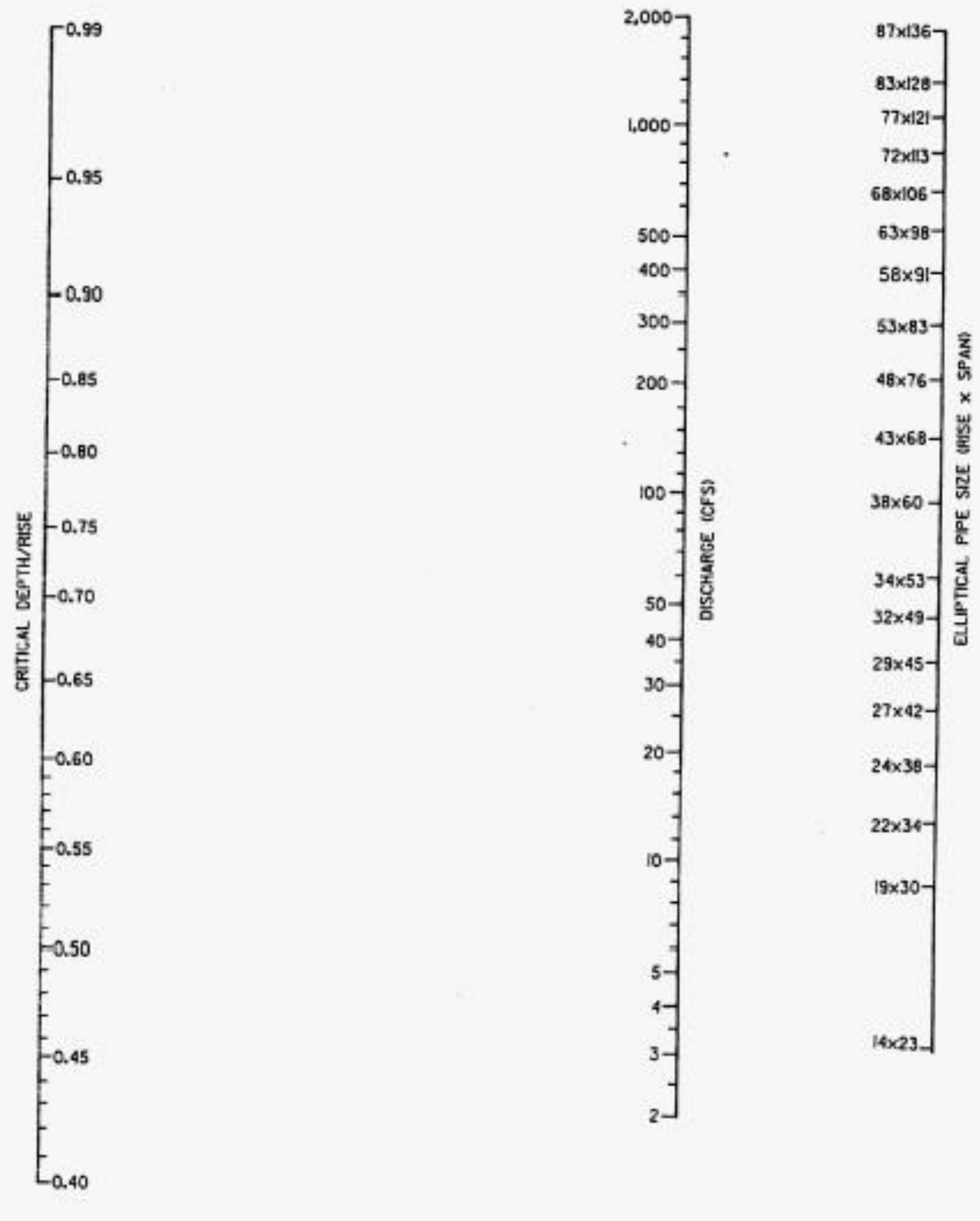


Figure 5-3: Velocity in Pipe Conduits



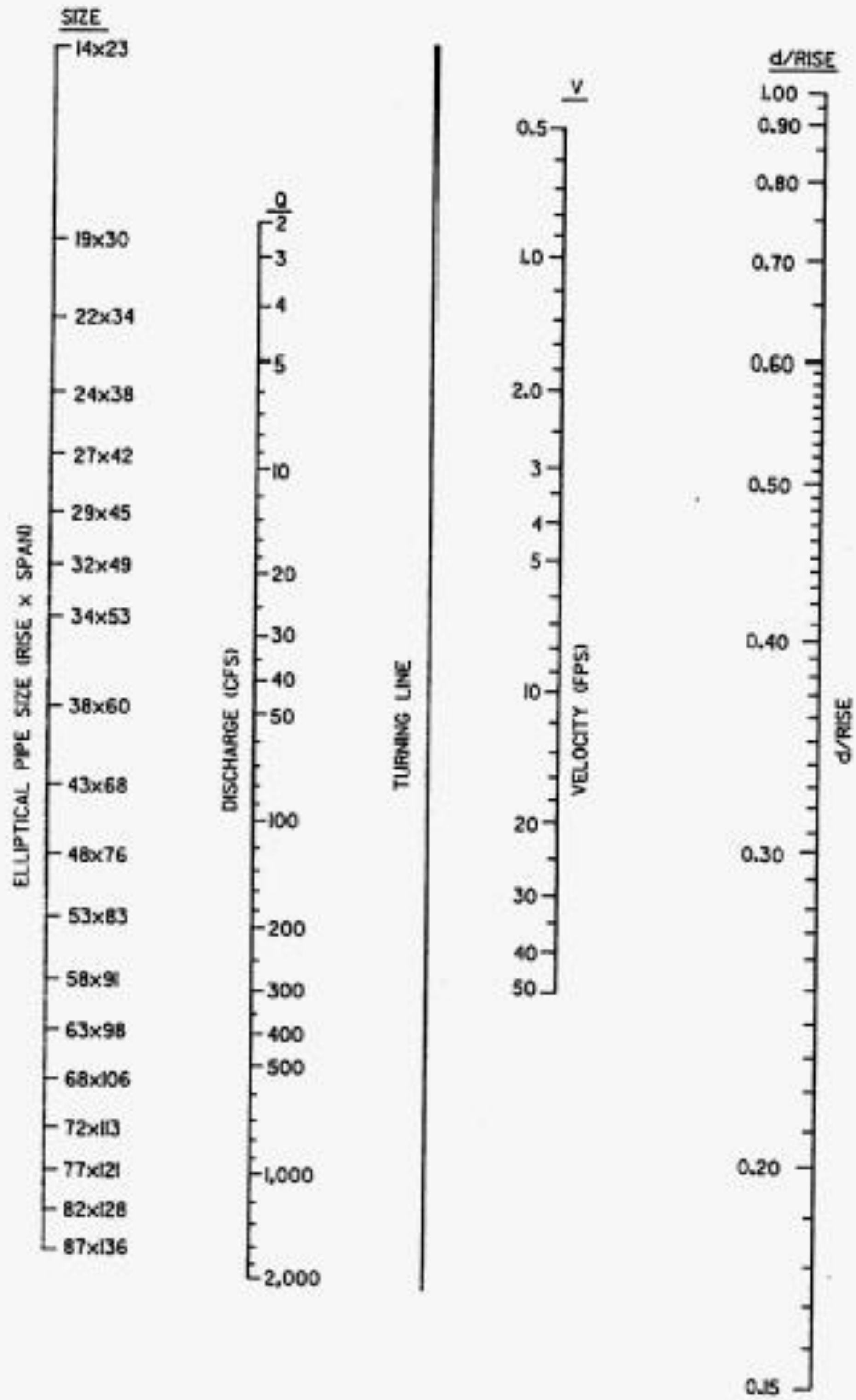
Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 5-4: Uniform Flow for Concrete Elliptical Pipe



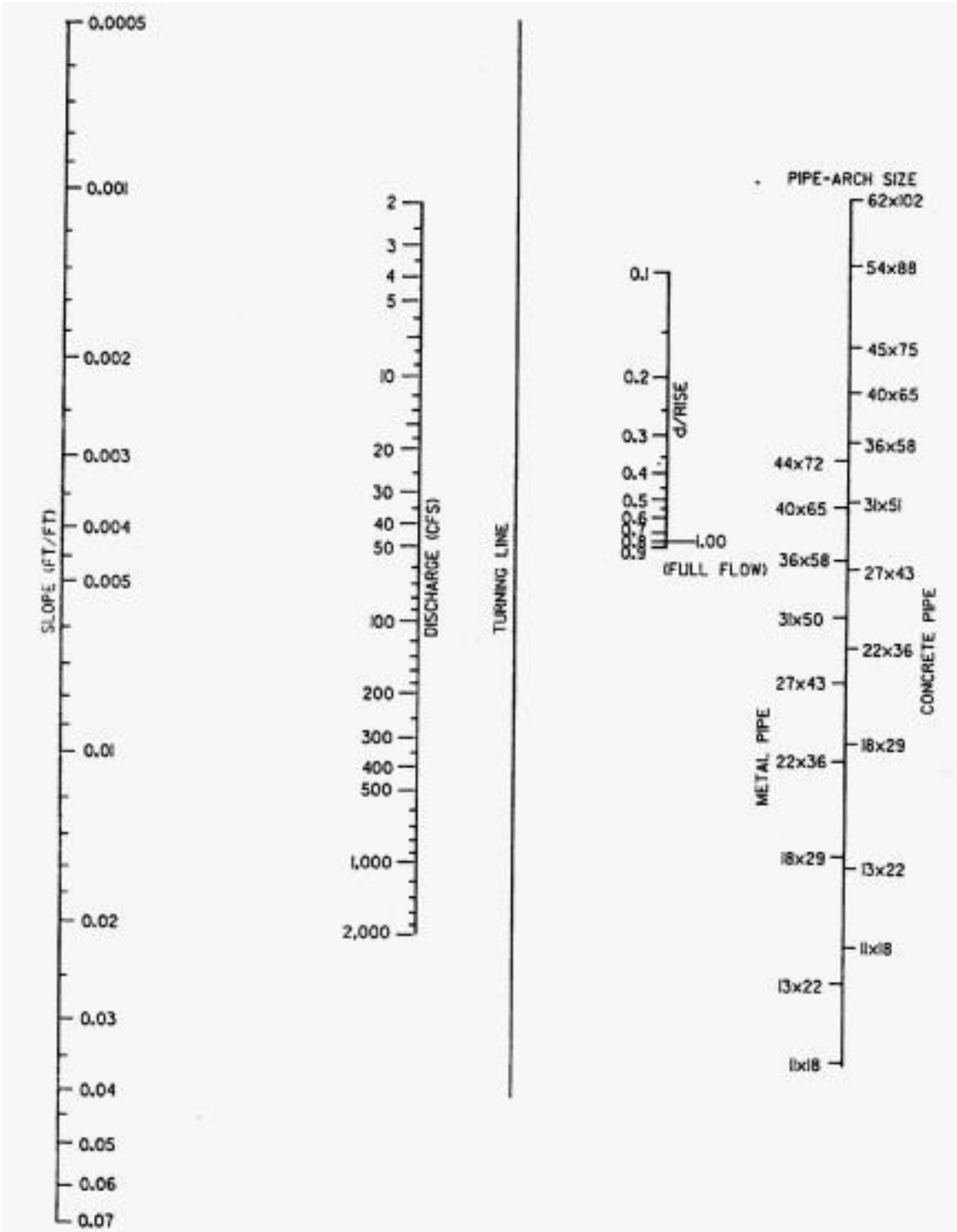
Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 5-5: Critical Depth for Elliptical Pipe



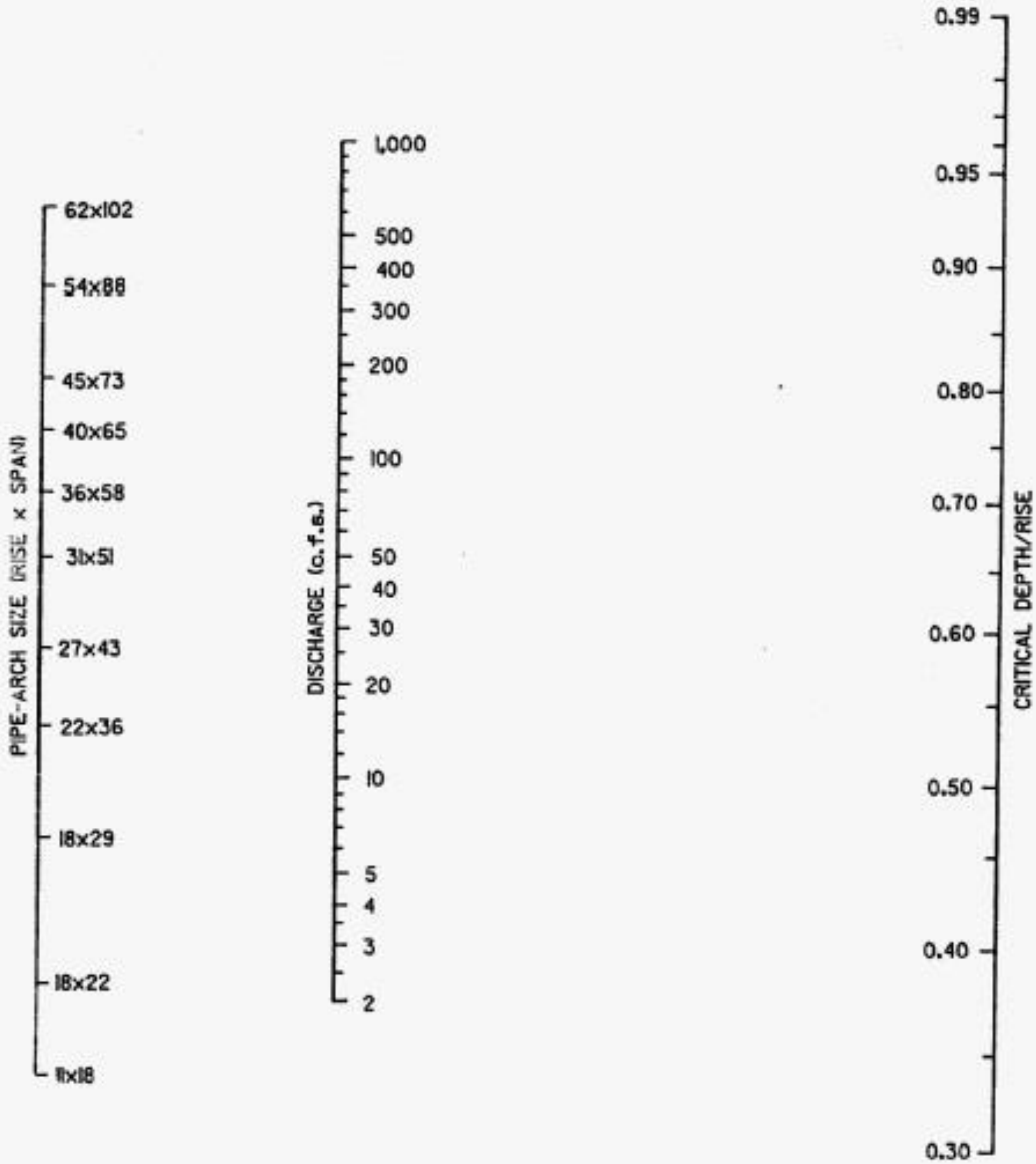
Source: City of Austin, Drainage Criteria Manual, Department of Public Works, Austin, Texas. January 1977.

Figure 5-6: Velocity in Elliptical Pipe



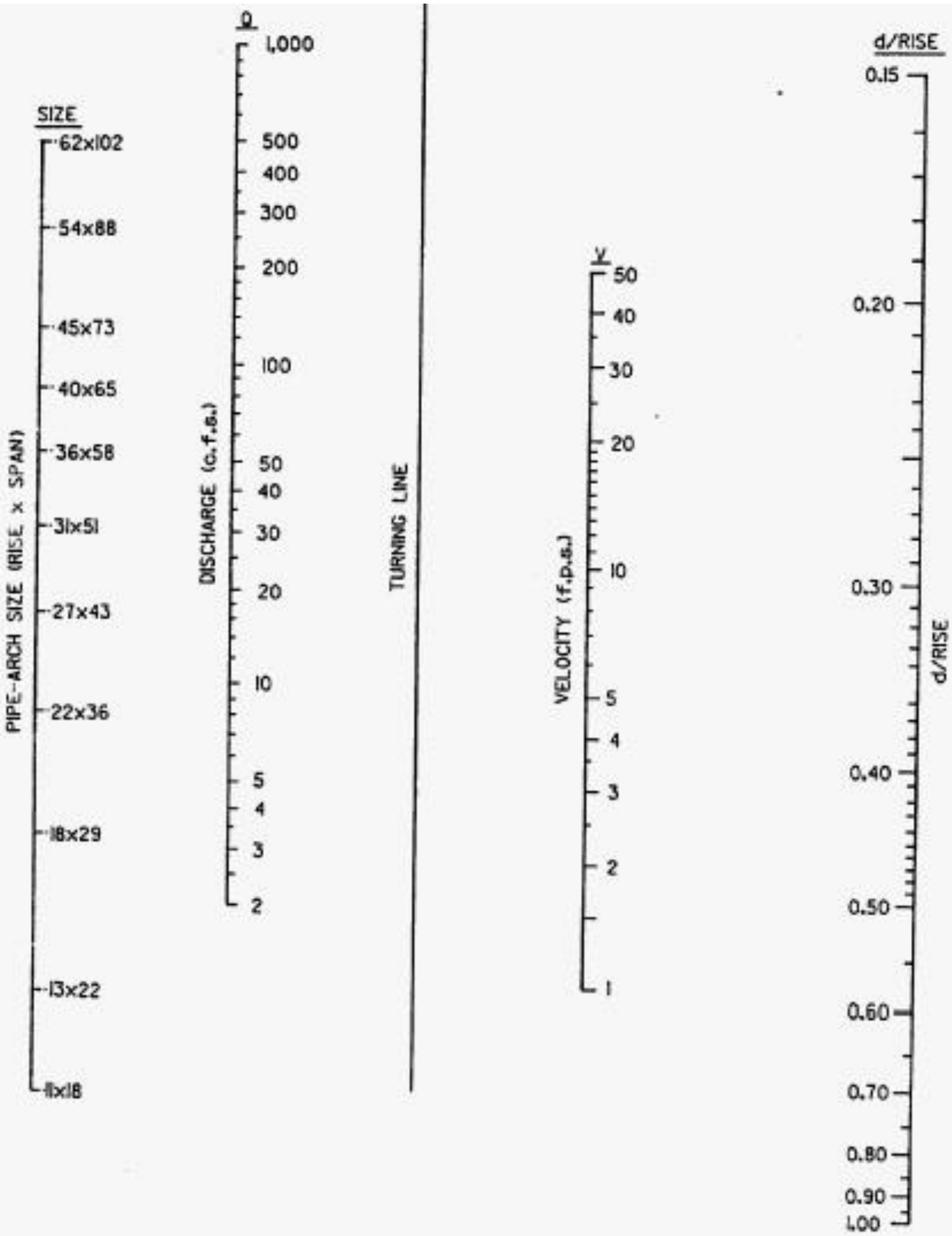
Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 5-7: Uniform Flow for Pipe Arch



Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 5-8: Depth of Flow for Pipe-Arch



Source: City of Austin. Drainage Criteria Manual. Department of Public Works. Austin, Texas. January 1977.

Figure 5-9: Velocity in Pipe-Arch

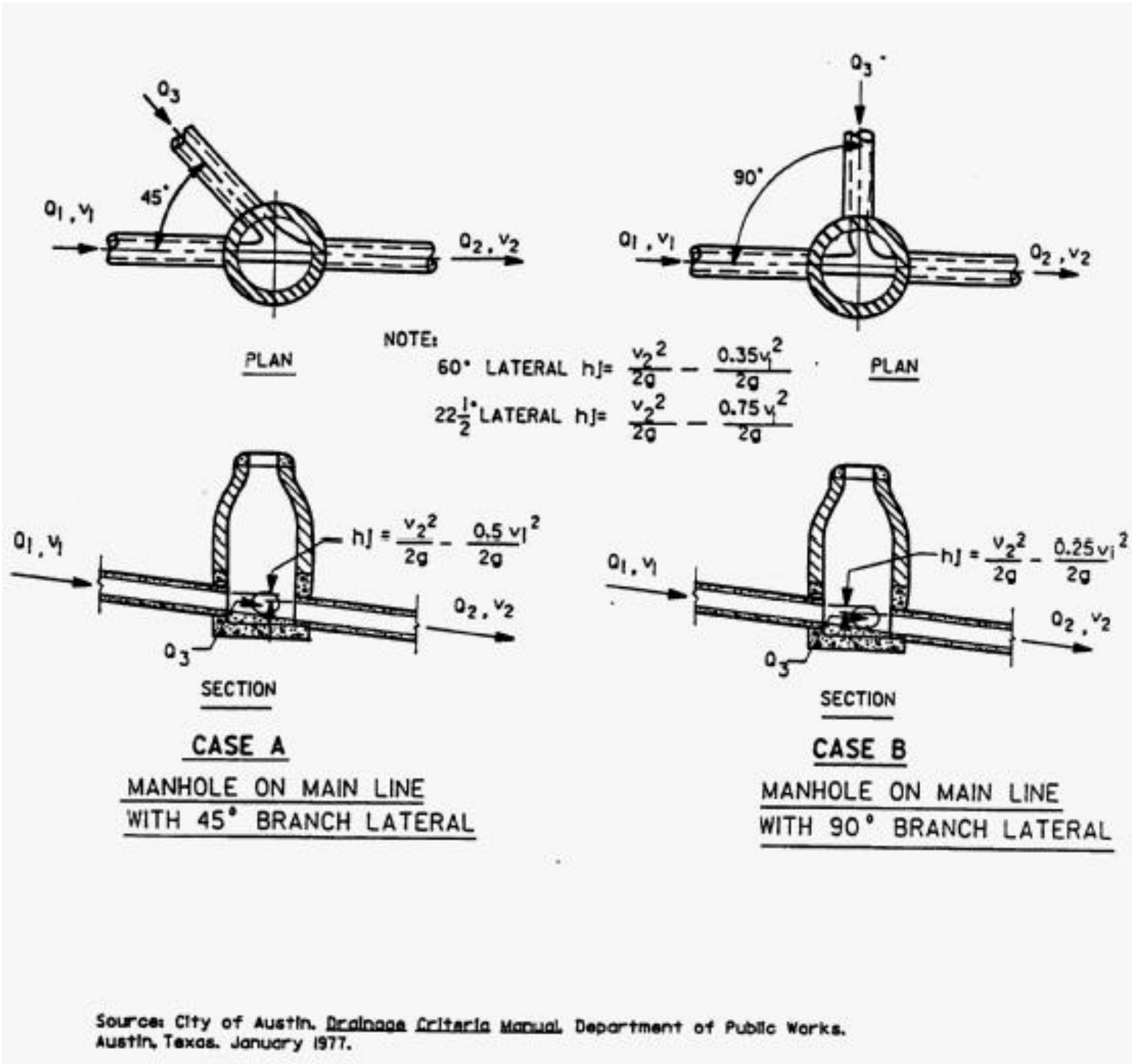


Figure 5-10: Minor Head Losses Due to Turbulence at Structures

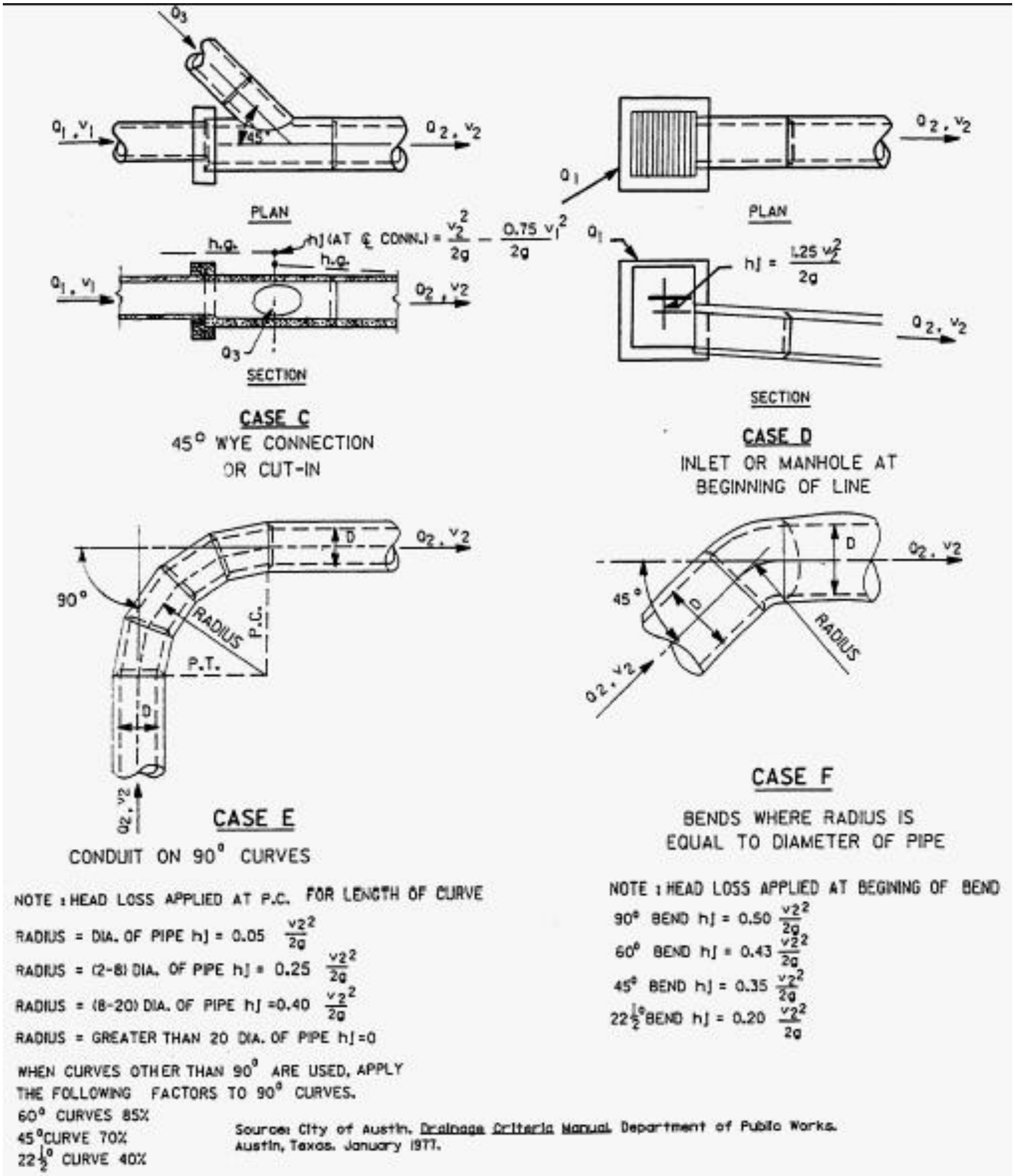


Figure 5-11: Minor Head Losses Due to Turbulence at Structures

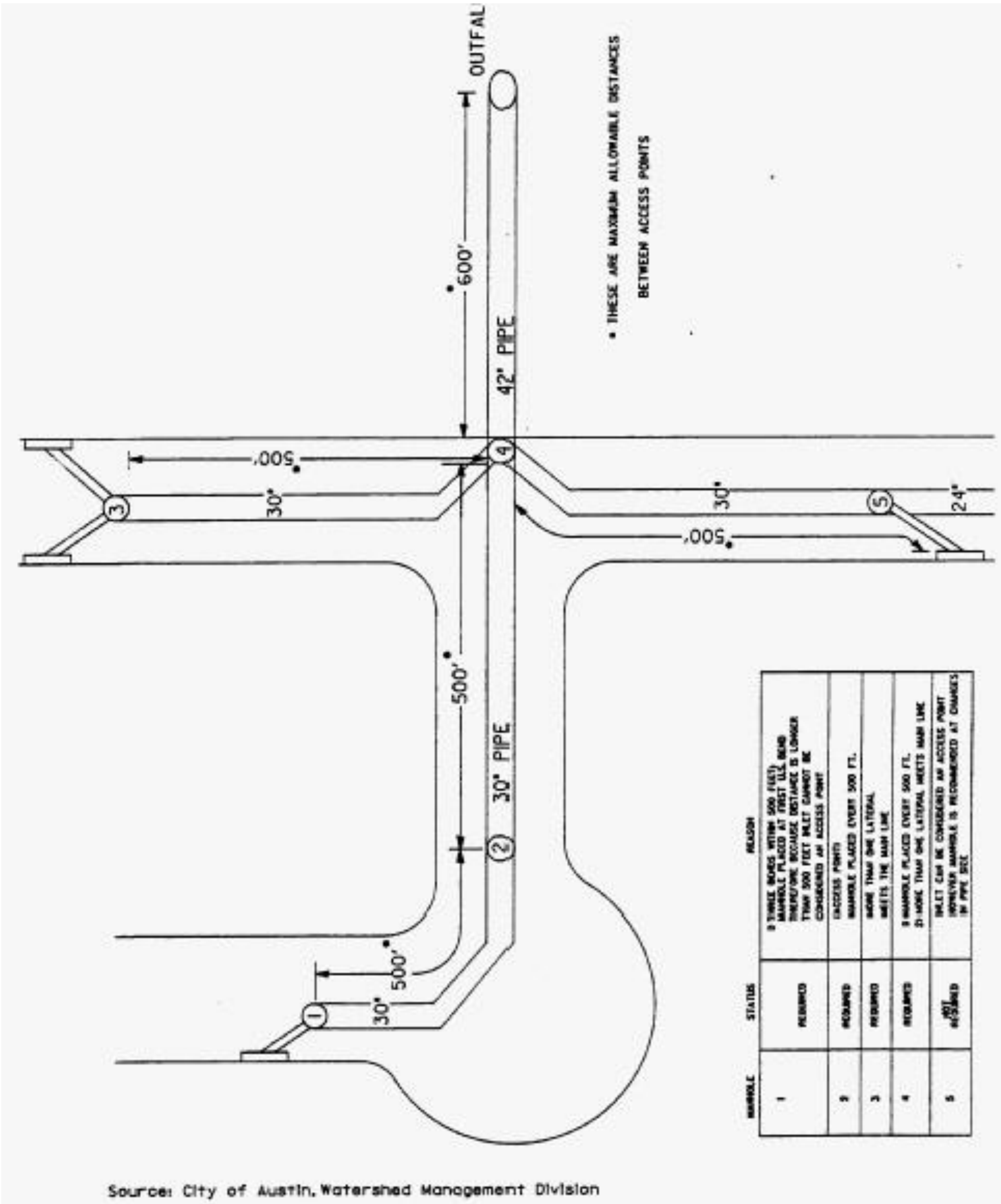


Figure 5-12: Sample Storm Sewer Layout

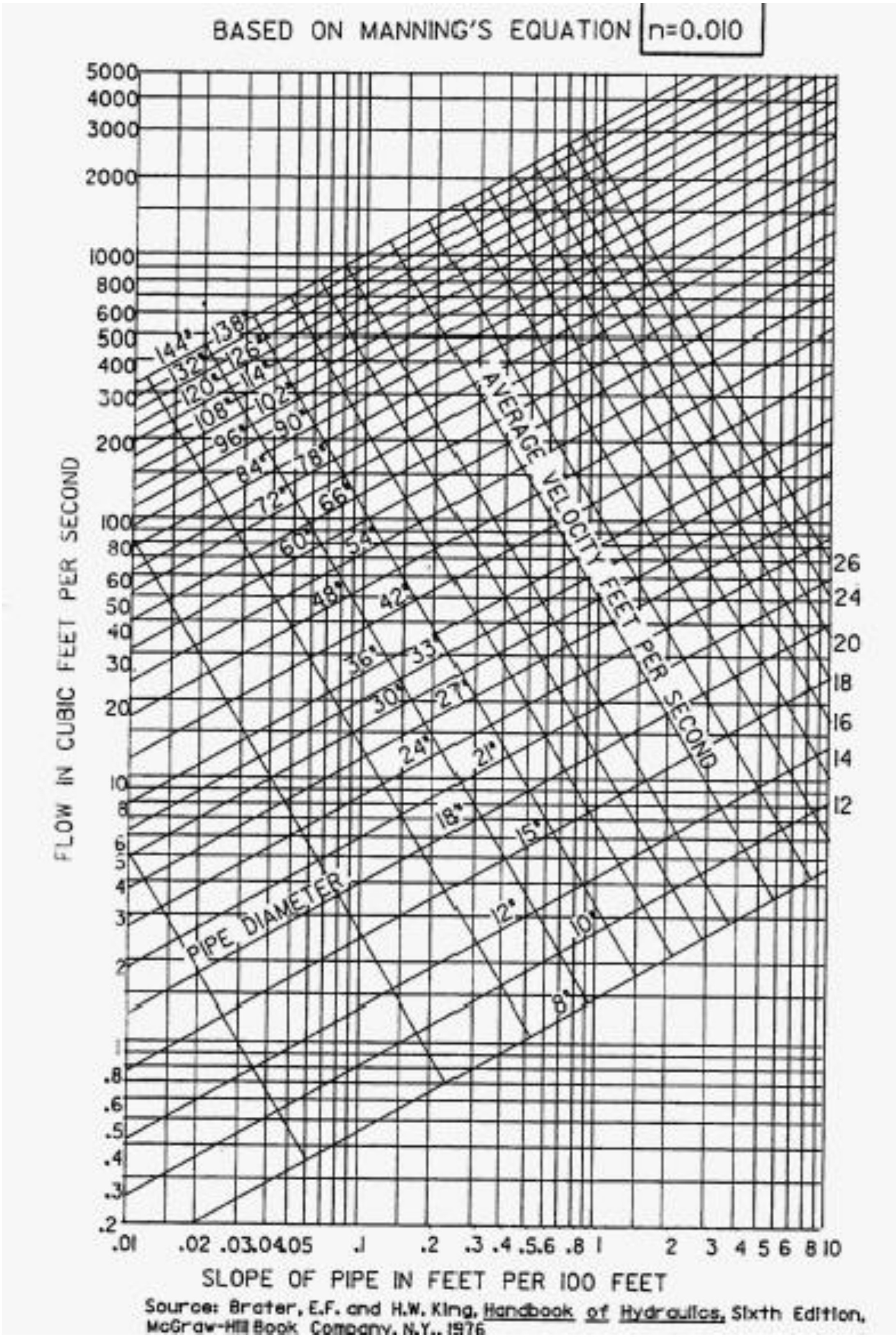


Figure 5-13: Flow for Circular Pipe Flowing Full (n=0.010)

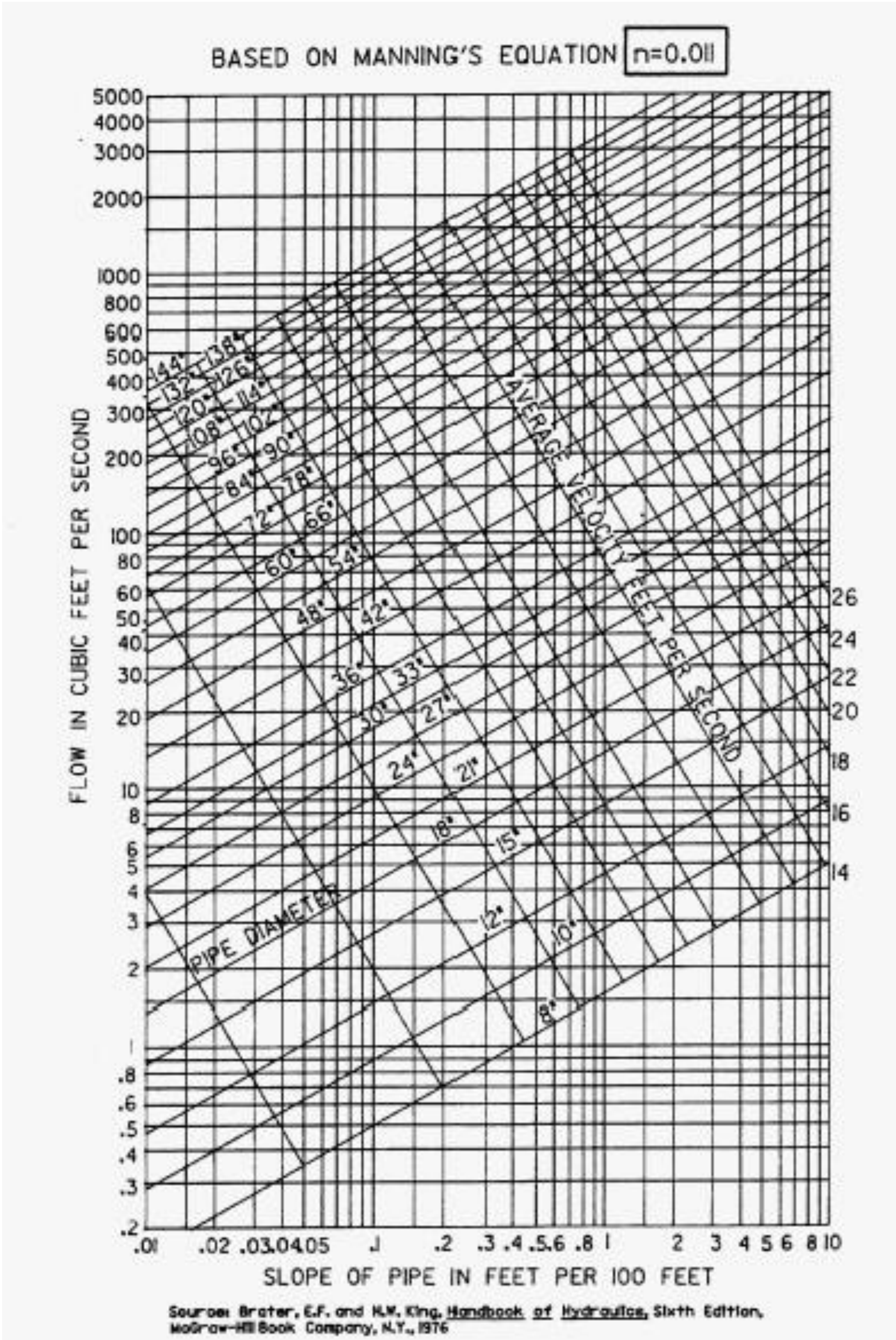


Figure 5-14: Flow for Circular Pipe Flowing Full (n=0.011)

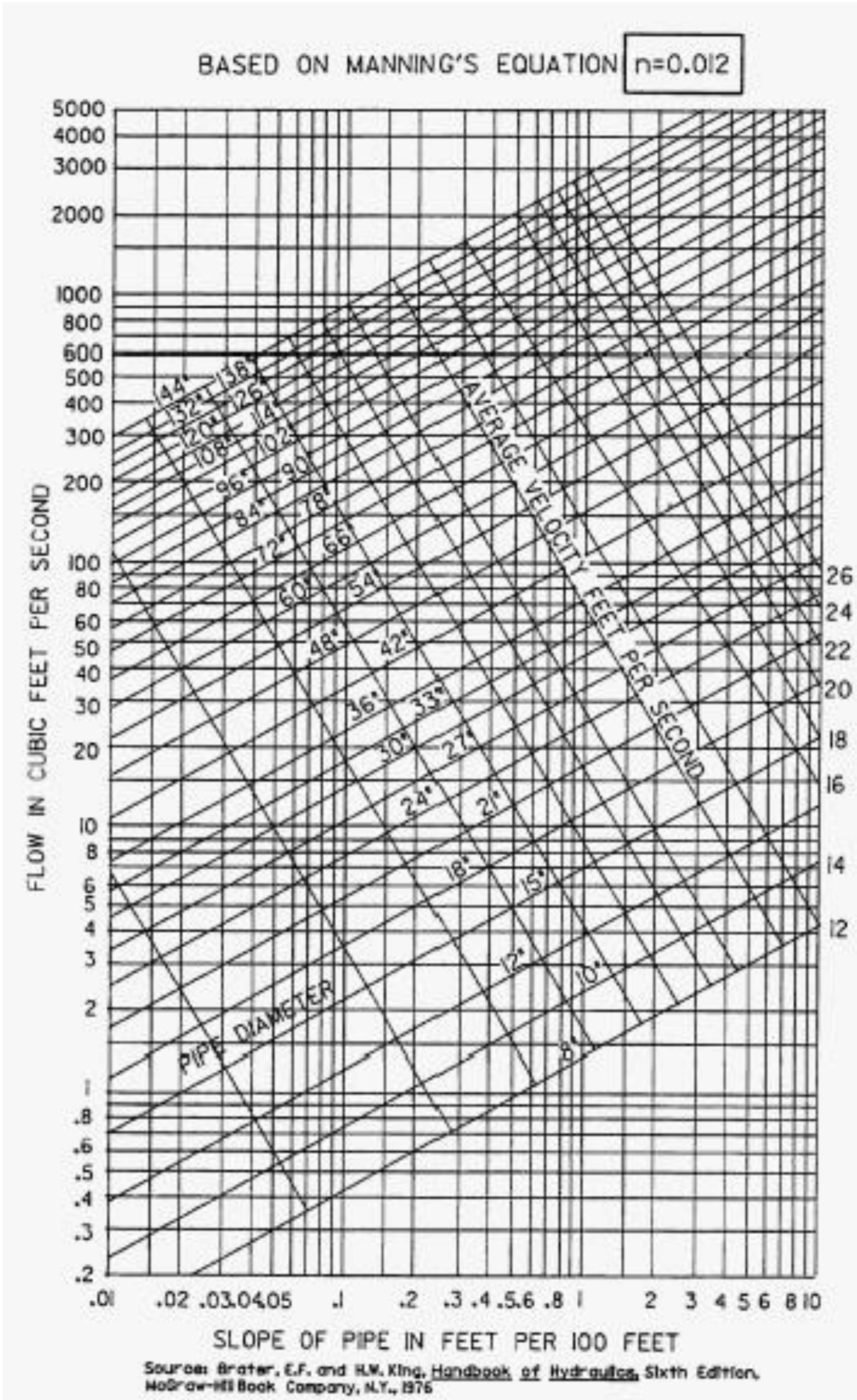
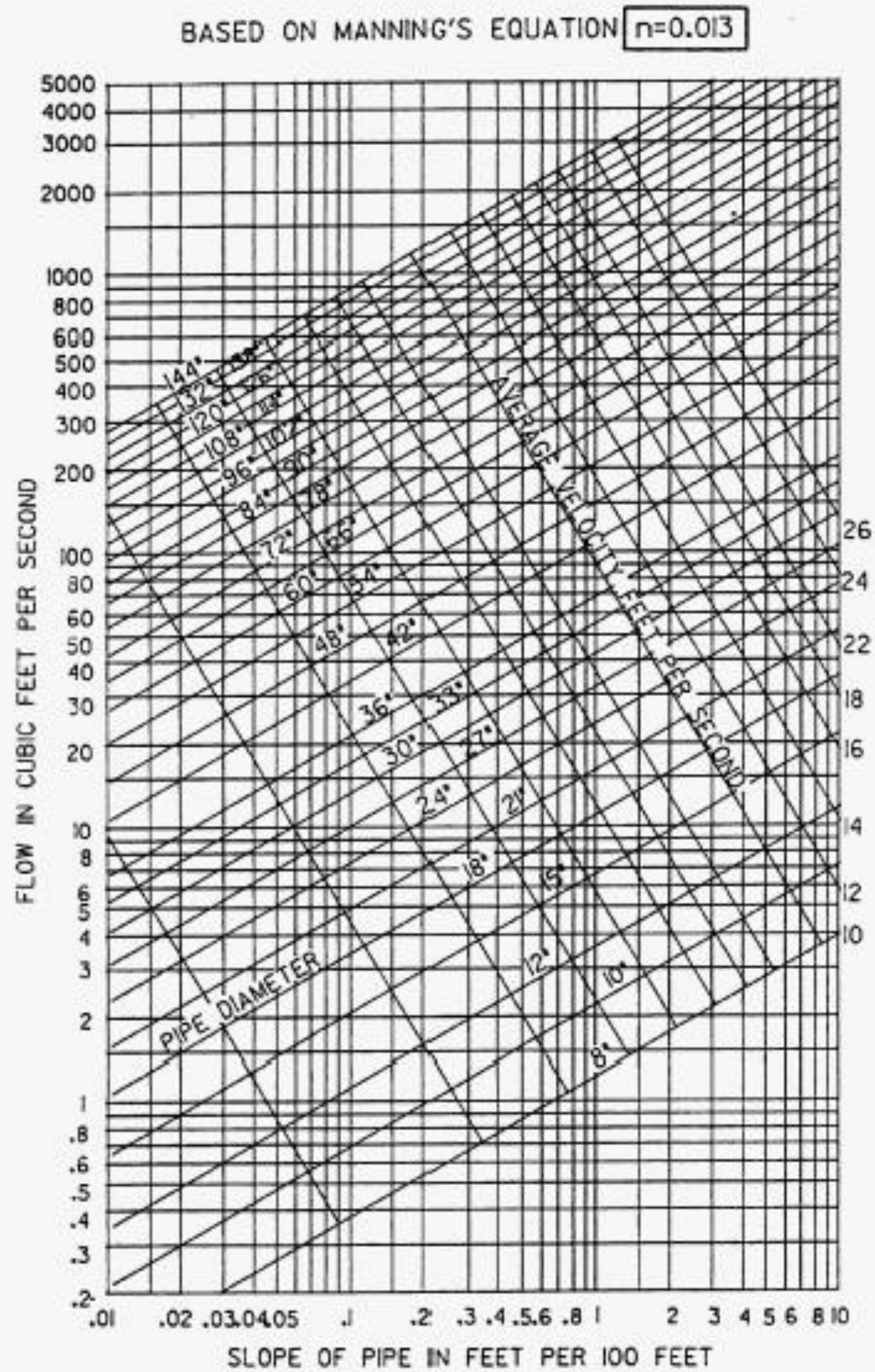


Figure 5-15: Flow for Circular Pipe Flowing Full (n=0.012)



Source: Brater, E.F. and H.W. King, Handbook of Hydraulics, Sixth Edition, McGraw-Hill Book Company, N.Y., 1976

Figure 5-16: Flow for Circular Pipe Flowing Full (n=0.013)

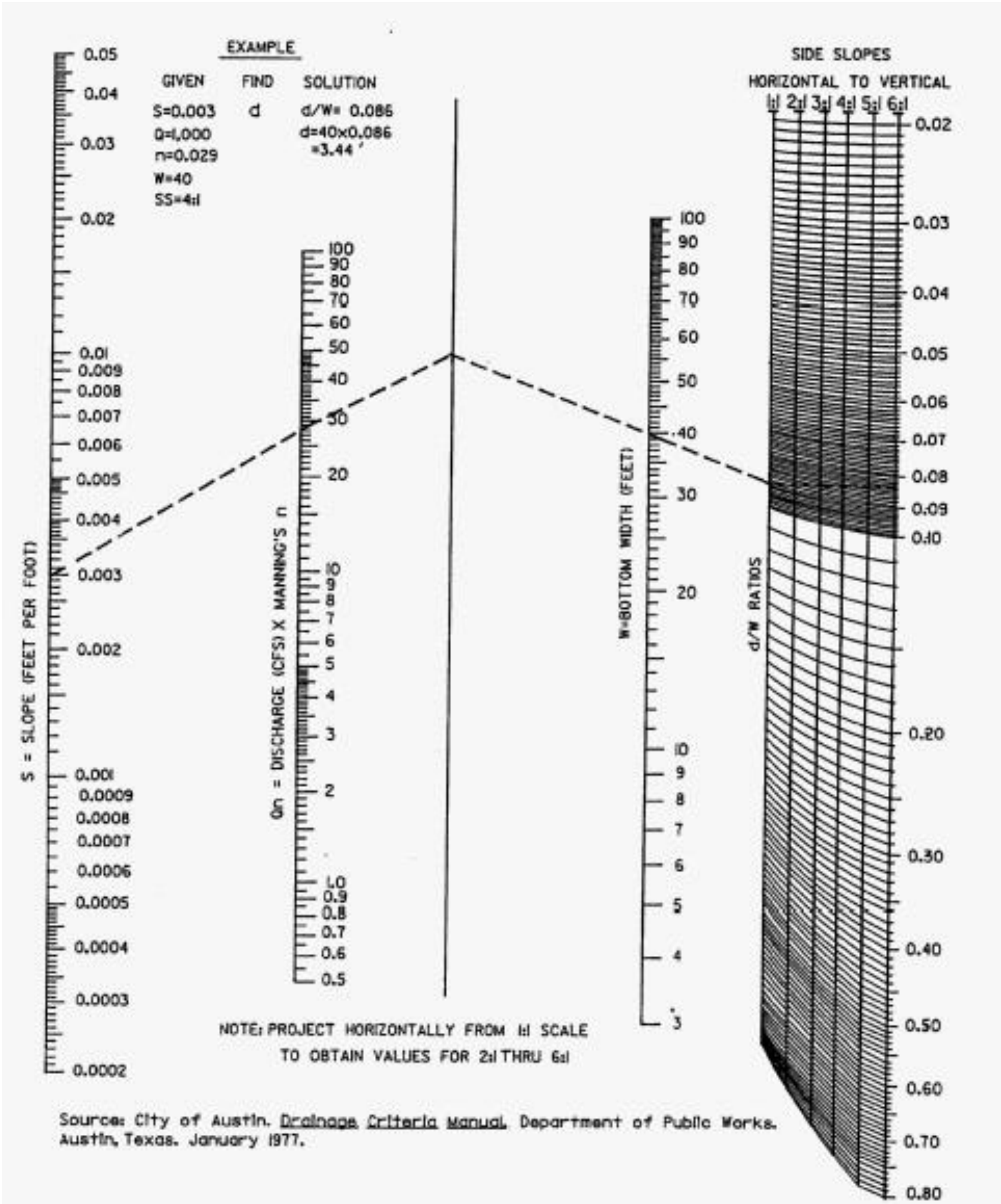
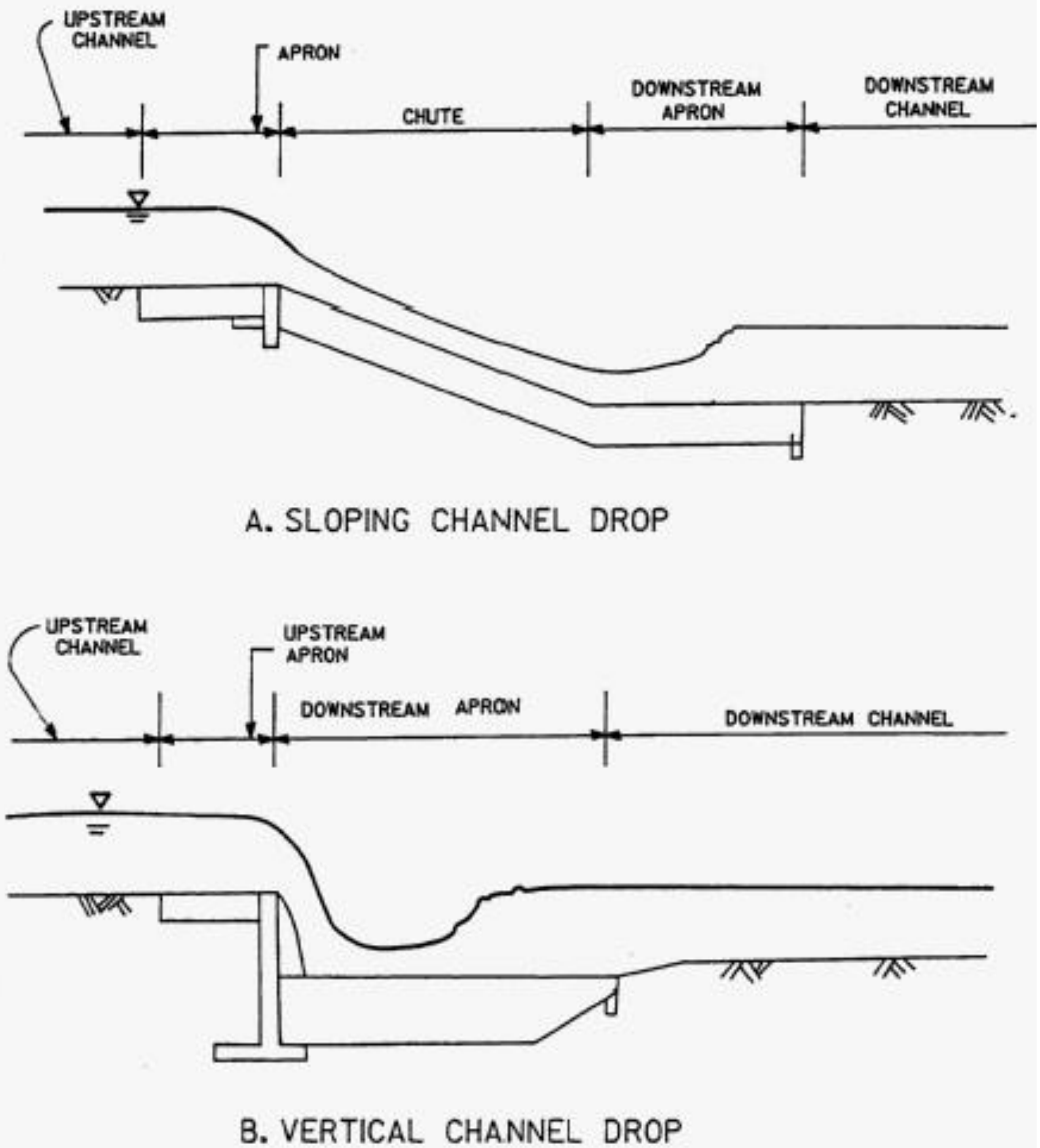
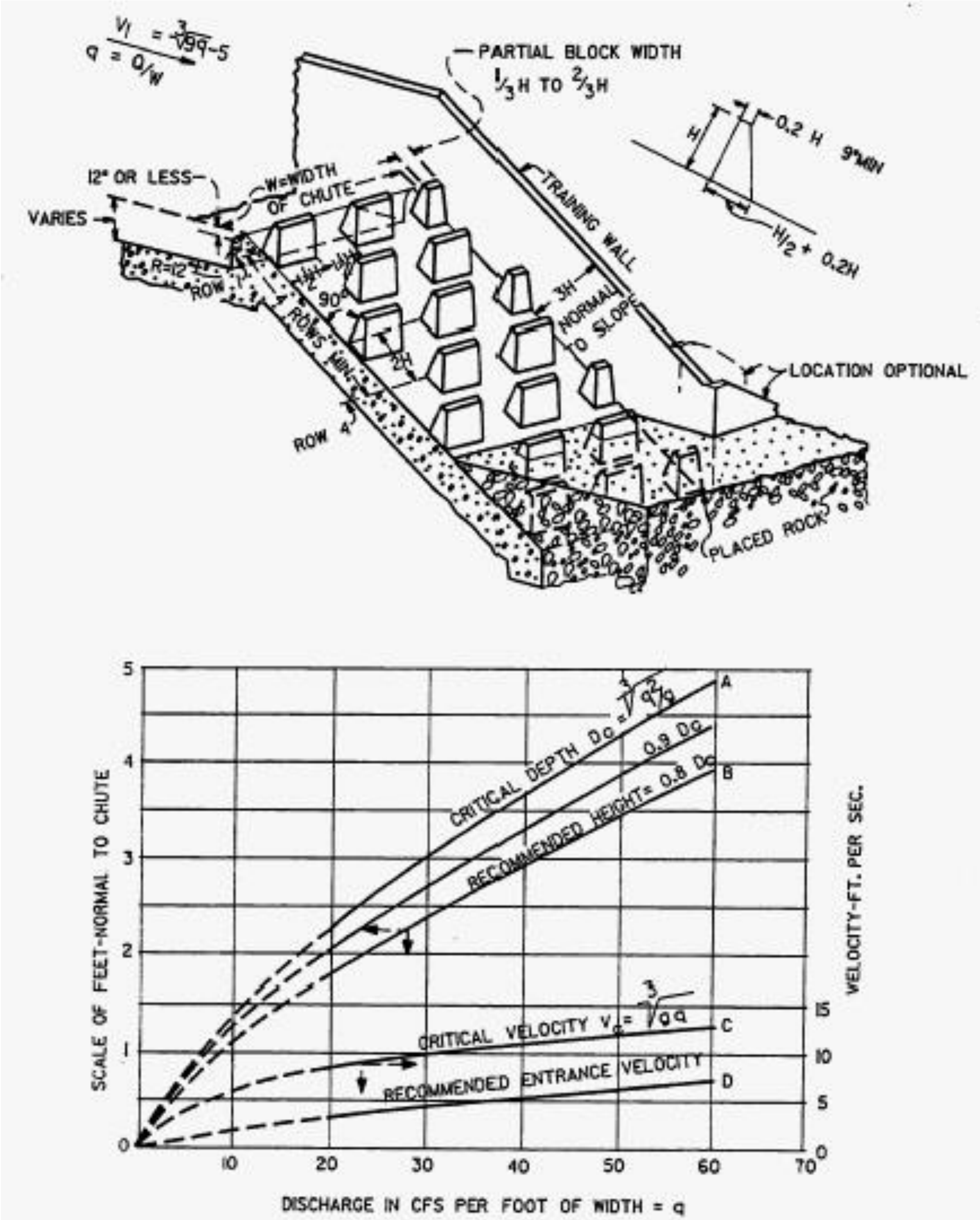


Figure 6-1: Uniform Flow for Trapezoidal Channels



Source: U.S. Bureau of Reclamation, "Hydraulic Design of Stilling Basins and Energy Disapators," Engineering Nomograph No. 25, Eigth Printing, Denver, May, 1984.

Figure 6-2: Sloping and Vertical Channel Drops



Source: U.S. Bureau of Reclamation, 'Hydraulic Design of Stilling Basins and Energy Discpators,' Engineering Nomograph No. 25, Elgth Printing, Denver, May, 1984.

Figure 6-3: Baffled Apron and its Design Curve

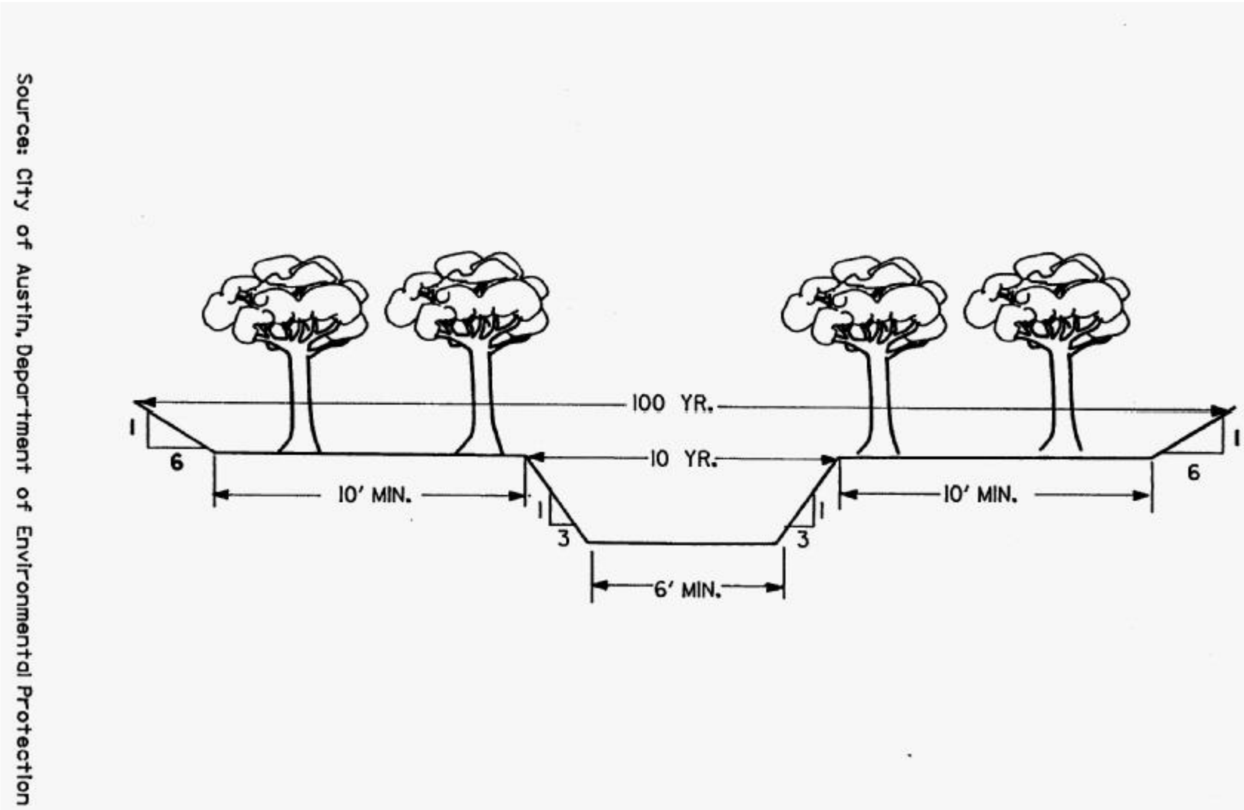


Figure 6-4: Conceptual Design of Alternative Channel

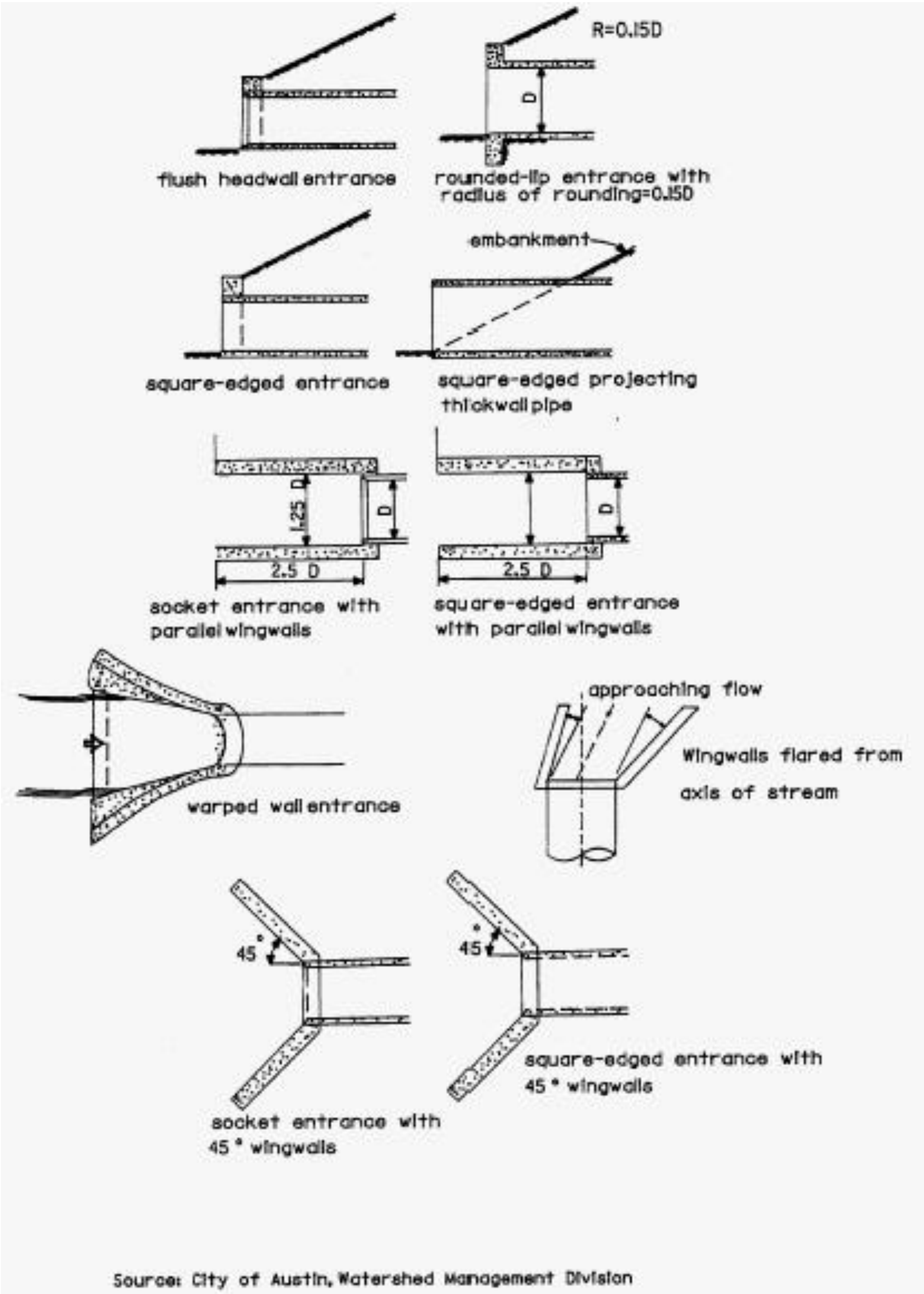


Figure 7-1: Headwall Entrance Type

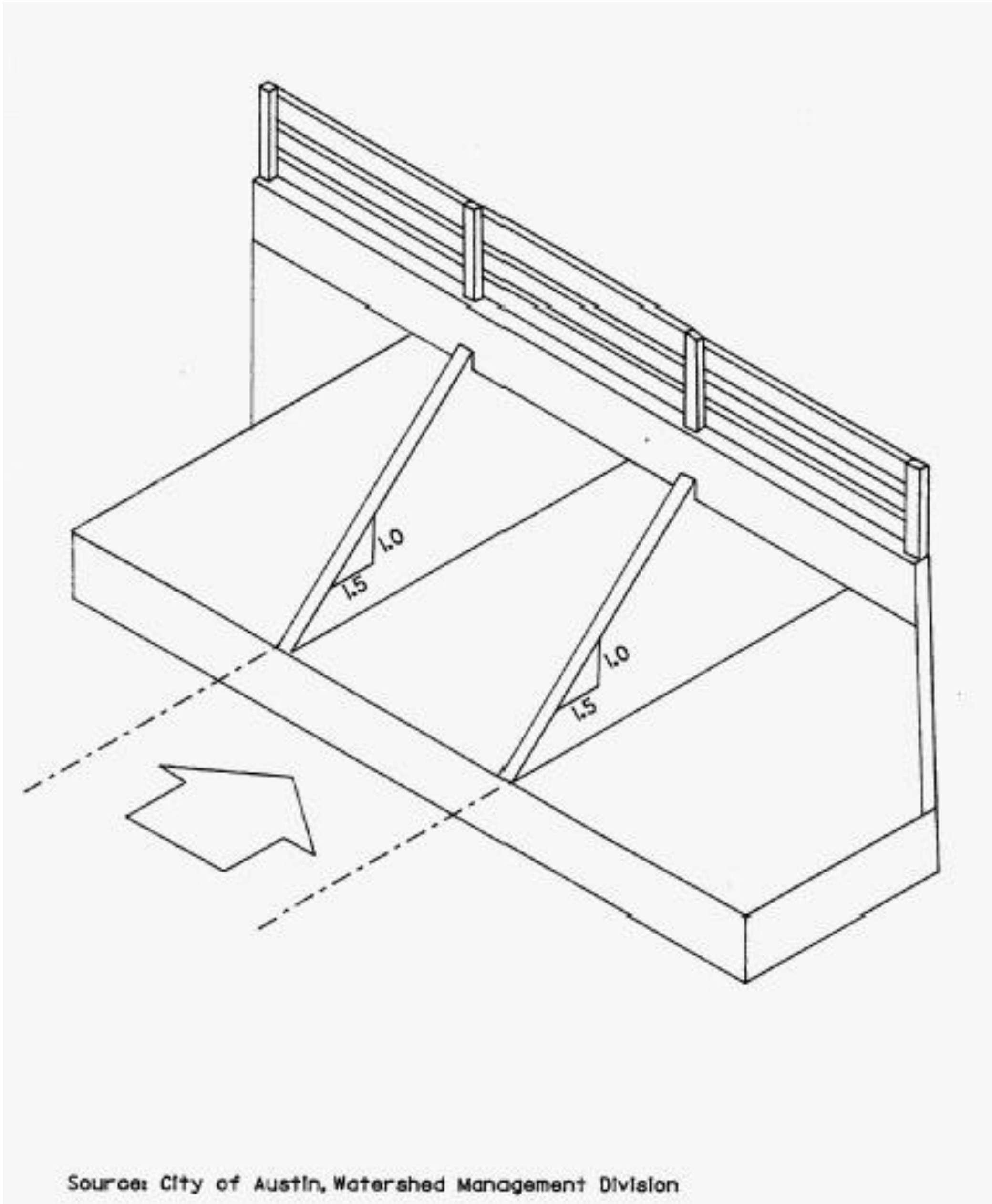


Figure 7-2: Conceptual Design of Debris Fins

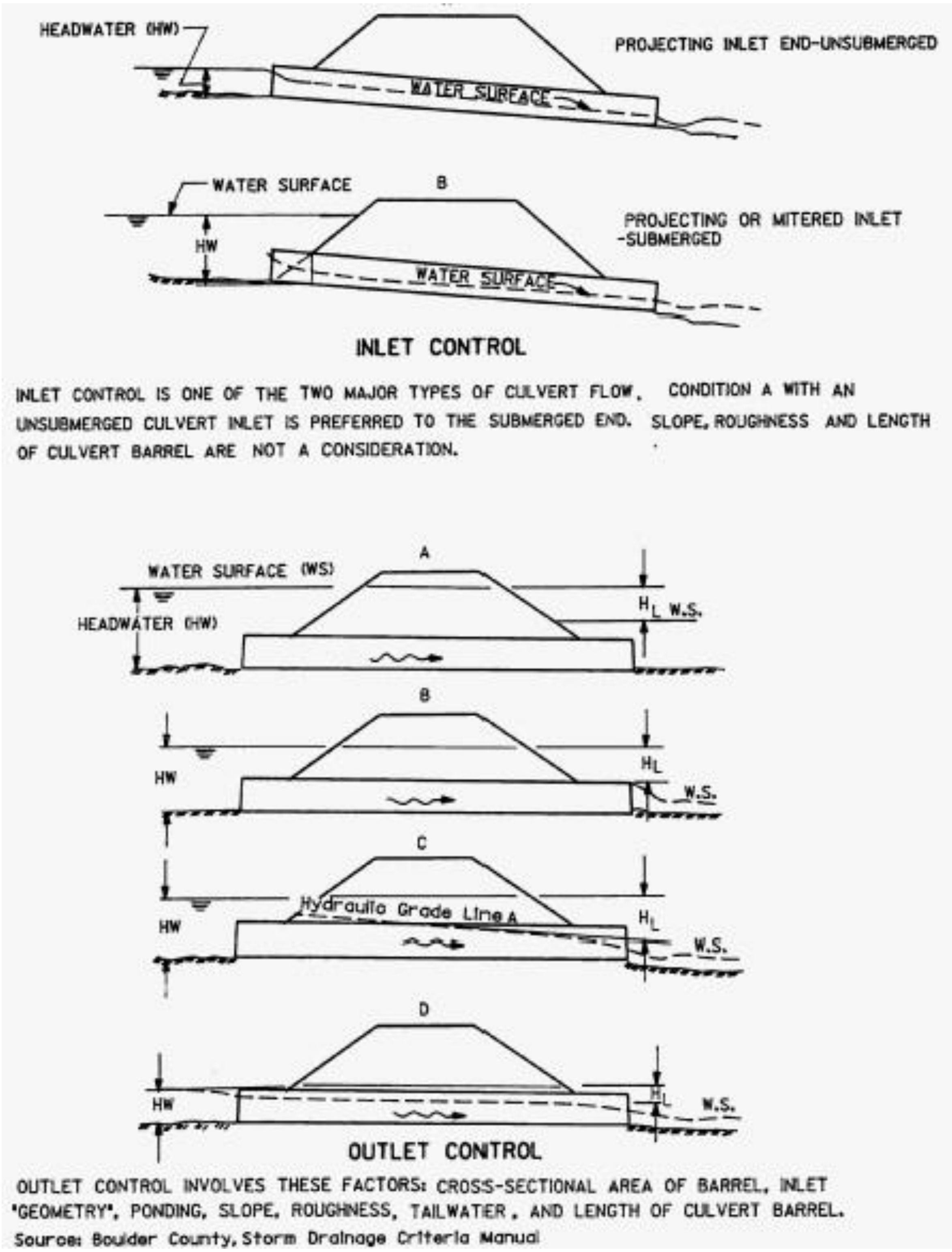


Figure 7-3: Inlet and Outlet Conditions for Culverts

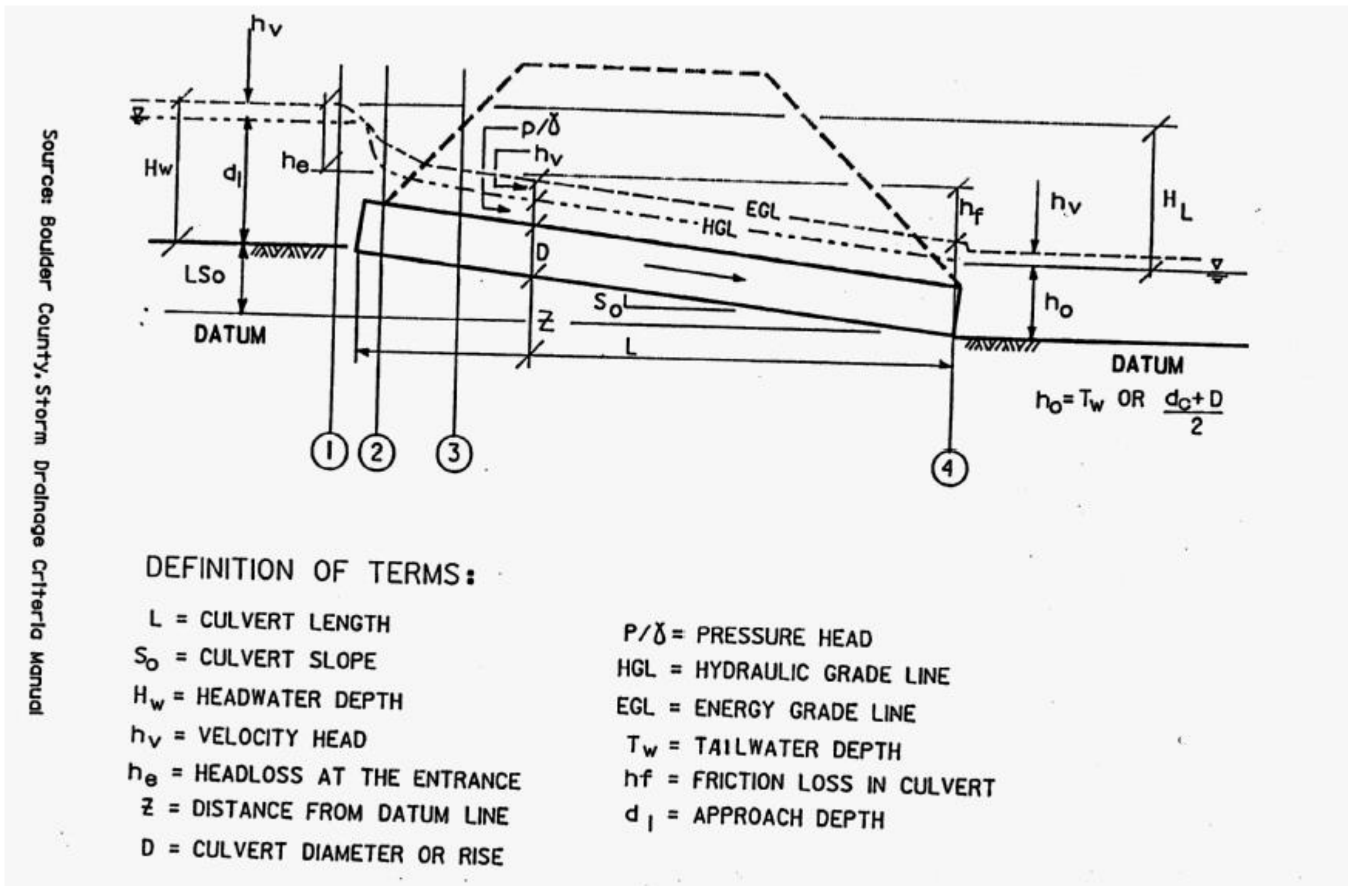


Figure 7-4: Hydraulics of a Culvert Under Outlet Control Condition

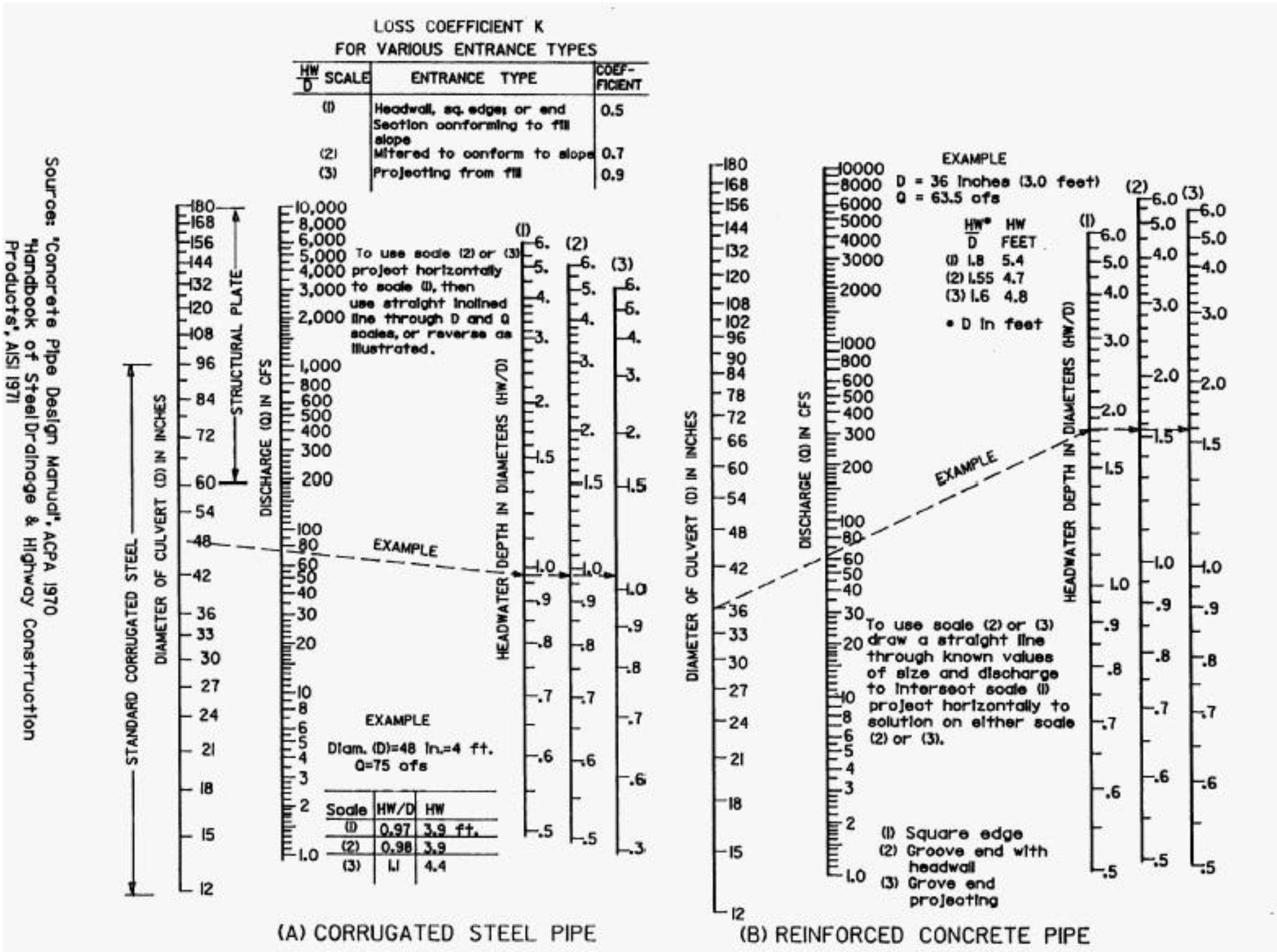


Figure 7-5: Inlet Control Nomograph, Circular Pipe

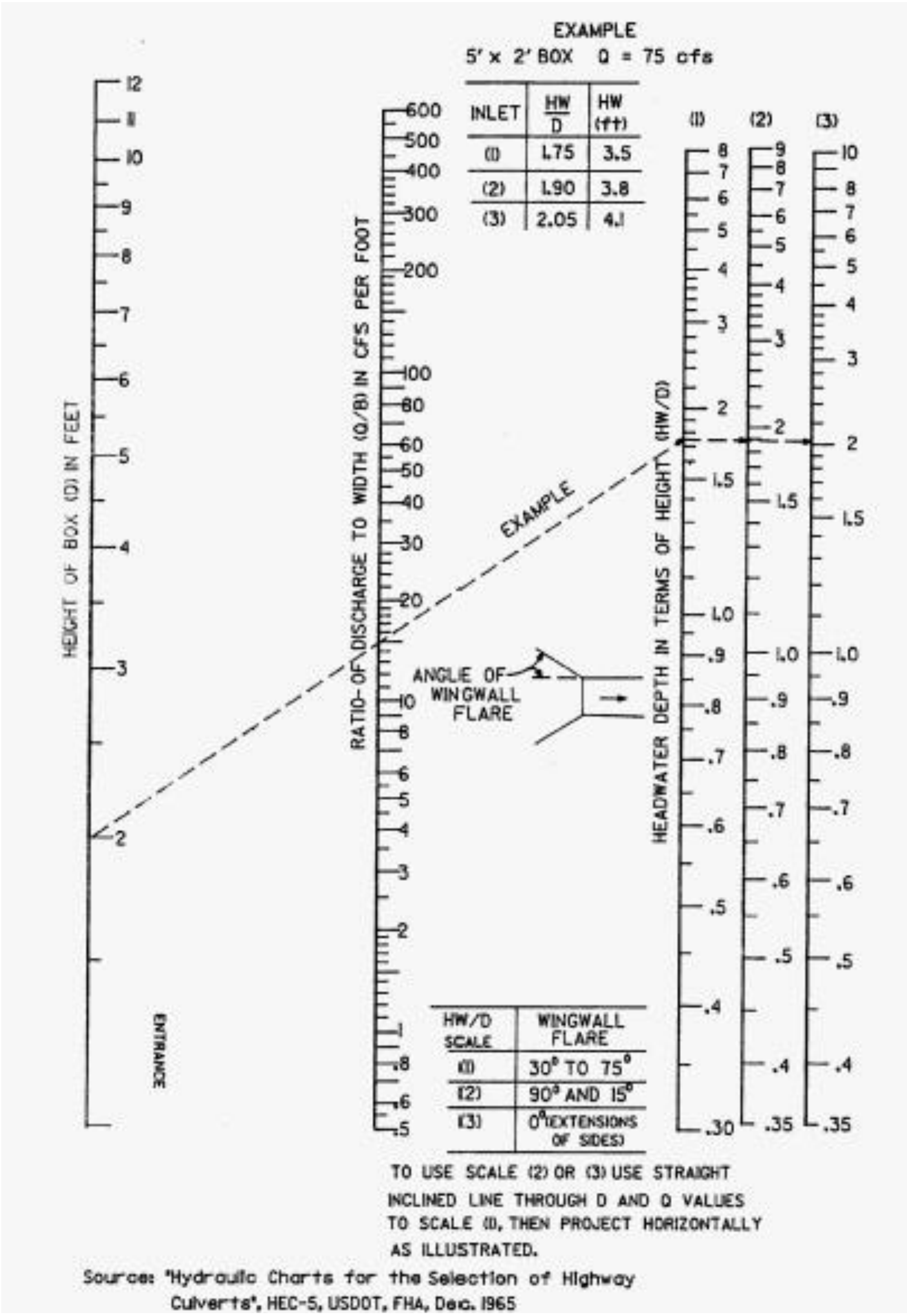


Figure 7-6: Inlet Control Nomograph, Box Culverts

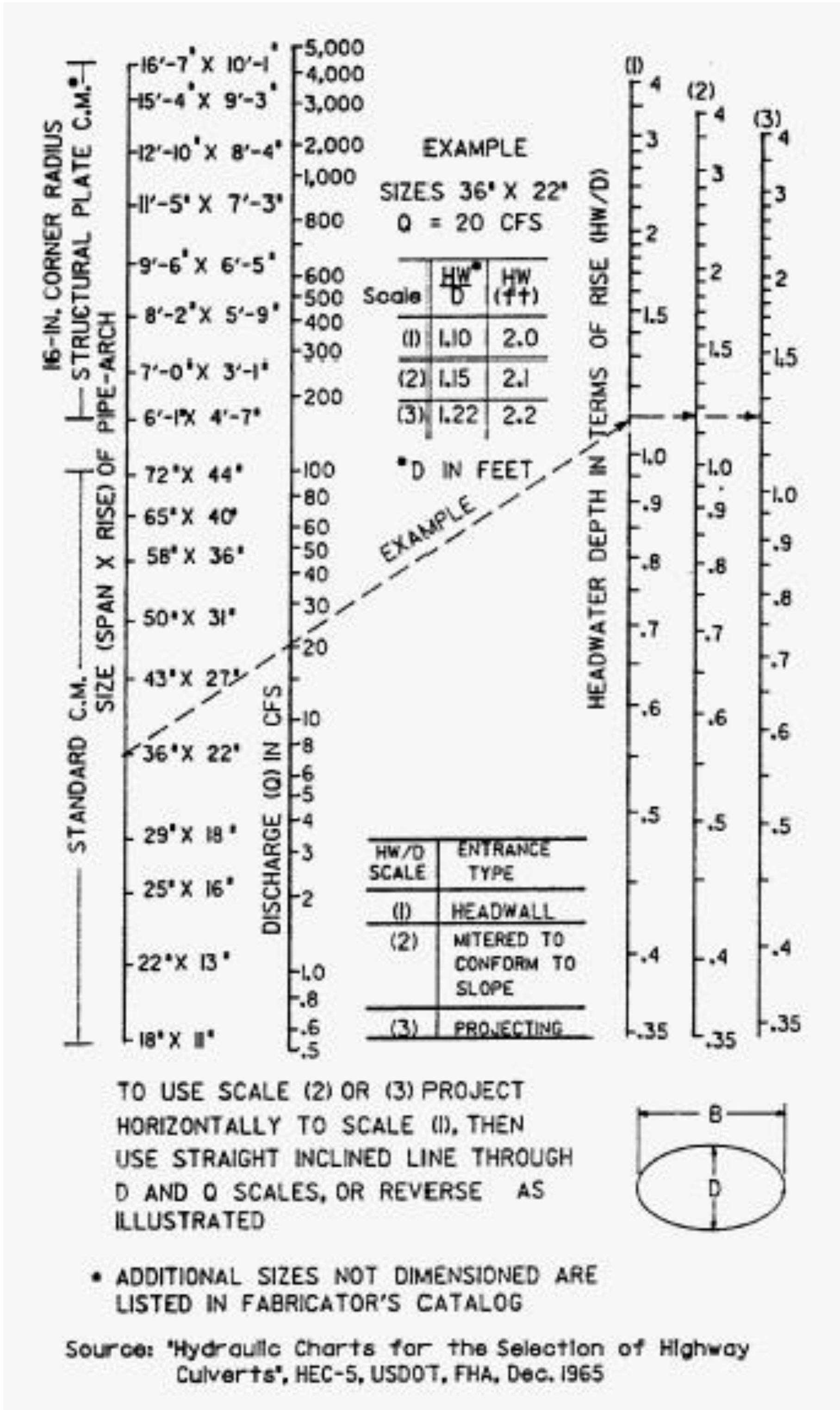


Figure 7-7: Inlet Control Nomograph, CSP Arch

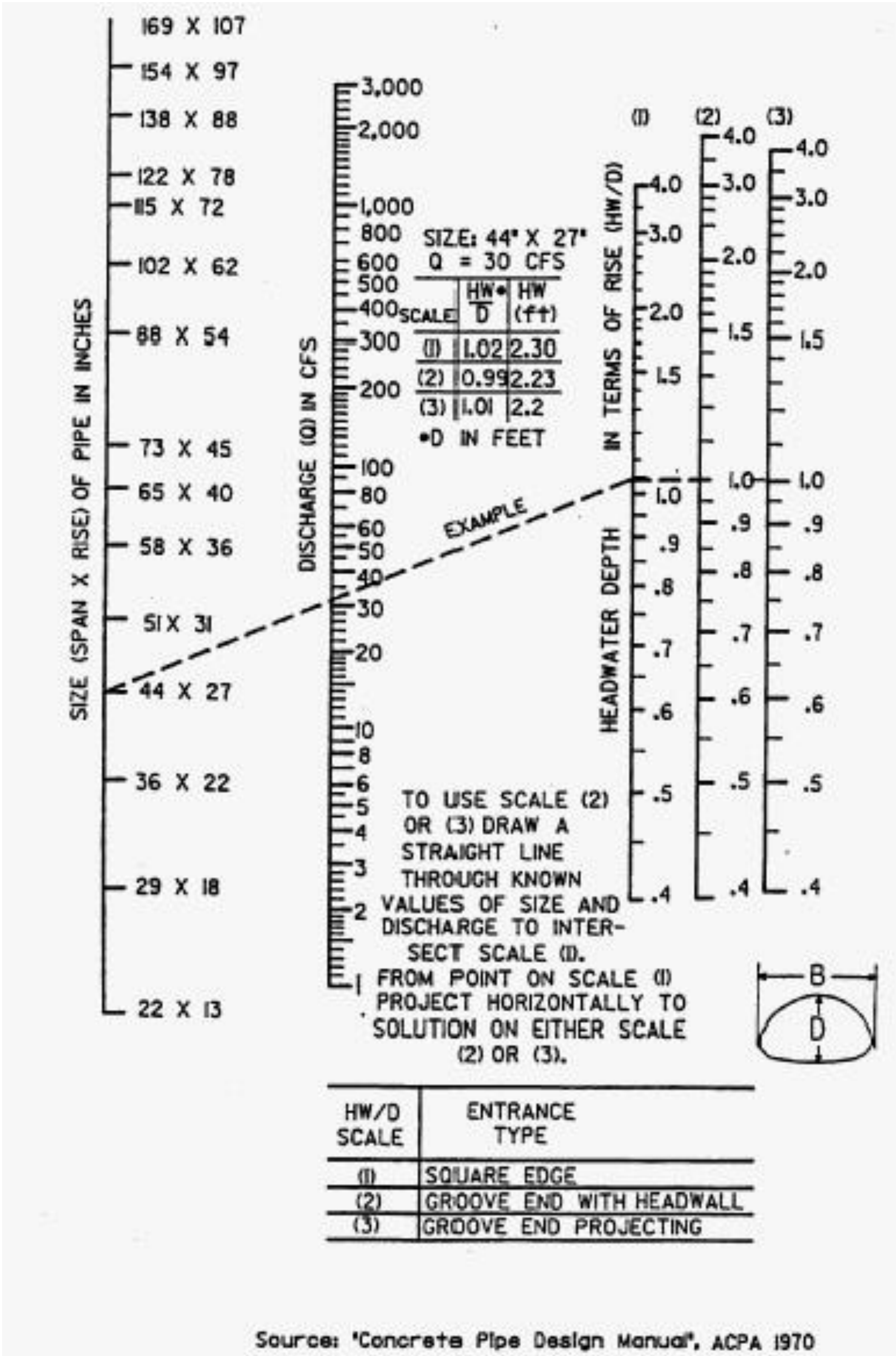
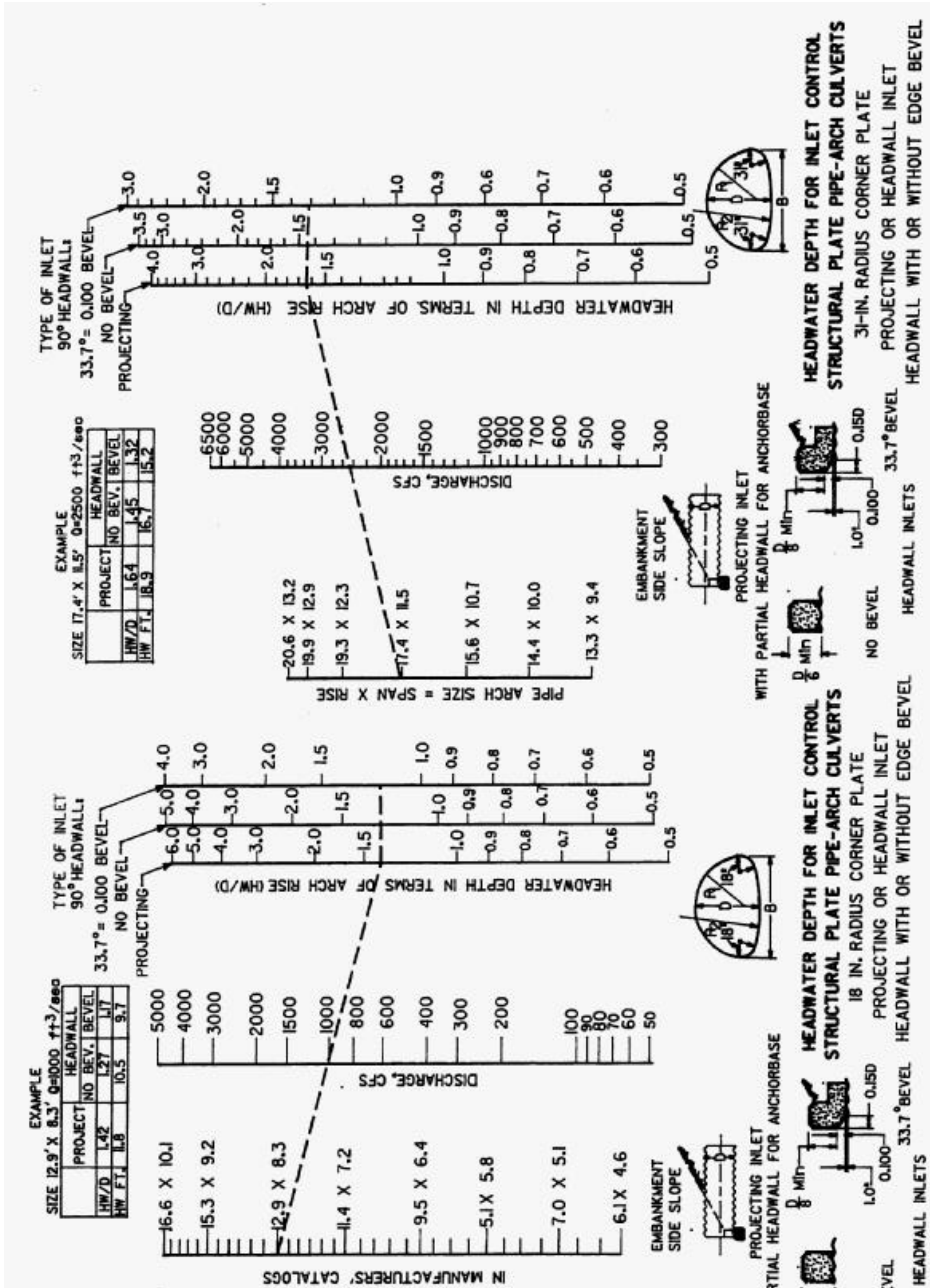


Figure 7-8: Inlet Control Nomograph, RCP Arch



Source: 'Handbook of Steel Drainage & Highway Construction Products', AISI 1971

Figure 7-9: Inlet Control Nomograph, SSP Arch

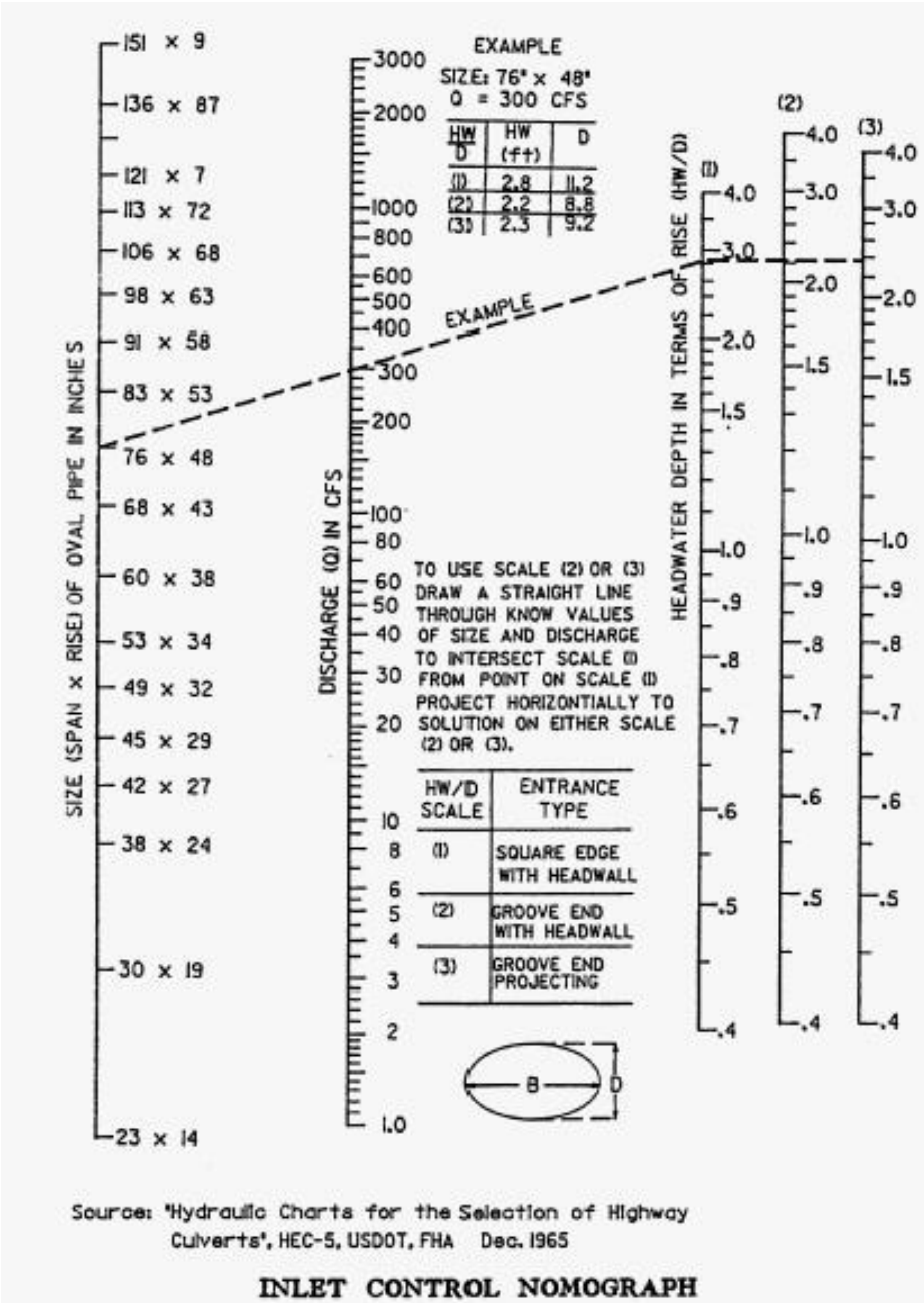
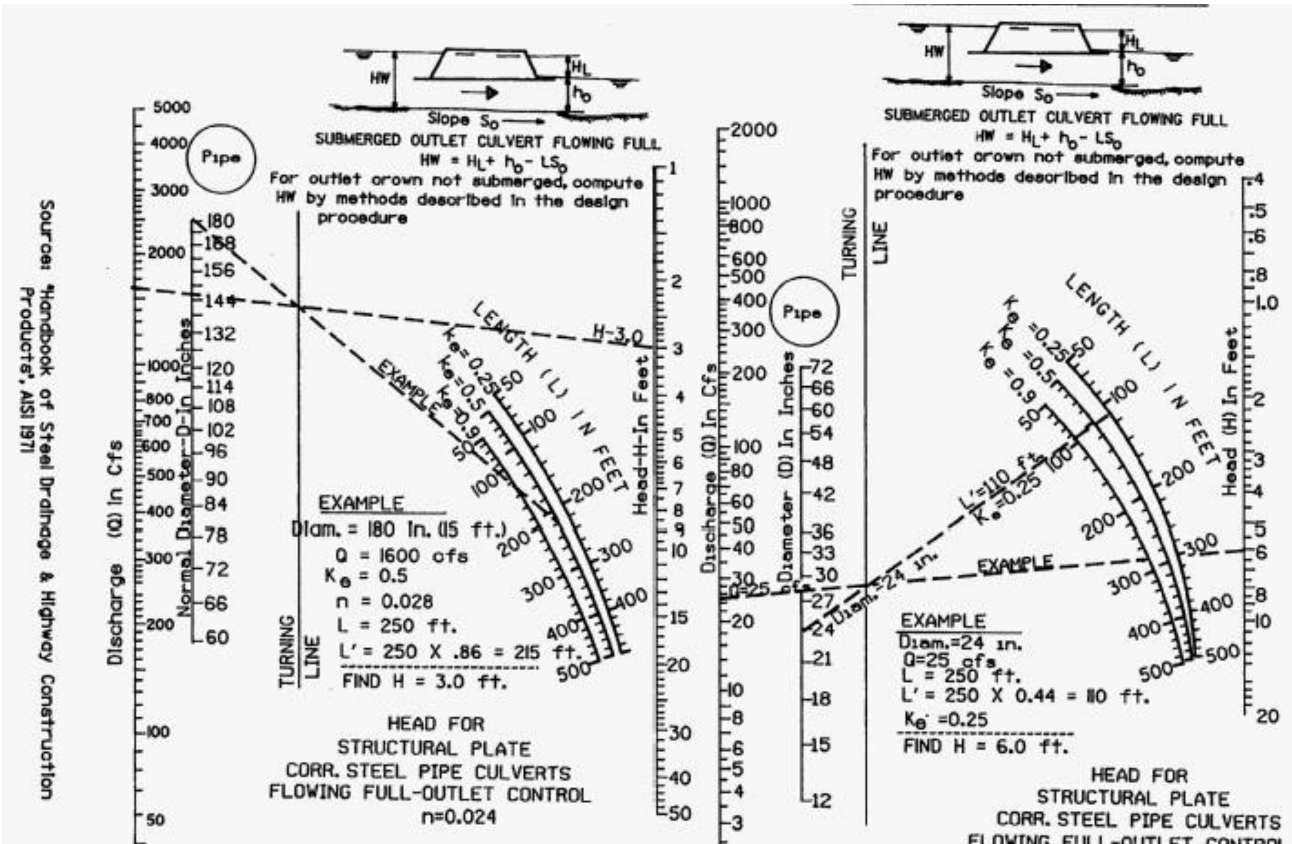


Figure 7-10: Inlet Control Nomograph, RCP Elipse



Length Adjustment for Improved Hydraulics

Pipe Diam. in Feet	Roughness Factor: Curves Based on n=	Roughness Factor: Actual n'= •	Length Adjustment Factor $\left(\frac{n'}{n}\right)^2$
5'	.0328	.033	1.0
7'	.0320	.032	1.0
10'	.0311	.030	0.93
15'	.0302	.028	0.86

Figure 7-11: Outlet Control Nomograph, Circular CSP

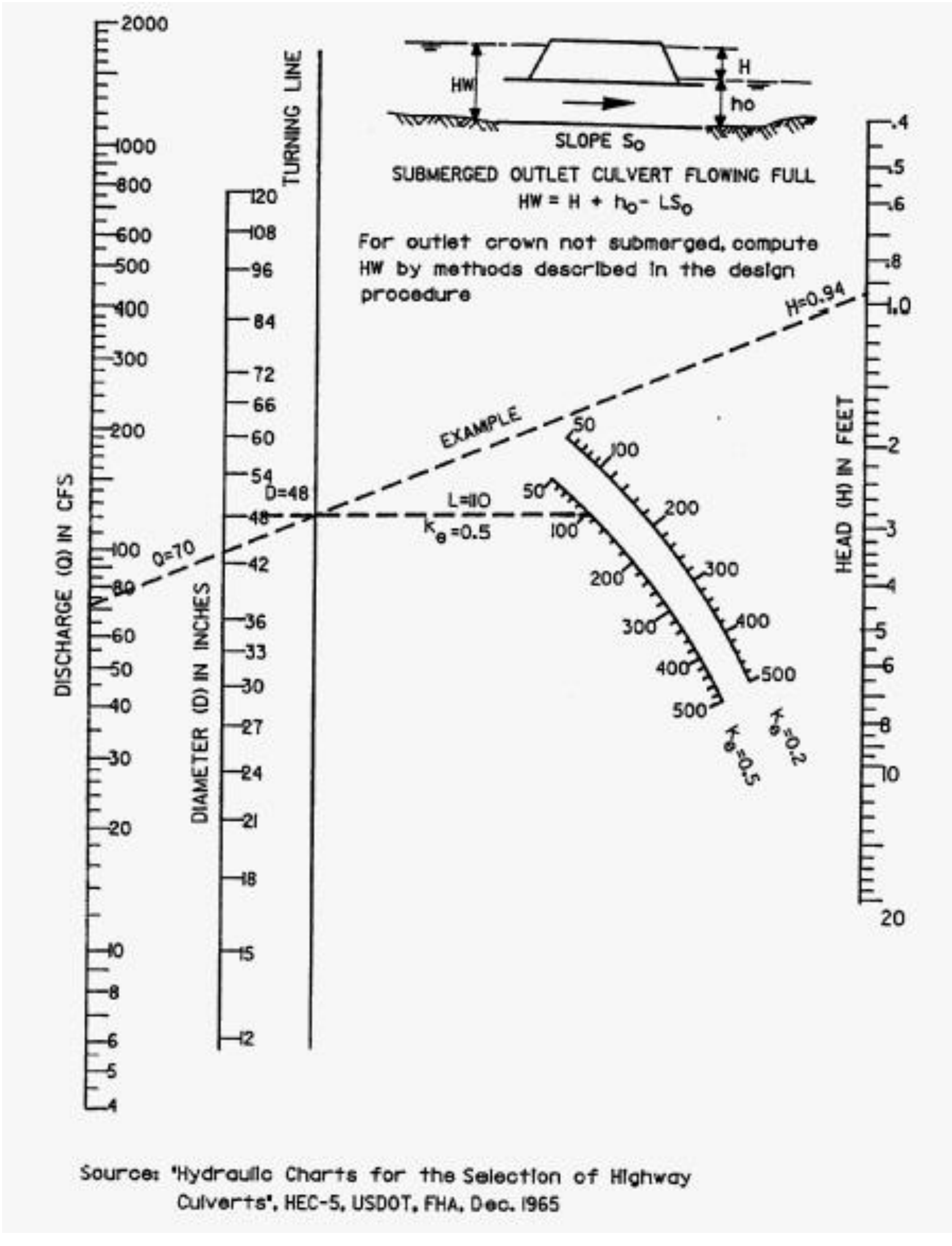


Figure 7-12: Outlet Control Nomograph, Circular RCP

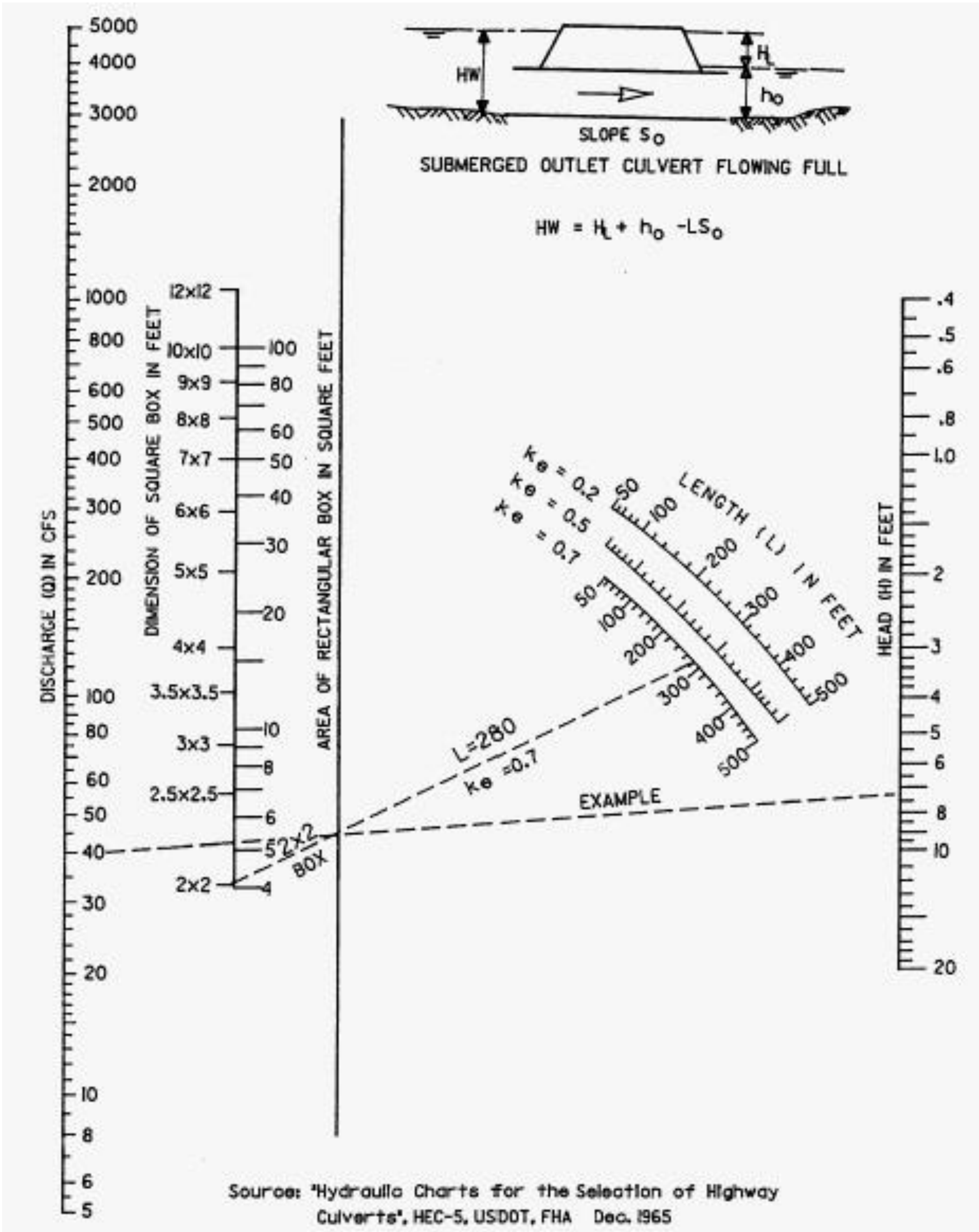
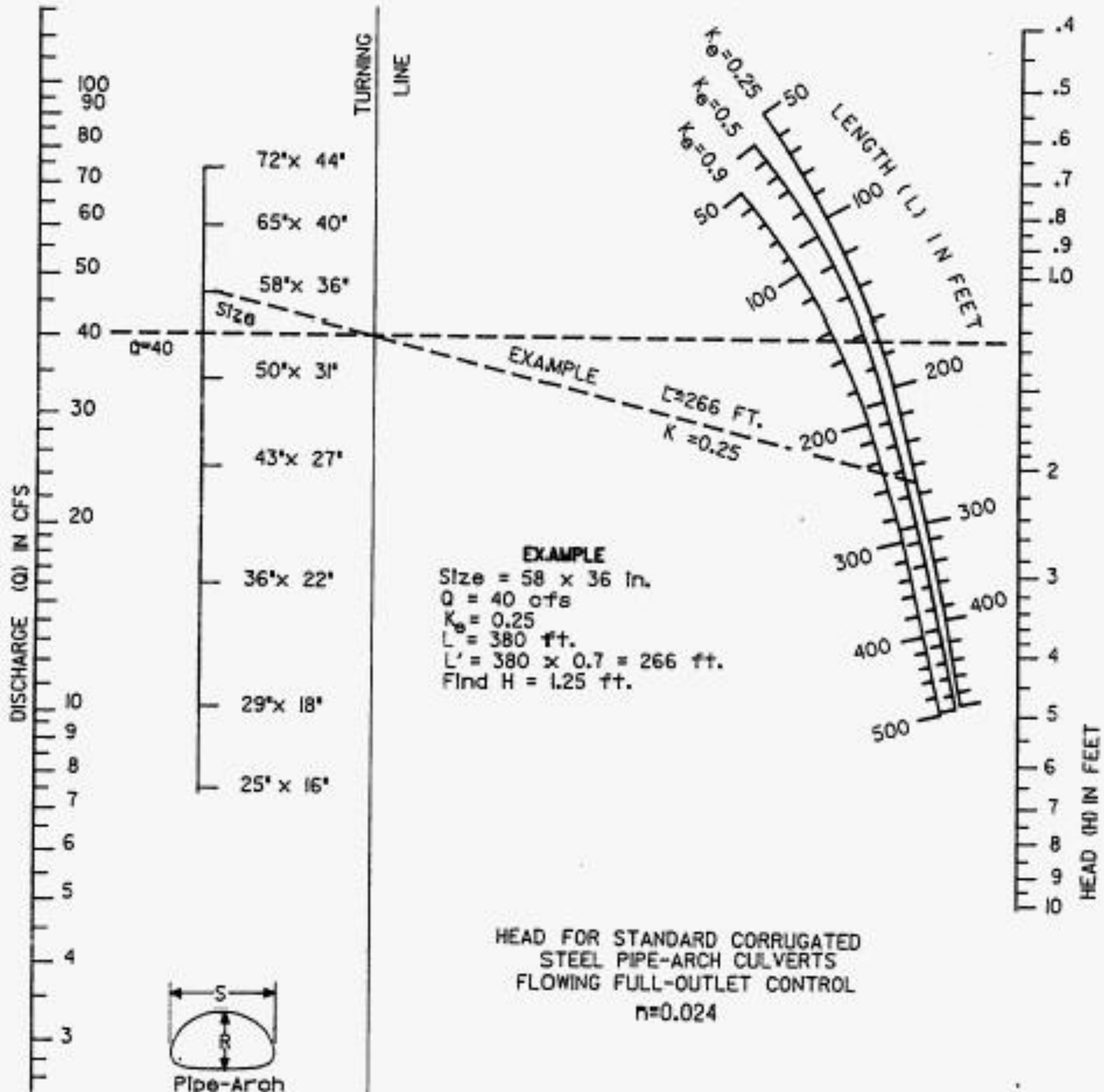


Figure 7-13: Outlet Control Nomograph, Box Culverts

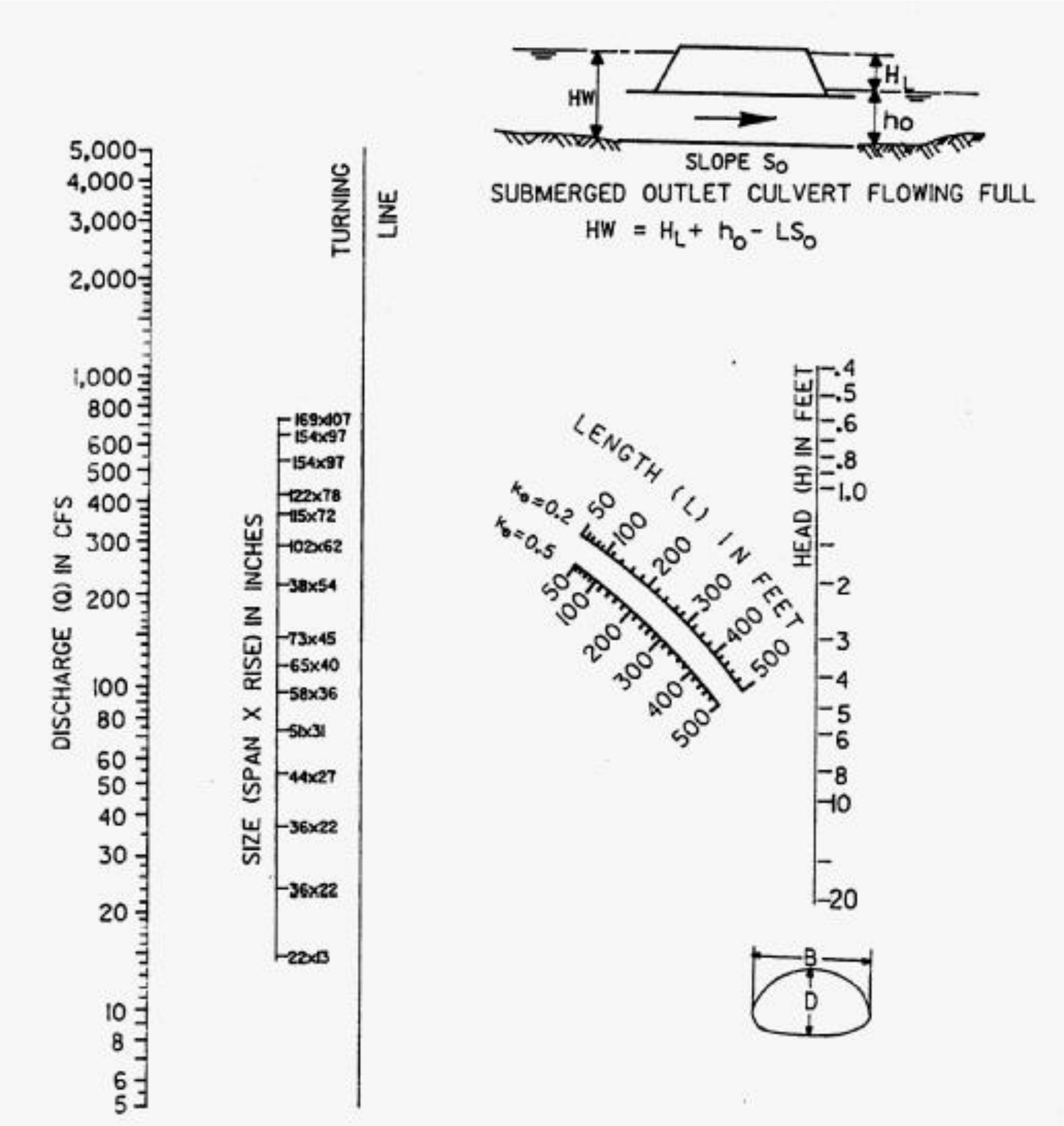


LENGTH ADJUSTMENT FOR IMPROVED HYDRAULICS

PIPE DIAMETER IN INCHES	ROUGHNESS FACTOR n' FOR HELICAL CORR.	LENGTH ADJUSTMENT FACTOR $\left(\frac{n'}{n}\right)^2$
12	.011	.21
24	.016	.44
36	.019	.61
48	.020	.70

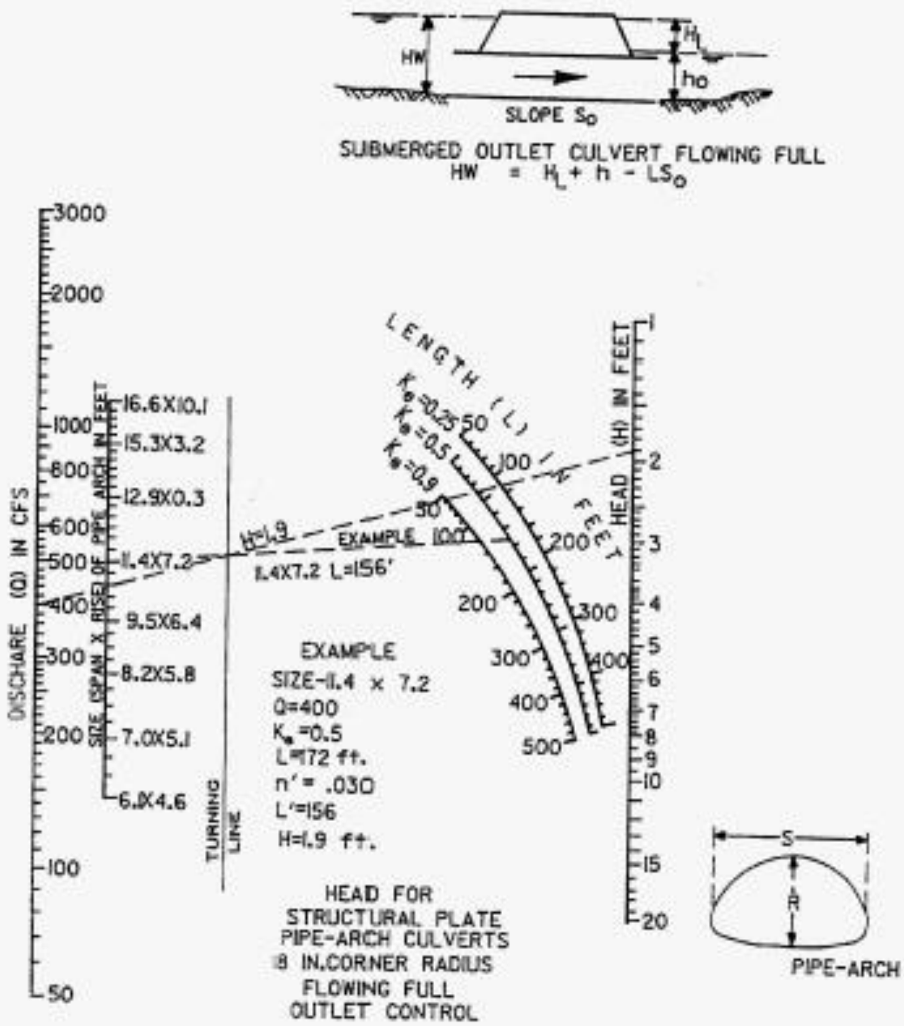
Source: "Handbook of Steel Drainage & Highway Construction Products", AISI 1971

Figure 7-14: Outlet Control Nomograph, CSP Arch



Source: "Concrete Pipe Design Manual", ACPA 1970

Figure 7-15: Outlet Control Nomograph, RCP Arch



OUTLET CONTROL. Head for structural plate pipe-arch culvert with 18 in corner radius with submerged outlet and flowing full. For 31 in. corner radius, use structure sizes with equivalent areas on the 18-in. corner radius scale.

Length Adjustment for Improved Hydraulics

Pipe-Arch Size in Feet	Roughness Factor		Length Adjustment Factor $\left(\frac{n'}{n}\right)^2$
	Curves based on n	Actual n'	
6.1 x 4.6	.0327	.0327	1.0
8.1 x 5.8	.0321	.032	1.0
11.4 x 7.2	.0315	.030	0.907
16.6 x 10.1	.0306	.028	0.837

Source: "Handbook of Steel Drainage & Highway Construction Products", AISI 1971

Figure 7-16: Outlet Control Nomograph, SPP Arch

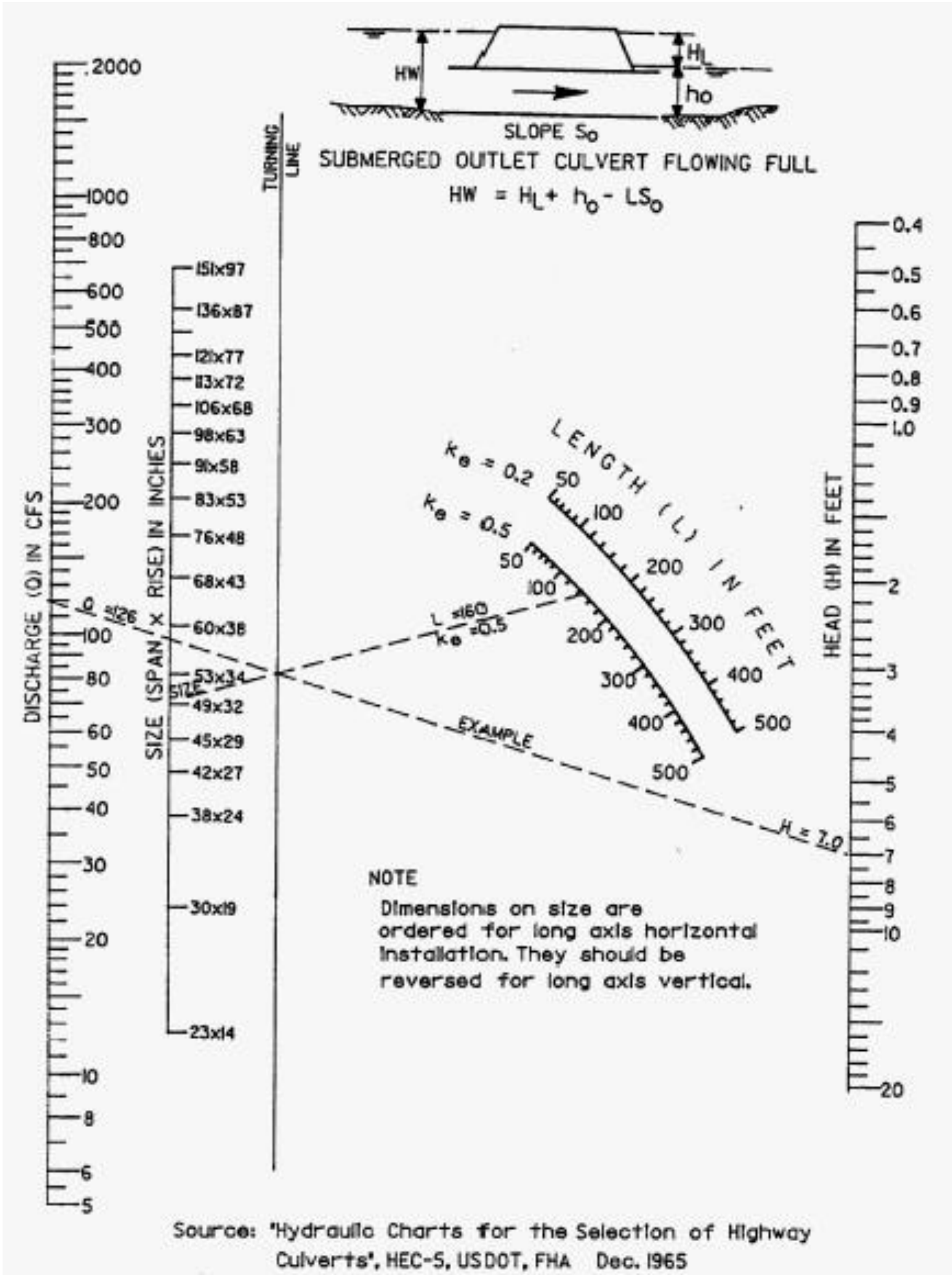


Figure 7-17: Outlet Control Nomograph, RCP Elipse

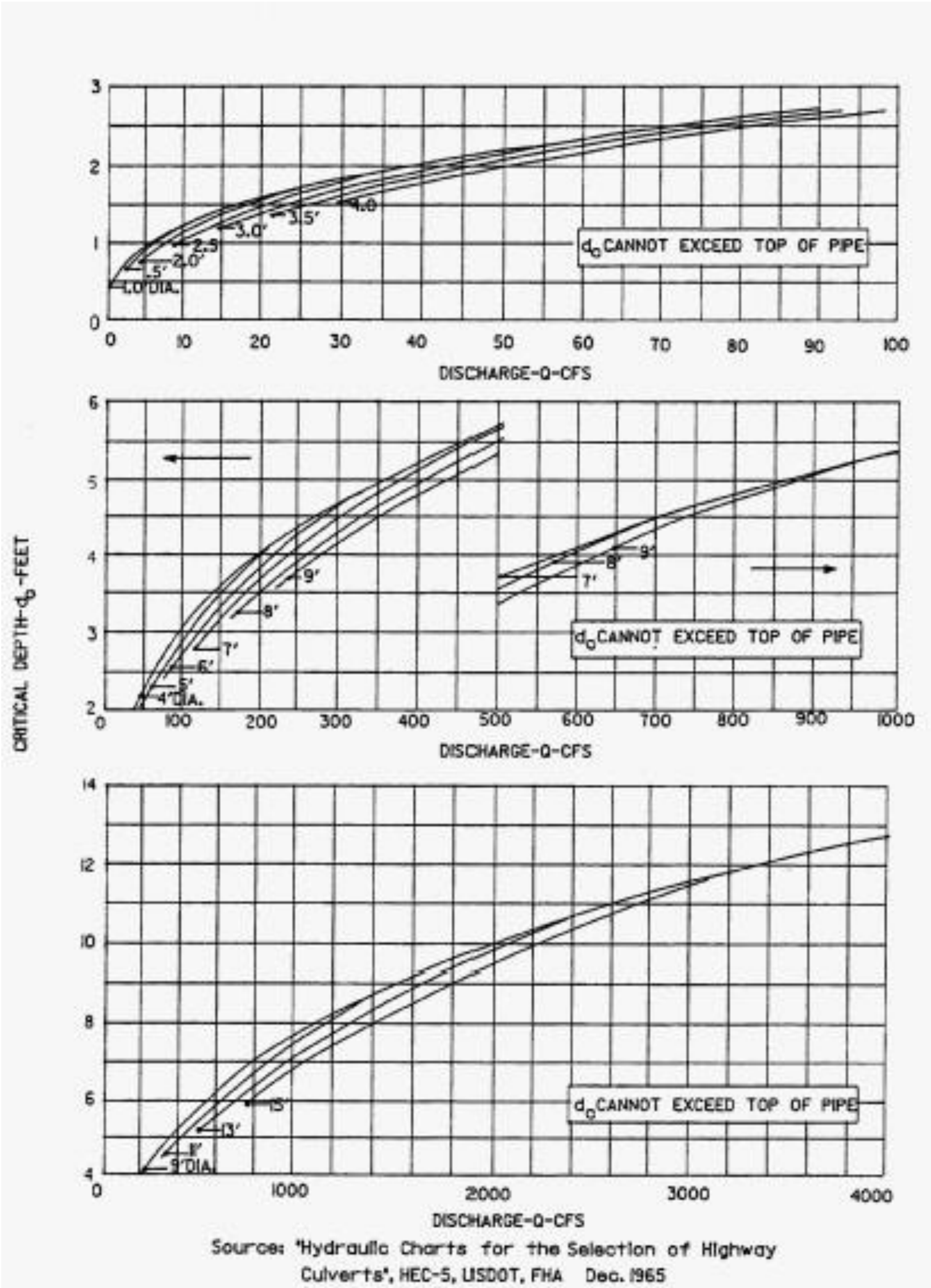
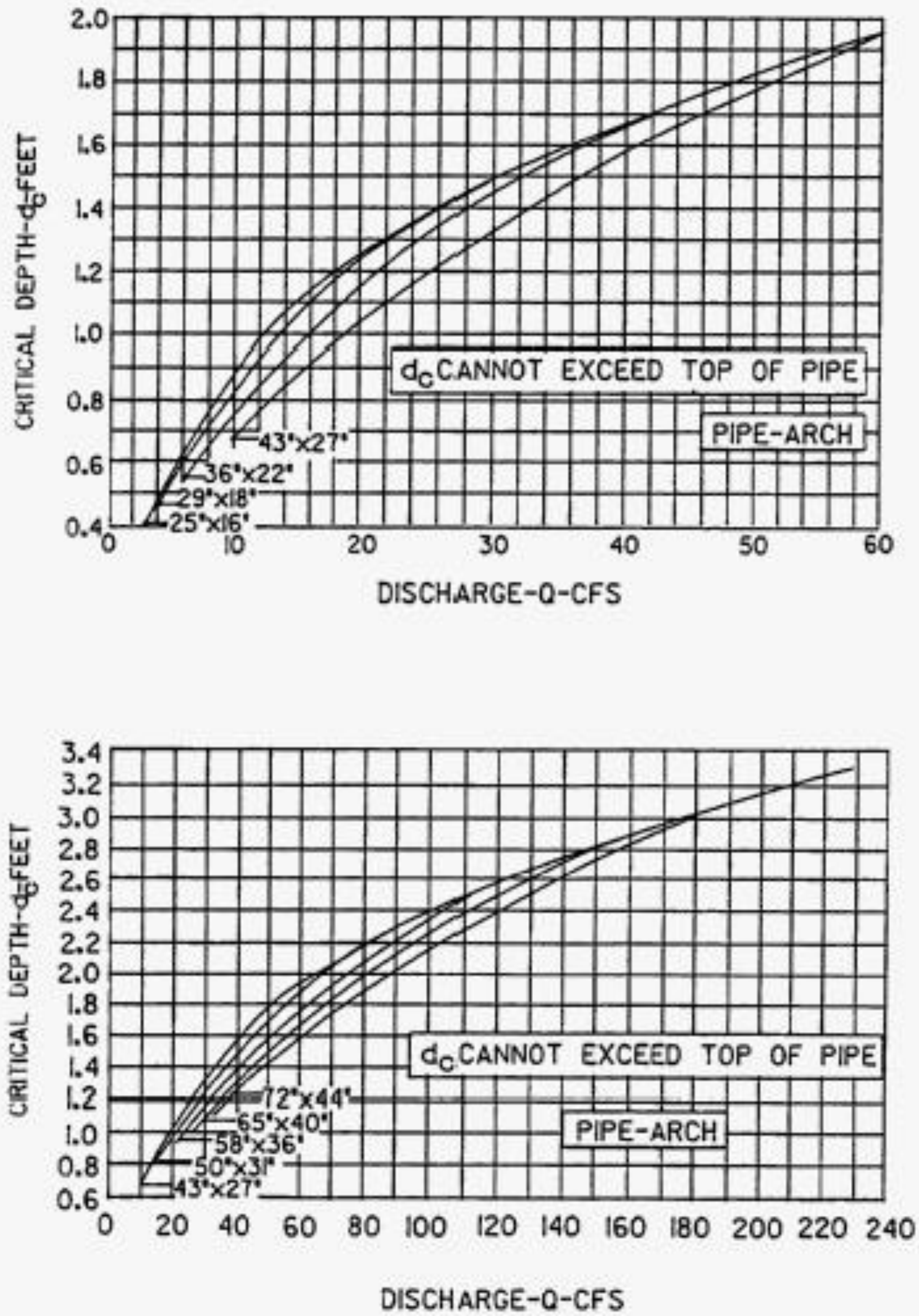


Figure 7-18: Critical Depth Curves, Circular Pipe



Source: "Handbook of Steel Drainage & Highway Construction Products", AISI 1971

Figure 7-19: Critical Depth Curves, CSP Arch

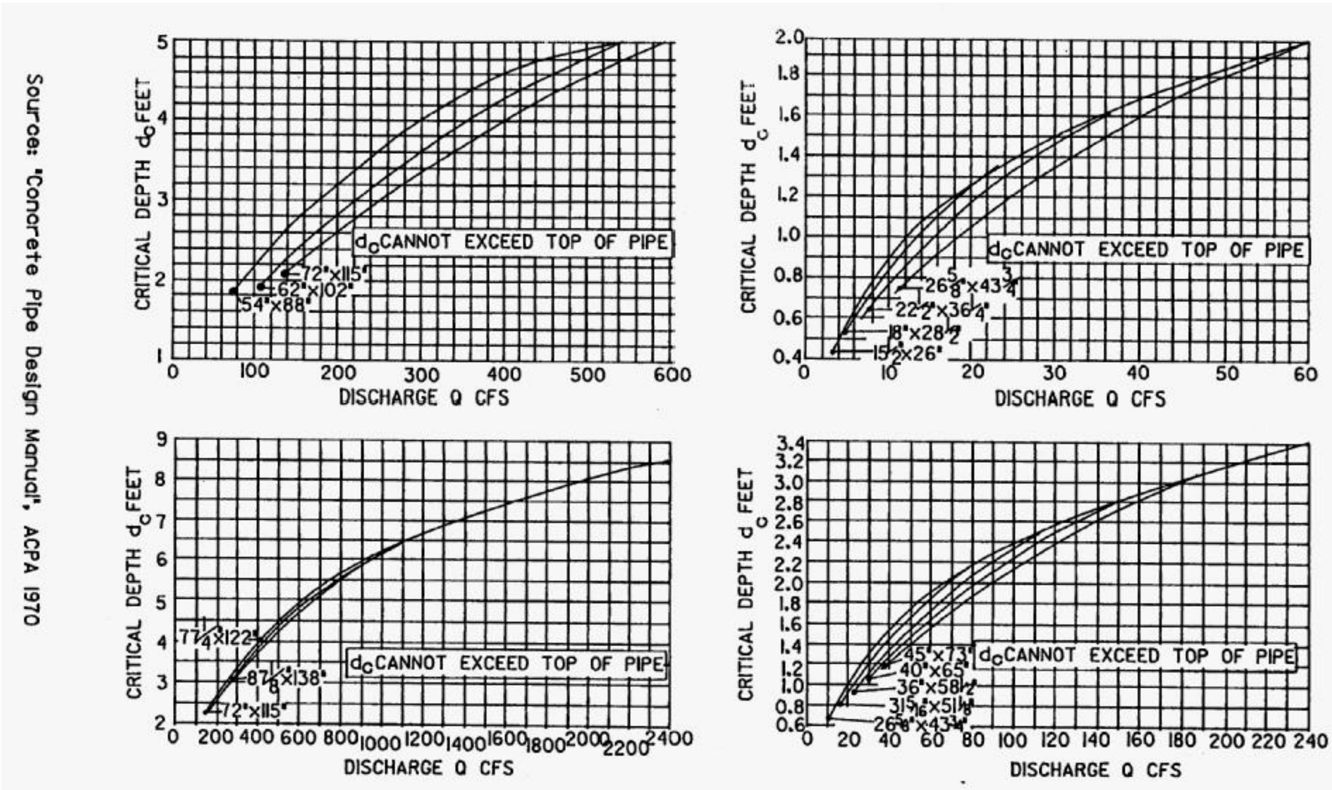
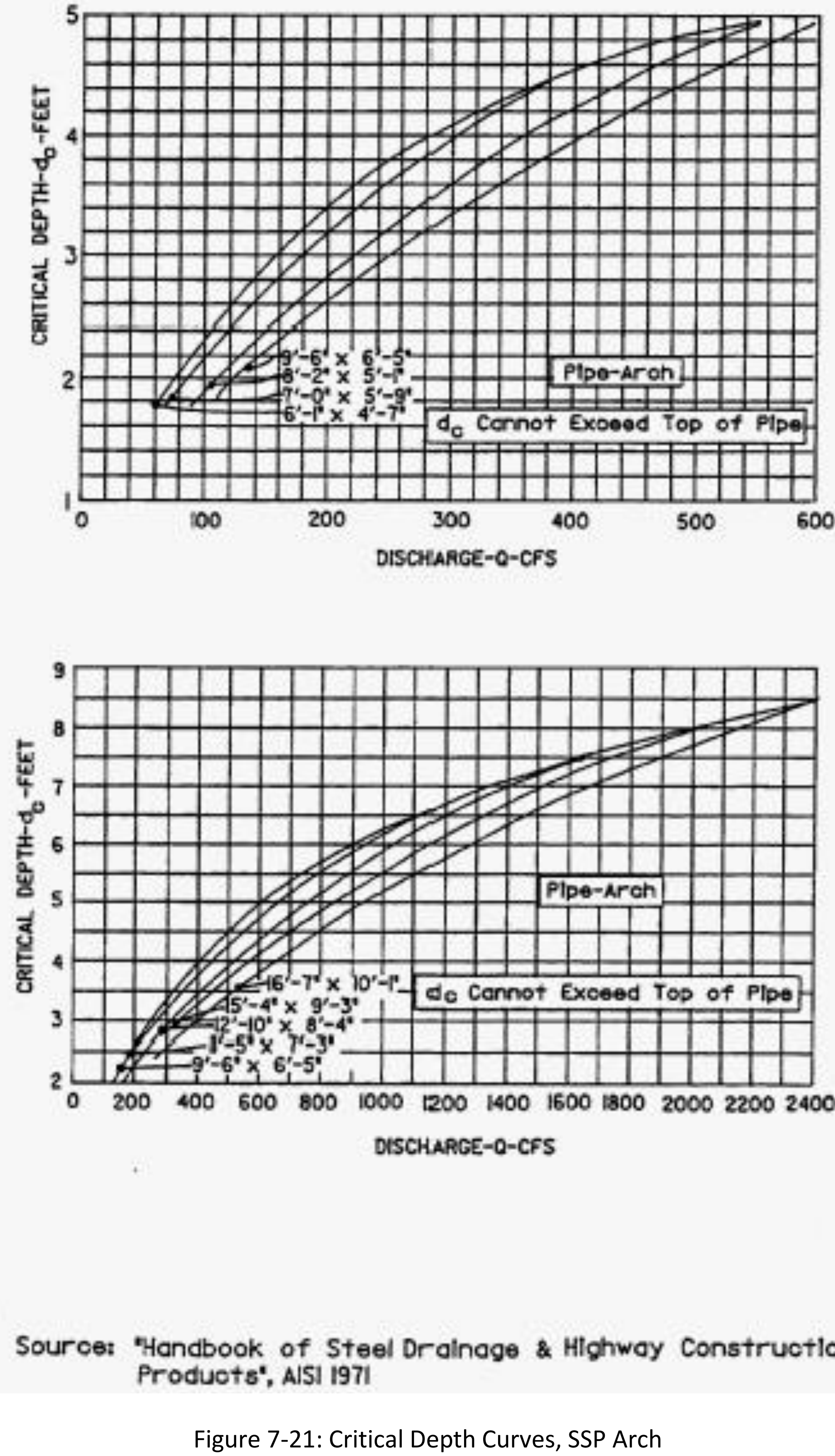


Figure 7-20: Critical Depth Curves, RCP Arch



Source: "Handbook of Steel Drainage & Highway Construction Products", AISI 1971

Figure 7-21: Critical Depth Curves, SSP Arch

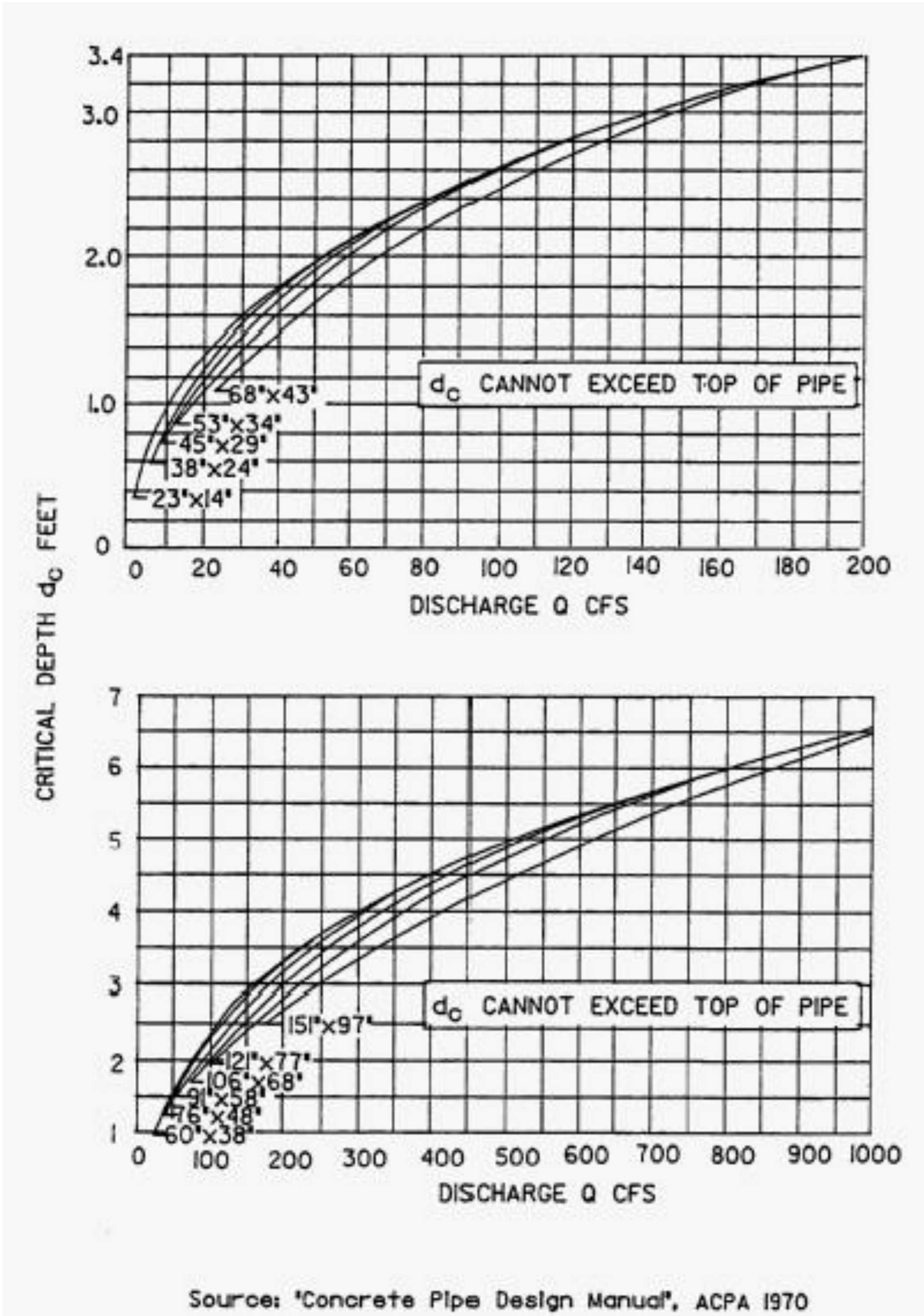


Figure 7-22: Critical Depth Curves, RCP Ellipse

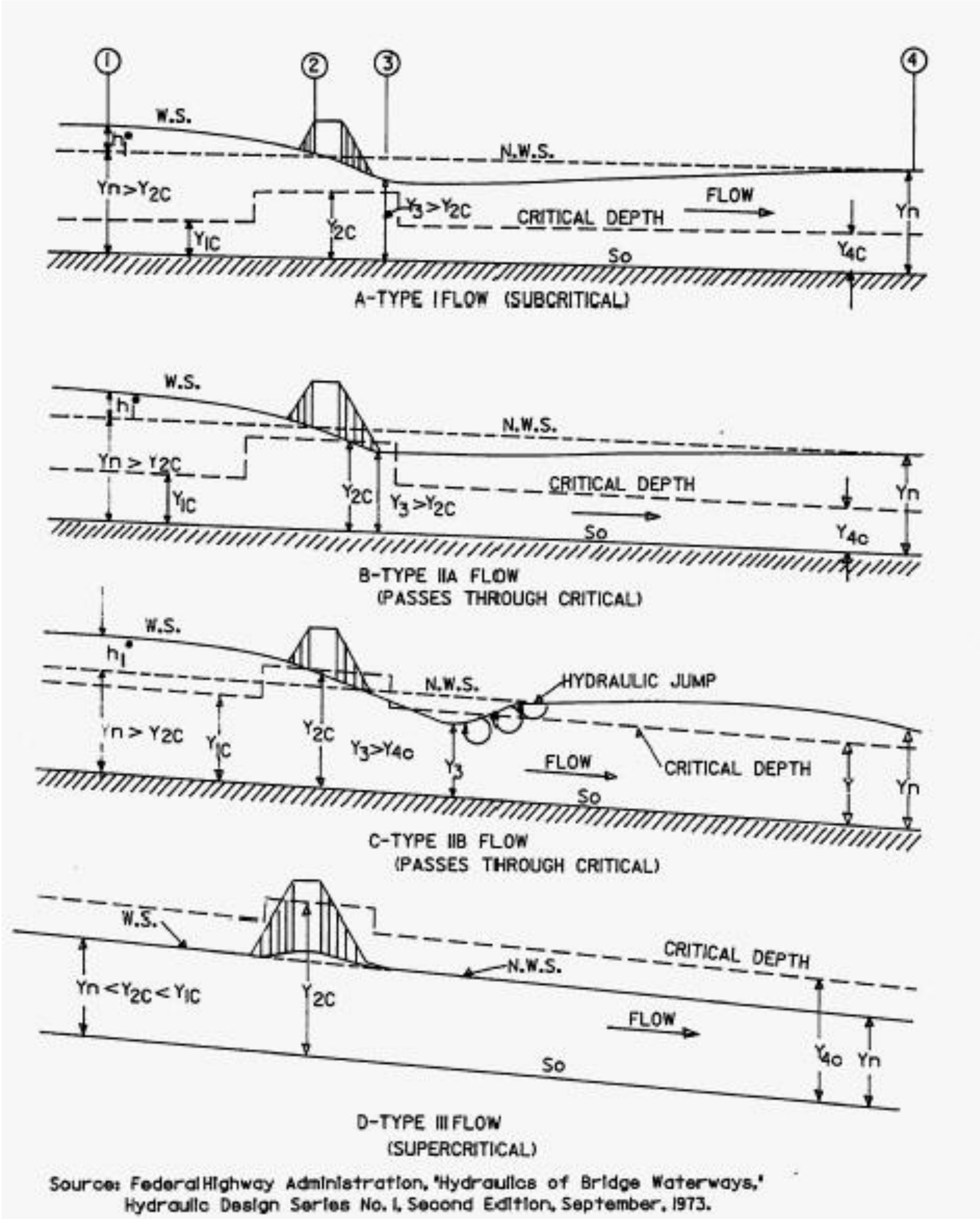


Figure 7-23: Types of Flow for Bridge Design

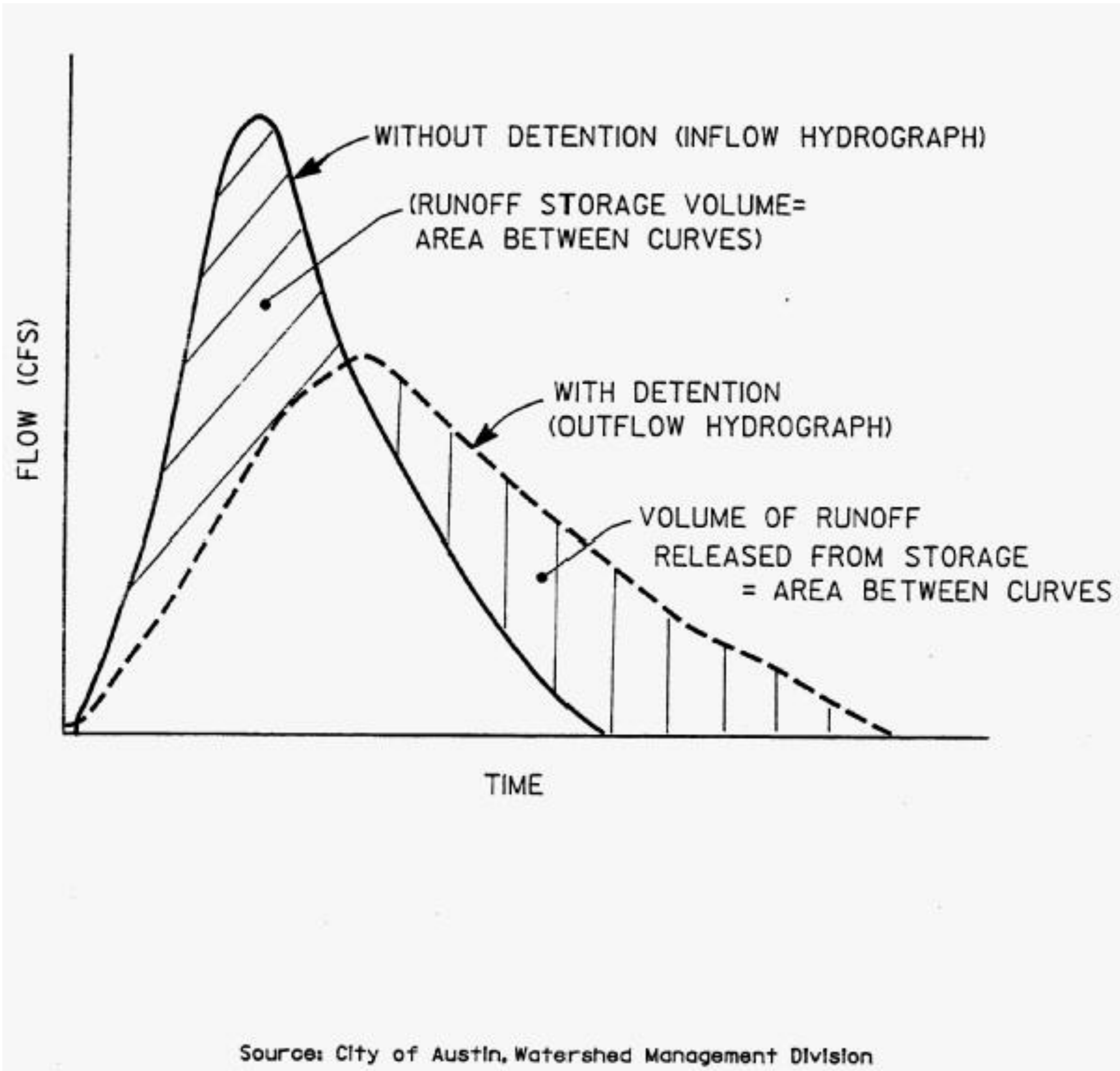


Figure 8-1: Concept of Detention Pond

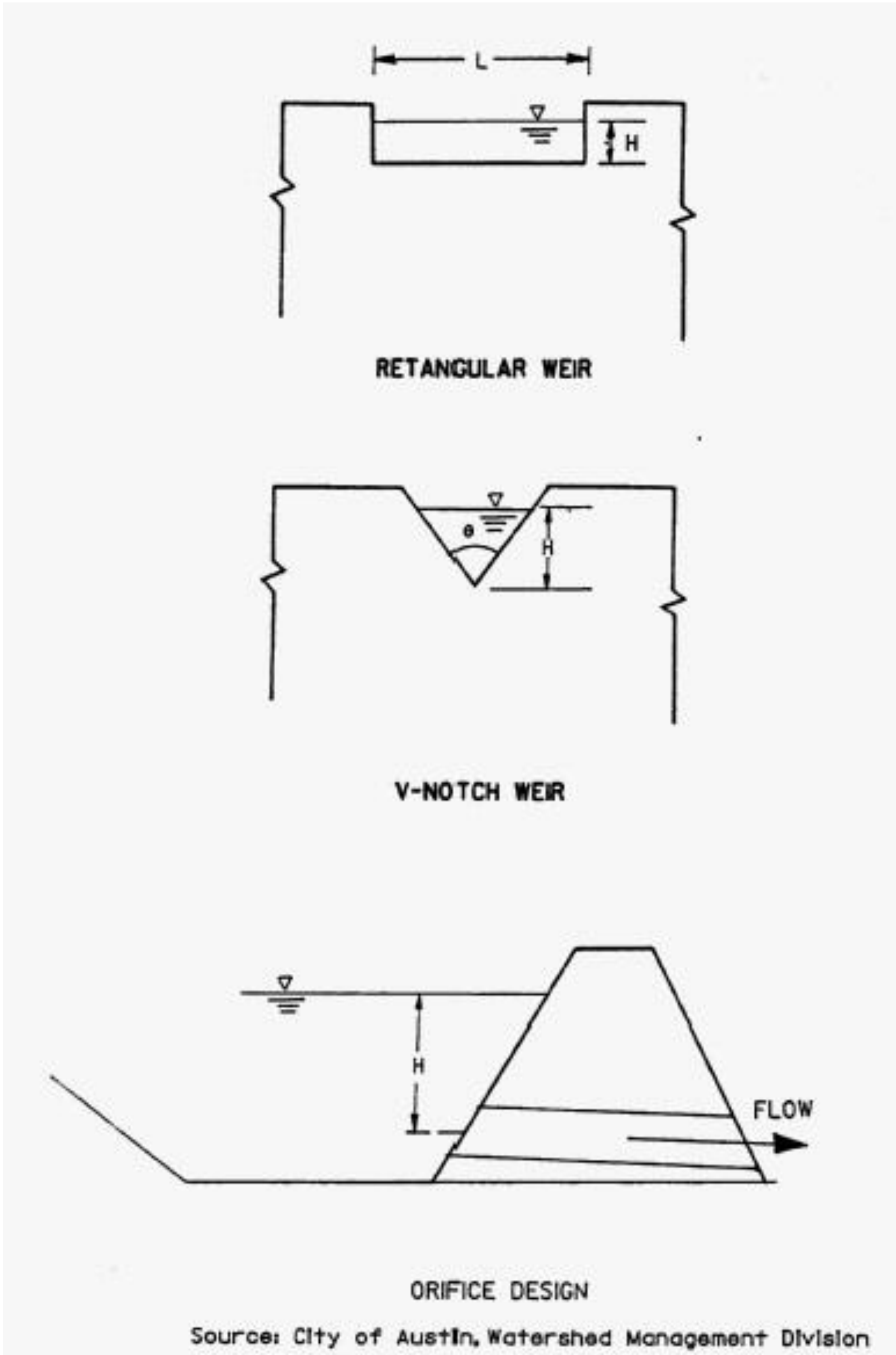


Figure 8-2: Weir and Orifice Flows