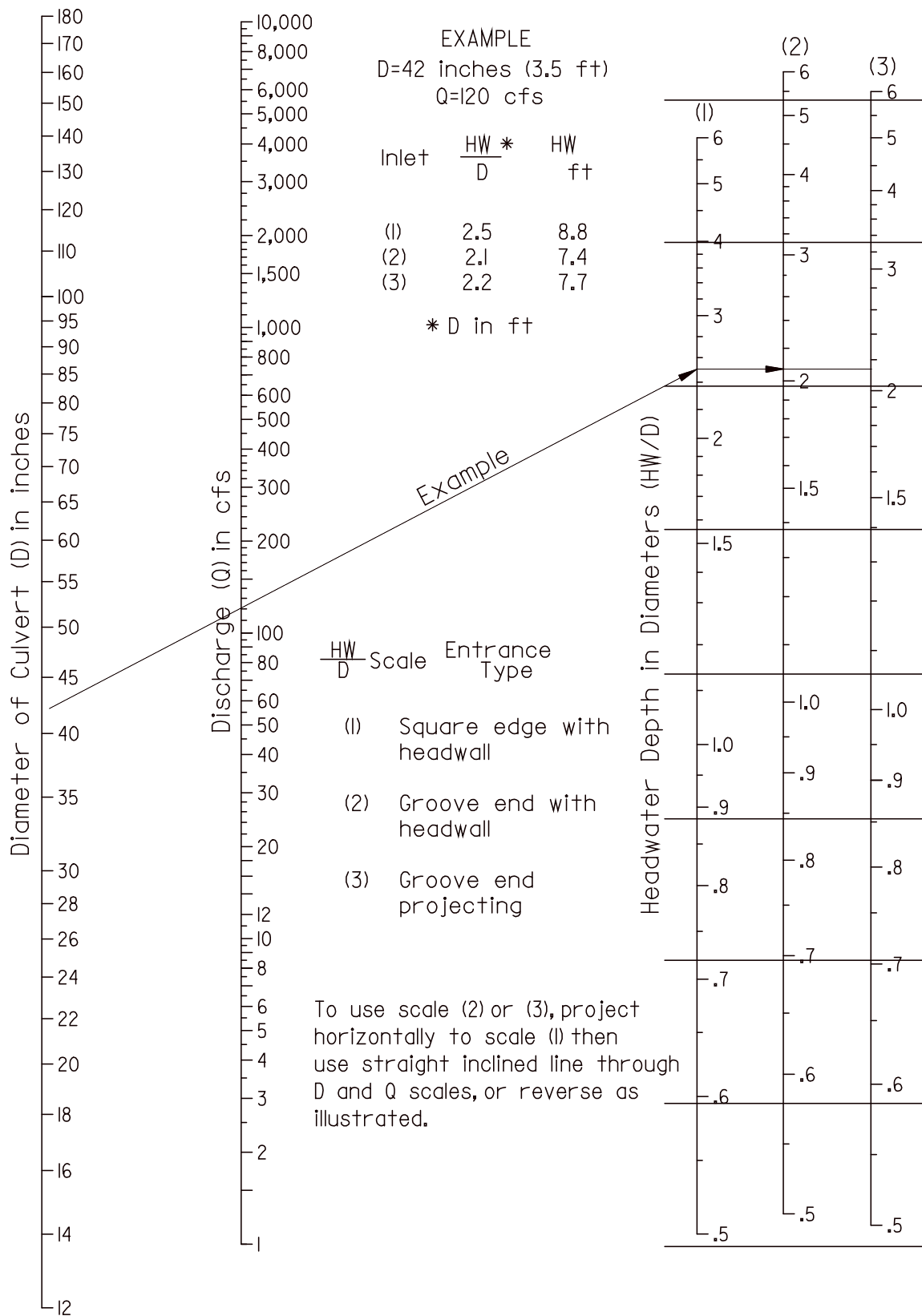


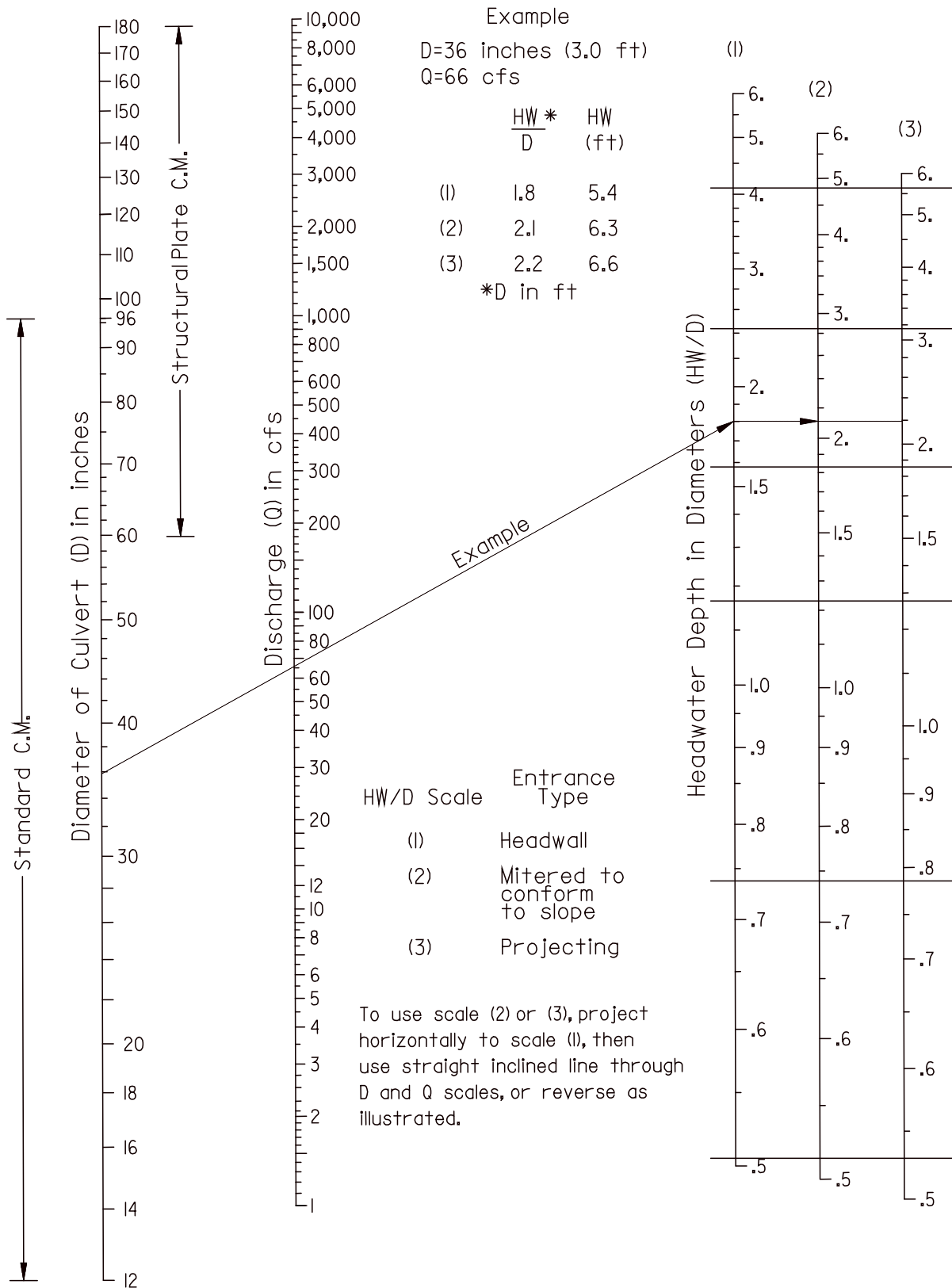
## APPENDIX F NOMOGRAPHS AND CHARTS FOR CULVERT DESIGN

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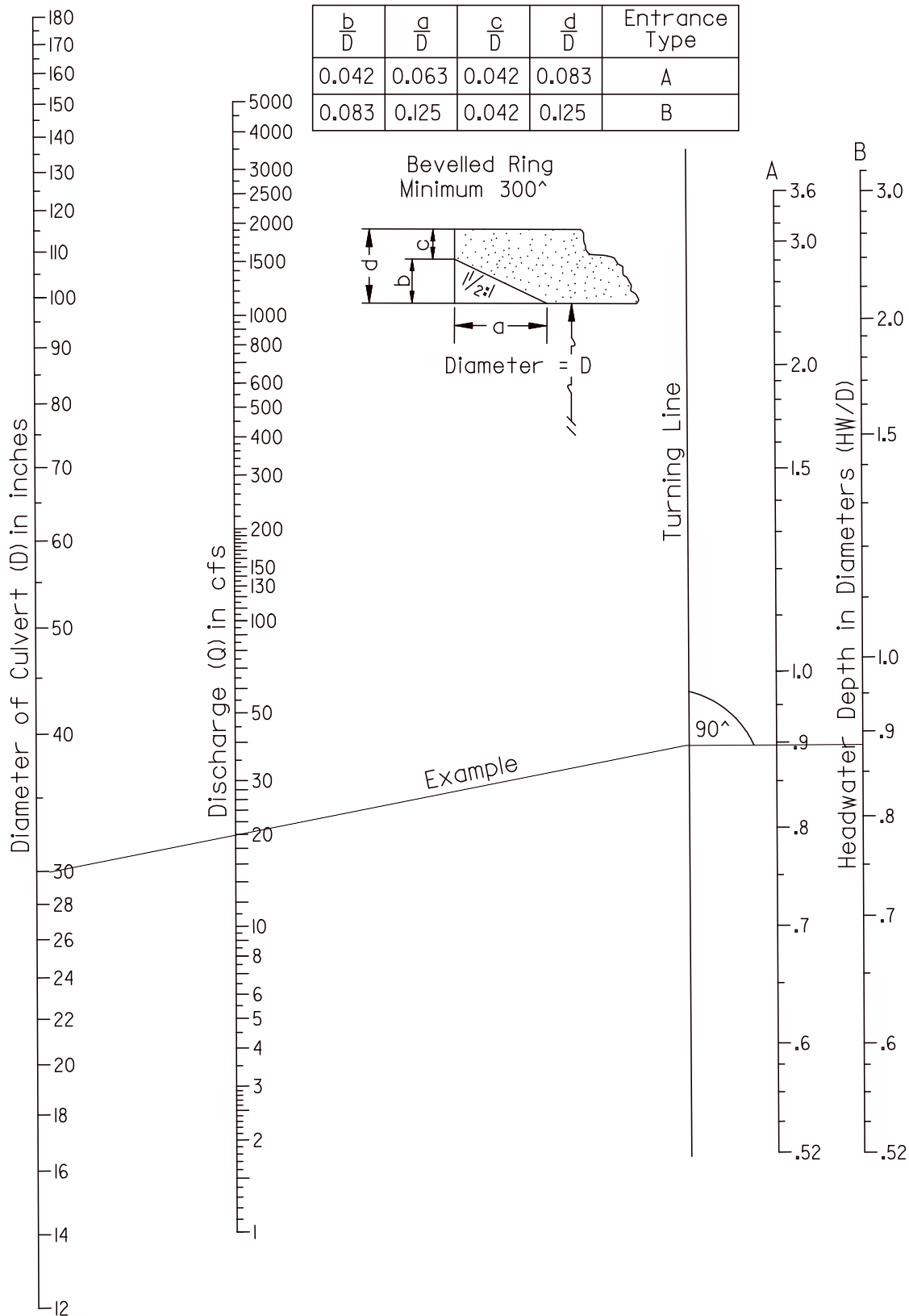
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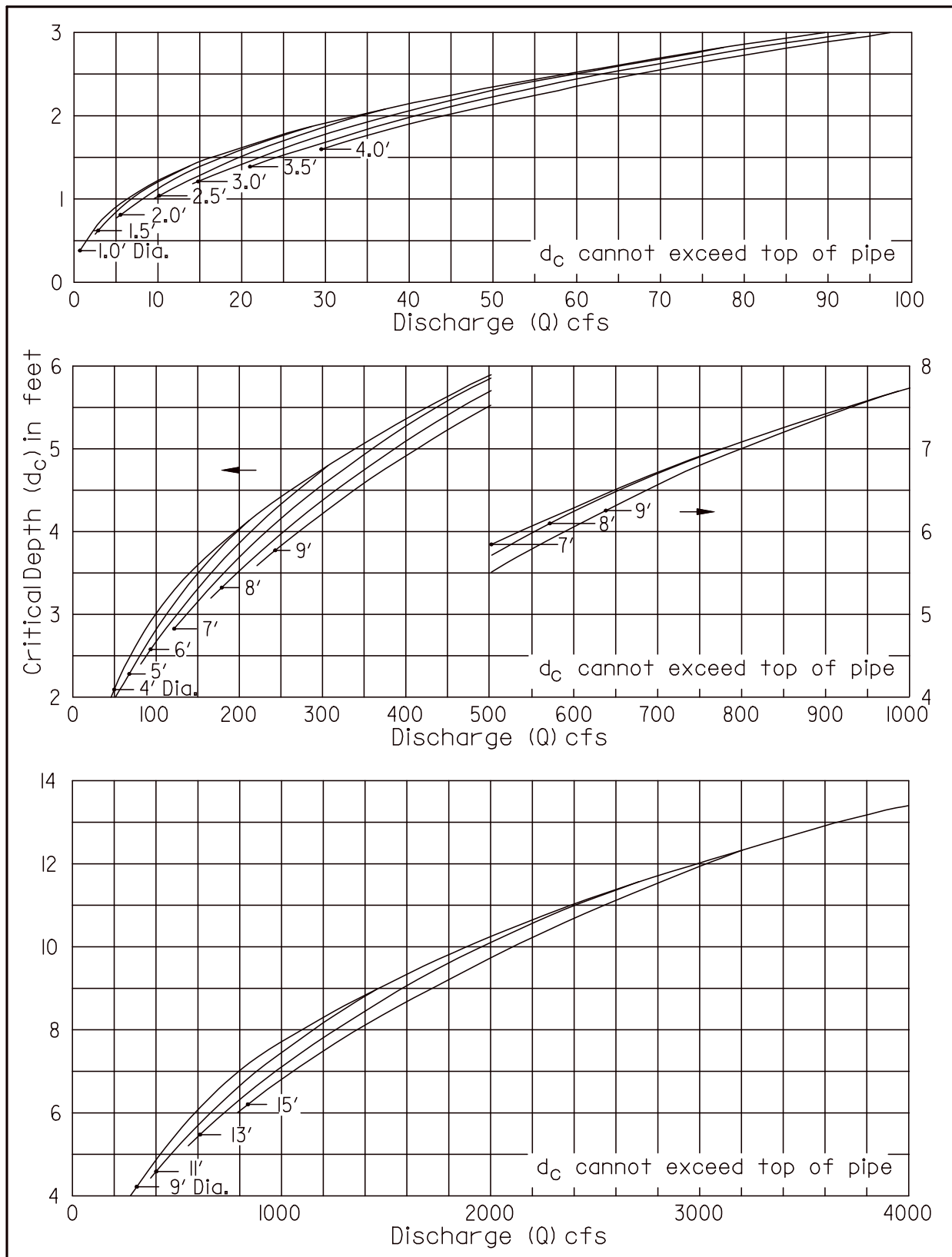
**Exhibit F.1 Headwater Depth for Concrete Pipe Culverts with Inlet Control (Source: Reference F.1)**



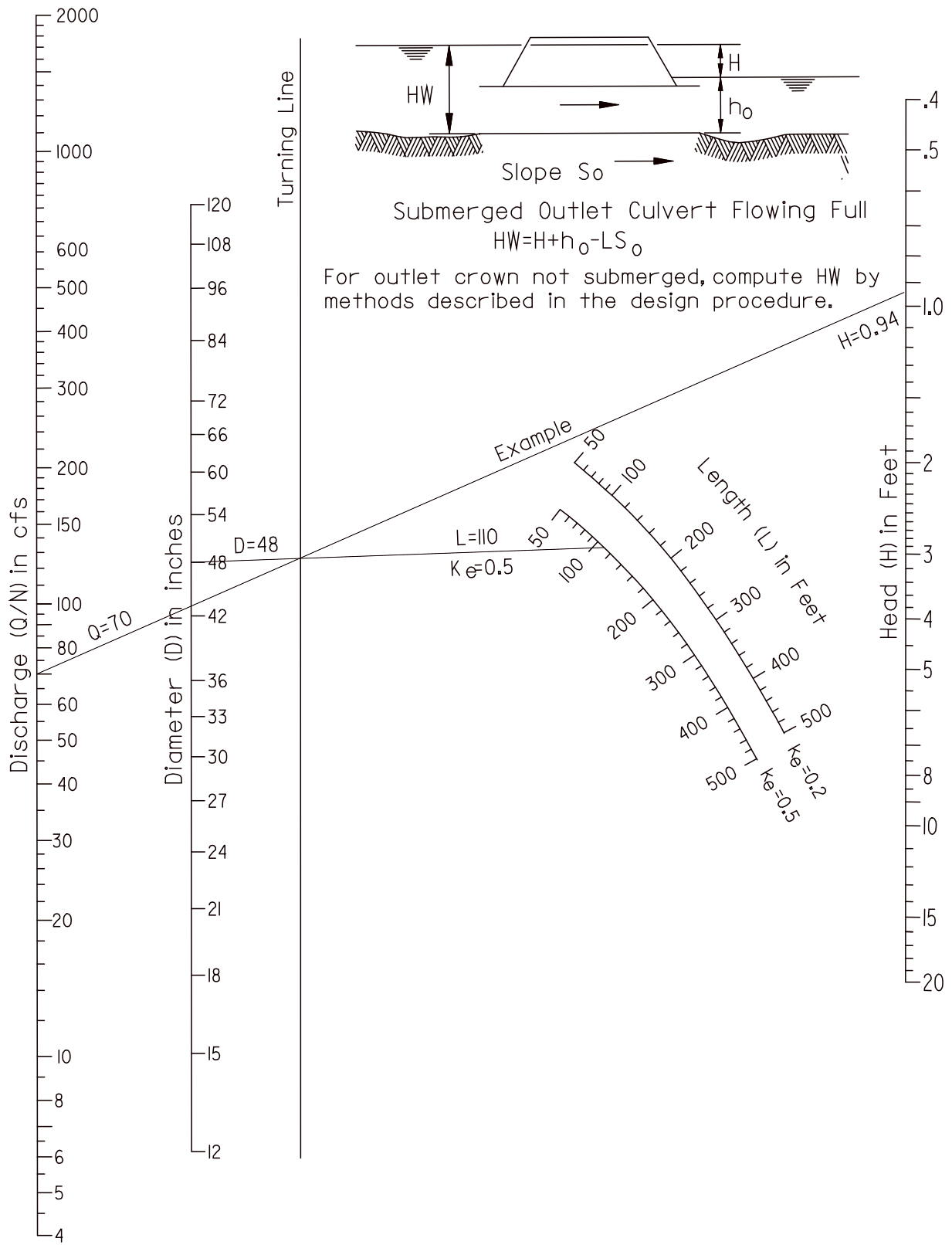
**Exhibit F.2 Headwater Depth for CMP Culverts with Inlet Control**  
 (Source: Reference F.1)



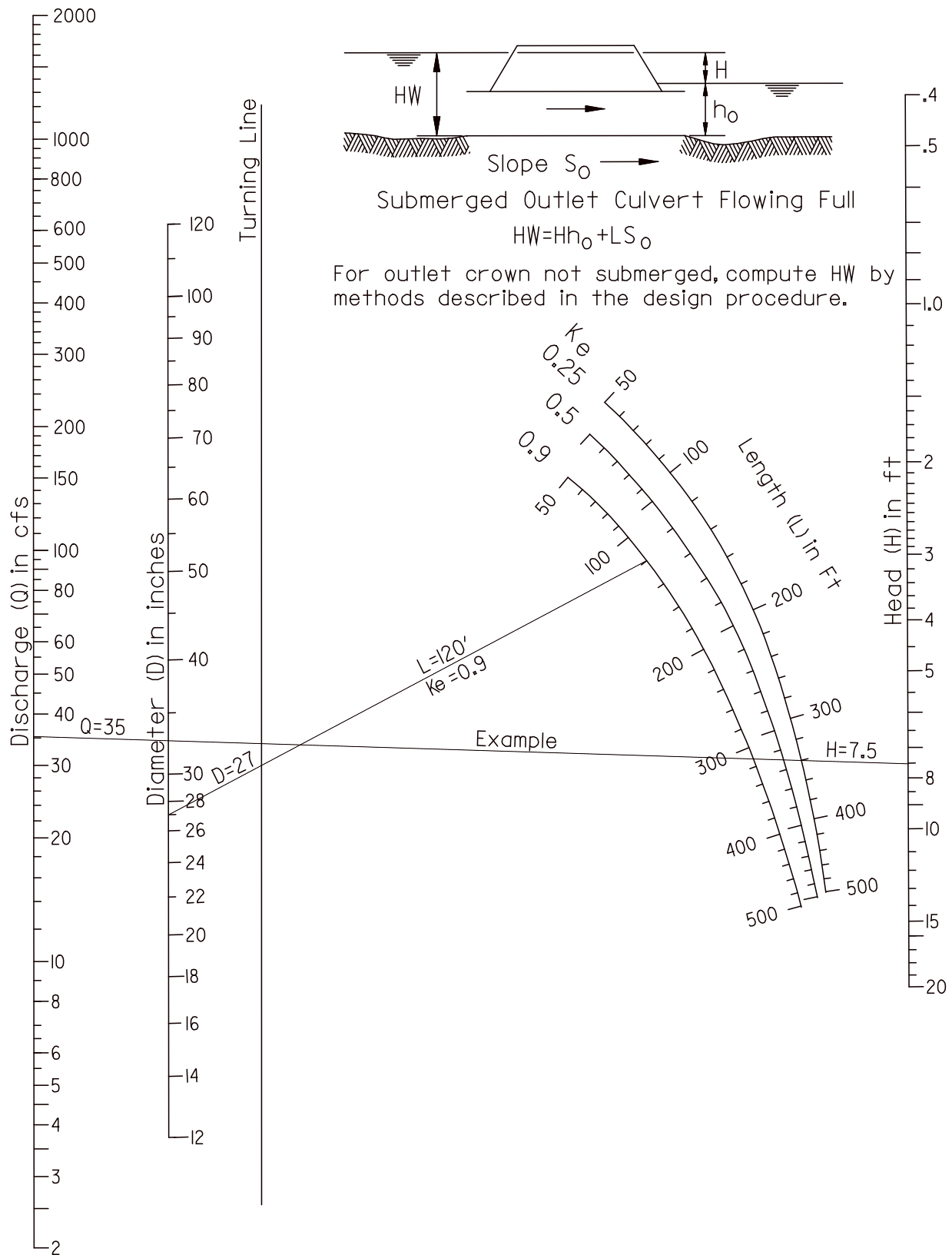
**Exhibit F.3 Headwater Depth for Circular Pipe Culverts with Beveled Ring Inlet Control (Source: Reference F.1)**



**Exhibit F.4 Critical Depth for Circular Pipe**  
 (Source: Reference F.1)

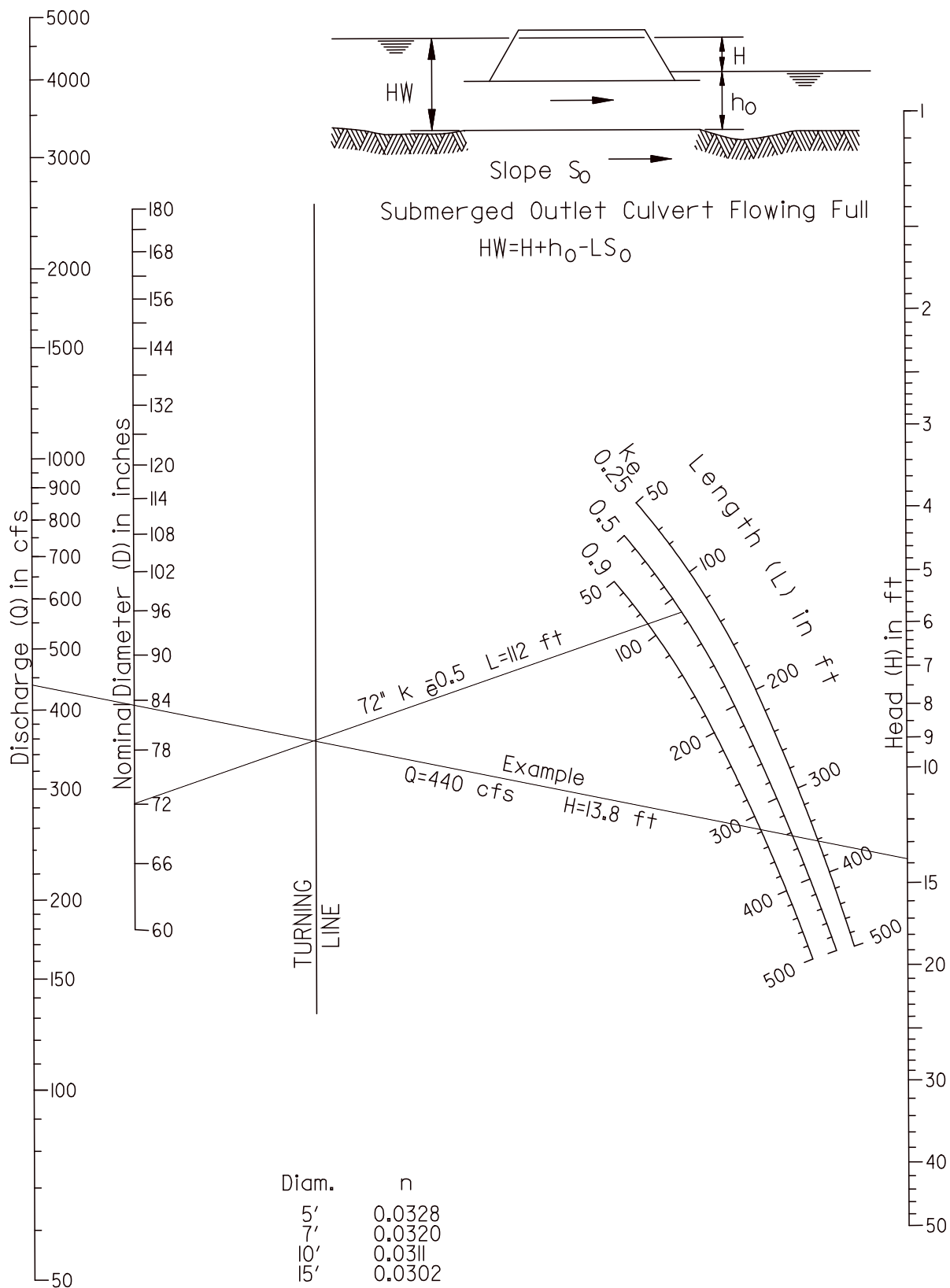


**Exhibit F.5 Head for Concrete Pipe Culverts Flowing Full ( $n=0.012$ )**  
 (Source: Reference F.1)

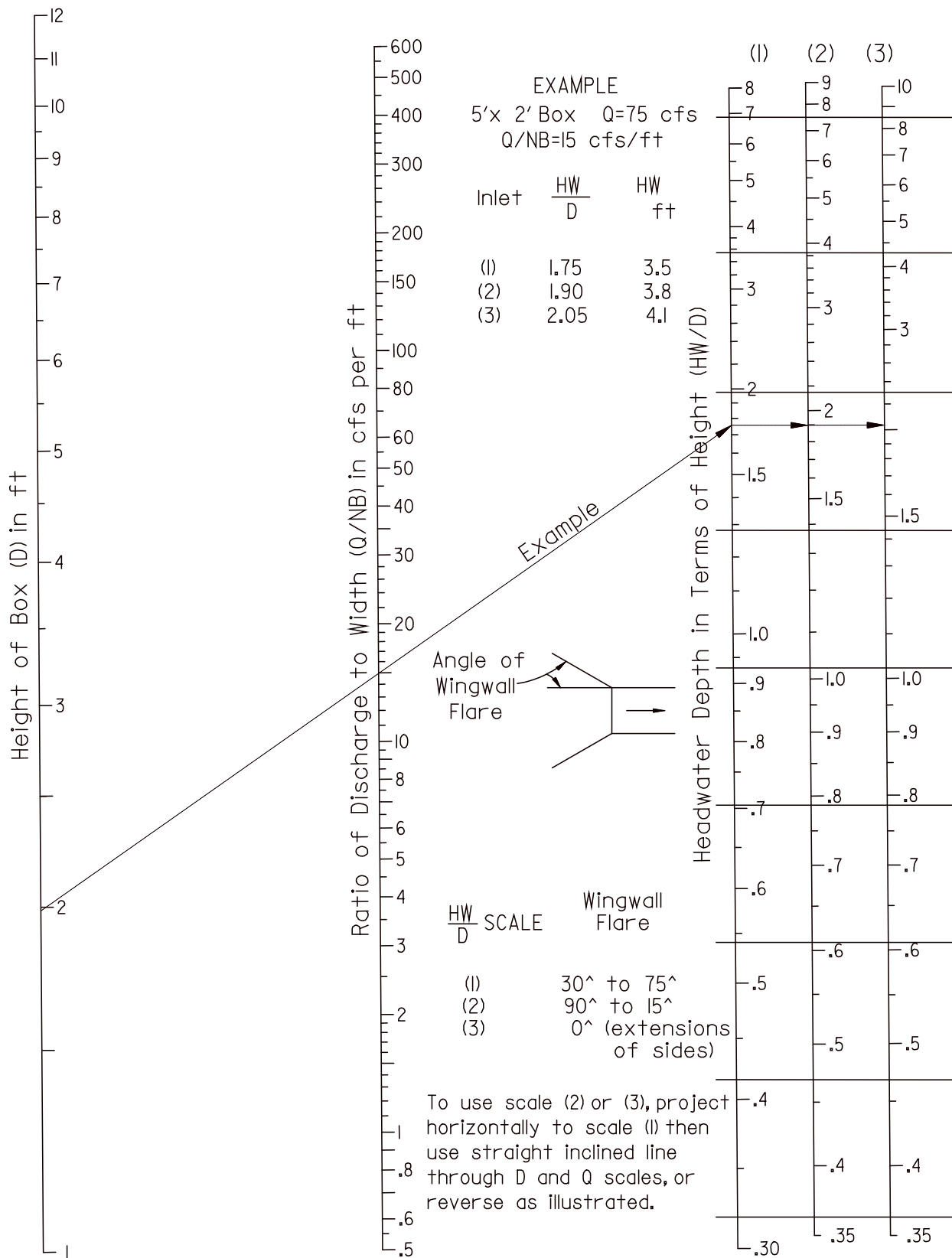


**Exhibit F.6 Head for Standard CMP Culverts Flowing Full ( $n=0.024$ )**  
 (Source: Reference F.1)





**Exhibit F.7 Head for Structural Plate CMP Culverts Flowing Full (n=0.0328 to 0.0302)**  
 (Source: Reference F.1)



**Exhibit F.8 Headwater Depth for Box Culverts with Inlet Control**  
 (Source: Reference F.1)

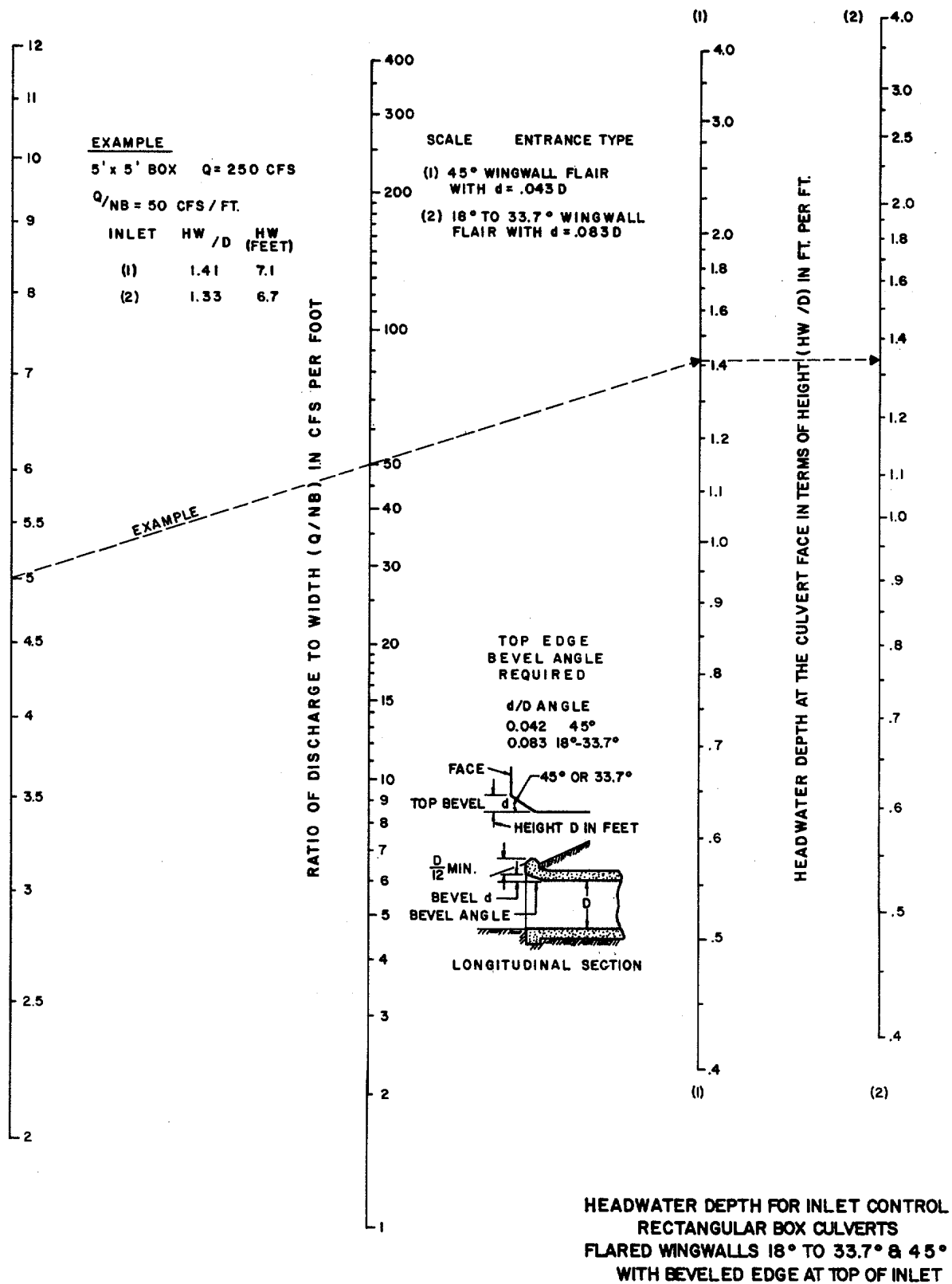


Exhibit F.9 Headwater Depth for Inlet Control Rectangular Box Culverts  
 (Flared Wingwalls 18° to 33.7° & 45° with Beveled Edge at Top of Inlet)  
 (Source: Reference F.1)

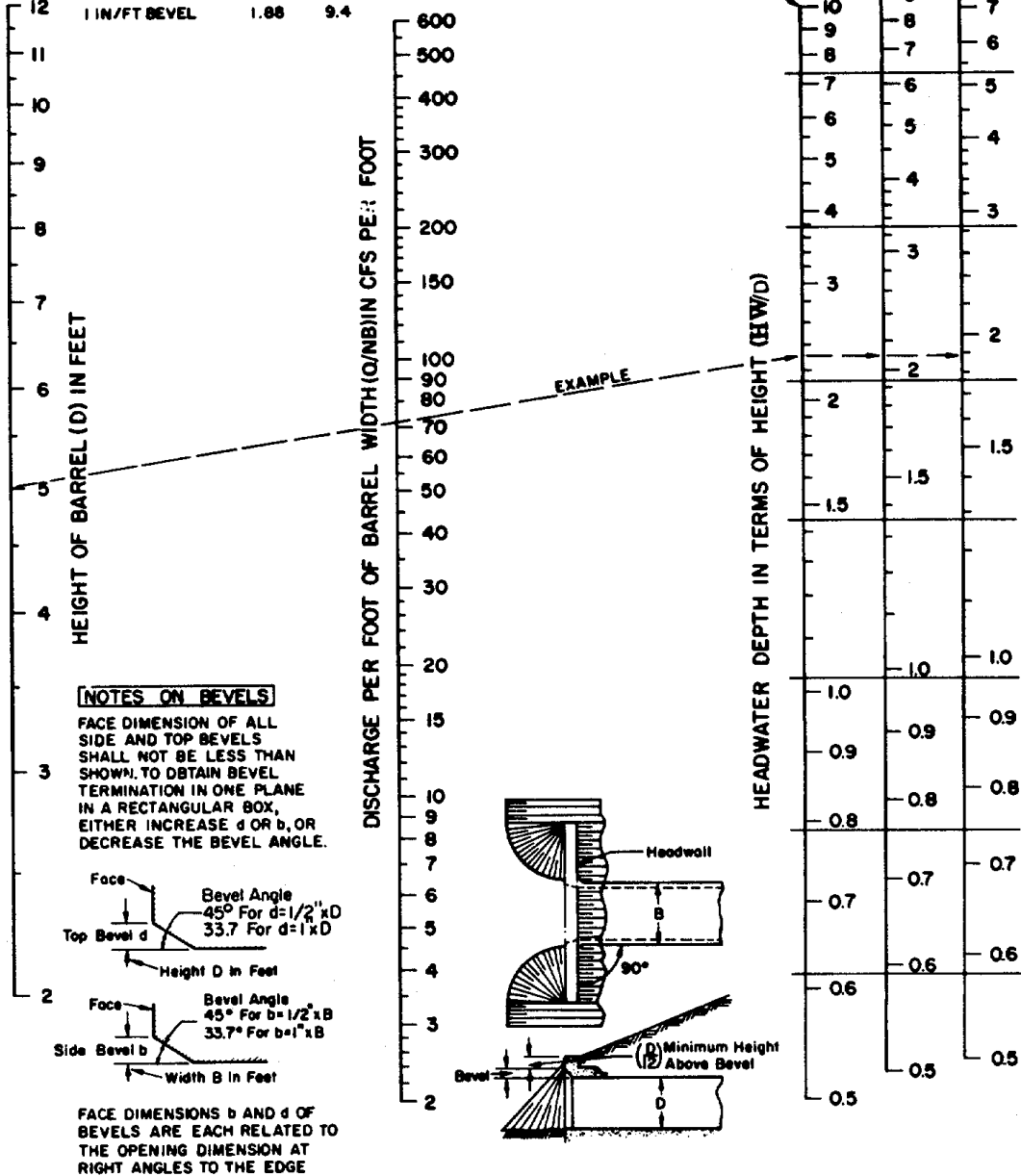
**EXAMPLE**

B=7 FT. D=5 FT. Q=500 CFS Q/NB = 71.5

	HW D	HW feet
ALL EDGES		
CHAMFER 3/4"	2.31	11.5
1/2 IN/FT BEVEL	2.09	10.4
1 IN/FT BEVEL	1.88	9.4

**INLET FACE-ALL EDGES:**

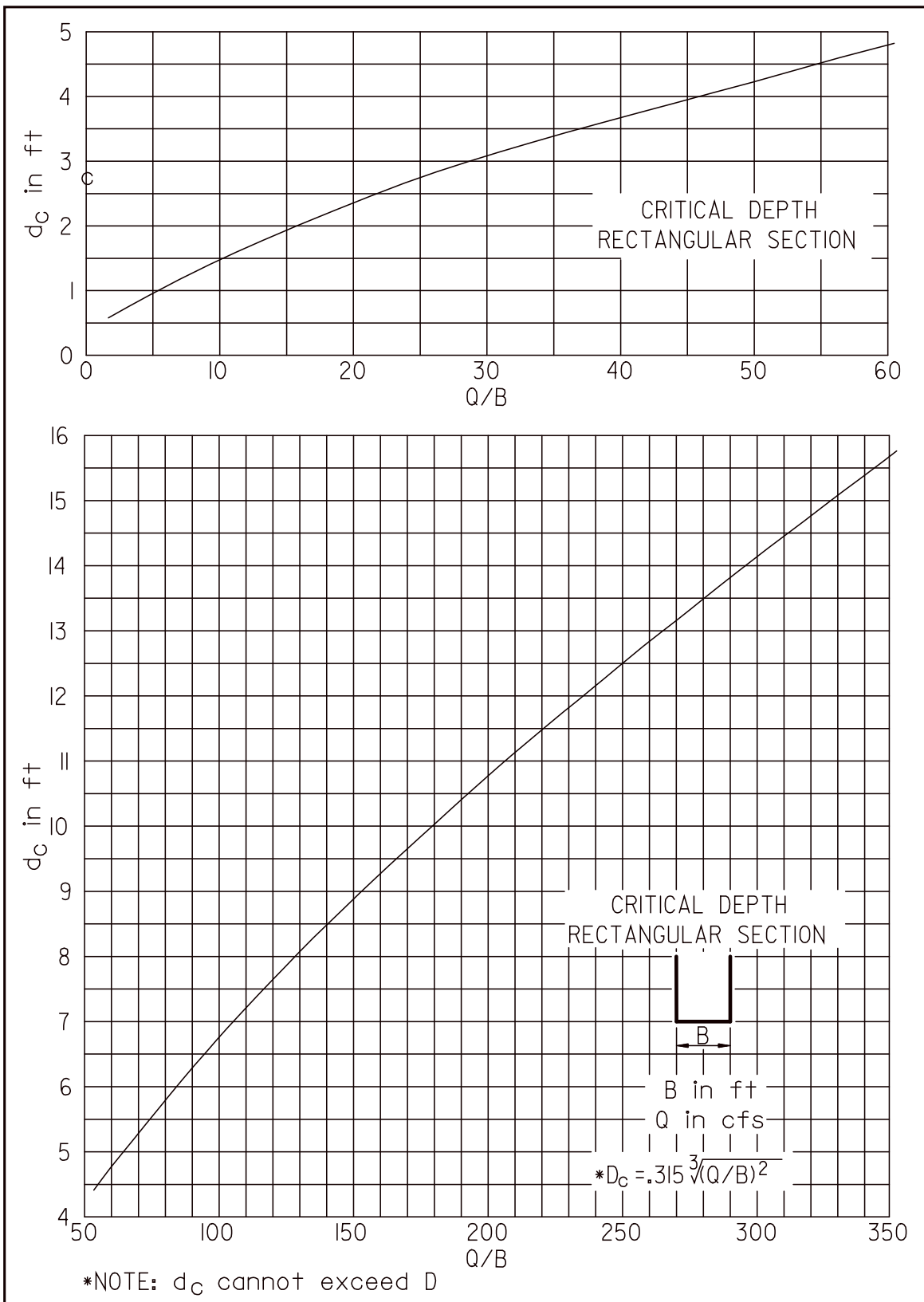
- 1 IN/FT BEVELS 33.7° (1:1.5)
- 1/2 IN/FT BEVELS 45° (1:1)
- 3/4 INCH CHAMFERS



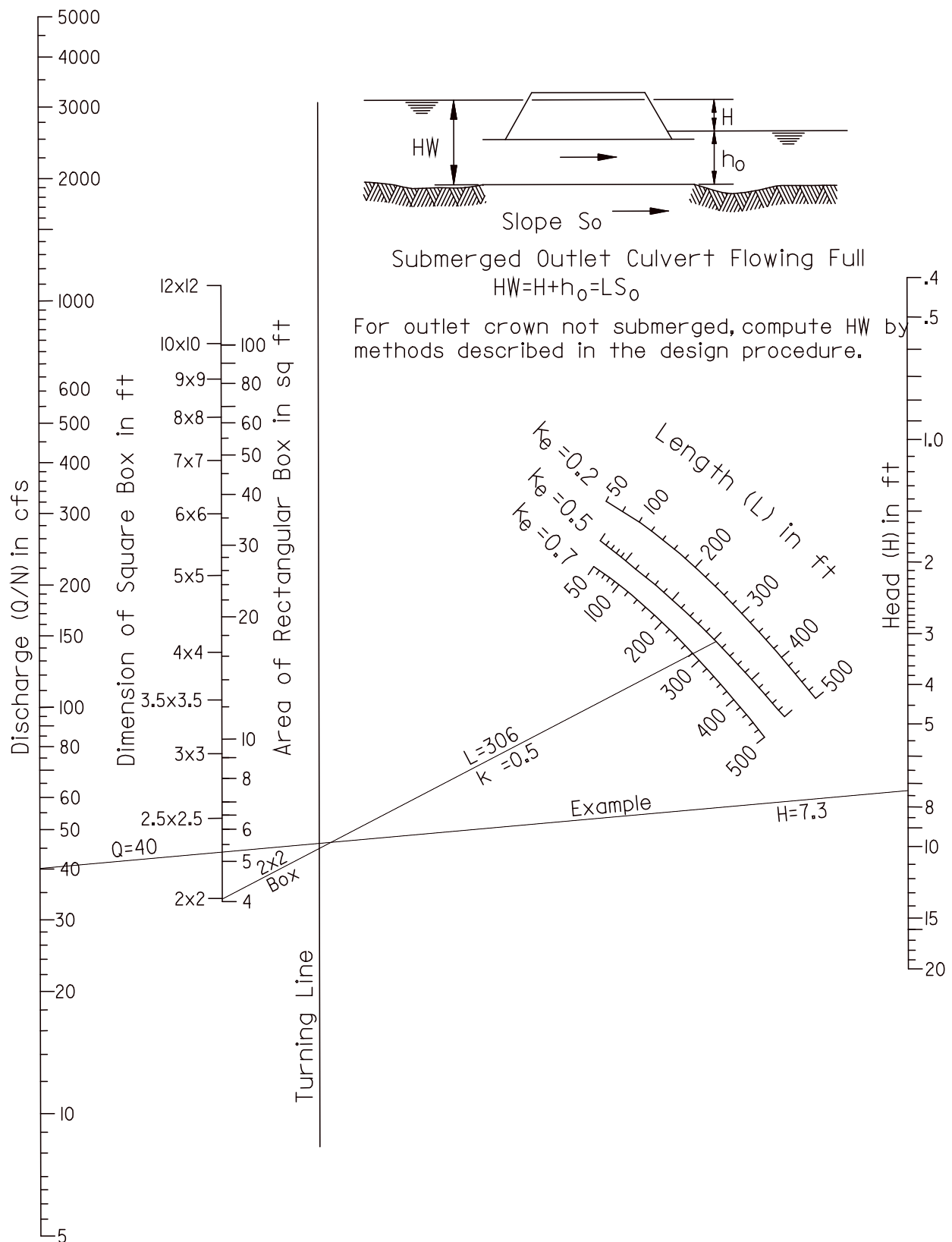
**HEADWATER DEPTH FOR INLET CONTROL  
 RECTANGULAR BOX CULVERTS  
 90° HEADWALL  
 CHAMFERED OR BEVELED INLET EDGES**

FEDERAL HIGHWAY ADMINISTRATION  
 MAY 1973

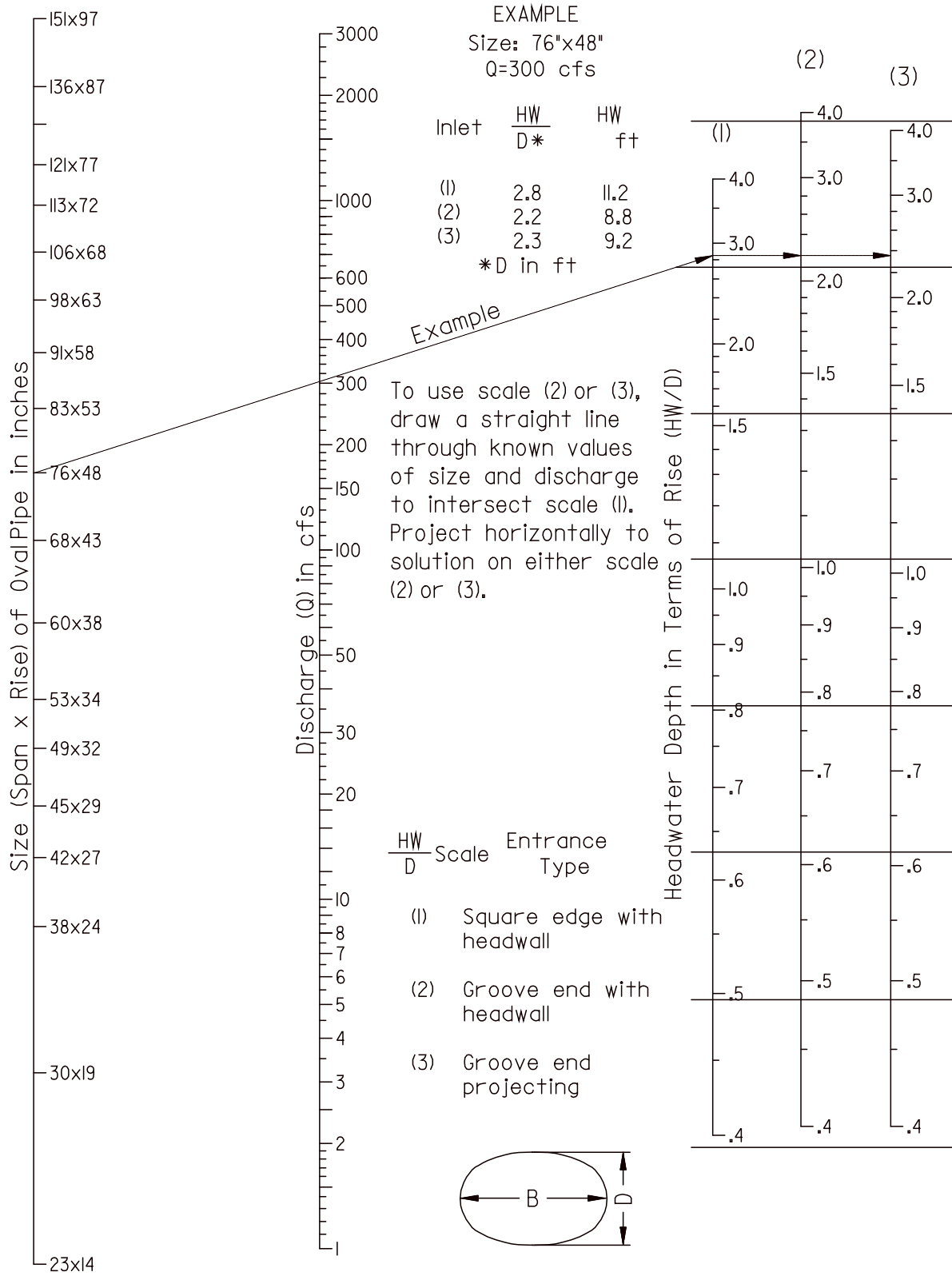
Exhibit F.10 Headwater Depth for Inlet Control Rectangular Box Culverts  
 (90° Headwall – Chamfered or Beveled Inlet Edges)  
 (Source: Reference F.1)



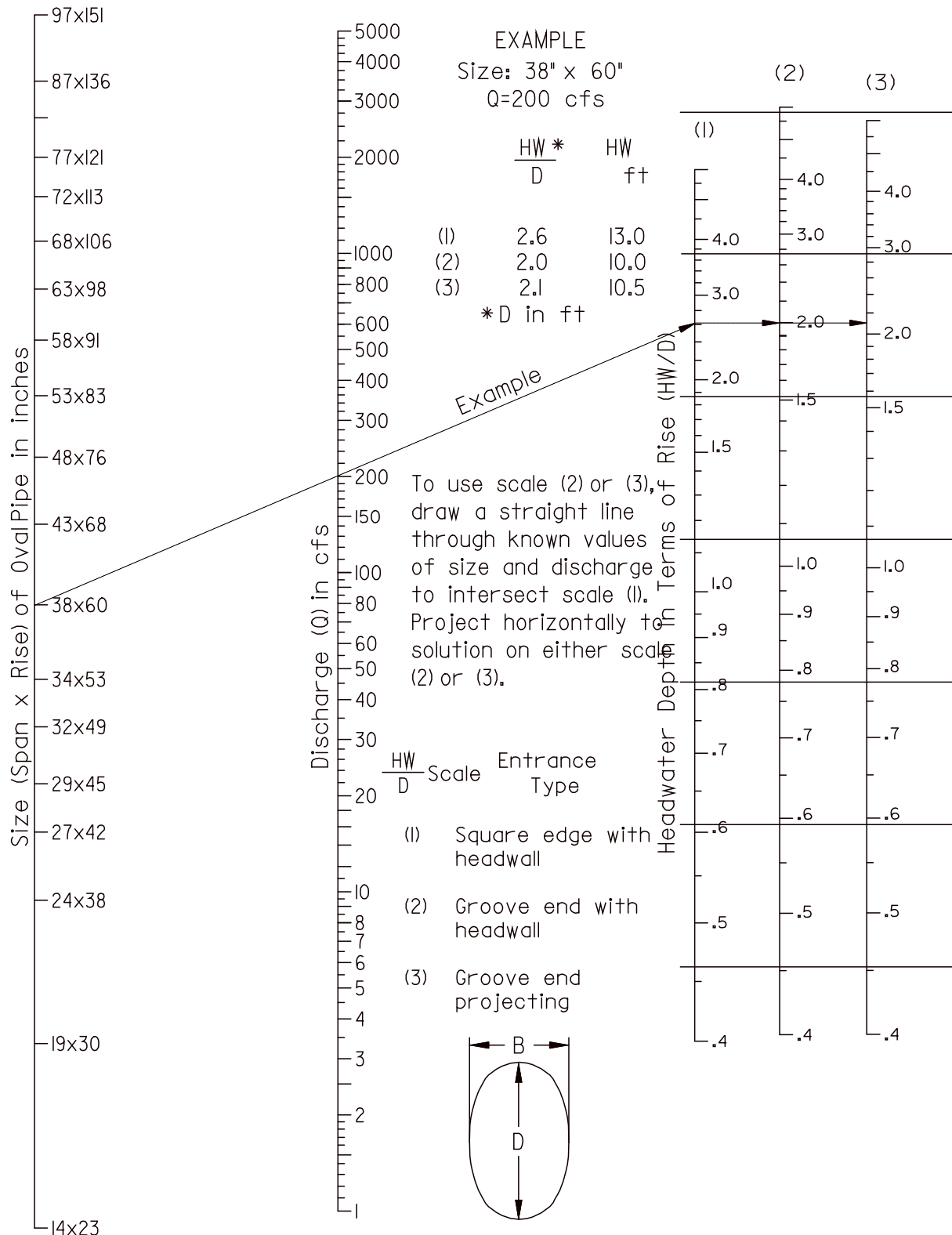
**Exhibit F.11 Critical Depth for Box Culvert**  
 (Source: Reference F.1)



**Exhibit F.12 Head for Concrete Box Culverts Flowing Full (n=0.012)**  
 (Source: Reference F.1)

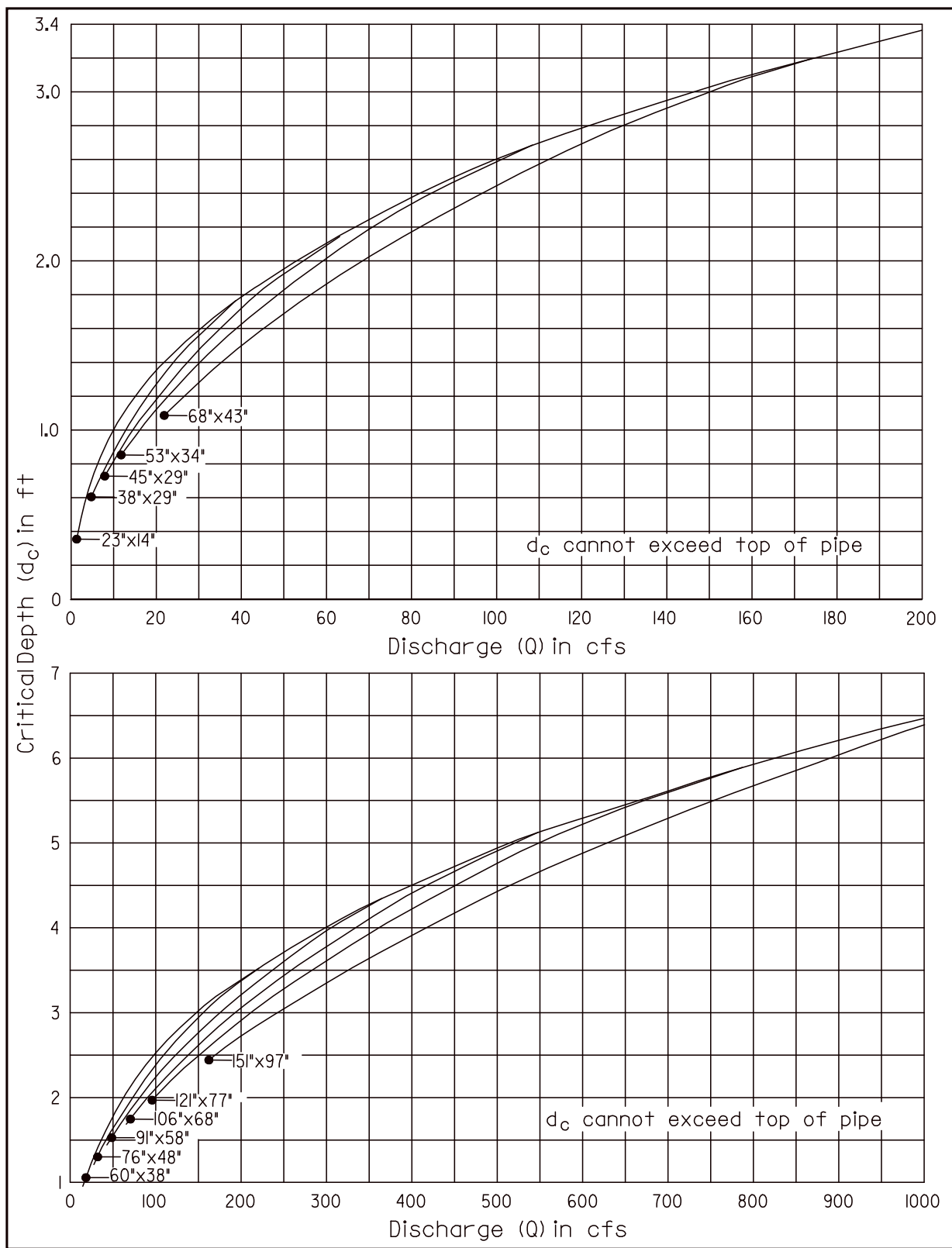


**Exhibit F.13 Headwater Depth for Elliptical Concrete Pipe Culverts  
 Long Axis Horizontal with Inlet Control  
 (Source: Reference F.1)**

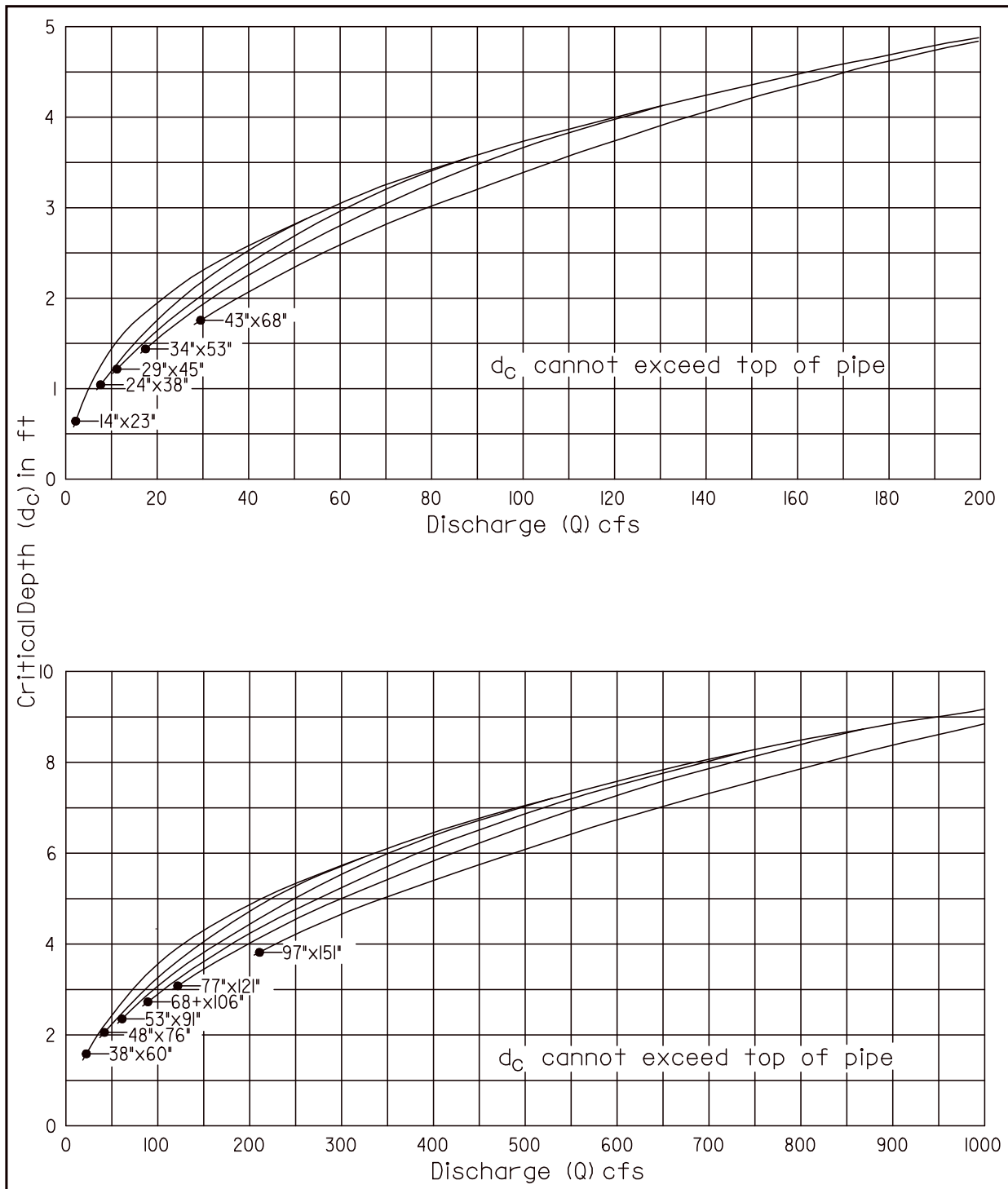


**Exhibit F.14 Headwater Depth for Elliptical Concrete Pipe Culverts  
 Long Axis Vertical with Inlet Control  
 (Source: Reference F.1)**

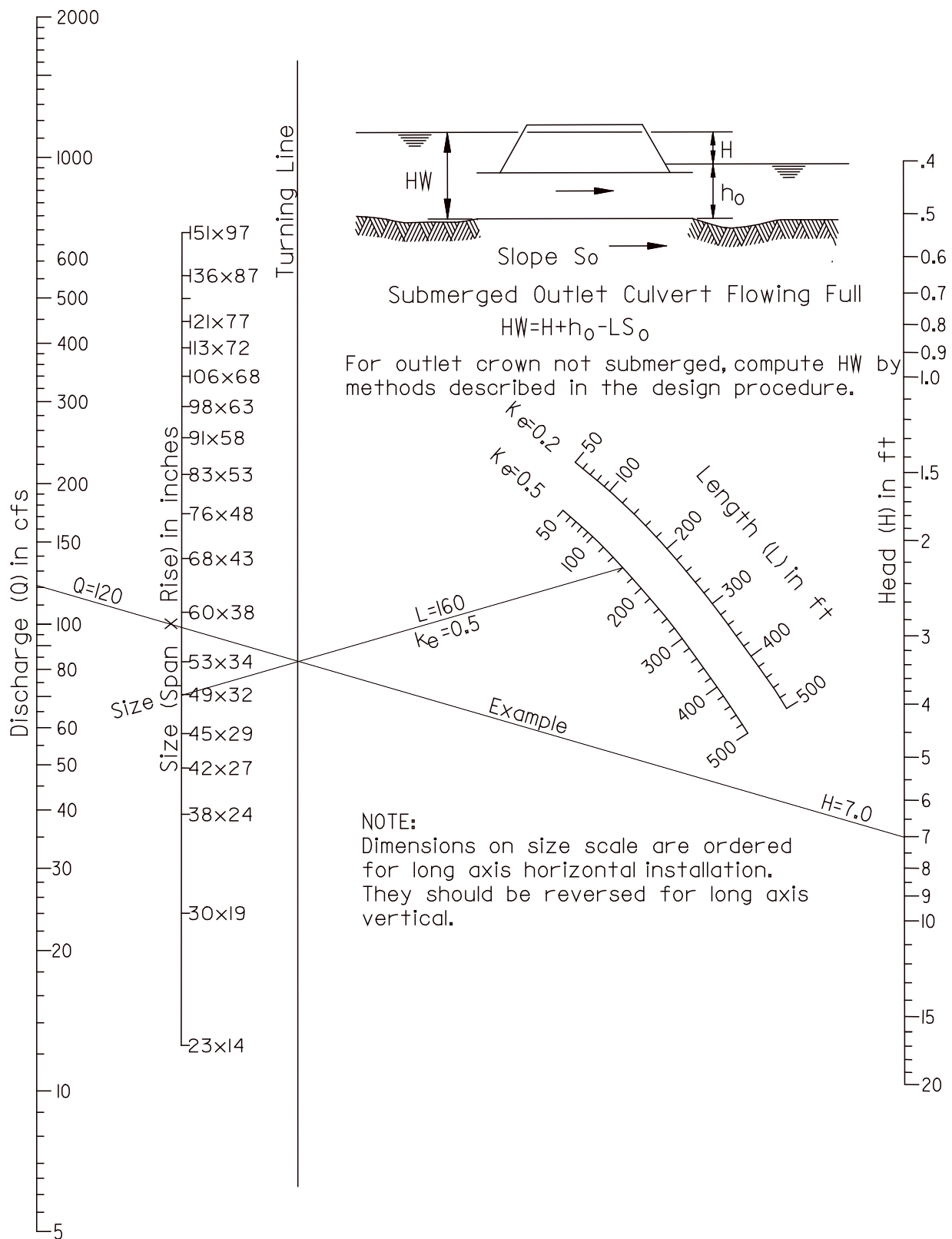




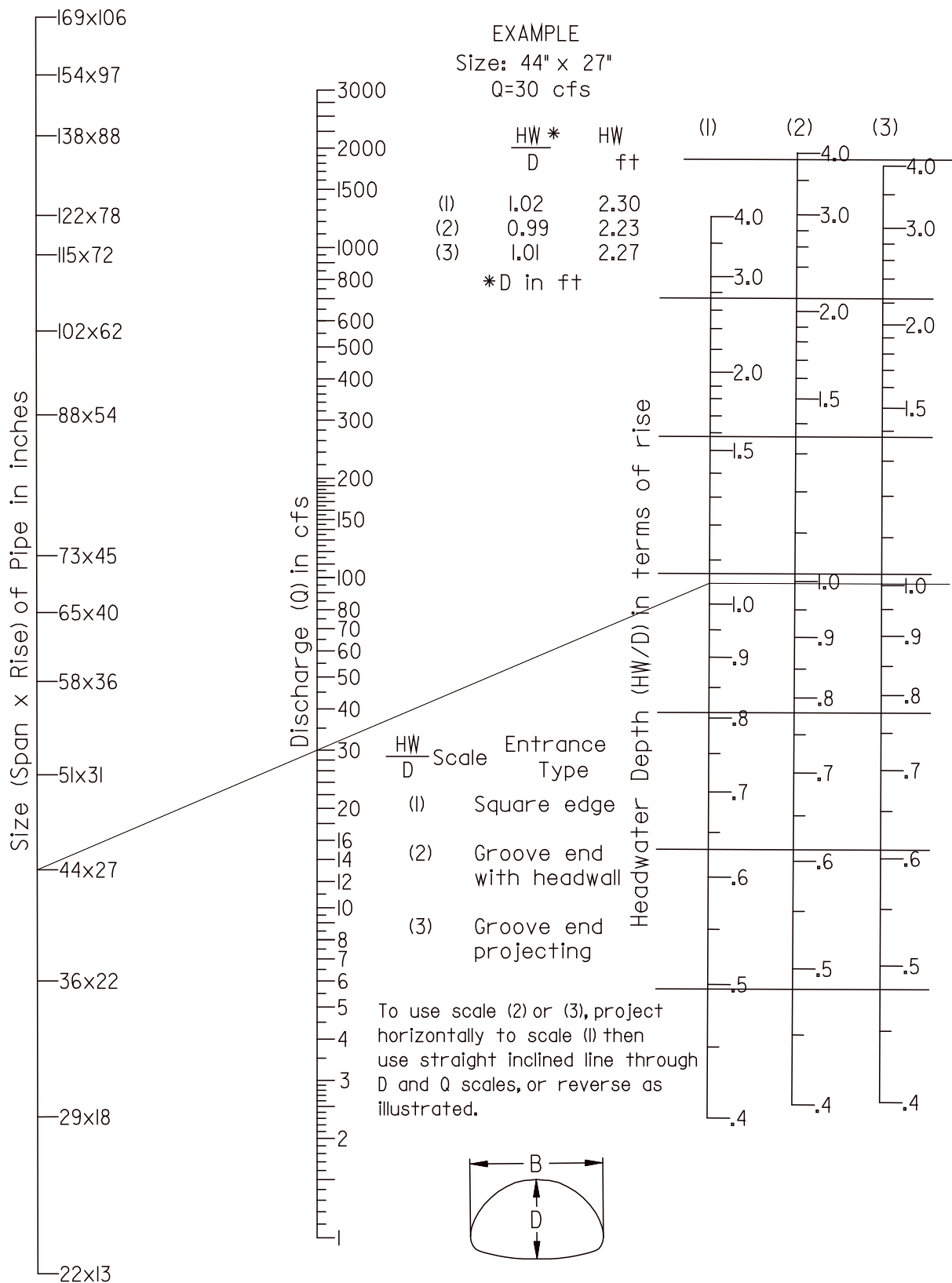
**Exhibit F.15 Critical Depth for Elliptical Concrete Pipe  
 Long Axis Horizontal  
 (Source: Reference F.1)**



**Exhibit F.16 Critical Depth for Elliptical Concrete Pipe  
 Long Axis Vertical  
 (Source: Reference F.1)**



**Exhibit F.17 Head for Elliptical Concrete Pipe Culverts  
 Long Axis Horizontal or Vertical Flowing Full (n=0.012)  
 (Source: Reference F.1)**



**Exhibit F.18 Headwater Depth for Concrete Arch Culverts with Inlet Control**  
 (Source: Reference F.2)

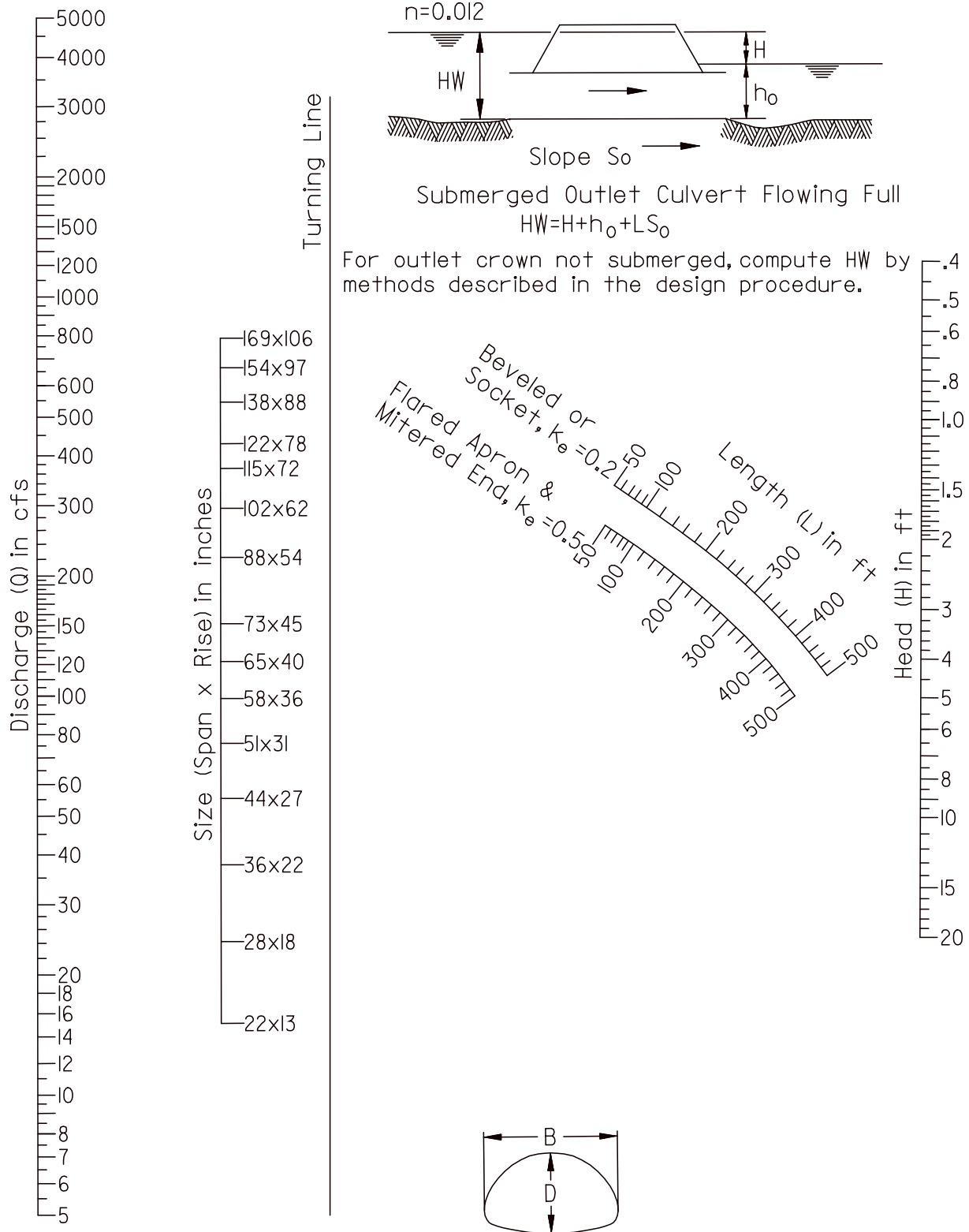
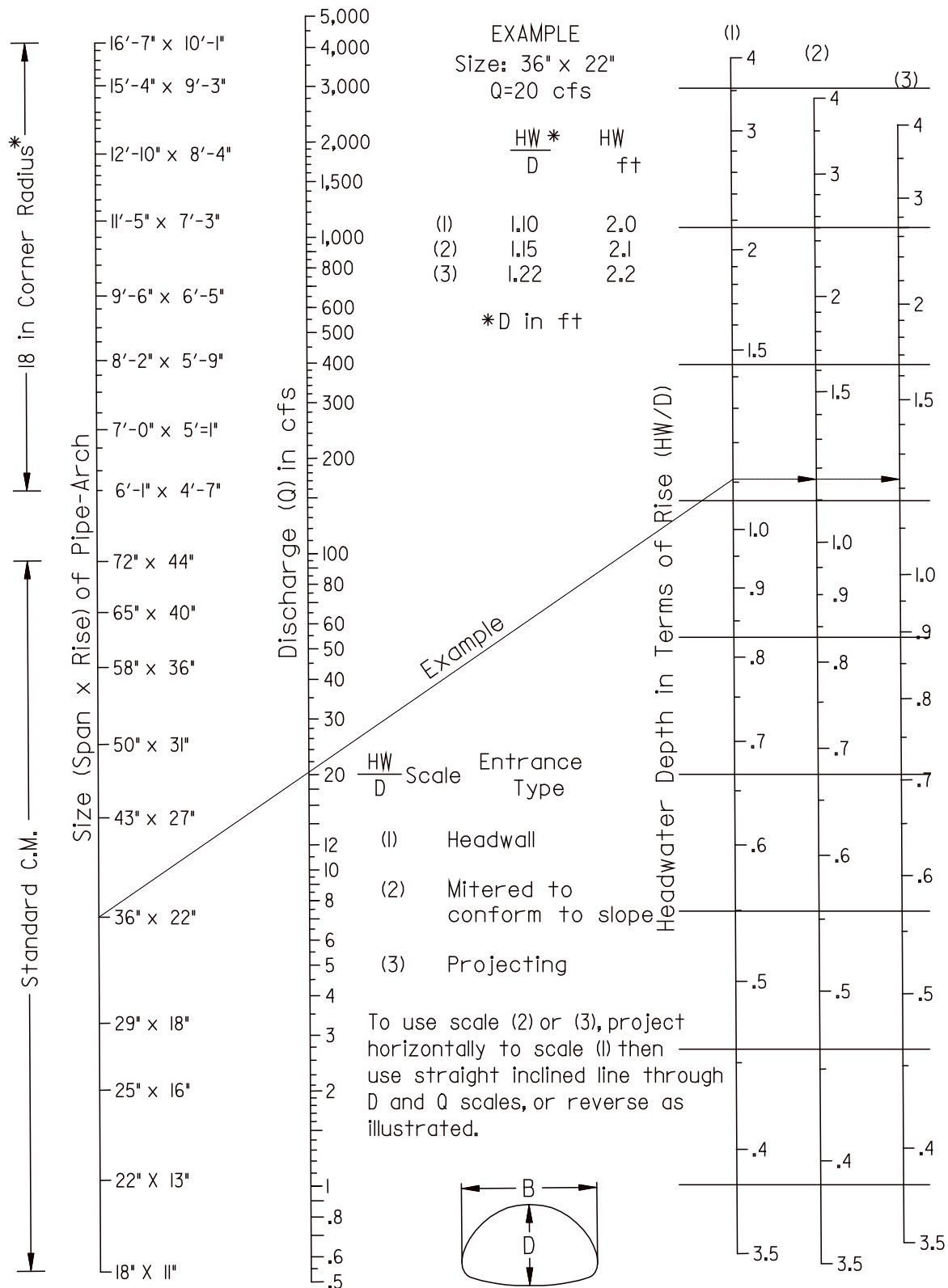


Exhibit F.19 Head for Concrete Arch Culverts Flowing Full  
 (Source: Reference F.2)



\*Additional sizes not dimensioned are listed in fabricator's catalog  
**Exhibit F.20 Headwater Depth for CMP-Arch Culverts with Inlet Control**  
 (Source: Reference F.1)

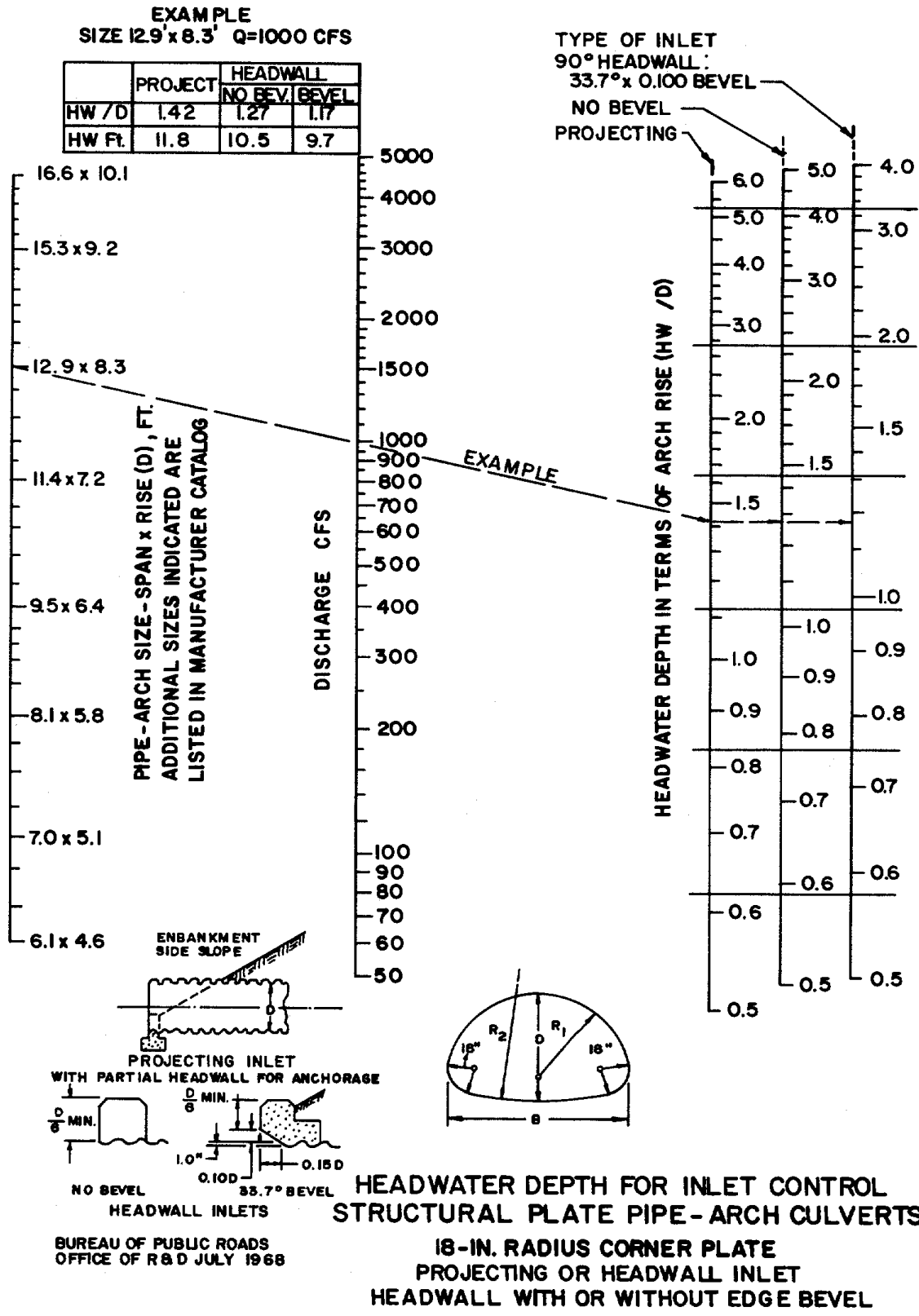
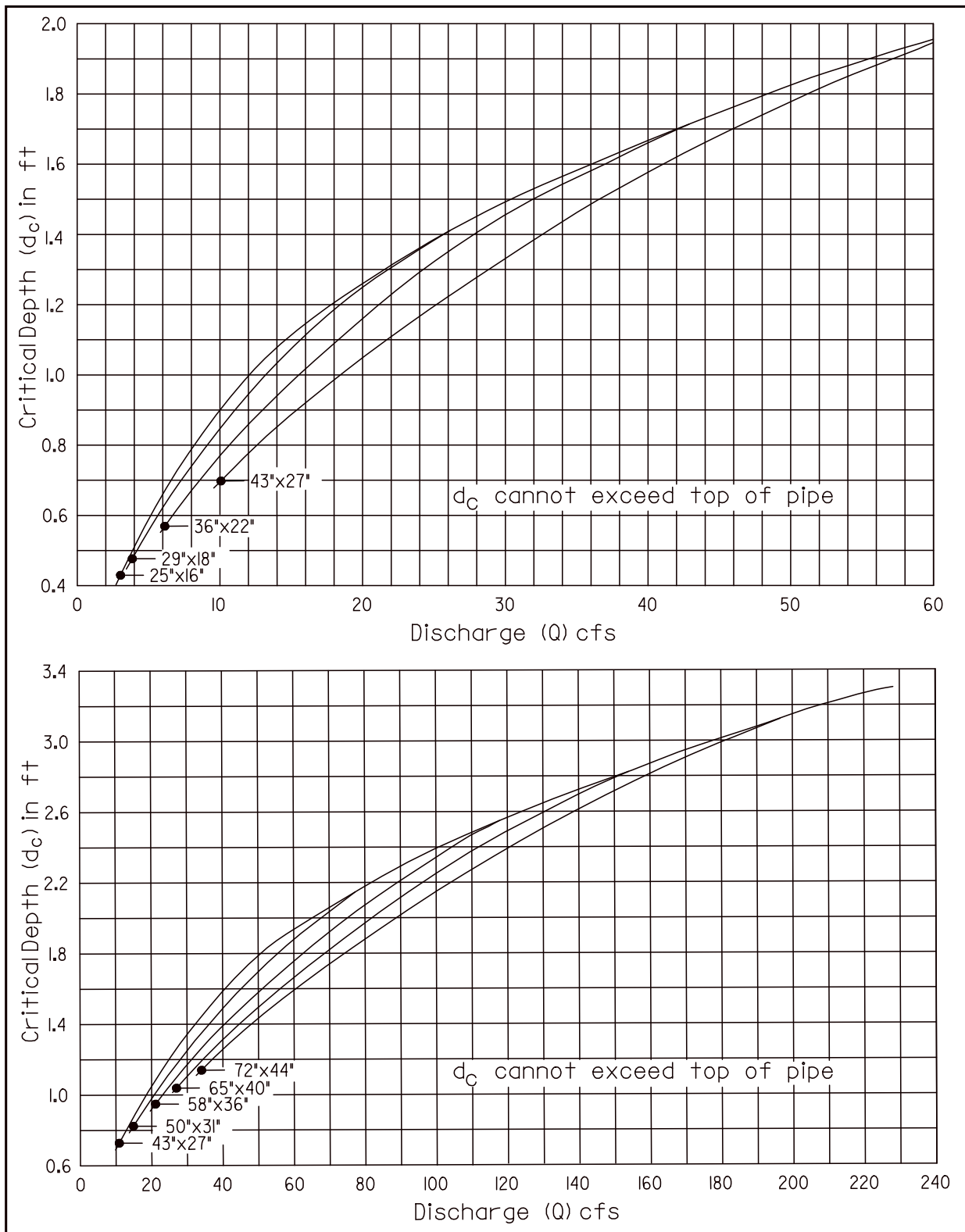
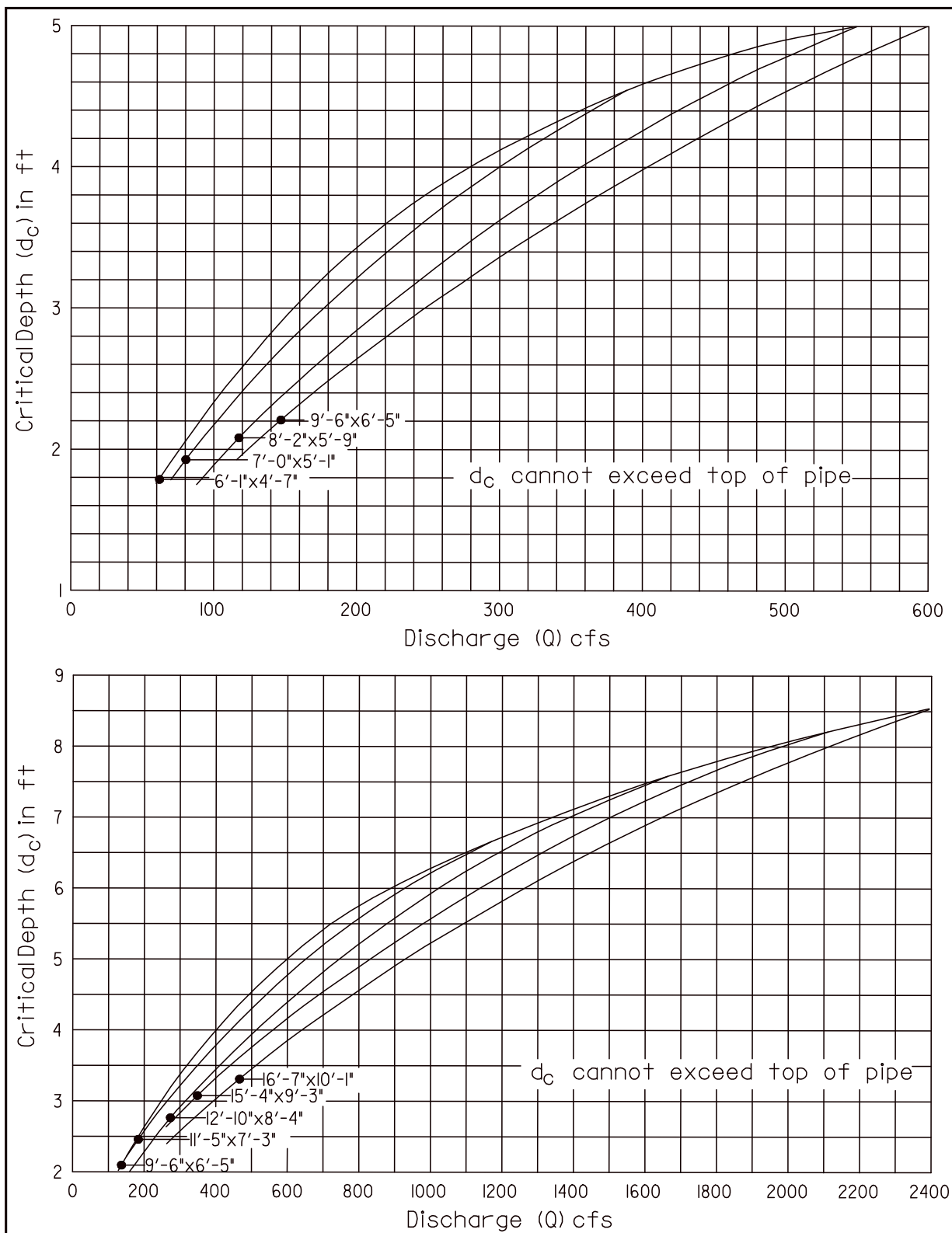


Exhibit F.21 Headwater Depth for Inlet Control Structural Plate Pipe-Arch Culverts  
 With 18 in. Radius Corner Plate  
 (Source: Reference F.1)



**Exhibit F.22 Critical Depth for Standard CMP-Arch Culverts**  
 (Source: Reference F.1)





**Exhibit F.23 Critical Depth for Structural Plate CMP-Arch Culverts  
 with 18 in. Corner Radius Plate  
 (Source: Reference F.1)**

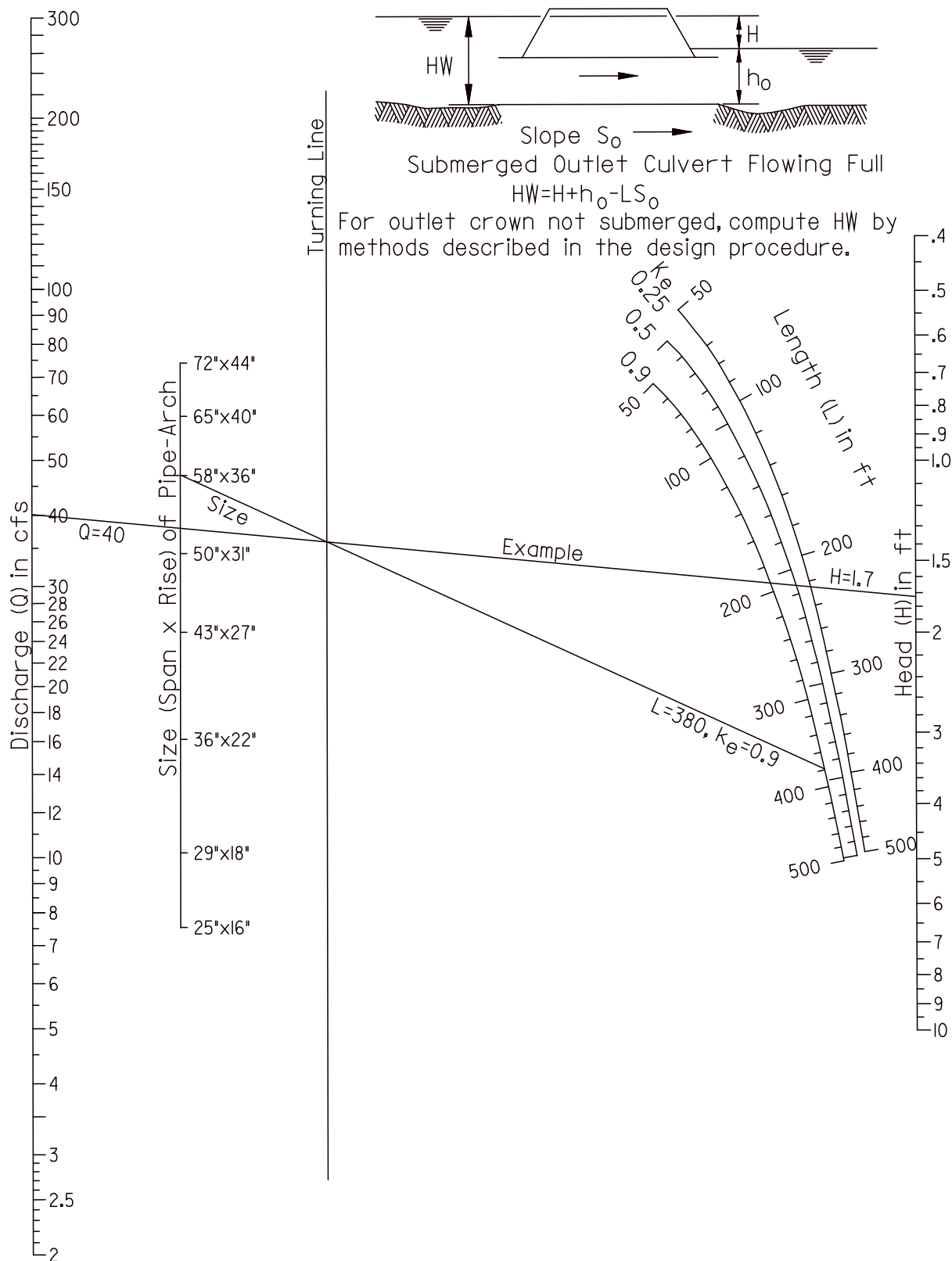
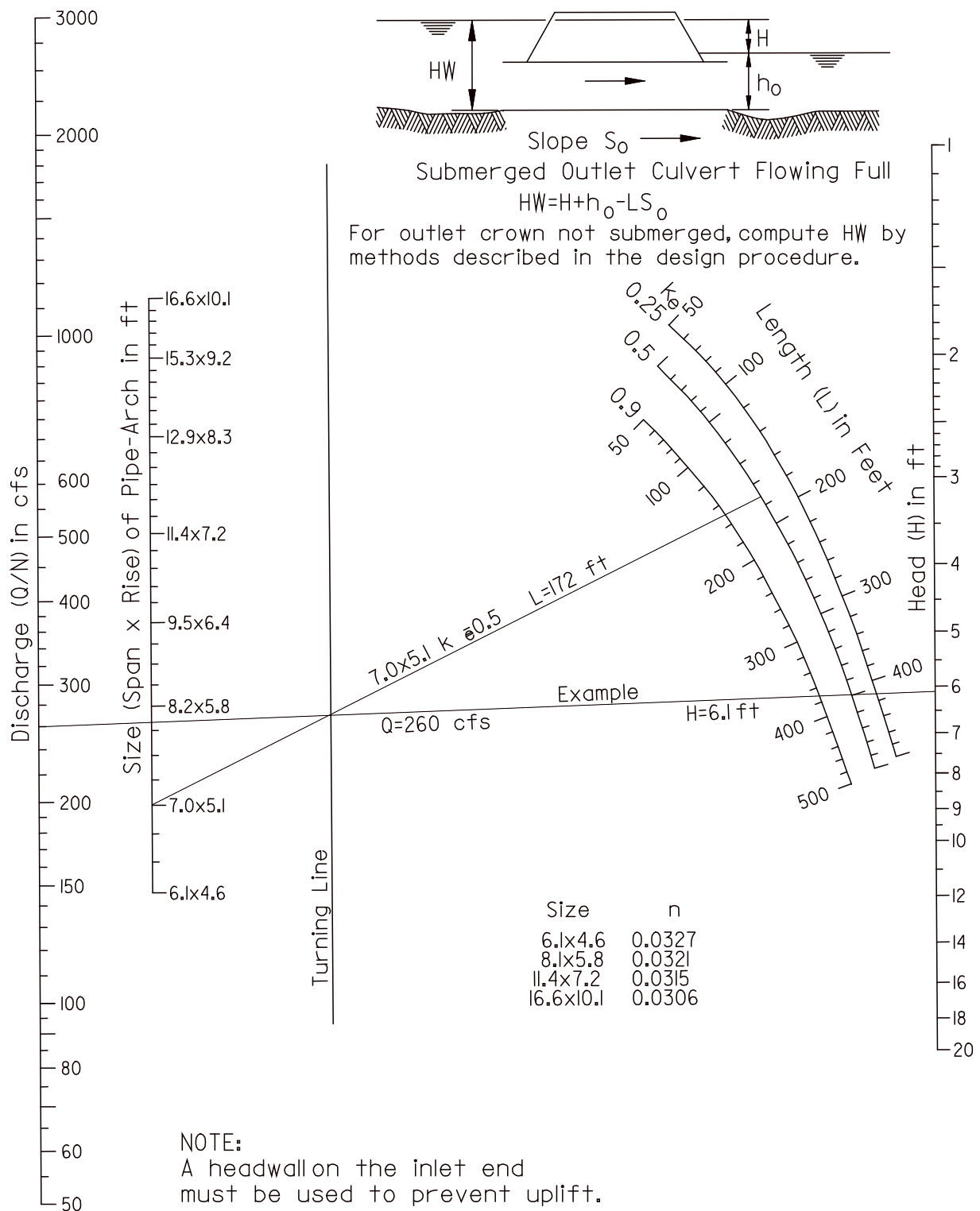


Exhibit F.24 Head for Standard CMP-Arch Culverts Flowing Full ( $n=0.024$ )  
 (Source: Reference F.1)



**Exhibit F.25 Head for Structural Plate CMP-Arch Culverts with 18 in. Corner Radius Plate Flowing Full (n=0.0327 to 0.0306) (Source: Reference F.1)**

## REFERENCES

- F.1 U.S. Department of Transportation, Federal Highway Administration, Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5, September, 1985.  
[https://www.fhwa.dot.gov/engineering/hydraulics/library\\_arc.cfm?pub\\_number=7&id=13](https://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=7&id=13)
- F.2 American Concrete Pipe Association. ([http://www.concrete-pipe.org/index.php?cp\\_Session=805edca166f308d21f57c53735e572af](http://www.concrete-pipe.org/index.php?cp_Session=805edca166f308d21f57c53735e572af))