TABLE 7.2 MANNING'S ROUGHNESS COEFFICIENTS

0.011

0.013

0.011

0.010

0.011

0.011

0.013

0.012

0.012

0.015

0.017

0.021

 $0.010 \\ 0.008$

0.010

0.013

0.014

0.015

0.013

0.011

0.013

0.012

0.015

0.013

0.014

0.017

0.019

0.024

0.010

0.009

0.012

0.016

Rough 0.014

0.016

0.017

0.017

0.017

0.013

0.014

0.014

0.017

0.014

0.016

0.020

0.021

0.030

0.010

0.011

0.014

0.017

Closed Conduits Cast Iron	Smooth	Normal
Coated	0.010	0.013
Uncoated	0.011	0.014

Clav

Concrete

Finished

Subdrain

Steel

Metal, Corrugated

Storm drain

Polyethylene (PE)

Vitrified Sewer

Vitrified sewer with manholes

Culvert strait and free of debris

Culvert with bends, connections

Unfinished smooth wood form

Unfinished rough wood form

Sewer with manhole inlets

Unfinished steel form

Polyvinyl Chloride (PVC)

Lockbar and welded

Riveted and spiral

Common drainage tile

Closed Conduits	Smooth	Normal	Rough
Wrought Iron Black	0.012	0.014	0.015
Galvanized	0.012	0.014	0.015 0.017
Lined or Built-up Channels	Minimum	Normal	Maximum
Asphalt		<u></u>	
Smooth	0.013	0.013	
Rough	0.016	0.016	
Brick Glazed	0.011	0.013	0.015
In cement mortar	0.011 0.012	0.013 0.015	0.015 0.018
Cement	0.012	0.013	0.016
Neat surface	0.010	0.011	0.013
Mortar	0.011	0.013	0.015
Concrete			
Trowel finish	0.011	0.013	0.015
Float finish	0.013	0.015	0.016
Finished with gravel on bottom Unfinished	0.015	0.017	0.020
Gunite (good section)	0.014 0.016	0.017 0.019	0.020 0.023
Gunite (wavy section)	0.018	0.015	0.025
On good excavated rock	0.017	0.020	0.025
On irregular excavated rock	0.022	0.027	
Concrete Bottom Float Finished with			
sides of			
Dressed stone in mortar	0.015	0.017	0.020
Random stone in mortar	0.017	0.020	0.024
Cement rubble masonry, plastered Cement rubble masonry	0.016 0.020	0.020 0.025	0.024 0.030
Dry rubble or rip rap	0.020	0.025	0.035
Dressed Ashlar	0.013	0.015	0.017
Gravel Bottom Sides of	5.5.5	5.0.25	3.55
Formed concrete	0.017	0.020	0.025
Random stone in mortar	0.020	0.023	0.026
Dry rubble or rip rap	0.023	0.033	0.036
Masonry Cement rubble	0.017	0.025	, 0.030
Dry rubble	0.017 0.023	0.025 0.032	0.030 0.035
Metal, Corrugated	0.023	0.025	0.030
Steel, Smooth Surface	0.021	0.025	0.050
Unpainted	0.011	0.012	0.014
Painted	0.012	0.013	0.017
Wood			
Planed, untreated	0.010	0.012	0.014
Planed, treated Unplaned	0.011 0.011	0.012 0.013	0.015 0.015
Plank with battens	0.011	0.015	0.013
Lined with roofing	0.012	0.014	0.017
Vegetal Lining	0.030	0.02	0.500
Excavated, Dredged, or Natural Chan-	<u>Minimum</u>	Normal	Maximum
nels			
Channels Not Maintained and Brush			
Uncut	0.050	0.000	0.120
Dense weeds, high flow depth Clean bottom, brush on sides	0.050 0.040	0.080 0.050	0.120 0.080
Same, highest stage of flow	0.045	0.070	0.110
Dense brush, high stage	0.080	0.100	0.140
Drag Line—Excavated or Dredged			
No vegetation	0.025	0.028	0.033
Light brush or banks	0.035	0.050	0.060
Earth, Straight and Uniform	0.016	0.018	0.020
Clean, recently completed Clean, after weathering	0.018	0.018	0.020
Gravel, uniform section, clean	0.013	0.025	0.030
Short grass, few weeds	0.022	0.027	0.033
Earth, Winding and Sluggish			
No vegetation	0.023	0.025	0.030

Grass, some weeds	Closed Conduits	Smooth	Normal	Rough
Earth bottom and rubble sides	Grass, some weeds	0.025	0.030	0.033
Stony bottom and weedy banks	Dense weeds or aquatic plants	0.030	0.035	0.040
Cobble bottoms and clean sides	Earth bottom and rubble sides	0.028	0.030	0.035
Rock Cuts	Stony bottom and weedy banks	0.025	0.035	
Smooth and uniform 0.025 0.035 0.040 0.050 Jagged and irregular 0.035 0.040 0.050 Minor Streams (top width at flood stage < 100 ft) (a) Streams on plain 1. Clean, straight, full stage, no rifts or deep pools 0.025 0.030 0.033 2. Same as above, but some stones and weeds 0.030 0.035 0.040 3. Clean, winding, some pools and shoals 0.033 0.040 0.045 4. Same as above, but some weeds and stones 0.035 0.045 0.050 5. Same as above, lower stages, more ineffective slopes and sections 0.045 0.050 0.050 6. Same as 4, but more stones 0.045 0.050 0.060 7. Sluggish reaches, weedy, deep pools 0.050 0.070 0.080 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.050 0.050 2. Bottom: cobbles with large 0.030 0.040 0.050	Cobble bottoms and clean sides	0.030	0.040	0.050
Jagged and irregular	Rock Cuts			
Minor Streams (top width at flood stage < 100 ft) (a) Streams on plain 1. Clean, straight, full stage, no rifts or deep pools 0.025 0.030 0.033 2. Same as above, but some stones and weeds 0.030 0.035 0.040 3. Clean, winding, some pools and shoals 0.033 0.040 0.045 4. Same as above, but some weeds and stones 0.035 0.045 0.050 5. Same as above, lower stages, more ineffective slopes and sections 0.040 0.048 0.055 6. Same as 4, but more stones 0.045 0.050 0.060 7. Sluggish reaches, weedy, deep pools 0.050 0.070 0.080 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks sub-merged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.040 0.050 2. Bottom: cobbles with large	Smooth and uniform	0.025	0.035	0.040
Stage < 100 ft (a) Streams on plain	Jagged and irregular	0.035	0.040	0.050
(a) Streams on plain 1. Clean, straight, full stage, no rifts or deep pools 2. Same as above, but some stones and weeds 3. Clean, winding, some pools and shoals 4. Same as above, but some weeds and stones 5. Same as above, lower stages, more ineffective slopes and sections 6. Same as 4, but more stones 7. Sluggish reaches, weedy, deep pools 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 6. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 2. Bottom: cobbles with large	Minor Streams (top width at flood			
1. Clean, straight, full stage, no rifts or deep pools 0.025 0.030 0.033 2. Same as above, but some stones and weeds 0.030 0.035 0.040 3. Clean, winding, some pools and shoals 0.033 0.040 0.045 4. Same as above, but some weeds and stones 0.035 0.045 0.050 5. Same as above, lower stages, more ineffective slopes and sections 0.040 0.048 0.055 6. Same as 4, but more stones 0.045 0.050 0.060 7. Sluggish reaches, weedy, deep pools 0.050 0.050 0.070 0.080 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.040 0.050 2. Bottom: cobbles with large	stage $< 100 \text{ ft}$)			
rifts or deep pools	(a) Streams on plain			
2. Same as above, but some stones and weeds 0.030 0.035 0.040 3. Clean, winding, some pools and shoals 0.033 0.040 0.045 4. Same as above, but some weeds and stones 0.035 0.045 0.050 5. Same as above, lower stages, more ineffective slopes and sections 0.040 0.048 0.055 6. Same as 4, but more stones 0.045 0.050 0.060 7. Sluggish reaches, weedy, deep pools 0.050 0.070 0.080 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.050 2. Bottom: cobbles with large	1. Clean, straight, full stage, no			
Stones and weeds 0.030 0.035 0.040	rifts or deep pools	0.025	0.030	0.033
3. Clean, winding, some pools and shoals 0.033 0.040 0.045 4. Same as above, but some weeds and stones 0.035 0.045 0.050 5. Same as above, lower stages, more ineffective slopes and sections 0.040 0.048 0.055 6. Same as 4, but more stones 0.045 0.050 0.060 7. Sluggish reaches, weedy, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.050 2. Bottom: cobbles with large	2. Same as above, but some			
and shoals 4. Same as above, but some weeds and stones 5. Same as above, lower stages, more ineffective slopes and sections 6. Same as 4, but more stones 7. Sluggish reaches, weedy, deep pools 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 2. Bottom: cobbles with large	stones and weeds	0.030	0.035	0.040
4. Same as above, but some weeds and stones 0.035 0.045 0.050 5. Same as above, lower stages, more ineffective slopes and sections 0.040 0.048 0.055 6. Same as 4, but more stones 0.045 0.050 0.060 7. Sluggish reaches, weedy, deep pools 0.050 0.070 0.080 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.050 2. Bottom: cobbles with large	3. Clean, winding, some pools			
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sections 0.040 0.048 0.055 6. Same as 4, but more stones 0.045 0.050 0.060 7. Sluggish reaches, weedy, deep pools 0.050 0.070 0.080 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.050 2. Bottom: cobbles with large	Same as above, lower stages,			
6. Same as 4, but more stones 7. Sluggish reaches, weedy, deep pools 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush 0.075 0.100 0.150 0.150 0.150 0.050 0.060 0.070 0.080	more ineffective slopes and			
7. Sluggish reaches, weedy, deep pools 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks sub- merged at high stages 1. Bottom: gravels, cobbles, and few boulders 2. Bottom: cobbles with large 0.050 0.070 0.070 0.070 0.080 0.070 0.070 0.070 0.080 0.070 0.080 0.070 0.080 0.080	sections		373.5	
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heavy stand of timber and underbrush 0.075 0.100 0.150 (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 0.030 0.040 0.050 2. Bottom: cobbles with large				
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(b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages 1. Bottom: gravels, cobbles, and few boulders 2. Bottom: cobbles with large				
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trees and brush along banks sub- merged at high stages 1. Bottom: gravels, cobbles, and few boulders 2. Bottom: cobbles with large				
merged at high stages 1. Bottom: gravels, cobbles, and few boulders 2. Bottom: cobbles with large				
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	boulders	0.040	0.050	0.070