

Table 6-1
Selected Plan Cost Estimates - Donkey Creek Watershed

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Donkey Creek Main Stem						
Detention						
Hidden Valley	\$ 5,735,646	\$ 1,720,694	\$ 7,456,340	\$ 1,118,451	\$ 870,014	\$ 9,445
Milne Valley -mid	\$ 1,992,321	\$ 597,696	\$ 2,590,017	\$ 388,502	\$ 551,540	\$ 3,530
Milne Valley -lower	\$ 3,573,306	\$ 1,071,992	\$ 4,645,298	\$ 696,795	\$ 216,382	\$ 5,558
Channel Improvements						
U/S of Butler Speath	\$ 385,612	\$ 115,684	\$ 501,295	\$ 75,194		\$ 576
U/S of Douglas Highway	\$ 227,548	\$ 68,264	\$ 295,812	\$ 44,372		\$ 340
Structure Improvements						
Unnamed Road (DP 6-202)	\$ 273,750	\$ 82,125	\$ 355,875	\$ 53,381		\$ 409
Brorby Blvd. (DP 9-202)	\$ 422,500	\$ 126,750	\$ 549,250	\$ 82,388		\$ 632
Jayhawker St. (DP 12-000)	\$ 244,000	\$ 73,200	\$ 317,200	\$ 47,580		\$ 365
Structure Improvements						
Fishing Lake Dam	\$ 612,954	\$ 183,886	\$ 796,840	\$ 119,526		\$ 916
Donkey Creek Main Stem - Total Cost	\$ 13,467,637	\$ 4,040,291	\$ 17,507,928	\$ 2,626,189	\$ 1,637,936	\$ 21,772
Antelope Butte Creek						
Main Stem						
Detention						
Antelope Butte Creek	\$ 1,931,231	\$ 579,369	\$ 2,510,600	\$ 376,590	\$ 83,590	\$ 2,971
Structure Improvements						
Douglas Highway (DP 6-218)	\$ 703,000	\$ 210,900	\$ 913,900	\$ 137,085		\$ 1,051
Antelope Butte Creek Main Stem - Total Cost	\$ 2,634,231	\$ 790,269	\$ 3,424,500	\$ 513,675	\$ 83,590	\$ 4,022

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Selected Plan Cost Estimates - Donkey Creek Watershed

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Antelope Butte Creek (Basin 6)						
Structure Improvements						
Tributary 602						
Schoonover Rd. (DP 6-220)	\$ 134,670	\$ 40,401	\$ 175,071	\$ 26,261		\$ 201
Tributary 605						
Garner Lake Rd. (DP 6-251)	\$ 254,200	\$ 76,260	\$ 330,460	\$ 49,569		\$ 380
Southern Dr. (DP 6-252)	\$ 149,200	\$ 44,760	\$ 193,960	\$ 29,094		\$ 223
Douglas Hwy. (DP 6-253)	\$ 149,200	\$ 44,760	\$ 193,960	\$ 29,094		\$ 223
Tributary 610						
Boxelder Rd. (DP6-293)	\$ 18,200	\$ 5,460	\$ 23,660	\$ 3,549		\$ 27
Antelope Butte Creek Tributaries - Total Cost	\$ 705,470	\$ 211,641	\$ 917,111	\$ 137,567	\$ -	\$ 1,055
Donkey Creek Tributary South (Basin 7)						
Detention						
City Land	\$ 2,436,417	\$ 730,925	\$ 3,167,342	\$ 475,101	\$ -	\$ 3,642
Saunders	\$ 301,693	\$ 90,508	\$ 392,201	\$ 58,830	\$ -	\$ 451
Hitt Estates	\$ 123,486	\$ 37,046	\$ 160,532	\$ 24,080	\$ 5,462	\$ 190
Sunburst	\$ 257,485	\$ 77,245	\$ 334,730	\$ 50,210	\$ 264,239	\$ 649
Structure Improvements						
Donkey Creek Trib. South						
Shoshone Ave. (DP 7-214)	\$ 432,000	\$ 129,600	\$ 561,600	\$ 84,240		\$ 646
Southern Dr. (DP 7-209)	\$ 397,000	\$ 119,100	\$ 516,100	\$ 77,415		\$ 594
Saunders Tributary						
Christinck Ave. Outfall	\$ 316,500	\$ 94,950	\$ 411,450	\$ 61,718		\$ 473
Remington Tributary						
Enzi Dr. (DP 7-240)	\$ 26,756	\$ 8,027	\$ 34,783	\$ 5,217		\$ 40

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Selected Plan Cost Estimates - Donkey Creek Watershed

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Enzi Tributary						
Shoshone Ave. (DP 7-252)	\$ 117,000	\$ 35,100	\$ 152,100	\$ 22,815		\$ 175
Donkey Creek Tributary South - Total Cost	\$ 4,408,337	\$ 1,322,501	\$ 5,730,838	\$ 859,626	\$ 269,701	\$ 6,860

Table 6-1
Selected Plan Cost Estimates - Donkey Creek Watershed

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
North Donkey Creek Tributary (Basin 8)						
Detention						
Sage Valley Park R1	\$ 198,880	\$ 59,664	\$ 258,545	\$ 38,782	\$ -	\$ 297
Sunflower Park	\$ 197,043	\$ 59,113	\$ 256,156	\$ 38,423	\$ -	\$ 295
Upper Sage Valley	\$ 234,514	\$ 70,354	\$ 304,868	\$ 45,730	\$ -	\$ 351
I-90 (1)	\$ 89,933	\$ 26,980	\$ 116,912	\$ 17,537	\$ -	\$ 134
I-90 (2 - 3)	\$ 169,624	\$ 50,887	\$ 220,511	\$ 33,077	\$ -	\$ 254
I-90 (4)	\$ 241,024	\$ 72,307	\$ 313,331	\$ 47,000	\$ -	\$ 360
Structure Improvements						
Emerson Ave. (DP 8-206)	\$ 220,000	\$ 66,000	\$ 286,000	\$ 42,900		\$ 329
Maple Ave. (DP 8-207)	\$ 124,000	\$ 37,200	\$ 161,200	\$ 24,180		\$ 185
Birch Ave. (DP 8-208)	\$ 83,400	\$ 25,020	\$ 108,420	\$ 16,263		\$ 125
Outlet of Sage Valley Park R1	\$ 363,280	\$ 108,984	\$ 472,264	\$ 70,840		\$ 543
Tributary 802						
Outlet of Cottonwood Park R3 Detention, 4-J Rd.	\$ 1,030,000	\$ 309,000	\$ 1,339,000	\$ 200,850		\$ 1,540
Outlets of Existing Upper Sage Valley Ponds to Upper Sage Detention (DP 8-231)	\$ 103,720	\$ 31,116	\$ 134,836	\$ 20,225		\$ 155
Outlets of Upper Sage Valley Ponds to Boxelder Storm (DP 8-231)	\$ 43,660	\$ 13,098	\$ 56,758	\$ 8,514		\$ 65
4-J Roadside Ditch (DP 8-230)	\$ 3,291	\$ 987	\$ 4,278	\$ 642		\$ 5
Channel Improvements						
E-Z St. to constructed channel end	\$ 118,848	\$ 35,654	\$ 154,502	\$ 23,175	\$ 47	\$ 178

Table 6-1
Selected Plan Cost Estimates - Donkey Creek Watershed

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
North Donkey Creek Tributary - Total Cost	\$ 3,221,216	\$ 966,365	\$ 4,187,581	\$ 628,137	\$ 47	\$ 4,816

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Donkey Creek Tributary (Basin 9)						
Detention						
Sutherland Estates	\$ 162,985	\$ 48,896	\$ 211,881	\$ 31,782	\$ 90,675	\$ 334
Sutherland Estates Pond outlet in 4J Road to DC (DP 9-217)	\$ 776,000	\$ 232,800	\$ 1,008,800	\$ 151,320		\$ 1,160
Structure Improvements						
Tributary 902						
4-J Rd. (DP 9-210)	\$ 194,000	\$ 58,200	\$ 252,200	\$ 37,830		\$ 290
Lakeway Rd. (DP 9-211)	\$ 44,160	\$ 13,248	\$ 57,408	\$ 8,611		\$ 66
Tributary 901						
4-J Rd. (DP 9-207)	\$ 35,200	\$ 10,560	\$ 45,760	\$ 6,864		\$ 53
Tributary 904						
4-J Rd. (DP 9-215)	\$ 31,840	\$ 9,552	\$ 41,392	\$ 6,209		\$ 48
Donkey Creek Tributary, Basin 9 - Total Cost	\$ 1,244,185	\$ 373,256	\$ 1,617,441	\$ 242,616	\$ 90,675	\$ 1,951
Basin 10 Milne Valley						
Structure Improvements						
Tributary 1000						
4-J Rd. (DP 10-201)	\$ 187,000	\$ 56,100	\$ 243,100	\$ 36,465		\$ 280
Southern Dr. (DP 10-202)	\$ 670,000	\$ 201,000	\$ 871,000	\$ 130,650		\$ 1,002
Tributary 1001						
U.S. Highway 50 (DP 10-210)	\$ 99,760	\$ 29,928	\$ 129,688	\$ 19,453		\$ 149

Table 6-1
Selected Plan Cost Estimates - Donkey Creek Watershed

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Tributary 1002						
Bunny Ln. (DP 10-220)	\$ 42,367	\$ 12,710	\$ 55,077	\$ 8,262		\$ 63
Southern Dr. (DP 10-221)	\$ 111,542	\$ 33,463	\$ 145,004	\$ 21,751		\$ 167
Tributary 1003						
Southern Dr. (DP 10-230)	\$ 53,419	\$ 16,026	\$ 69,445	\$ 10,417		\$ 80
Donkey Creek Basin 10 - Total Cost	\$ 1,164,088	\$ 349,226	\$ 1,513,314	\$ 226,997	\$ -	\$ 1,740

Table 6-1
Selected Plan Cost Estimates - Donkey Creek Watershed

Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Projects	Construction Cost	Construction Contingency (30%)	Subtotal Construction Cost	Design Contingency (15%)	Land Cost	Total Cost (x\$1,000)
Basin 12 Donkey Creek Direct Flow Areas						
Structure Improvements						
Tributary 1201						
Force Rd. (DP 12-230)	\$ 92,584	\$ 27,775	\$ 120,359	\$ 18,054		\$ 138
Tributary 1202						
Spring Hill Rd. (DP 12-220)	\$ 20,604	\$ 6,181	\$ 26,785	\$ 4,018		\$ 31
Tributary 1203						
Spring Hill Rd. (DP 12-210)	\$ 9,078	\$ 2,723	\$ 11,801	\$ 1,770		\$ 14
Tributary 1240						
Spring Hill Rd. (DP 12-240)	\$ 29,252	\$ 8,776	\$ 38,028	\$ 5,704		\$ 44
Tributary 1250						
Force Rd. (DP 12-250)	\$ 175,700	\$ 52,710	\$ 228,410	\$ 34,262		\$ 263
Donkey Creek Basin 12 - Total Cost	\$ 327,218	\$ 98,165	\$ 425,383	\$ 63,808	\$ -	\$ 489

Table 1
Construction Cost Estimates Summary

Major Basin	Donkey Creek	
Alternative	Conveyance	Detention
Item	Total Cost (\$)	Total Cost (\$)
Channels	3,181,220	1,424,661
Culverts	-	940,250
Drop Structures	1,582,200	434,000
Detention Facilities	612,954	11,914,227
Bridges	18,469,500	495,000
Sub-Total (Rounded)	\$23,846,000	\$15,208,000
30% Construction Contingency	\$7,153,800	\$4,562,400
15% Engineering Contingency	\$3,576,900	\$2,281,200
Total (Rounded)	\$34,577,000	\$22,052,000

**Table 7-1-CU
Bridge Cost Estimate**

Donkey Creek Alternative - Conveyance

Design Point	Road Crossing	Channel and Reach	Future 100-yr Flow (cfs)	Road Class	Bridge Length (ft) ¹	Constructi on Area (ft ²)	Unit Cost (\$)	Total Cost (\$)
6-202	Unnamed Road	Donkey Creek	6157	Local	170	11220	150	1,683,000
6-206	Butler Spaeth Rd.	Donkey Creek	5313	Minor Arterial	200	16400	150	2,460,000
9-200	Enzi Dr.	Donkey Creek	4964	Minor Arterial	170	13940	150	2,091,000
9-201	Saunders Blvd.	Donkey Creek	4873	Local	170	11220	150	1,683,000
9-202	Brorby Rd	Donkey Creek	4744	Local	170	11220	150	1,683,000
9-204	Donkey Creek Dr.	Donkey Creek	4698	Local	120	7920	150	1,188,000
9-209	4-J Rd.	Donkey Creek	4636	Minor Arterial	225	18450	150	2,767,500
12-000	Jayhawker St.	Donkey Creek	4615	Local	400	26400	150	3,960,000
12-201	Highway 50	Donkey Creek	3343	Major Arterial	60	6360	150	954,000

¹ Length is based on Future Land Use Road widths

\$18,469,500

**Table 7-2-CU
Bridge Cost Estimate
Donkey Creek Alternative - Detention**

Design Point	Road Crossing	Channel and Reach	Future 100-yr Flow (cfs)	Road Class	Bridge Length (ft) ¹	Constructi on Area (ft ²)	Unit Cost (\$)	Total Cost (\$)
9-204	Donkey Creek Dr	Donkey Creek	2294	Local	50	3300	150	495,000

\$495,000

**Table 7-1-CH
Channel Cost Estimates**

Donkey Creek Alternative - Conveyance

Design Point	Channel and Reach	Future 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length	Channel Type	Material	Excavation (CY)	Unit Cost (\$)	Total Cost (\$)
6-208	Donkey Creek Channel Capacity (Carlisle Rd to DP 6-208)	6498	6498	6,500	3,600	Steep Channel Design	Grass	122,400	239	861,496
6-206	Donkey Creek Channel Capacity (DP 6-207 to Butler Spaeth Rd.)	5313	6473	6,500	2,050	Steep Channel Design	Grass	69,700	239	490,574
9-208	Donkey Creek Channel (4-J Rd to DP 9-208)	4650	6044	6,500	3,400	Steep Channel Design	Grass	115,600	239	813,635
9-204	Donkey Creek Channel Capacity (DP 9-205 to Donkey Cr Dr)	4698	6074	6,500	2,960	Steep Channel Design	Grass	100,640	239	708,341
12-000	Donkey Creek Channel Capacity (Hwy 50 to Jayhawker St)	4615	6022	6,500	900	Steep Channel Design	Grass	30,600	341	307,174

Sub-Total \$3,181,220

**Table 7-2-CH
Channel Cost Estimates**

Donkey Creek Alternative - Detention

	Channel and Reach	Future 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length	Channel Type	Material	Excavation (CY)	Unit Cost (\$)	Total Cost (\$)
6-208	Donkey Creek Channel Capacity (Carlisle Rd to DP 6-208)	2943	2943	3,000	3,600	Steep Channel Design	Grass	68,600	134	481,866
6-206	Donkey Creek Channel (DP 6-207 to Butler Spaeth Rd.)	3929	3929	4,000	2,050	Steep Channel Design	Grass	45,783	227	465,002
9-204	Donkey Creek Channel Capacity (DP 9-205 to Donkey Creek Rd)	2294	2294	2,500	2,960	Steep Channel Design	Grass	46,373	161	477,793

Sub-Total \$1,424,661

Table 7-1-CU
Culvert Cost Estimate
Donkey Creek Alternative - Conveyance

Facility Number	Road Crossing	Channel and Reach	Existing Size	Future 100-yr Flow (cfs)	Necessary Facility for Future 100-year Flow	Number of Culverts	Culvert Length (ft) ¹	Unit Cost (\$)	End Section Unit Cost (\$)	Total Cost (\$)

Table 7-2-CU
Culvert Cost Estimate
Donkey Creek - Detention

Facility Number	Road Crossing	Channel and Reach	Existing Size	Future 100-yr Flow (cfs)	Necessary Facility for Future 100-year Flow	Number of Culverts	Culvert Length (ft) ¹	Unit Cost (\$)	End Section Unit Cost (\$)	Total Cost (\$)
6-202	Unnamed	Donkey Creek	2-48"CMP	2950	CBC 5-10'x7'	5	55	850	40,000	273,750
9-202	Brorby Blvd.	Donkey Creek	CMP 4-66"	2509	CBC 5-10'x7'	5	90	850	40,000	422,500
12-000	Jayhawker St	Donkey Creek	CBC 10'x4'	1897	CBC 6-10'x4'	6	40	850	40,000	244,000

¹ Length is based on Future Land Use Road widths

Sub-Total \$940,250

Table 7-2-D
Detention Facility Construction Cost Estimates
Donkey Creek Alternative Detention

Detention Name	Storage Volume (ac-ft)	Excavation (CY)	Excavation Cost (\$)	Embankment (CY)	Embankment Cost (\$)	Reveg. Area (SF)	Topsoil (CY)	Topsoil Cost at 4" Thick (\$)	Seeding Cost (\$)	Low Level Outlet Intake Structure/EA (\$)	Low Level Outlet Conveyance Structure Type	Length of Low Level Outlet Conveyance Structure (ft)	Cost Low Level Outlet Conveyance Structure (\$)	Low Level Outlet Conveyance End Treatment Type	Low Level Outlet Conveyance End Treatment Cost (\$)	Spillway Flow Rate (cfs)	Spillway Cost (\$)	Total Cost (\$)
Unit costs		<10,000CY :	8.00		22.00			20.00	2400	5800								
		>10,000CY :	5.00															
Regional Detention Lower	133	70661	353,304	125546	2,762,019	995192	12,274	245,481	54,832	5,800	10'x6' CBC	100	82,000	HW&WW	40,000	914	29,871	3,573,306
Regional Detention Mid	135	210127	1,050,634	20680	454,958	889725	10,973	219,465	49,021	5,800	12'x6' CBC	100	136,142	HW&WW	40,000	1,180	36,300	1,992,321
Hidden Valley Upper	794	624774	3,123,870	71094	1,564,067	2574518	31,752	635,048	141,847	5,800	9'x5' CBC	231	196,350	HW&WW	40,000	862	28,665	5,735,646
Fishing Lake	N/A	2933	23,467	5667	124,667	69500	857	17,143	3,829		10'x6' CBC	130	106,600	HW&WW	40,000	3,876	68,448	384,154
Fishing Lake Repaving	N/A					44000	Paving unit cost		5.20									228,800
																	Sub-Total	\$11,914,227

Detention Facility Construction Cost Estimates
Donkey Creek Alternative Conveyance

Detention Name	Storage Volume (ac-ft)	Excavation (CY)	Excavation Cost (\$)	Embankment (CY)	Embankment Cost (\$)	Reveg. Area (SF)	Topsoil (CY)	Topsoil Cost at 4" Thick (\$)	Seeding Cost (\$)	Low Level Outlet Intake Structure/EA (\$)	Low Level Outlet Conveyance Structure Type	Length of Low Level Outlet Conveyance Structure (ft)	Cost Low Level Outlet Conveyance Structure (\$)	Low Level Outlet Conveyance End Treatment Type	Low Level Outlet Conveyance End Treatment Cost (\$)	Spillway Flow Rate (cfs)	Spillway Cost (\$)	Total Cost (\$)
Unit costs		<10,000CY :	8.00		22.00			20.00	2400	5800								
		>10,000CY :	5.00															
Fishing Lake	N/A	2933	23,467	5667	124,667	69500	857	17,143	3,829		10'x6' CBC	130	106,600	HW&WW	40,000	3,876	68,448	384,154
Fishing Lake Repaving	N/A					44000	Paving unit cost		5.20									228,800
																	Sub-Total	\$612,954

Table 7-1-DS
Drop Structure Cost Estimate
Donkey Creek Alternative - Conveyance

Channel	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Existing Slope	Proposed Slope	Elevation Change (ft)	No. of Drops	Unit Cost (\$)	Total Cost (\$)
Dp 6-207 to Butler Spaeth (spillway from fishing Lake)	3721	6437	6,500	2050	0.50%	0.30%	4.1	2	87,900	175,800
Douglas Hwy to DP 6-207		6405	6,500	4400	0.50%	0.10%	17.6	5	87,900	439,500
Carlisle to DP 6-208		6498	6,500	3600	0.50%	0.10%	14.4	4	87,900	351,600
DP 9205 to Donkey Creek Rd.		6074	6,500	2960	0.50%	0.10%	11.84	3	87,900	263,700
Donkey Creek Channel Capacity (4-J Rd. to DP 9-208)	4665	6044	6,500	3400	0.50%	0.15%	11.9	3	87,900	263,700
Hwy 50 to Jayhawker		6022	6,500	900	0.50%	0.10%	3.6	1	87,900	87,900

Sub-Total \$1,582,200

Table X
Drop Structure Cost Estimate
Major Basin 6 Alternative - Detention

Channel	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Existing Slope	Proposed Slope	Elevation Change (ft)	No. of Drops	Unit Cost (\$)	Total Cost (\$)
6- 206		2943	3,000	2050	0.50%	0.30%	4.1	2	49,000	98,000
6-208		3929	4,000	3,600	0.50%	0.10%	14.4	4	61,100	244,400
9-204		2294	2,500	2960	0.50%	0.25%	7.4	2	45,800	91,600

Sub-Total \$434,000

Table C-1
General Grass Lined Channel Design with Drop Structures

Channel Dimensions														<div><div></div><div>Flow Depth</div></div>	Channel Costs									
															Excavation Area = 0.75* cross section						TOTAL COST for		TOTAL COST for	
Q (cfs)	n	Slope	Side Slopes	Bottom Width (ft)	Normal Depth (ft)	Froude Number	Constructed Depth with Freeboard(ft)	Velocity (fps)	Flow Area (sf)	Wetted Perimeter (ft)	R (ft)	Regime	t _g (psf)		area (ft ² /lin. ft)	Excavation (cy/lin. ft)	Surface Area (ft/lin. ft)	4" Topsoil (cy/ lin. ft)	4" Topsoil Cost (\$/lin. ft)	Seeding (acre)	Seeding Cost (\$/lin. ft)	<50K CY Cut (\$/LF)	>50K CY Cut (\$/LF)	
GRASS																								
300	0.035	0.70%	4	12	2.60	0.68	4	5.1	58.31	33.46	1.743	sub	0.76	84	3.1	44.98	0.56	11.11	0.00103	2.48	38.47	29.14		
500	0.035	0.65%	4	12	3.40	0.68	5	5.7	87.04	40.04	2.174	sub	0.88	120	4.4	53.23	0.66	13.14	0.00122	2.93	51.63	38.30		
600	0.035	0.60%	4	12	3.78	0.66	6	5.9	102.50	43.17	2.375	sub	0.89	162	6.0	61.48	0.76	15.18	0.00141	3.39	66.57	48.57		
800	0.035	0.60%	4	12	4.33	0.67	6	6.3	126.75	47.67	2.659	sub	1.00	162	6.0	61.48	0.76	15.18	0.00141	3.39	66.57	48.57		
900	0.035	0.60%	4	12	4.57	0.68	6	6.5	138.28	49.67	2.784	sub	1.04	162	6.0	61.48	0.76	15.18	0.00141	3.39	66.57	48.57		
1000	0.035	0.60%	4	12	4.79	0.68	7	6.7	149.50	51.54	2.901	sub	1.09	210	7.8	69.72	0.86	17.22	0.00160	3.84	83.28	59.95		
1100	0.035	0.60%	4	12	5.01	0.69	7	6.9	160.44	53.30	3.010	sub	1.13	210	7.8	69.72	0.86	17.22	0.00160	3.84	83.28	59.95		
1200	0.035	0.55%	4	12	5.31	0.66	7	6.8	176.75	55.82	3.166	sub	1.09	210	7.8	69.72	0.86	17.22	0.00160	3.84	83.28	59.95		
1300	0.035	0.50%	4	15	5.36	0.64	7	6.7	195.37	59.21	3.300	sub	1.03	226	8.4	72.72	0.90	17.96	0.00167	4.01	88.85	63.77		
1400	0.035	0.50%	4	15	5.55	0.64	7	6.8	206.37	60.75	3.397	sub	1.06	226	8.4	72.72	0.90	17.96	0.00167	4.01	88.85	63.77		
1500	0.035	0.50%	4	25	4.96	0.64	7	6.8	222.16	65.87	3.373	sub	1.05	278	10.3	82.72	1.02	20.43	0.00190	4.56	107.43	76.51		
1700	0.035	0.50%	4	25	5.28	0.65	7	7.0	243.28	68.51	3.551	sub	1.11	278	10.3	82.72	1.02	20.43	0.00190	4.56	107.43	76.51		
2000	0.035	0.40%	4	45	4.85	0.58	7	6.4	312.64	85.02	3.677	sub	0.92	383	14.2	102.72	1.27	25.36	0.00236	5.66	144.58	102.00		
2500	0.035	0.40%	4	70	4.46	0.58	6	6.4	391.50	106.76	3.667	sub	0.92	423	15.7	119.48	1.48	29.50	0.00274	6.58	161.42	114.42		
3000	0.035	0.45%	4	70	4.78	0.63	7	7.0	425.74	109.40	3.892	sub	1.09	515	19.1	127.72	1.58	31.54	0.00293	7.04	191.02	133.85		
3500	0.035	0.45%	4	90	4.59	0.63	6	7.0	497.00	127.83	3.888	sub	1.09	513	19.0	139.48	1.72	34.44	0.00320	7.68	194.12	137.12		
4000	0.035	0.45%	4	110	4.45	0.63	6	7.0	568.97	146.71	3.878	sub	1.09	603	22.3	159.48	1.97	39.38	0.00366	8.79	226.83	159.83		
4500	0.035	0.40%	4	115	4.81	0.60	7	7.0	646.13	154.69	4.177	sub	1.04	751	27.8	172.72	2.13	42.65	0.00397	9.52	274.61	191.19		
5000	0.035	0.40%	4	130	4.79	0.60	7	7.0	713.89	169.47	4.212	sub	1.05	830	30.7	187.72	2.32	46.35	0.00431	10.34	302.47	210.31		
5500	0.035	0.40%	4	150	4.68	0.60	6	7.0	788.88	188.56	4.184	sub	1.04	783	29.0	199.48	2.46	49.25	0.00458	10.99	292.24	205.24		
6000	0.035	0.40%	4	170	4.59	0.60	6	6.9	864.15	207.83	4.158	sub	1.04	873	32.3	219.48	2.71	54.19	0.00504	12.09	324.95	227.95		
6500	0.035	0.40%	4	180	4.66	0.60	6	7.0	924.82	218.40	4.235	sub	1.06	918	34.0	229.48	2.83	56.66	0.00527	12.64	341.30	239.30		

Channel Dimensions			Drop Structures & Costs																				
Q (cfs)	n	Slope	Constructed Depth (ft)	Length Perp. To Channel (ft/lin. ft)	Drop Depth (ft)	Height of Concrete Cutoff Wall (1' thick) (ft)	Volume of Concrete (cy)	Concrete Cost (\$/Str)	Structure Excavation (cy)	Structure Excavation Cost (\$/Str)	Approach Armoring Length (ft)	Approach Armoring Bed Thickness (ft)	Approach Armoring Volume of Riprap (cy)	Approach Armoring Cost - 12" Riprap (\$/Str)	Approach Armoring Geotextile (yd²)	Approach Armoring Geotextile Cost (\$/Str)	Exit Armoring Length (ft)	Exit Armoring Bed Thickness (ft)	Exit Armoring Volume of Riprap (cy)	Exit Armoring Cost - 24" Riprap (\$/Str)	Exit Armoring Geotextile (yd²)	Exit Armoring Geotextile Cost (\$/Str)	TOTAL COST (\$/STR)
GRASS																							
300	0.035	0.70%	8	44.98	3	9	15.0	9,147	10.00	79.97	12	2	39.99	7,797	69	207	24	2	79.97	0	138	0.00	17,300
500	0.035	0.65%	8	53.23	3	9	17.7	10,824	11.83	94.63	12	2	47.32	9,227	82	245	64	2	252.35	0	435	0.00	20,400
600	0.035	0.60%	8	61.48	3	9	20.5	12,500	13.66	109.29	12	2	54.65	10,656	94	283	64	2	291.45	0	503	0.00	23,600
800	0.035	0.60%	8	61.48	3	9	20.5	12,500	13.66	109.29	12	2	54.65	10,656	94	283	64	2	291.45	0	503	0.00	23,600
900	0.035	0.60%	8	61.48	3	9	20.5	12,500	13.66	109.29	12	2	54.65	10,656	94	283	64	2	291.45	0	503	0.00	23,600
1000	0.035	0.60%	8	69.72	3	9	23.2	14,177	15.49	123.95	12	2	61.98	12,085	107	321	64	2	330.54	0	570	0.00	26,800
1100	0.035	0.60%	9	69.72	3	9	23.2	14,177	15.49	123.95	12	3	92.96	18,128	107	321	72	3	557.79	0	641	0.00	32,800
1200	0.035	0.55%	10	69.72	3	9	23.2	14,177	15.49	123.95	12	4	123.95	24,171	107	321	80	4	826.35	0	713	0.00	38,800
1300	0.035	0.50%	11	72.72	3	9	24.2	14,787	16.16	129.29	12	5	161.61	31,514	112	335	88	5	1185.12	0	818	0.00	46,800
1400	0.035	0.50%	12	72.72	3	9	24.2	14,787	16.16	129.29	12	6	193.93	37,816	112	335	96	6	1551.43	0	892	0.00	53,100
1500	0.035	0.50%	8	82.72	3	9	27.6	16,820	18.38	147.06	12	2	73.53	14,339	127	381	64	2	392.17	0	676	0.00	31,700
1700	0.035	0.50%	9	82.72	3	9	27.6	16,820	18.38	147.06	12	3	110.30	21,508	127	381	72	3	661.79	0	761	0.00	38,900
2000	0.035	0.40%	8	102.72	3	9	34.2	20,887	22.83	182.62	12	2	91.31	17,805	158	473	64	2	486.99	0	840	0.00	39,400
2500	0.035	0.40%	8	119.48	3	9	39.8	24,294	26.55	212.40	12	2	106.20	20,709	183	550	64	2	566.41	0	977	0.00	45,800
3000	0.035	0.45%	8	127.72	3	9	42.6	25,970	28.38	227.06	12	2	113.53	22,139	196	588	64	2	605.50	0	1044	0.00	49,000
3500	0.035	0.45%	8	139.48	3	9	46.5	28,360	30.99	247.96	12	2	123.98	24,176	214	642	64	2	661.23	0	1141	0.00	53,500
4000	0.035	0.45%	8	159.48	3	9	53.2	32,427	35.44	283.52	12	2	141.76	27,643	245	734	64	2	756.04	0	1304	0.00	61,100
4500	0.035	0.40%	8	172.72	3	9	57.6	35,120	38.38	307.06	12	2	153.53	29,939	265	795	64	2	818.84	0	1412	0.00	66,200
5000	0.035	0.40%	8	187.72	3	9	62.6	38,170	41.72	333.73	12	2	166.87	32,539	288	864	64	2	889.95	0	1535	0.00	72,000
5500	0.035	0.40%	8	199.48	3	9	66.5	40,560	44.33	354.63	12	2	177.31	34,576	306	918	64	2	945.67	0	1631	0.00	76,500
6000	0.035	0.40%	8	219.48	3	9	73.2	44,627	48.77	390.18	12	2	195.09	38,043	337	1,010	64	2	1040.48	0	1795	0.00	84,100
6500	0.035	0.40%	8	229.48	3	9	76.5	46,660	50.99	407.96	12	2	203.98	39,776	352	1,056	64	2	1087.89	0	1877	0.00	87,900



Table C-2
Flat Grass Lined Channel Design

Channel Dimensions													Flow Depth	Channel Costs												
														Excavation Area = 0.75* cross section area (ft²/lin. ft)		Excavation (cy/lin. ft)	Surface Area (ft/lin. ft)	4" Topsoil (cy/ lin. ft)	4" Topsoil Cost (\$/lin. ft)	Seeding (acre)	Seeding Cost (\$/lin. ft)	TOTAL COST for ≤50K CY Cut (\$/LF)	TOTAL COST for >50K CY Cut (\$/LF)			
Q (cfs)	n	Slope	Side Sops	Bottom Width (ft)	Normal Depth (ft)	Froude Number	Constructed Depth with Freeboard(ft)	Velocity (fps)	Flow Area (sf)	Wetted Perimeter (ft)	R (ft)	Regime	t _d (psf)													
GRASS																										
300	0.035	0.18%	4	12	3.62	0.36	5	3.1	95.85	41.85	2.290	sub	0.26	120	4.4	53.23	0.66	13.14	0.00122	2.93	51.63	38.30				
500	0.035	0.18%	4	12	4.60	0.37	6	3.6	139.74	49.92	2.800	sub	0.31	162	6.0	61.48	0.76	15.18	0.00141	3.39	66.57	48.57				
600	0.035	0.18%	4	12	5.00	0.38	7	3.8	159.95	53.22	3.005	sub	0.34	210	7.8	69.72	0.86	17.22	0.00160	3.84	83.28	59.95				
800	0.035	0.18%	4	12	5.69	0.38	7	4.0	198.02	58.95	3.359	sub	0.38	210	7.8	69.72	0.86	17.22	0.00160	3.84	83.28	59.95				
900	0.035	0.18%	4	12	6.00	0.39	8	4.2	216.14	61.50	3.515	sub	0.39	264	9.8	77.97	0.96	19.25	0.00179	4.30	101.77	72.44				
1000	0.035	0.18%	4	12	6.29	0.39	8	4.3	233.76	63.87	3.660	sub	0.41	264	9.8	77.97	0.96	19.25	0.00179	4.30	101.77	72.44				
1100	0.035	0.18%	4	12	6.56	0.39	8	4.4	250.95	66.11	3.796	sub	0.43	264	9.8	77.97	0.96	19.25	0.00179	4.30	101.77	72.44				
1200	0.035	0.18%	4	15	6.53	0.39	8	4.5	268.78	68.88	3.902	sub	0.44	282	10.4	80.97	1.00	19.99	0.00186	4.46	108.01	76.68				
1300	0.035	0.18%	4	15	6.78	0.40	8	4.6	285.23	70.87	4.025	sub	0.45	282	10.4	80.97	1.00	19.99	0.00186	4.46	108.01	76.68				
1400	0.035	0.18%	4	20	6.56	0.40	8	4.6	303.61	74.13	4.096	sub	0.46	312	11.6	85.97	1.06	21.23	0.00197	4.74	118.41	83.74				
1500	0.035	0.18%	4	25	6.38	0.40	8	4.7	322.31	77.61	4.153	sub	0.47	342	12.7	90.97	1.12	22.46	0.00209	5.01	128.81	90.81				
1700	0.035	0.18%	4	30	6.41	0.40	8	4.8	356.66	82.86	4.304	sub	0.48	372	13.8	95.97	1.18	23.70	0.00220	5.29	139.21	97.87				
2000	0.035	0.18%	4	45	6.00	0.40	8	4.8	414.45	94.52	4.385	sub	0.49	462	17.1	110.97	1.37	27.40	0.00255	6.11	170.40	119.07				
3000	0.035	0.15%	4	70	6.48	0.38	8	4.8	621.18	123.41	5.033	sub	0.47	612	22.7	135.97	1.68	33.57	0.00312	7.49	222.40	154.40				
3500	0.035	0.15%	4	90	6.26	0.38	8	4.9	719.91	141.61	5.084	sub	0.48	732	27.1	155.97	1.93	38.51	0.00358	8.59	263.99	182.66				
4000	0.035	0.15%	4	105	6.25	0.38	8	4.9	811.79	156.50	5.187	sub	0.49	822	30.4	170.97	2.11	42.21	0.00392	9.42	295.19	203.86				
4500	0.035	0.15%	4	115	6.37	0.38	8	5.0	895.34	167.55	5.344	sub	0.50	882	32.7	180.97	2.23	44.68	0.00415	9.97	315.99	217.99				
5000	0.035	0.15%	4	140	6.10	0.38	8	5.0	1003.68	190.34	5.273	sub	0.49	1032	38.2	205.97	2.54	50.86	0.00473	11.35	367.98	253.32				
5500	0.035	0.15%	4	160	6.00	0.38	8	5.0	1104.29	209.49	5.271	sub	0.49	1152	42.7	225.97	2.79	55.79	0.00519	12.45	409.58	281.58				
6000	0.035	0.15%	4	180	5.92	0.38	8	5.0	1205.24	228.80	5.268	sub	0.49	1272	47.1	245.97	3.04	60.73	0.00565	13.55	451.17	309.84				
6500	0.035	0.15%	4	190	6.02	0.38	8	5.0	1288.13	239.62	5.376	sub	0.50	1332	49.3	255.97	3.16	63.20	0.00588	14.10	471.97	323.97				

= Flow depth button will calculate these cells using Manning's Equation



Table S-1
Detention Spillway Design

Flow Rate	Weir Width (B) (ft)	Weir Width (B) (ft)	Head (H) on Weir (ft)	Weir Design Depth (Ft)	Weir Side Slope H:1	Cutoff Wall Length (ft)	Chute Length (ft)	Chute Armored Area (sf)	Chute Cost (\$)	Calculated Flow Rate (cfs)	Cutoff Wall Volume with 5 ft Depth and 1 ft. thick (CY)	Cutoff Wall Cost (\$)	Spillway Cost
300	13.42	14	3.0	4	3	39	20	775	11,191	300	7	4,376	15,567
500	12.72	13	4.0	5	3	44	20	872	12,594	500	8	4,925	17,518
600	17.19	18	4.0	5	3	49	20	972	14,038	600	9	5,489	19,528
800	13.56	14	5.0	9	3	68	20	1,367	19,740	800	13	7,719	27,459
900	16.75	17	5.0	9	3	71	20	1,427	20,607	900	13	8,058	28,665
1000	19.94	20	5.0	9	3	74	20	1,487	21,474	1000	14	8,397	29,871
1500	35.92	36	5.0	9	3	90	20	1,807	26,096	1500	17	10,204	36,300
2000	51.89	52	5.0	9	3	106	20	2,127	30,718	2000	20	12,012	42,730
2500	67.86	68	5.0	9	3	122	20	2,447	35,340	2500	23	13,819	49,159
3000	83.83	84	5.0	9	3	138	20	2,767	39,963	3000	26	15,626	55,589
3500	99.80	100	5.0	9	3	154	20	3,087	44,585	3500	29	17,434	62,019
4000	115.78	116	5.0	9	3	170	20	3,407	49,207	4000	32	19,241	68,448
4500	131.75	132	5.0	9	3	186	20	3,727	53,829	4500	35	21,049	74,878
5000	147.72	148	5.0	9	3	202	20	4,047	58,452	5000	37	22,856	81,308
5500	163.69	164	5.0	9	3	218	20	4,367	63,074	5500	40	24,663	87,737

$$Q = CH^{3/2} [B + 4ZH/5]$$

Weir coefficient=2.8

Design Channel Type	Design Bridge Type	Width (ft) ROW	
Steep Channel Design	Local	66	60
Flat Channel Design	Collector	66	60
	Minor Arterial	82	76
	Major Arterial	106	100