APPENDIX 11-QQ

NORTH FORK DIVERSION CHANNEL

FEBRUARY 2001

NORTH FORK DIVERSION CHANNEL

HYDROLOGY

FEBRUARY 2001

NORTH FORK DIVERSION CHANNEL

Hydrology model for the North Fork Diversion Channel. Refer to Exhibit 11-142A for the SEDCAD watershed subdivisions and Exhibit 11-142B & 142C for design plan, profile, and sections.

LR

BHP Navajo Coal Company
Navajo Mine
PO Box 1717
Fruitland, NM 87415

Phone: 505-598-5861

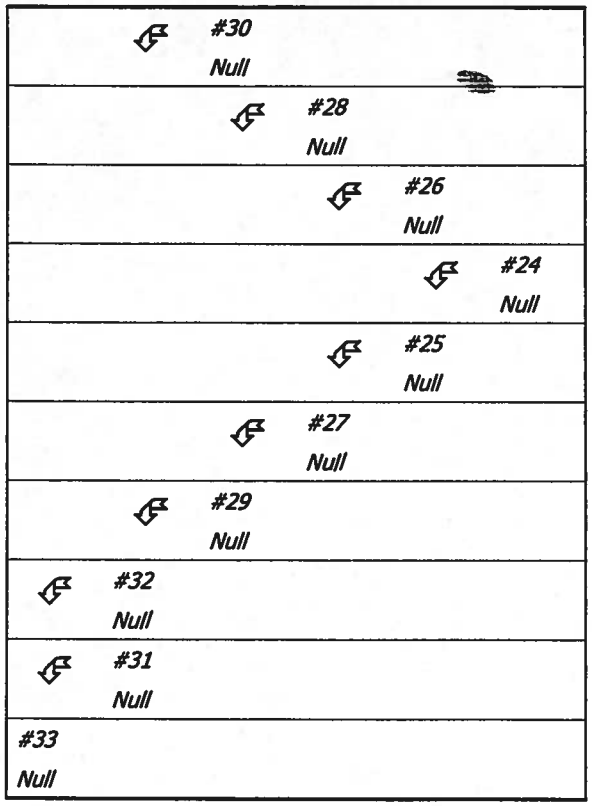
General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#24	==>	#25	0.964	0.340	
Null	#25	==>	#27	1.454	0.333	
Null	#26	==>	#27	1.454	0.333	
Null	#27	==>	#29	0.800	0.323	
Null	#28	==>	#29	0.800	0.323	
Null	#29	==>	#32	0.479	0.298	
Null	#30	==>	#32	0.479	0.298	
Null	#31	==>	#33	0.000	0.000	
Null	#32	==>	#33	0.000	0.000	
Null	#33	==>	End	0.000	0.000	Inlet to North Fork Diversion



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#24	8. Large gullies, diversions, and low flowing streams	1.46	184.00	12,568.00	3.62	0.964
#24	**Muskingum K:**					**0.964**
#25	8. Large gullies, diversions, and low flowing streams	1.28	228.00	17,755.00	3.39	1.454
#25	**Muskingum K:**					**1.454**
#26	8. Large gullies, diversions, and low flowing streams	1.28	228.00	17,755.62	3.39	1.454
#26	**Muskingum K:**					**1.454**
#27	8. Large gullies, diversions, and low flowing streams	1.07	96.00	8,938.00	3.10	0.800
#27	**Muskingum K:**					**0.800**
#28	8. Large gullies, diversions, and low flowing streams	1.07	96.00	8,938.00	3.10	0.800
#28	**Muskingum K:**					**0.800**
#29	8. Large gullies, diversions, and low flowing streams	0.70	30.00	4,313.00	2.50	0.479
#29	**Muskingum K:**					**0.479**
#30	8. Large gullies, diversions, and low flowing streams	0.70	30.00	4,313.00	2.50	0.479
#30	**Muskingum K:**					**0.479**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#30	476.400	476.400	0.20	0.04
#28	1,217.900	1,217.900	127.50	21.24
#26	2,486.400	2,486.400	5.44	2.30
#24	8,061.800	8,061.800	6.64	4.91
#25	1,015.700	9,077.500	25.38	9.08
#27	1,783.700	13,347.600	51.42	18.56
#29	966.000	15,531.500	173.24	56.11
#32	293.700	16,301.600	178.81	63.51
#31	957.100	957.100	135.01	21.90
#33	0.000	17,258.700	243.60	85.41

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#30	1	476.400	1.131	0.000	0.000	73.100	M	0.20	0.043
	Σ	**476.400**						**0.20**	**0.043**
#28	1	772.300	0.657	0.523	0.334	90.400	M	106.00	13.472
	2	445.600	0.587	0.000	0.000	90.400	M	65.74	7.773
	Σ	**1,217.900**						**127.50**	**21.244**
#26	1	447.600	2.192	0.000	0.000	74.200	M	0.34	0.114
	2	2,038.800	3.000	0.000	0.000	77.000	M	5.10	2.186
	Σ	**2,486.400**						**5.44**	**2.300**
#24	1	2,607.500	5.367	2.377	0.305	75.200	M	2.02	1.246
	2	2,331.900	4.813	2.431	0.304	74.700	M	1.48	0.833
	3	1,758.500	2.231	1.788	0.297	76.200	M	3.66	1.366
	4	1,363.900	2.618	0.000	0.000	77.000	M	3.63	1.463
	Σ	**8,061.800**						**6.64**	**4.907**
#25	1	515.200	0.990	0.342	0.357	78.200	M	3.32	0.833
	2	130.500	0.787	0.342	0.357	78.100	M	0.89	0.204
	3	370.000	0.516	0.000	0.000	85.700	M	25.34	3.140
	Σ	**9,077.500**						**25.38**	**9.084**
#27	1	354.400	0.612	1.233	0.337	83.100	M	11.81	1.882
	2	305.200	0.529	1.054	0.328	84.000	M	14.02	1.922
	3	289.800	0.692	0.551	0.328	75.500	M	0.59	0.162
	4	253.000	0.361	0.551	0.328	79.400	M	3.26	0.579
	5	581.300	0.980	0.000	0.000	82.300	M	12.58	2.629
	Σ	**13,347.600**						**51.42**	**18.559**
#29	1	508.800	0.409	0.416	0.312	89.500	M	80.63	7.795
	2	233.200	0.521	0.291	0.312	91.600	M	44.78	4.818
	3	224.000	0.467	0.000	0.000	90.000	M	35.63	3.690
	Σ	**15,531.500**						**173.24**	**56.106**
#32	1	293.700	0.576	0.000	0.000	93.000	M	65.60	7.363
	Σ	**16,301.600**						**178.81**	**63.512**
#31	1	431.100	0.588	0.450	0.336	91.500	M	75.71	8.782
	2	325.800	0.432	0.149	0.327	93.000	M	85.40	8.167
	3	200.200	0.373	0.000	0.000	92.900	M	55.57	4.950
	Σ	**957.100**						**135.01**	**21.900**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#33	**∑**	**17,258.700**						**243.60**	**85.412**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#24	1	5. Nearly bare and untilled, and alluvial valley fans	1.71	430.00	25,118.00	1.300	5.367
#24	**1**	**Time of Concentration:**					**5.367**
#24	2	5. Nearly bare and untilled, and alluvial valley fans	1.84	430.00	23,393.00	1.350	4.813
#24	**2**	**Time of Concentration:**					**4.813**
#24	3	5. Nearly bare and untilled, and alluvial valley fans	1.82	155.00	8,498.00	1.350	1.748
		8. Large gullies, diversions, and low flowing streams	0.84	40.00	4,771.00	2.740	0.483
#24	**3**	**Time of Concentration:**					**2.231**
#24	4	5. Nearly bare and untilled, and alluvial valley fans	1.24	50.00	4,042.00	1.110	1.011
		8. Large gullies, diversions, and low flowing streams	0.49	60.00	12,150.00	2.100	1.607
#24	**4**	**Time of Concentration:**					**2.618**
#25	1	5. Nearly bare and untilled, and alluvial valley fans	0.51	10.00	1,950.00	0.710	0.762
		8. Large gullies, diversions, and low flowing streams	1.81	60.00	3,322.00	4.030	0.228
#25	**1**	**Time of Concentration:**					**0.990**
#25	2	5. Nearly bare and untilled, and alluvial valley fans	1.11	25.00	2,254.00	1.050	0.596
		8. Large gullies, diversions, and low flowing streams	2.36	75.00	3,178.00	4.600	0.191
#25	**2**	**Time of Concentration:**					**0.787**
#25	3	5. Nearly bare and untilled, and alluvial valley fans	3.23	30.00	929.00	1.790	0.144
		8. Large gullies, diversions, and low flowing streams	2.45	154.00	6,297.00	4.690	0.372
#25	**3**	**Time of Concentration:**					**0.516**
#26	1	5. Nearly bare and untilled, and alluvial valley fans	1.20	103.00	8,602.00	1.090	2.192
#26	**1**	**Time of Concentration:**					**2.192**
#26	2	5. Nearly bare and untilled, and alluvial valley fans	1.23	120.00	9,780.00	1.100	2.469
		8. Large gullies, diversions, and low flowing streams	2.18	184.00	8,454.00	4.420	0.531
#26	**2**	**Time of Concentration:**					**3.000**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	1	5. Nearly bare and untilled, and alluvial valley fans	4.32	50.00	1,158.02	2.070	0.155
		8. Large gullies, diversions, and low flowing streams	2.53	198.00	7,838.16	4.760	0.457
#27	**1**	**Time of Concentration:**					**0.612**
#27	2	5. Nearly bare and untilled, and alluvial valley fans	5.26	30.00	570.00	2.290	0.069
		8. Large gullies, diversions, and low flowing streams	3.15	278.00	8,822.00	5.320	0.460
#27	**2**	**Time of Concentration:**					**0.529**
#27	3	5. Nearly bare and untilled, and alluvial valley fans	16.33	80.00	490.00	4.040	0.033
		8. Large gullies, diversions, and low flowing streams	2.15	225.00	10,443.00	4.400	0.659
#27	**3**	**Time of Concentration:**					**0.692**
#27	4	5. Nearly bare and untilled, and alluvial valley fans	12.43	65.00	523.00	3.520	0.041
		8. Large gullies, diversions, and low flowing streams	3.49	225.00	6,454.00	5.600	0.320
#27	**4**	**Time of Concentration:**					**0.361**
#27	5	5. Nearly bare and untilled, and alluvial valley fans	9.40	25.00	266.00	3.060	0.024
		8. Large gullies, diversions, and low flowing streams	2.32	364.00	15,700.00	4.560	0.956
#27	**5**	**Time of Concentration:**					**0.980**
#28	1	5. Nearly bare and untilled, and alluvial valley fans	5.25	40.00	762.00	2.290	0.092
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**1**	**Time of Concentration:**					**0.657**
#28	2	5. Nearly bare and untilled, and alluvial valley fans	25.86	105.00	406.00	5.080	0.022
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**2**	**Time of Concentration:**					**0.587**
#29	1	5. Nearly bare and untilled, and alluvial valley fans	11.58	30.00	259.00	3.400	0.021
		8. Large gullies, diversions, and low flowing streams	3.61	288.00	7,976.00	5.700	0.388
#29	**1**	**Time of Concentration:**					**0.409**
#29	2	5. Nearly bare and untilled, and alluvial valley fans	8.06	40.00	496.00	2.830	0.048
		8. Large gullies, diversions, and low flowing streams	2.90	252.00	8,693.55	5.100	0.473
#29	**2**	**Time of Concentration:**					**0.521**
#29	3	5. Nearly bare and untilled, and alluvial valley fans	7.25	25.00	345.00	2.690	0.035

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.26	158.00	7,001.00	4.500	0.432
#29	**3**	**Time of Concentration:**					**0.467**
#30	1	5. Nearly bare and untilled, and alluvial valley fans	4.93	35.00	710.00	2.220	0.088
		8. Large gullies, diversions, and low flowing streams	1.67	243.00	14,540.00	3.870	1.043
#30	**1**	**Time of Concentration:**					**1.131**
#31	1	5. Nearly bare and untilled, and alluvial valley fans	2.91	15.00	515.00	1.700	0.084
		8. Large gullies, diversions, and low flowing streams	2.74	247.00	9,006.00	4.960	0.504
#31	**1**	**Time of Concentration:**					**0.588**
#31	2	5. Nearly bare and untilled, and alluvial valley fans	7.46	25.00	335.00	2.730	0.034
		8. Large gullies, diversions, and low flowing streams	2.18	138.00	6,335.00	4.420	0.398
#31	**2**	**Time of Concentration:**					**0.432**
#31	3	5. Nearly bare and untilled, and alluvial valley fans	3.84	20.00	521.00	1.950	0.074
		8. Large gullies, diversions, and low flowing streams	2.24	108.00	4,826.00	4.480	0.299
#31	**3**	**Time of Concentration:**					**0.373**
#32	1	5. Nearly bare and untilled, and alluvial valley fans	3.48	22.00	632.00	1.860	0.094
		8. Large gullies, diversions, and low flowing streams	1.56	101.00	6,494.00	3.740	0.482
#32	**1**	**Time of Concentration:**					**0.576**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#24	1	8. Large gullies, diversions, and low flowing streams	0.79	180.00	22,769.00	2.660	2.377
#24	**1**	**Muskingum K:**					**2.377**
#24	2	8. Large gullies, diversions, and low flowing streams	0.78	180.00	23,111.00	2.640	2.431
#24	**2**	**Muskingum K:**					**2.431**
#24	4	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#24	**4**	**Muskingum K:**					**0.000**
#25	1	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**1**	**Muskingum K:**					**0.342**
#25	2	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#25	**2**	**Muskingum K:**					**0.342**
#25	3	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#25	**3**	**Muskingum K:**					**0.000**
#27	1	8. Large gullies, diversions, and low flowing streams	1.38	216.00	15,629.00	3.520	1.233
#27	**1**	**Muskingum K:**					**1.233**
#27	2	8. Large gullies, diversions, and low flowing streams	1.17	144.00	12,301.00	3.240	1.054
#27	**2**	**Muskingum K:**					**1.054**
#27	3	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**3**	**Muskingum K:**					**0.551**
#27	4	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**4**	**Muskingum K:**					**0.551**
#28	1	8. Large gullies, diversions, and low flowing streams	1.30	84.00	6,445.17	3.420	0.523
#28	**1**	**Muskingum K:**					**0.523**
#29	1	8. Large gullies, diversions, and low flowing streams	0.88	37.00	4,210.00	2.810	0.416
#29	**1**	**Muskingum K:**					**0.416**
#29	2	8. Large gullies, diversions, and low flowing streams	0.88	26.00	2,949.00	2.810	0.291
#29	**2**	**Muskingum K:**					**0.291**
#31	1	8. Large gullies, diversions, and low flowing streams	1.35	76.00	5,639.00	3.480	0.450
#31	**1**	**Muskingum K:**					**0.450**
#31	2	8. Large gullies, diversions, and low flowing streams	1.15	20.00	1,734.00	3.220	0.149
#31	**2**	**Muskingum K:**					**0.149**

General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	5 yr - 6 hr
Rainfall Depth:	1.100 inches

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#30	476.400	476.400	5.05	1.30
#28	1,217.900	1,217.900	253.26	41.01
#26	2,486.400	2,486.400	33.98	13.87
#24	8,061.800	8,061.800	48.15	37.81
#25	1,015.700	9,077.500	67.51	49.99
#27	1,783.700	13,347.600	149.85	85.35
#29	966.000	15,531.500	373.04	158.08
#32	293.700	16,301.600	385.04	172.34
#31	957.100	957.100	249.28	39.41
#33	0.000	17,258.700	471.63	211.76

General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.300 inches

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#30	476.400	476.400	12.85	2.98
#28	1,217.900	1,217.900	348.89	55.85
#26	2,486.400	2,486.400	65.87	26.07
#24	8,061.800	8,061.800	94.58	74.22
#25	1,015.700	9,077.500	103.41	93.53
#27	1,783.700	13,347.600	236.67	153.83
#29	966.000	15,531.500	535.73	253.00
#32	293.700	16,301.600	553.89	272.97
#31	957.100	957.100	333.75	52.17
#33	0.000	17,258.700	646.50	325.15

NORTH FORK DIVERSION CHANNEL

CHANNEL DESIGN

FEBRUARY 2001

North Fork Diversion Channel, Sta. 0+00 to 26+37 and Sta. 31+50 to 39+80, 2yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	3.0:1	3.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	244.00 cfs	
Depth:	2.17 ft	3.17 ft
Top Width:	38.00 ft	44.00 ft
Velocity:	3.58 fps	
X-Section Area:	68.22 sq ft	
Hydraulic Radius:	1.763	
Froude Number:	0.47	

North Fork Diversion Channel, Sta. 26+57 to 26+88, 2yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	3.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	244.00 cfs	
Depth:	2.21 ft	3.21 ft
Top Width:	34.94 ft	39.44 ft
Velocity:	3.69 fps	
X-Section Area:	66.19 sq ft	
Hydraulic Radius:	1.845	
Froude Number:	0.47	

North Fork Diversion Channel, Sta. 27+08 to 27+85, 2yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	2.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	244.00 cfs	
Depth:	2.24 ft	3.24 ft
Top Width:	32.84 ft	36.34 ft
Velocity:	3.77 fps	
X-Section Area:	64.80 sq ft	
Hydraulic Radius:	1.904	
Froude Number:	0.47	

North Fork Diversion Channel, Sta. 28+05 to 29+30, 2yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	1.5:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	244.00 cfs	
Depth:	2.26 ft	3.26 ft
Top Width:	31.78 ft	34.78 ft
Velocity:	3.81 fps	
X-Section Area:	64.12 sq ft	
Hydraulic Radius:	1.935	
Froude Number:	0.47	

North Fork Diversion Channel, Sta. 29+50 to 31+30, 2yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	3.0:1	2.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	244.00 cfs	
Depth:	2.19 ft	3.19 ft
Top Width:	35.97 ft	40.97 ft
Velocity:	3.65 fps	
X-Section Area:	66.87 sq ft	
Hydraulic Radius:	1.817	
Froude Number:	0.47	

North Fork Diversion Channel, Sta. 0+00 to 26+37 and Sta. 31+50 to 39+80, 5yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	3.0:1	3.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	472.00 cfs	
Depth:	3.13 ft	4.13 ft
Top Width:	43.75 ft	49.75 ft
Velocity:	4.39 fps	
X-Section Area:	107.44 sq ft	
Hydraulic Radius:	2.400	
Froude Number:	0.49	

North Fork Diversion Channel, Sta. 26+57 to 26+88, 5yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	3.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	472.00 cfs	
Depth:	3.21 ft	4.21 ft
Top Width:	39.46 ft	43.96 ft
Velocity:	4.56 fps	
X-Section Area:	103.55 sq ft	
Hydraulic Radius:	2.537	
Froude Number:	0.50	

North Fork Diversion Channel, Sta. 27+08 to 27+85, 5yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	2.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	472.00 cfs	
Depth:	3.28 ft	4.28 ft
Top Width:	36.48 ft	39.98 ft
Velocity:	4.68 fps	
X-Section Area:	100.86 sq ft	
Hydraulic Radius:	2.639	
Froude Number:	0.50	

North Fork Diversion Channel, Sta. 28+05 to 29+30, 5yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	1.5:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	472.00 cfs	
Depth:	3.32 ft	4.32 ft
Top Width:	34.96 ft	37.96 ft
Velocity:	4.74 fps	
X-Section Area:	99.52 sq ft	
Hydraulic Radius:	2.692	
Froude Number:	0.50	

North Fork Diversion Channel, Sta. 29+50 to 31+30, 5yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	3.0:1	2.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	472.00 cfs	
Depth:	3.18 ft	4.18 ft
Top Width:	40.91 ft	45.91 ft
Velocity:	4.50 fps	
X-Section Area:	104.87 sq ft	
Hydraulic Radius:	2.489	
Froude Number:	0.50	

North Fork Diversion Channel, Sta. 0+00 to 26+37 and Sta. 31+50 to 39+80, 10yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	3.0:1	3.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	647.00 cfs	
Depth:	3.71 ft	4.71 ft
Top Width:	47.25 ft	53.25 ft
Velocity:	4.83 fps	
X-Section Area:	134.00 sq ft	
Hydraulic Radius:	2.765	
Froude Number:	0.51	

North Fork Diversion Channel, Sta. 26+57 to 26+88, 10yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	3.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	647.00 cfs	
Depth:	3.83 ft	4.83 ft
Top Width:	42.24 ft	46.74 ft
Velocity:	5.02 fps	
X-Section Area:	128.76 sq ft	
Hydraulic Radius:	2.936	
Froude Number:	0.51	

North Fork Diversion Channel, Sta. 27+08 to 27+85, 10yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	2.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	647.00 cfs	
Depth:	3.93 ft	4.93 ft
Top Width:	38.74 ft	42.24 ft
Velocity:	5.17 fps	
X-Section Area:	125.12 sq ft	
Hydraulic Radius:	3.065	
Froude Number:	0.51	

North Fork Diversion Channel, Sta. 28+05 to 29+30, 10yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	1.5:1	1.5:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	647.00 cfs	
Depth:	3.98 ft	4.98 ft
Top Width:	36.94 ft	39.94 ft
Velocity:	5.25 fps	
X-Section Area:	123.30 sq ft	
Hydraulic Radius:	3.133	
Froude Number:	0.51	

North Fork Diversion Channel, Sta. 29+50 to 31+30, 10yr-6hr Storm Event

Material: Shale and clays

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
25.00	3.0:1	2.0:1	0.3	0.0310	1.00			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	647.00 cfs	
Depth:	3.79 ft	4.79 ft
Top Width:	43.94 ft	48.94 ft
Velocity:	4.96 fps	
X-Section Area:	130.55 sq ft	
Hydraulic Radius:	2.876	
Froude Number:	0.51	

NORTH FORK DIVERSION CHANNEL

RIPRAPPED DOWNDRAIN DESIGNS FOR SIDE DRAINAGES

FEBRUARY 2001

NORTH FORK DIVERSION CHANNEL

Hydrology model and designs for rip-rapped downdrains. Refer to attached 8 1/2 X 11 sheet for watershed subdivisions. The location of the downdrains are shown on Exhibit 11-142B & 11-142C.

LR

BHP Navajo Coal Company
Navajo Mine
PO Box 1717
Fruitland, NM 87415

Phone: 505-598-5861

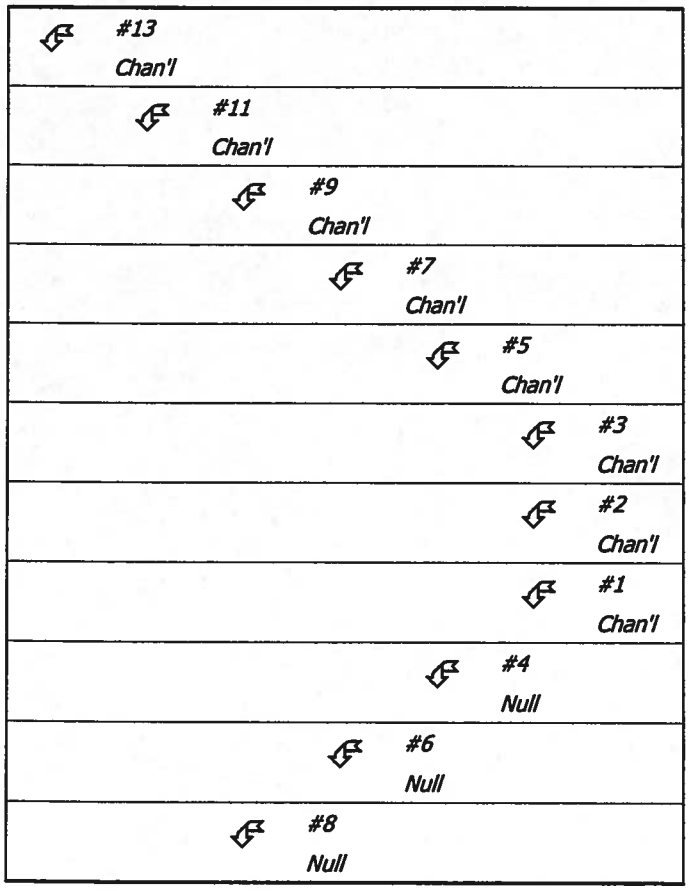
General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#4	0.041	0.236	Downdrain @ Sta. 1+55
Channel	#2	==>	#4	0.000	0.000	Downdrain @ Sta. 3+50
Channel	#3	==>	#4	0.000	0.000	Downdrain @ Sta. 3+80
Null	#4	==>	#6	0.063	0.237	
Channel	#5	==>	#6	0.000	0.000	Downdrain @ Sta. 7+30
Null	#6	==>	#8	0.045	0.237	
Channel	#7	==>	#8	0.000	0.000	Downdrain @ Sta. 9+82
Null	#8	==>	#10	0.199	0.237	
Channel	#9	==>	#10	0.000	0.000	Downdrain @ Sta. 20+80
Null	#10	==>	#12	0.093	0.237	
Channel	#11	==>	#12	0.000	0.000	Downdrain @ Sta. 25+95
Null	#12	==>	#14	0.070	0.238	
Channel	#13	==>	#14	0.000	0.000	Downdrain @ Sta. 29+85
Null	#14	==>	End	0.000	0.000	



	#10 *Null*	
#12 *Null*		
#14 *Null*		

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.26	0.58	225.00	1.52	0.041
#1	**Muskingum K:**					**0.041**
#2	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.00	0.000
#2	**Muskingum K:**					**0.000**
#4	8. Large gullies, diversions, and low flowing streams	0.26	0.92	350.07	1.53	0.063
#4	**Muskingum K:**					**0.063**
#6	8. Large gullies, diversions, and low flowing streams	0.26	0.66	252.00	1.53	0.045
#6	**Muskingum K:**					**0.045**
#8	8. Large gullies, diversions, and low flowing streams	0.26	2.89	1,098.00	1.53	0.199
#8	**Muskingum K:**					**0.199**
#10	8. Large gullies, diversions, and low flowing streams	0.26	1.35	515.00	1.53	0.093
#10	**Muskingum K:**					**0.093**
#12	8. Large gullies, diversions, and low flowing streams	0.26	1.03	390.00	1.54	0.070
#12	**Muskingum K:**					**0.070**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#13	8.020	8.020	10.45	0.46
#11	1.620	1.620	2.11	0.09
#9	6.850	6.850	8.93	0.40
#7	2.190	2.190	2.85	0.13
#5	5.780	5.780	7.53	0.33
#3	2.250	2.250	2.93	0.13
#2	37.760	37.760	29.33	2.19
#1	4.920	4.920	6.41	0.28
#4	0.000	44.930	34.27	2.60
#6	0.000	50.710	37.13	2.94
#8	0.000	52.900	39.99	3.06
#10	0.000	59.750	35.60	3.46
#12	0.000	61.370	34.94	3.55
#14	0.000	69.390	36.39	4.02

Structure Detail:

Structure #13 (Riprap Channel)

Downdrain @ Sta. 29+85

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	3.0:1	3.0:1	15.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	10.45 cfs	
Depth:	0.16 ft	1.16 ft
Top Width:	5.98 ft	11.98 ft
Velocity*:		
X-Section Area:	0.90 sq ft	
Hydraulic Radius:	0.149	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #11 (Riprap Channel)

Downdrain @ Sta. 25+95

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	3.0:1	3.0:1	15.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.11 cfs	
Depth:	0.12 ft	1.12 ft
Top Width:	2.70 ft	8.70 ft
Velocity*:		
X-Section Area:	0.28 sq ft	
Hydraulic Radius:	0.101	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #9 (Riprap Channel)

Downdrain @ Sta. 20+80

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	3.0:1	3.0:1	15.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.93 cfs	
Depth:	0.15 ft	1.15 ft
Top Width:	5.88 ft	11.88 ft
Velocity*:		
X-Section Area:	0.80 sq ft	
Hydraulic Radius:	0.135	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #7 (Riprap Channel)

Downdrain @ Sta. 9+82

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
4.00	3.0:1	3.0:1	20.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.85 cfs	
Depth:	0.07 ft	1.07 ft
Top Width:	4.41 ft	10.41 ft
Velocity*:		
X-Section Area:	0.29 sq ft	
Hydraulic Radius:	0.064	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #5 (Riprap Channel)

Downdrain @ Sta. 7+30

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	3.0:1	3.0:1	15.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	7.53 cfs	
Depth:	0.13 ft	1.13 ft
Top Width:	5.79 ft	11.79 ft
Velocity*:		
X-Section Area:	0.71 sq ft	
Hydraulic Radius:	0.121	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #3 (Riprap Channel)

Downdrain @ Sta. 3+80

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
4.00	3.0:1	3.0:1	20.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.93 cfs	
Depth:	0.07 ft	1.07 ft
Top Width:	4.41 ft	10.41 ft
Velocity*:		
X-Section Area:	0.29 sq ft	
Hydraulic Radius:	0.065	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #2 (Riprap Channel)

Downdrain @ Sta. 3+50

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	15.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	29.33 cfs	
Depth:	0.33 ft	1.33 ft
Top Width:	7.98 ft	13.98 ft
Velocity*:		
X-Section Area:	2.30 sq ft	
Hydraulic Radius:	0.285	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #1 (Riprap Channel)

Downdrain @ Sta. 1+55

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
4.00	3.0:1	3.0:1	15.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	6.41 cfs	
Depth:	0.14 ft	1.14 ft
Top Width:	4.81 ft	10.81 ft
Velocity*:		
X-Section Area:	0.60 sq ft	
Hydraulic Radius:	0.123	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #4 (Null)

Structure #6 (Null)

Structure #8 (Null)

Structure #10 (Null)

Structure #12 (Null)

Structure #14 (Null)

Subwatershed Hydrology Detail:

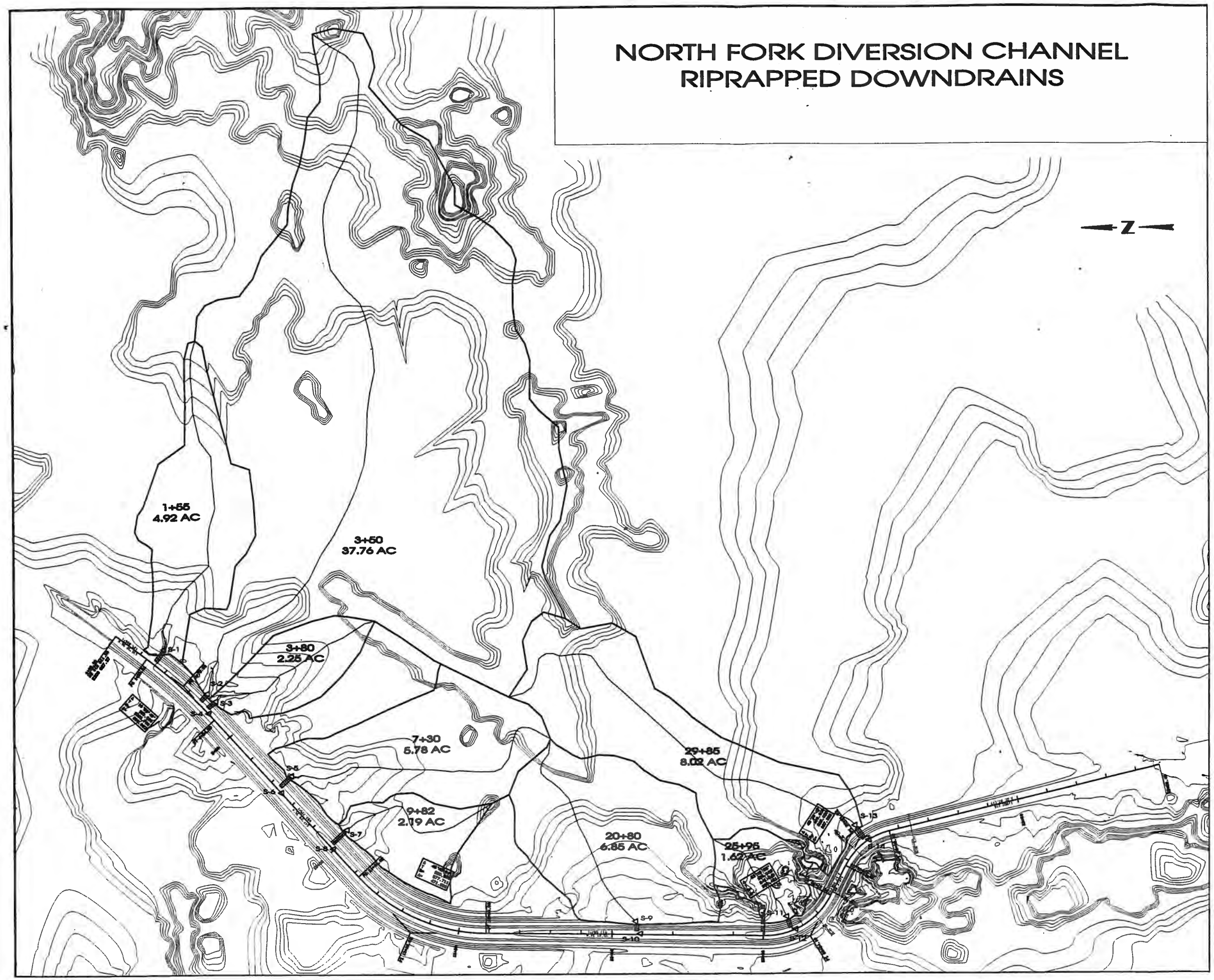
Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#13	1	8.020	0.110	0.000	0.000	93.000	M	10.45	0.464
	Σ	**8.020**						**10.45**	**0.464**
#11	1	1.620	0.029	0.000	0.000	93.000	M	2.11	0.094
	Σ	**1.620**						**2.11**	**0.094**
#9	1	6.850	0.049	0.000	0.000	93.000	M	8.93	0.397
	Σ	**6.850**						**8.93**	**0.397**
#7	1	2.190	0.048	0.000	0.000	93.000	M	2.85	0.127
	Σ	**2.190**						**2.85**	**0.127**
#5	1	5.780	0.079	0.000	0.000	93.000	M	7.53	0.335
	Σ	**5.780**						**7.53**	**0.335**
#3	1	2.250	0.035	0.000	0.000	93.000	M	2.93	0.130
	Σ	**2.250**						**2.93**	**0.130**
#2	1	37.760	0.235	0.000	0.000	93.000	M	29.33	2.186
	Σ	**37.760**						**29.33**	**2.186**
#1	1	4.920	0.104	0.000	0.000	93.000	M	6.41	0.285
	Σ	**4.920**						**6.41**	**0.285**
#4	Σ	**44.930**						**34.27**	**2.601**
#6	Σ	**50.710**						**37.13**	**2.935**
#8	Σ	**52.900**						**39.99**	**3.062**
#10	Σ	**59.750**						**35.60**	**3.459**
#12	Σ	**61.370**						**34.94**	**3.552**
#14	Σ	**69.390**						**36.39**	**4.017**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.35	20.00	460.00	2.080	0.061
		8. Large gullies, diversions, and low flowing streams	1.98	13.00	658.00	4.210	0.043

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	**1**	**Time of Concentration:**					**0.104**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	3.56	32.00	900.00	1.880	0.132
		8. Large gullies, diversions, and low flowing streams	2.06	33.00	1,601.00	4.300	0.103
#2	**1**	**Time of Concentration:**					**0.235**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	23.00	23.00	100.00	4.790	0.005
		8. Large gullies, diversions, and low flowing streams	2.37	12.00	506.00	4.610	0.030
#3	**1**	**Time of Concentration:**					**0.035**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	6.18	21.00	340.00	2.480	0.038
		8. Large gullies, diversions, and low flowing streams	1.91	12.00	627.00	4.150	0.041
#5	**1**	**Time of Concentration:**					**0.079**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	6.67	20.00	300.00	2.580	0.032
		8. Large gullies, diversions, and low flowing streams	2.46	7.00	284.00	4.700	0.016
#7	**1**	**Time of Concentration:**					**0.048**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	10.33	31.00	300.00	3.210	0.025
		8. Large gullies, diversions, and low flowing streams	2.44	10.00	409.00	4.690	0.024
#9	**1**	**Time of Concentration:**					**0.049**
#11	1	5. Nearly bare and untilled, and alluvial valley fans	7.00	14.00	200.00	2.640	0.021
		8. Large gullies, diversions, and low flowing streams	3.37	6.00	178.00	5.500	0.008
#11	**1**	**Time of Concentration:**					**0.029**
#13	1	5. Nearly bare and untilled, and alluvial valley fans	3.67	11.00	300.00	1.910	0.043
		8. Large gullies, diversions, and low flowing streams	2.38	27.00	1,133.00	4.630	0.067
#13	**1**	**Time of Concentration:**					**0.110**

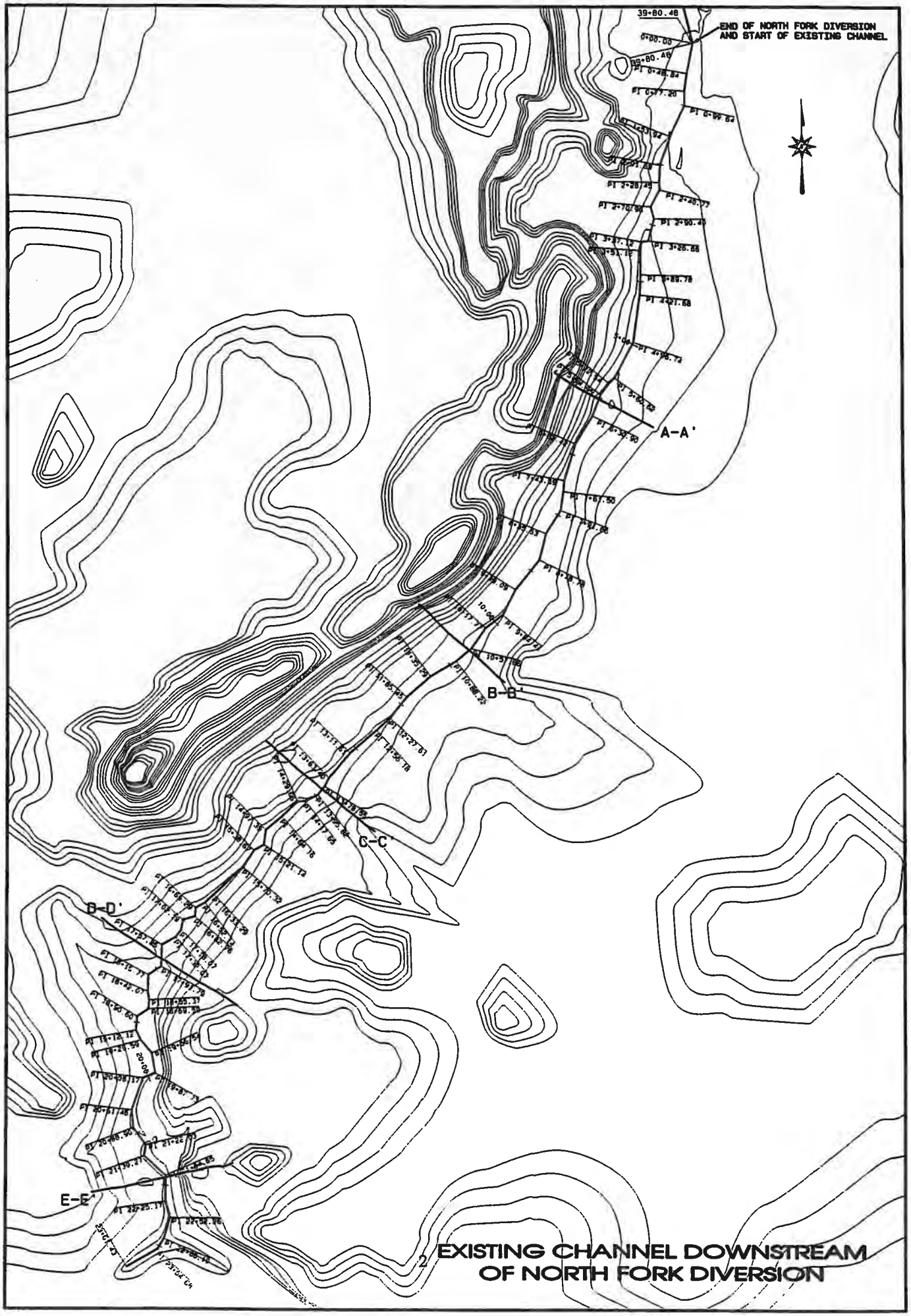
NORTH FORK DIVERSION CHANNEL
RIPRAPPED DOWNDRAINS



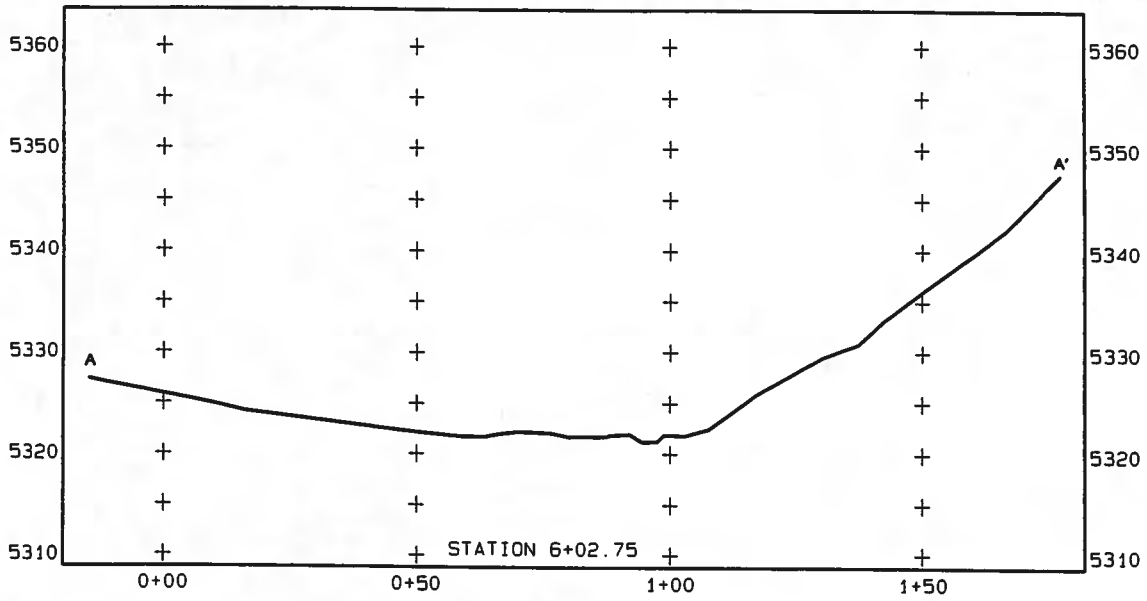
NORTH FORK DIVERSION CHANNEL

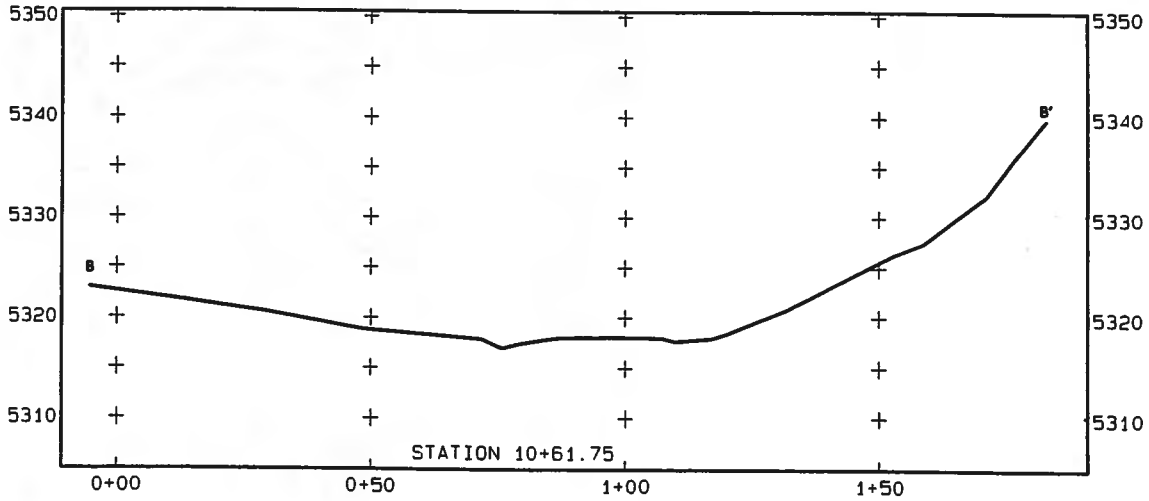
HYDRAULIC EVALUATION OF THE REACH IN THE NATURAL DRAINAGE

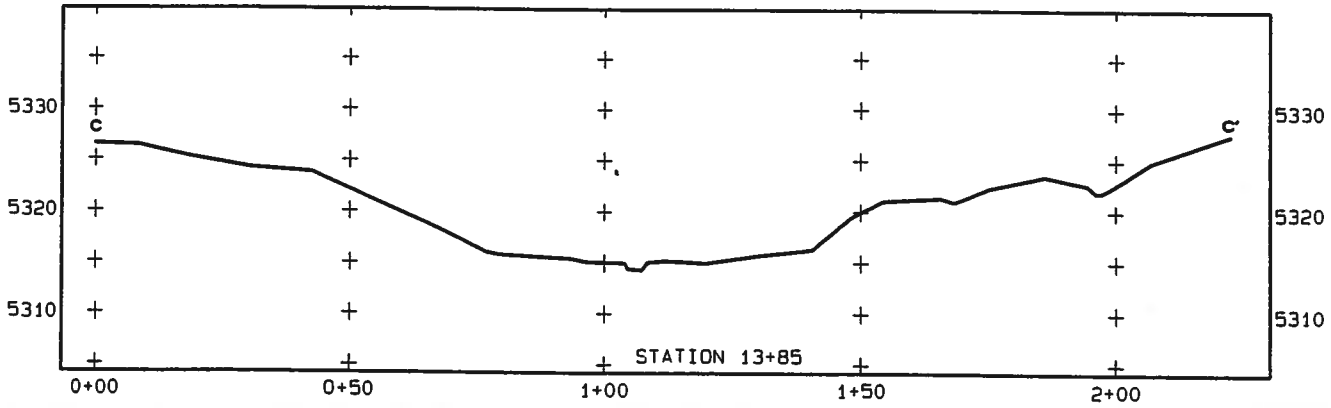
FEBRUARY 2001



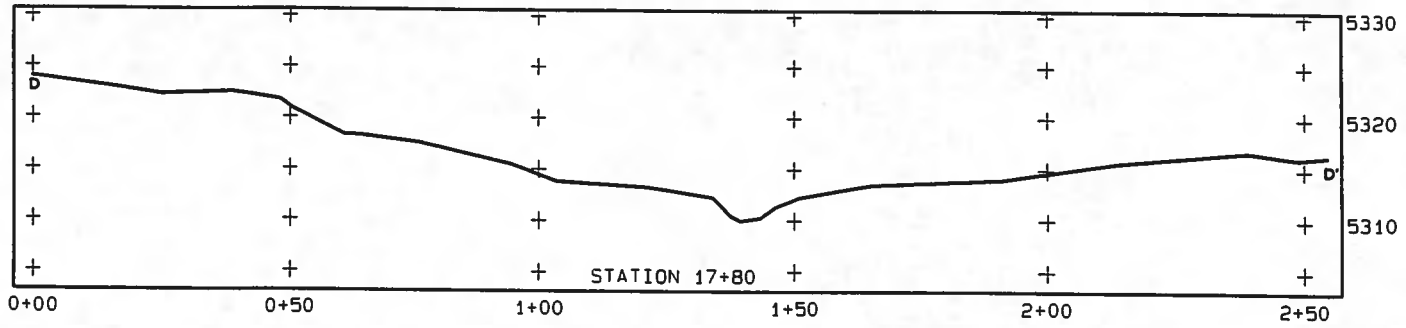
2 EXISTING CHANNEL DOWNSTREAM OF NORTH FORK DIVERSION

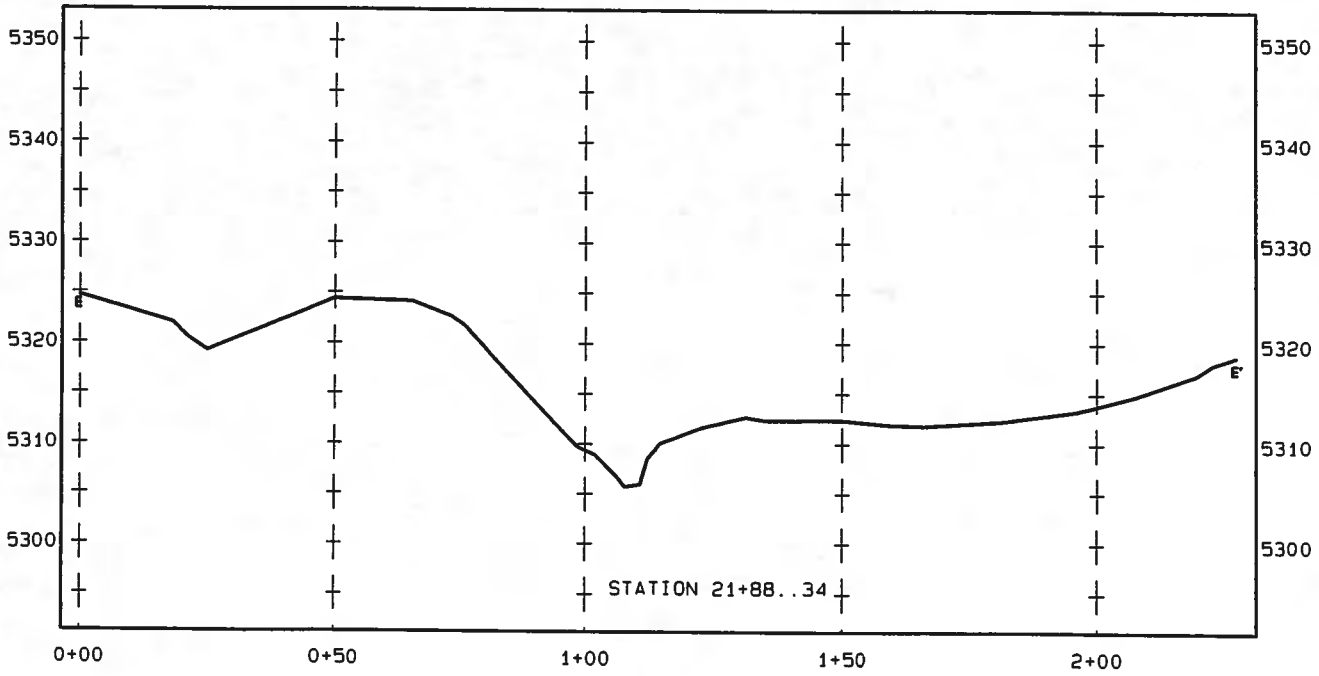






SCALE: H - 1"=40'
V - 1"=20'





SCALE: H - 1"=40'
V - 1"=20'

NORTH FORK DIVERSION CHANNEL
X-SECTION DATA FOR EXISTING DRAINAGE

	CHANNEL DEPTH (ft)	INCERMENTAL AREA (sq ft)	ACCUMLATIVE AREA (sq ft)	PERIMETER (ft) WETTED	TOTAL	@ H2O SURFACE	LT OVERBANK FLOW, n=0.042	LT BANK, n=0.035	BOTTOM, n=0.030	RT BANK, n=0.035	RT OVERBANK FLOW, n=0.042	COMPOSITE n VALUE	CENTERLINE STA. / EL.	UPSTREAM STA. / EL.	DOWN STREAM STA. / EL.
X-SECTION-A-A' @ Sta. 6+02.75															
	0.00	0.00	0.00	0.00	0.00	0.00							6+02.75	5+02.75	7+02.75
	0.50	2.10	2.10	5.80	11.30	5.50		1.67	2.69	1.11		0.033	5321.23	5322.35	5320.36
	1.00	18.50	20.60	57.10	113.90	56.80	21.92	2.50	2.69	1.55	6.91	0.040		1.12	-0.87
	1.50	30.70	51.30	68.40	136.30	67.90	51.84	2.50	2.69	1.55	9.51	0.041		S= 1.00%	
	2.00	36.50	87.80	78.30	156.10	77.80	60.29	2.50	2.69	1.55	11.00	0.041			
	2.50	40.10	127.90	78.80	175.50	96.70	68.78	2.50	2.69	1.55	12.50	0.041			
	3.00	47.10	175.00	108.70	194.10	87.40	76.41	2.50	2.69	1.55	14.00	0.041			
	3.50	49.10	224.10	103.20	205.60	102.40	80.74	2.50	2.69	1.55	15.48	0.041			
	4.00	53.00	277.10	109.80	218.60	108.80	85.77	2.50	2.69	1.55	16.98	0.041			
	4.50	56.60	333.70	116.40	231.70	115.30	91.15	2.50	2.69	1.55	18.47	0.041			
	5.00	59.10	392.80	124.90	245.30	120.40	95.05	2.50	2.69	1.55	20.19	0.041			
X-SECTION B-B' @ Sta. 10+61.75															
	0.00	0.00	0.00	0.00	0.00	0.00							10+61.75	9+61.75	11+61.75
	0.50	2.00	2.00	7.40	14.80	7.40		2.01	0.89	4.71		0.034	5316.83	5317.97	5316.3
	1.00	7.90	9.90	29.20	57.90	28.70	3.02	3.64	0.89	11.01		0.036		1.14	-0.53
	1.50	27.20	37.10	64.50	128.70	64.20	15.58	3.64	0.89	11.01	33.31	0.040		S= 0.84%	
	2.00	35.80	72.90	76.90	153.50	76.60	25.53	3.64	0.89	11.01	35.79	0.041			
	2.50	40.20	113.10	84.80	169.30	84.50	31.00	3.64	0.89	11.01	38.27	0.041			
	3.00	44.00	157.10	92.80	185.10	92.30	36.62	3.64	0.89	11.01	40.90	0.041			
	3.50	48.00	205.10	100.60	200.70	100.10	41.80	3.64	0.89	11.01	43.24	0.041			
	4.00	51.40	256.50	109.90	219.30	109.40	48.91	3.64	0.89	11.01	45.50	0.041			
	4.50	59.30	315.80	119.10	237.60	118.50	56.02	3.64	0.89	11.01	47.58	0.041			
	5.00	60.70	376.50	128.20	255.70	127.50	63.12	3.64	0.89	11.01	49.57	0.041			
	5.50	65.70	442.20	137.40	273.90	136.50	70.23	3.64	0.89	11.01	51.57	0.041			
X-SECTION-C-C' @ Sta. 13+85															
	0.00	0.00	0.00	0.00	0.00	0.00							13+85.00	12+85	14+85
	0.50	1.50	1.50	4.20	8.10	3.90		0.60	2.68	0.94		0.032	5314.14	5315.09	5312.8
	1.00	7.00	8.50	30.20	59.90	29.70	9.47	0.92	2.68	1.42	15.68	0.040		0.95	-1.34
	1.50	20.00	28.50	52.70	104.90	52.20	24.71	0.92	2.68	1.42	22.96	0.041		S= 1.14%	
	2.00	29.90	58.40	65.20	129.90	64.70	28.26	0.92	2.68	1.42	31.98	0.041			
	2.50	31.80	90.20	68.60	136.50	67.90	30.35	0.92	2.68	1.42	33.24	0.041			
	3.00	36.10	126.30	72.00	143.10	71.10	32.44	0.92	2.68	1.42	34.53	0.041			
	3.50	35.50	161.80	75.40	149.70	74.30	34.53	0.92	2.68	1.42	35.82	0.041			
	4.00	38.20	200.00	78.70	156.30	77.60	36.64	0.92	2.68	1.42	37.11	0.041			
	4.50	40.50	240.50	82.40	163.50	81.10	39.01	0.92	2.68	1.42	38.40	0.041			
	5.00	41.00	281.50	86.10	170.70	84.60	41.37	0.92	2.68	1.42	39.69	0.041			

n-values:

Left overbank flow	0.042
Left bank	0.035
Bottom	0.03
Right bank	0.035
Right overbank flow	0.042

NORTH FORK DIVERSION CHANNEL
X-SECTION DATA FOR EXISTING DRAINAGE

	CHANNEL DEPTH (ft)	INCERMENTAL AREA (sq ft)	ACCUMLATIVE AREA (sq ft)	PERIMETER (ft) WETTED	TOTAL	@ H2O SURFACE	LT OVERBANK FLOW, n=0.042	LT BANK, n=0.035	BOTTOM, n=0.030	RT BANK, n=0.035	RT OVERBANK FLOW, n=0.042	COMPOSITE n-VALUE	CENTERLINE STA. / EL.	UPSTREAM STA. / EL.	DOWN STREAM STA. / EL.
X-SECTION-D-D' @ Sta. 17+80															
	0.00	0.00	0.00	0.00	0.00	0.00							17+80.00	16+80	18+80
	0.50	2.00	2.00	6.50	12.90	6.40		1.92	3.97	0.63		0.032	5309.99	5310.88	5309
	1.00	3.70	5.70	9.00	17.70	8.70		2.98	3.97	2.06		0.033		0.89	-0.99
	1.50	5.00	10.70	11.80	23.10	11.30		4.06	3.97	3.78		0.033		S=	0.94%
	2.00	6.50	17.20	15.50	30.30	14.80		5.14	3.97	6.37		0.034			
	2.50	8.50	25.70	22.40	44.00	21.60	2.36	5.84	3.97	7.99	2.27	0.036			
	3.00	14.00	39.70	35.60	69.80	34.20	8.96	5.84	3.97	7.99	8.28	0.038			
	3.50	19.90	59.60	50.80	100.70	49.90	19.11	5.84	3.97	7.99	13.88	0.039			
	4.00	36.20	95.80	90.40	176.60	86.20	31.37	5.64	3.97	7.99	37.99	0.040			
	4.50	46.10	141.90	98.30	195.70	97.40	34.15	5.84	3.97	7.99	46.40	0.041			
	5.00	51.00	192.90	107.80	214.50	106.70	36.95	5.84	3.97	7.99	53.02	0.041			
	5.50	55.30	248.20	122.60	233.20	110.60	39.80	5.84	3.97	7.99	59.63	0.041			
X-SECTION-E-E' @ Sta. 21+88.34															
	0.00	0.00	0.00	0.00	0.00	0.00							21+88.34	20+88.34	22+88.34
	0.50	1.34	1.34	4.20	8.10	3.90		0.96	2.93	0.30		0.031	5305.81	5307.06	5305.15
	1.00	2.26	3.60	5.70	10.70	5.00		1.91	2.93	0.87		0.032		1.25	-0.66
	1.50	2.80	6.40	7.40	13.60	6.20		2.99	2.93	1.44		0.033		S=	0.96%
	2.00	3.40	9.80	9.00	16.50	7.50		4.08	2.93	2.12		0.033			
	2.50	4.00	13.80	10.70	19.40	8.70		5.16	2.93	2.59		0.034			
	3.00	4.70	18.50	12.50	22.60	10.10		6.25	2.93	3.31		0.034			
	3.50	5.60	24.10	15.20	27.80	12.60	1.33	6.66	2.93	4.24		0.035			
	4.00	7.10	31.20	18.30	33.90	15.60	3.57	6.66	2.93	5.16		0.036			
	4.50	8.30	39.50	21.00	39.00	18.00	4.66	6.66	2.93	5.73	1.02	0.036			
	5.00	9.80	49.30	24.70	46.20	21.50	5.75	6.66	2.93	5.73	3.43	0.037			
	5.50	11.70	61.00	28.40	53.40	25.00	6.84	6.66	2.93	5.73	6.19	0.038			
	6.00	13.30	74.30	32.30	61.20	28.90	7.92	6.66	2.93	5.73	9.12	0.038			
	6.50	15.10	89.40	36.60	72.50	33.90	9.01	6.66	2.93	5.73	13.18	0.039			
	7.00	45.10	134.50	99.80	194.60	94.80	10.10	6.66	2.93	5.73	73.24	0.041			
	7.50	49.90	184.40	107.20	210.40	103.20	11.19	6.66	2.93	5.73	80.67	0.041			

n-values:

Left overbank flow	0.042
Left bank	0.035
Bottom	0.03
Right bank	0.035
Right overbank flow	0.042

NORTH FORK DIVERSION CHANNEL
STAGE FLOW DATA FOR EXISTING DRAINAGE

Channel Bed Slope S = 1.00 %

STAGE FLOW @ Sta 6+02.75 (Section A-A' existing channel)

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Composite n-value	Peak Flow (CFS)	Average Velocity (FPS)	Froude number
0.00	0.00	0.00	0.00		0.00	0.00	
0.50	2.10	5.80	0.36	0.033	4.86	2.31	0.58
1.00	20.60	57.10	0.36	0.040	38.35	1.86	0.33
1.50	51.30	68.40	0.75	0.041	153.02	2.98	0.43
2.00	87.80	78.30	1.12	0.041	341.99	3.90	0.49
2.50	127.90	78.80	1.62	0.041	636.96	4.98	0.56
3.00	175.00	106.70	1.64	0.041	876.34	5.01	0.51
3.50	224.10	103.20	2.17	0.041	1,353.30	6.04	0.57
4.00	277.10	109.80	2.52	0.041	1,849.15	6.67	0.59
4.50	333.70	116.40	2.87	0.041	2,423.62	7.26	0.60
5.00	392.80	124.90	3.14	0.041	3,033.75	7.72	0.61

FLOW DEPTH AND AVERAGE VELOCITY AT PEAK FLOWS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Average Velocity (fps)	Froude number
2 year - 6 hour	244.00	1.74	3.42	0.46
5 year - 6 hour	472.00	2.22	4.37	0.52
10 year - 6 hour	647.00	2.52	4.98	0.55

NORTH FORK DIVERSION CHANNEL
STAGE FLOW DATA FOR EXISTING DRAINAGE

Channel Bed Slope S = 0.84 %

STAGE FLOW @ 10+61.75 (Sta. Section B-B' existing channel)

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Composite n-value	Peak Flow (CFS)	Average Velocity (FPS)	Froude number
0.00	0.00	0.00	0.00		0.00	0.00	
0.50	2.00	7.40	0.27	0.034	3.30	1.65	0.41
1.00	9.90	29.20	0.34	0.036	18.19	1.84	0.32
1.50	37.10	64.50	0.58	0.040	86.66	2.34	0.34
2.00	72.90	76.90	0.95	0.041	236.36	3.24	0.40
2.50	113.10	84.80	1.33	0.041	459.42	4.06	0.45
3.00	157.10	92.80	1.69	0.041	746.61	4.75	0.48
3.50	205.10	100.60	2.04	0.041	1,101.64	5.37	0.51
4.00	256.50	109.90	2.33	0.041	1,504.95	5.87	0.52
4.50	315.80	119.10	2.65	0.041	2,014.47	6.38	0.53
5.00	376.50	128.20	2.94	0.041	2,567.80	6.82	0.54
5.50	442.20	137.40	3.22	0.041	3,202.25	7.24	0.54

FLOW DEPTH AND AVERAGE VELOCITY AT PEAK FLOWS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Average Velocity (fps)	Froude number
2 year - 6 hour	244.00	2.02	3.27	0.41
5 year - 6 hour	472.00	2.52	4.09	0.45
10 year - 6 hour	647.00	2.83	4.51	0.47

NORTH FORK DIVERSION CHANNEL
STAGE FLOW DATA FOR EXISTING DRAINAGE

Channel Bed Slope S = 1.14 %

STAGE FLOW @ Sta. 13+85 (Section C-C' existing channel)

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Composite n-value	Peak Flow (CFS)	Average Velocity (FPS)	Froude number
0.00	0.00	0.00	0.00		0.00	0.00	
0.50	1.50	4.20	0.36	0.032	3.77	2.51	0.63
1.00	8.50	30.20	0.28	0.040	14.34	1.69	0.30
1.50	28.50	52.70	0.54	0.041	73.29	2.57	0.37
2.00	58.40	65.20	0.90	0.041	209.74	3.59	0.45
2.50	90.20	68.60	1.31	0.041	418.62	4.64	0.52
3.00	126.30	72.00	1.75	0.041	710.49	5.63	0.57
3.50	161.80	75.40	2.15	0.041	1,041.08	6.43	0.61
4.00	200.00	78.70	2.54	0.041	1,440.36	7.20	0.63
4.50	240.50	82.40	2.92	0.041	1,899.22	7.90	0.66
5.00	281.50	86.10	3.27	0.041	2,397.26	8.52	0.67

FLOW DEPTH AND AVERAGE VELOCITY AT PEAK FLOWS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Average Velocity (fps)	Froude number
2 year - 6 hour	244.00	2.08	3.76	0.46
5 year - 6 hour	472.00	2.59	4.82	0.53
10 year - 6 hour	647.00	2.89	5.41	0.56

NORTH FORK DIVERSION CHANNEL
STAGE FLOW DATA FOR EXISTING DRAINAGE

Channel Bed Slope S = 0.94 %

STAGE FLOW @ Sta. 18+80 (Section D-D' existing channel)

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Composite n-value	Peak Flow (CFS)	Average Velocity (FPS)	Froude number
0.00	0.00	0.00	0.00		0.00	0.00	
0.50	2.00	6.50	0.31	0.032	4.11	2.05	0.51
1.00	5.70	9.00	0.63	0.033	18.49	3.24	0.57
1.50	10.70	11.80	0.91	0.033	43.47	4.06	0.58
2.00	17.20	15.50	1.11	0.034	79.06	4.60	0.57
2.50	25.70	22.40	1.15	0.036	114.35	4.45	0.50
3.00	39.70	35.60	1.12	0.038	162.62	4.10	0.42
3.50	59.60	50.80	1.17	0.039	244.46	4.10	0.39
4.00	95.80	90.40	1.06	0.040	356.56	3.72	0.33
4.50	141.90	98.30	1.44	0.041	646.75	4.56	0.38
5.00	192.90	107.80	1.79	0.041	1,012.21	5.25	0.41
5.50	248.20	122.60	2.02	0.041	1,411.05	5.69	0.43

FLOW DEPTH AND AVERAGE VELOCITY AT PEAK FLOWS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Average Velocity (fps)	Froude number
2 year - 6 hour	244.00	3.50	4.10	0.39
5 year - 6 hour	472.00	4.20	4.05	0.35
10 year - 6 hour	647.00	4.50	4.56	0.38

NORTH FORK DIVERSION CHANNEL
STAGE FLOW DATA FOR EXISTING DRAINAGE

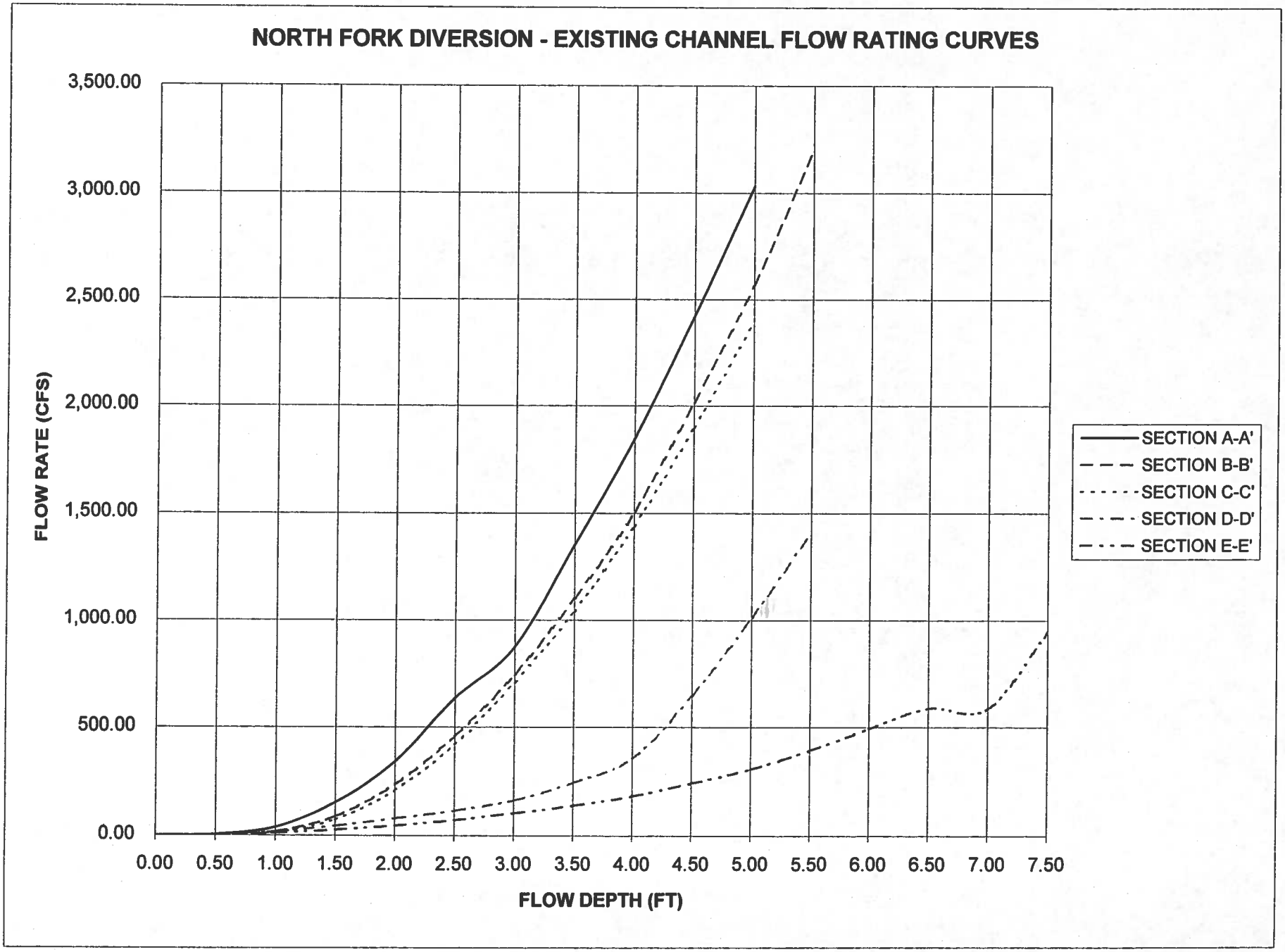
Channel Bed Slope S = 0.96 %

STAGE FLOW @ Sta. 21+88 (Section E-E' existing channel)

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Composite n-value	Peak Flow (CFS)	Average Velocity (FPS)	Froude number
0.00	0.00	0.00	0.00		0.00	0.00	
0.50	1.34	4.20	0.32	0.031	2.88	2.15	0.54
1.00	3.60	5.70	0.63	0.032	11.88	3.30	0.58
1.50	6.40	7.40	0.86	0.033	25.62	4.00	0.58
2.00	9.80	9.00	1.09	0.033	45.26	4.62	0.58
2.50	13.80	10.70	1.29	0.034	70.90	5.14	0.57
3.00	18.50	12.50	1.48	0.034	103.63	5.60	0.57
3.50	24.10	15.20	1.59	0.035	137.90	5.72	0.54
4.00	31.20	18.30	1.70	0.036	182.46	5.85	0.52
4.50	39.50	21.00	1.88	0.036	242.34	6.14	0.51
5.00	49.30	24.70	2.00	0.037	307.60	6.24	0.49
5.50	61.00	28.40	2.15	0.038	392.61	6.44	0.48
6.00	74.30	32.30	2.30	0.038	493.77	6.65	0.48
6.50	89.40	38.60	2.32	0.039	588.98	6.59	0.46
7.00	134.50	99.80	1.35	0.041	586.88	4.36	0.29
7.50	184.40	107.20	1.72	0.041	945.34	5.13	0.33

FLOW DEPTH AND AVERAGE VELOCITY AT PEAK FLOWS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Average Velocity (fps)	Froude number
2 year - 6 hour	244.00	4.51	6.14	0.51
5 year - 6 hour	472.00	5.89	6.60	0.48
10 year - 6 hour	647.00	7.08	4.49	0.30


NORTH FORK DIVERSION - EXISTING CHANNEL FLOW RATING CURVES
FLOW RATE (CFS)
3,500.00
3,000.00
2,500.00
2,000.00
1,500.00
1,000.00
500.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
5.50
6.00
6.50
7.00
7.50
FLOW DEPTH (FT)
SECTION A-A'
SECTION B-B'
SECTION C-C'
SECTION D-D'
SECTION E-E'

(6/01)

NORTH FORK DIVERSION CHANNEL
AS-BUILT

CHANNEL DESIGN

JULY 2002

NORTH FORK DIVERSION CHANNEL - AS-BUILT

FLOW DEPTHS AND VELOCITIES AT PEAK FLOWS

		2 year-6 hour		5 year-6 hour		10 year-6 hour	
Channel Reach (% grade)	Channel Material	Flow Depth (ft)	Velocity (fps)	Flow Depth (ft)	Velocity (fps)	Flow Depth (ft)	Velocity (fps)
Sta. 3+00 to 5+00, 10+00 to 18+00 & 28+00 to 36+00 @ max. grade, (0.852%)	Sandstone	1.74	5.52	2.49	6.76	2.95	7.42
Sta. 0+00 to 3+00, 5+00 to 10+00, 18+00 to 28+00 & 36+00 to 39+70 @ max. grade, (0.321%)	Shale	2.22	4.05	3.22	4.99	3.83	5.49
Sta. 2+49 Min. Channel Depth (0.227%)	Shale/Clay	2.52	3.36	3.50	4.03	4.08	4.39

The flow velocities in the reaches in sandstone material at maximum grade (0.852%) exceeds 5 fps, these reaches are in competent sandstone formation capable of withstanding flow velocities up to 15 fps. In the reaches that are in shale material at maximum grade (0.321%) the velocities for the 2 and 5 year peak flows are less than 5 fps. The limiting flow velocity or erosive velocity for shale is 5 fps. Some erosion can be expected to occur during the 10 year 6 hour storm event when the flow velocity exceeds 5 fps.

The minimum channel embankment height is approximately 8.5 feet at Station 2+49. The maximum flow depth during the peak flow from the 10 year-6 hour storm event is 4.1 feet. Thus, the channel is capable of safely passing the peak flow form the 10 year-6 hour storm event with a freeboard of 4.4 feet.

NORTH FORK DIVERSION CHANNEL - AS-BUILT

CHANNEL BED MATERIAL

CHANNEL REACH	CHANNEL BED MATERIAL	MAXIMUM GRADE	MINIMUM GRADE
0+00 to 3+00	Shale/Clay	0.227	n/a
3+00 to 5+00	Sandstone	0.852	n/a
5+00 to 10+00	Shale	0.287	n/a
10+00 to 18+00	Sandstone	0.835	0.022
18+00 to 28+00	Shale	0.321	0.169
28+00 to 36+00	Sandstone	0.456	0.179
36+00 to 39+70	Shale	0.309	n/a

NORTH FORK DIVERSION CHANNEL - AS-BUILT

CHANNEL DATA (STA 3+78)

Bottom Channel Width (ft)	W =	19.50	
Side Slopes (Z1:1)	Z1 =	3.70	
(Z2:1)	Z2 =	3.10	
Manning's Roughness Coefficient	n =	0.031	
Channel Bed Slope (%)	S =	0.852	(max.)
D50 Riprap Size (ft)	D50=	n/a	

STAGE FLOW AND VELOCITIES @ MAX. GRADE IN SANDSTONE CUT

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Discharge Rate (CFS)	Velocity (FPS)
0.00	0.00	19.50	0.00	0.00	0.00
0.25	5.09	21.27	0.24	8.66	1.70
0.50	10.60	23.05	0.46	27.95	2.64
0.75	16.54	24.82	0.67	55.90	3.38
1.00	22.90	26.59	0.86	91.92	4.01
1.25	29.69	28.36	1.05	135.80	4.57
1.50	36.90	30.14	1.22	187.50	5.08
1.75	44.54	31.91	1.40	247.06	5.55
2.00	52.60	33.68	1.56	314.59	5.98
2.25	61.09	35.45	1.72	390.23	6.39
2.50	70.00	37.23	1.88	474.13	6.77
2.75	79.34	39.00	2.03	566.47	7.14
3.00	89.10	40.77	2.19	667.44	7.49
3.25	99.29	42.54	2.33	777.22	7.83
3.50	109.90	44.32	2.48	896.03	8.15
3.75	120.94	46.09	2.62	1024.05	8.47
4.00	132.40	47.86	2.77	1161.49	8.77
4.25	144.29	49.63	2.91	1308.55	9.07

FLOW DEPTH AND VELOCITY BY STORM EVENTS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Flow Velocity (fps)
2 year - 6 hour	244.00	1.74	5.52
5 year - 6 hour	472.00	2.49	6.76
10 year - 6 hour	647.00	2.95	7.42

NORTH FORK DIVERSION CHANNEL - AS-BUILT

CNANNEL DATA (STA 26+74)

Bottom Channel Width (ft)	W =	21.80	
Side Slopes (Z1:1)	Z1 =	2.00	
(Z2:1)	Z2 =	2.70	
Manning's Roughness Coefficient	n =	0.031	
Channel Bed Slope (%)	S =	0.321	(max.)
D50 Riprap Size (ft)	D50=	N/A	

STAGE FLOW AND VELOCITIES @ MAX. GRADE IN SHALE CUT

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Discharge Rate (CFS)	Velocity (FPS)
0.00	0.00	21.80	0.00	0.00	0.00
0.25	5.60	23.08	0.24	5.90	1.05
0.50	11.49	24.36	0.47	18.91	1.65
0.75	17.67	25.64	0.69	37.51	2.12
1.00	24.15	26.92	0.90	61.16	2.53
1.25	30.92	28.19	1.10	89.58	2.90
1.50	37.99	29.47	1.29	122.62	3.23
1.75	45.35	30.75	1.47	160.19	3.53
2.00	53.00	32.03	1.65	202.25	3.82
2.25	60.95	33.31	1.83	248.79	4.08
2.50	69.19	34.59	2.00	299.81	4.33
2.75	77.72	35.87	2.17	355.33	4.57
3.00	86.55	37.15	2.33	415.41	4.80
3.25	95.67	38.42	2.49	480.06	5.02
3.50	105.09	39.70	2.65	549.35	5.23
3.75	114.80	40.98	2.80	623.33	5.43
4.00	124.80	42.26	2.95	702.06	5.63
4.25	135.10	43.54	3.10	785.60	5.82
4.50	145.69	44.82	3.25	874.00	6.00

FLOW DEPTH AND VELOCITY BY STORM EVENTS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Flow Velocity (fps)
2 year - 6 hour	244.00	2.22	4.05
5 year - 6 hour	472.00	3.22	4.99
10 year - 6 hour	647.00	3.83	5.49

NORTH FORK DIVERSION CHANNEL - AS-BUILT

CHANNEL DATA (2+49)

Bottom Channel Width (ft)	W =	17.30	
Side Slopes (Z1:1)	Z1 =	3.80	
(Z2:1)	Z2 =	5.40	
Manning's Roughness Coefficient	n =	0.031	
Channel Bed Slope (%)	S =	0.227	(min.)
D50 Riprap Size (ft)	D50=	N/A	

STAGE FLOW AND VELOCITY @ MIN. GRADE AND MIN. CHANNEL DEPTH

Flow Depth (Ft)	Area (Sq Ft)	Wetted Perimeter (Ft)	Hydraulic Radius	Discharge Rate (CFS)	Velocity (FPS)
0.00	0.00	17.30	0.00	0.00	0.00
0.25	4.61	19.66	0.23	4.00	0.87
0.50	9.80	22.01	0.45	13.05	1.33
0.75	15.56	24.37	0.64	26.39	1.70
1.00	21.90	26.72	0.82	43.89	2.00
1.25	28.81	29.08	0.99	65.58	2.28
1.50	36.30	31.43	1.15	91.55	2.52
1.75	44.36	33.79	1.31	121.92	2.75
2.00	53.00	36.14	1.47	156.86	2.96
2.25	62.21	38.50	1.62	196.50	3.16
2.50	72.00	40.85	1.76	241.03	3.35
2.75	82.36	43.21	1.91	290.59	3.53
3.00	93.30	45.56	2.05	345.36	3.70
3.25	104.81	47.92	2.19	405.50	3.87
3.50	116.90	50.27	2.33	471.18	4.03
3.75	129.56	52.63	2.46	542.57	4.19
4.00	142.80	54.98	2.60	619.83	4.34
4.25	156.61	57.34	2.73	703.12	4.49

FLOW DEPTH AND VELOCITY BY STORM EVENTS

Storm Event	Peak Flow (cfs)	Flow Depth (ft)	Flow Velocity (fps)
2 year - 6 hour	244.00	2.52	3.36
5 year - 6 hour	472.00	3.50	4.03
10 year - 6 hour	647.00	4.08	4.39

NORTH FORK DIVERSION CHANNEL
RIP-RAPPED DOWNDRAINS
AS-BUILT

Hydrology model and designs for rip-rapped downdrains. For the watershed subdivisions, refer to the 8 1/2 X 11 sheet in the original design submitted. The location and details of the downdrains are presented on Exhibit 11-142D & 11-142E.

LR

BHP Navajo Coal Company
Navajo Mine
PO Box 1717
Fruitland, NM 87415

Phone: 505-598-5861

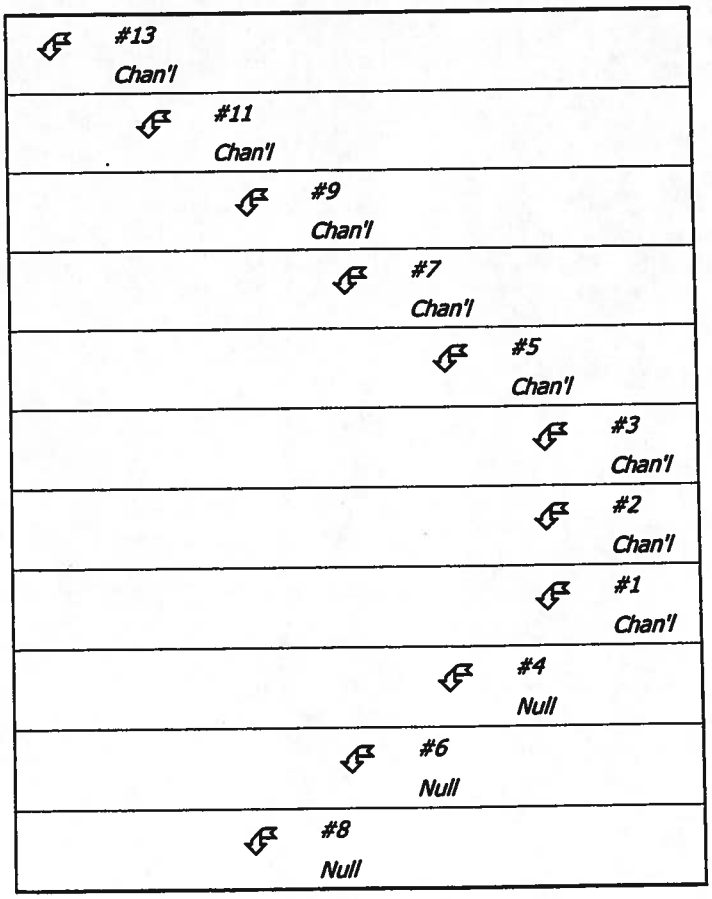
General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#4	0.041	0.236	Downdrain @ Sta. 1+59
Channel	#2	==>	#4	0.000	0.000	Downdrain @ Sta. 3+55
Channel	#3	==>	#4	0.000	0.000	Sta. 3+80 Sandstone Downdrain
Null	#4	==>	#6	0.063	0.237	
Channel	#5	==>	#6	0.000	0.000	Downdrain @ Sta. 7+43
Null	#6	==>	#8	0.045	0.237	
Channel	#7	==>	#8	0.000	0.000	Downdrain @ Sta. 9+89
Null	#8	==>	#10	0.199	0.237	
Channel	#9	==>	#10	0.000	0.000	Downdrain @ Sta. 20+84
Null	#10	==>	#12	0.093	0.237	
Channel	#11	==>	#12	0.000	0.000	Downdrain @ Sta. 26+16
Null	#12	==>	#14	0.070	0.238	
Channel	#13	==>	#14	0.000	0.000	Downdrain @ Sta. 29+88
Null	#14	==>	End	0.000	0.000	



#10 *Null*
#12 *Null*
#14 *Null*

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.26	0.58	225.00	1.52	0.041
#1	**Muskingum K:**					**0.041**
#2	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.00	0.000
#2	**Muskingum K:**					**0.000**
#4	8. Large gullies, diversions, and low flowing streams	0.26	0.92	350.07	1.53	0.063
#4	**Muskingum K:**					**0.063**
#6	8. Large gullies, diversions, and low flowing streams	0.26	0.66	252.00	1.53	0.045
#6	**Muskingum K:**					**0.045**
#8	8. Large gullies, diversions, and low flowing streams	0.26	2.89	1,098.00	1.53	0.199
#8	**Muskingum K:**					**0.199**
#10	8. Large gullies, diversions, and low flowing streams	0.26	1.35	515.00	1.53	0.093
#10	**Muskingum K:**					**0.093**
#12	8. Large gullies, diversions, and low flowing streams	0.26	1.03	390.00	1.54	0.070
#12	**Muskingum K:**					**0.070**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#13	8.020	8.020	5.06	0.20
#11	1.620	1.620	1.02	0.04
#9	6.850	6.850	4.32	0.17
#7	2.190	2.190	1.38	0.05
#5	5.780	5.780	3.64	0.14
#3	2.250	2.250	1.42	0.06
#2	37.760	37.760	12.84	0.95
#1	4.920	4.920	3.10	0.12
#4	0.000	44.930	14.33	1.13
#6	0.000	50.710	15.20	1.27
#8	0.000	52.900	16.58	1.33
#10	0.000	59.750	14.78	1.50
#12	0.000	61.370	14.77	1.54
#14	0.000	69.390	15.55	1.74

Structure Detail:

Structure #13 (Riprap Channel)

Downdrain @ Sta. 29+88

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
4.00	3.0:1	3.0:1	10.7	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	5.06 cfs	
Depth:	0.14 ft	1.14 ft
Top Width:	4.87 ft	10.87 ft
Velocity*:		
X-Section Area:	0.64 sq ft	
Hydraulic Radius:	0.130	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #11 (Riprap Channel)

Downdrain @ Sta. 26+16

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
4.00	3.0:1	3.0:1	23.5	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.02 cfs	
Depth:	0.03 ft	1.03 ft
Top Width:	4.20 ft	10.20 ft
Velocity*:		
X-Section Area:	0.14 sq ft	
Hydraulic Radius:	0.033	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #9 (Riprap Channel)

Downdrain @ Sta. 20+84

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	3.0:1	3.0:1	21.5	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	4.32 cfs	
Depth:	0.06 ft	1.06 ft
Top Width:	5.38 ft	11.38 ft
Velocity*:		
X-Section Area:	0.33 sq ft	
Hydraulic Radius:	0.061	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #7 (Riprap Channel)

Downdrain @ Sta. 9+89

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	3.0:1	3.0:1	24.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.38 cfs	
Depth:	0.04 ft	1.04 ft
Top Width:	3.26 ft	9.26 ft
Velocity*:		
X-Section Area:	0.13 sq ft	
Hydraulic Radius:	0.041	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #5 (Riprap Channel)

Downdrain @ Sta. 7+43

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.0:1	2.0:1	20.5	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.64 cfs	
Depth:	0.08 ft	1.08 ft
Top Width:	3.34 ft	7.34 ft
Velocity*:		
X-Section Area:	0.27 sq ft	
Hydraulic Radius:	0.079	
Froude Number*:		
Manning's n*:		
Dmin:	4.00 in	
D50:	12.00 in	
Dmax:	15.00 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #3 (Nonerodible Channel)

Sta. 3+80 Sandstone Downdrain

Trapezoidal Nonerodible Channel Inputs:

Material: Sandstone

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	24.0	0.0290	1.00		

Nonerodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.42 cfs	
Depth:	0.12 ft	1.12 ft
Top Width:	2.46 ft	6.46 ft
Velocity:	5.50 fps	
X-Section Area:	0.26 sq ft	
Hydraulic Radius:	0.102	
Froude Number:	3.00	

Structure #2 (Riprap Channel)

Downdrain @ Sta. 3+55

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
4.00	3.0:1	3.0:1	10.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	12.84 cfs	
Depth:	0.25 ft	1.25 ft
Top Width:	5.52 ft	11.52 ft
Velocity*:		
X-Section Area:	1.20 sq ft	
Hydraulic Radius:	0.215	
Froude Number*:		
Manning's n*:		
Dmin:	4.00 in	
D50:	12.00 in	
Dmax:	15.00 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #1 (Riprap Channel)

Downdrain @ Sta. 1+59

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	3.0:1	3.0:1	15.8	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.10 cfs	
Depth:	0.11 ft	1.11 ft
Top Width:	3.65 ft	9.65 ft
Velocity*:		

	w/o Freeboard	w/ Freeboard
X-Section Area:	0.36 sq ft	
Hydraulic Radius:	0.097	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #4 (Null)

Structure #6 (Null)

Structure #8 (Null)

Structure #10 (Null)

Structure #12 (Null)

Structure #14 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#13	1	8.020	0.110	0.000	0.000	93.000	M	5.06	0.201
	Σ	**8.020**						**5.06**	**0.201**
#11	1	1.620	0.029	0.000	0.000	93.000	M	1.02	0.041
	Σ	**1.620**						**1.02**	**0.041**
#9	1	6.850	0.049	0.000	0.000	93.000	M	4.32	0.172
	Σ	**6.850**						**4.32**	**0.172**
#7	1	2.190	0.048	0.000	0.000	93.000	M	1.38	0.055
	Σ	**2.190**						**1.38**	**0.055**
#5	1	5.780	0.079	0.000	0.000	93.000	M	3.64	0.145
	Σ	**5.780**						**3.64**	**0.145**
#3	1	2.250	0.035	0.000	0.000	93.000	M	1.42	0.056
	Σ	**2.250**						**1.42**	**0.056**
#2	1	37.760	0.235	0.000	0.000	93.000	M	12.84	0.947
	Σ	**37.760**						**12.84**	**0.947**
#1	1	4.920	0.104	0.000	0.000	93.000	M	3.10	0.123
	Σ	**4.920**						**3.10**	**0.123**
#4	Σ	**44.930**						**14.33**	**1.126**
#6	Σ	**50.710**						**15.20**	**1.271**
#8	Σ	**52.900**						**16.58**	**1.326**
#10	Σ	**59.750**						**14.78**	**1.498**
#12	Σ	**61.370**						**14.77**	**1.538**
#14	Σ	**69.390**						**15.55**	**1.740**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.35	20.00	460.00	2.080	0.061
		8. Large gullies, diversions, and low flowing streams	1.98	13.00	658.00	4.210	0.043

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Civil Software Design

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	**1**	**Time of Concentration:**					**0.104**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	3.56	32.00	900.00	1.880	0.132
		8. Large gullies, diversions, and low flowing streams	2.06	33.00	1,601.00	4.300	0.103
#2	**1**	**Time of Concentration:**					**0.235**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	23.00	23.00	100.00	4.790	0.005
		8. Large gullies, diversions, and low flowing streams	2.37	12.00	506.00	4.610	0.030
#3	**1**	**Time of Concentration:**					**0.035**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	6.18	21.00	340.00	2.480	0.038
		8. Large gullies, diversions, and low flowing streams	1.91	12.00	627.00	4.150	0.041
#5	**1**	**Time of Concentration:**					**0.079**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	6.67	20.00	300.00	2.580	0.032
		8. Large gullies, diversions, and low flowing streams	2.46	7.00	284.00	4.700	0.016
#7	**1**	**Time of Concentration:**					**0.048**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	10.33	31.00	300.00	3.210	0.025
		8. Large gullies, diversions, and low flowing streams	2.44	10.00	409.00	4.690	0.024
#9	**1**	**Time of Concentration:**					**0.049**
#11	1	5. Nearly bare and untilled, and alluvial valley fans	7.00	14.00	200.00	2.640	0.021
		8. Large gullies, diversions, and low flowing streams	3.37	6.00	178.00	5.500	0.008
#11	**1**	**Time of Concentration:**					**0.029**
#13	1	5. Nearly bare and untilled, and alluvial valley fans	3.67	11.00	300.00	1.910	0.043
		8. Large gullies, diversions, and low flowing streams	2.38	27.00	1,133.00	4.630	0.067
#13	**1**	**Time of Concentration:**					**0.110**