APPENDIX 11-DD

BARBER WASH POST-MINE HYDROLOGY & SEDIMENTOLOGY

(2 YR-6 HR, 10 YR-6 HR, 25 YR-6 HR, & 100 YR-6 HR STORM EVENTS)

September-04

Barber Wash Post-mine Hydrology and Sedimentology

The hydrology model and drainage subdivisions are presented on Exhibit 11-75A. The alignment and details of the reclaimed channels are presented on Exhibit 11-76 and 11-76A thru 11-76E.

AY/LR

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

Phone: 505-598-5861

General Information

Storm Information:

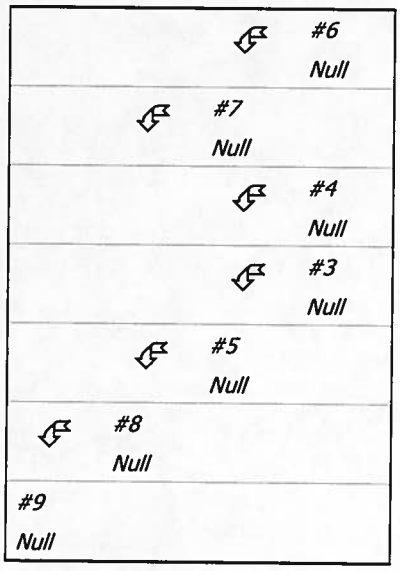
Storm Type:	NRCS Type II-60
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.800 inches

Particle Size Distribution:

Size (mm)	Badland Premining	Badland Postmining	LoamySand Premining	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	100.000%
0.1000	83.500%	75.900%	30.000%	26.500%
0.0500	77.000%	70.000%	17.000%	14.000%
0.0020	56.000%	47.000%	11.000%	11.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#3	==>	#5	0.000	0.000	
Null	#4	==>	#5	0.000	0.000	
Null	#5	==>	#8	0.106	0.356	
Null	#6	==>	#7	0.076	0.369	
Null	#7	==>	#8	0.216	0.358	
Null	#8	==>	#9	1.115	0.335	
Null	#9	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	8. Large gullies, diversions, and low flowing streams	1.98	32.00	1,617.06	4.22	0.106
#5	**Muskingum K:**					**0.106**
#6	8. Large gullies, diversions, and low flowing streams	2.58	34.00	1,320.00	4.81	0.076
#6	**Muskingum K:**					**0.076**
#7	8. Large gullies, diversions, and low flowing streams	2.04	68.00	3,333.00	4.28	0.216
#7	**Muskingum K:**					**0.216**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	8. Large gullies, diversions, and low flowing streams	1.33	185.00	13,888.88	3.46	1.115
#8	**Muskingum K:**					**1.115**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#6	173.800	173.800	0.38	0.10	0.8	8,394	5.24	4.58
#7	81.500	255.300	0.59	0.15	1.3	8,647	5.46	4.76
#4	292.340	292.340	0.67	0.18	1.2	6,260	3.90	3.38
#3	144.950	144.950	0.33	0.09	0.4	4,437	2.76	2.38
#5	0.000	437.290	0.98	0.27	1.6	5,640	3.51	3.05
#8	155.930	848.520	30.52	3.06	87.1	43,774	2.19	1.29
#9	1,666.640	2,515.160	79.84	16.70	273.6	22,880	0.14	0.09

Particle Size Distribution(s) at Each Structure

Structure #6:

Size (mm)	In/Out
2.0000	100.000%
0.1000	45.830%
0.0500	24.212%
0.0020	19.024%
0.0010	0.000%

Structure #7:

Size (mm)	In/Out
2.0000	100.000%
0.1000	43.959%
0.0500	23.223%
0.0020	18.247%
0.0010	0.000%

Structure #4:

Size (mm)	In/Out
2.0000	100.000%
0.1000	46.305%
0.0500	24.463%
0.0020	19.221%
0.0010	0.000%

Structure #3:

Size (mm)	In/Out
2.0000	100.000%
0.1000	46.685%
0.0500	24.664%

Size (mm)	In/Out
0.0020	19.378%
0.0010	0.000%

Structure #5:

Size (mm)	In/Out
2.0000	100.000%
0.1000	46.394%
0.0500	24.510%
0.0020	19.258%
0.0010	0.000%

Structure #8:

Size (mm)	In/Out
2.0000	100.000%
0.1000	98.224%
0.0500	97.529%
0.0020	89.018%
0.0010	0.000%

Structure #9:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.516%
0.0020	98.932%
0.0010	0.000%

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)
#6	1	173.800	0.596	0.000	0.000	75.600	M	0.38	0.102
	Σ	**173.800**						**0.38**	**0.102**
#7	1	81.500	0.255	0.000	0.000	75.700	M	0.24	0.050
	Σ	**255.300**						**0.59**	**0.153**
#4	1	292.340	0.623	0.406	0.238	75.700	M	0.68	0.181
	Σ	**292.340**						**0.67**	**0.181**
#3	1	144.950	0.703	0.000	0.000	75.700	M	0.33	0.090
	Σ	**144.950**						**0.33**	**0.090**
#5	Σ	**437.290**						**0.98**	**0.270**
#8	1	101.800	0.347	0.000	0.000	90.300	M	20.04	1.751
	2	54.130	0.327	0.000	0.000	90.000	M	10.48	0.892
	Σ	**848.520**						**30.52**	**3.065**
#9	1	506.100	0.855	0.473	0.336	87.900	M	38.54	6.107
	2	403.250	0.671	0.697	0.338	79.600	M	4.90	0.974
	3	397.610	0.997	0.697	0.338	78.200	M	2.55	0.643
	4	97.780	0.364	0.473	0.336	86.900	M	10.40	1.009
	5	261.900	0.579	0.000	0.000	90.900	M	42.25	4.904
	Σ	**2,515.160**						**79.84**	**16.702**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#6	1	0.190	175.00	5.40	0.3150	1.0000	4	0.8	8,394	5.24	4.58
	Σ							**0.8**	**8,394**	**5.24**	**4.58**
#7	1	0.190	150.00	6.10	0.3150	1.0000	4	0.4	9,580	6.18	5.12
	Σ							**1.3**	**8,647**	**5.46**	**4.76**
#4	1	0.190	175.00	4.20	0.3150	1.0000	4	1.2	7,157	4.46	3.86
	Σ							**1.2**	**6,260**	**3.90**	**3.38**
#3	1	0.190	200.00	3.20	0.3150	1.0000	4	0.4	4,437	2.76	2.38

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**0.4**	**4,437**	**2.76**	**2.38**
#5	Σ							**1.6**	**5,640**	**3.51**	**3.05**
#8	1	0.207	150.00	6.80	0.3990	1.0000	1	58.3	45,607	1.35	0.89
	2	0.205	175.00	5.90	0.3990	1.0000	1	26.0	40,262	1.32	0.87
	Σ							**87.1**	**43,774**	**2.19**	**1.29**
#9	1	0.186	175.00	5.50	0.3000	1.0000	1	101.0	20,971	0.00	0.00
	2	0.156	200.00	3.70	0.3830	1.0000	3	7.3	9,073	4.59	3.50
	3	0.151	300.00	2.70	0.3930	1.0000	3	3.4	6,142	3.28	2.59
	4	0.177	175.00	5.60	0.2560	1.0000	1	14.6	19,478	0.00	0.00
	5	0.190	125.00	8.60	0.1940	1.0000	1	84.1	22,709	0.00	0.00
	Σ							**273.6**	**22,880**	**0.14**	**0.09**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	5. Nearly bare and untilled, and alluvial valley fans	2.56	103.00	4,027.05	1.590	0.703
#3	**1**	**Time of Concentration:**					**0.703**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	4.27	80.00	1,875.00	2.060	0.252
		8. Large gullies, diversions, and low flowing streams	2.02	115.00	5,700.00	4.260	0.371
#4	**1**	**Time of Concentration:**					**0.623**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	0.93	6.00	642.00	0.960	0.185
		8. Large gullies, diversions, and low flowing streams	1.17	56.00	4,799.00	3.240	0.411
#6	**1**	**Time of Concentration:**					**0.596**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	6.05	45.00	744.02	2.450	0.084
		8. Large gullies, diversions, and low flowing streams	3.12	102.00	3,266.09	5.300	0.171
#7	**1**	**Time of Concentration:**					**0.255**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	4.73	45.00	951.00	2.170	0.121
		8. Large gullies, diversions, and low flowing streams	2.38	90.00	3,776.00	4.630	0.226
#8	**1**	**Time of Concentration:**					**0.347**
#8	2	5. Nearly bare and untilled, and alluvial valley fans	4.17	75.00	1,798.00	2.040	0.244

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.13	50.00	1,597.00	5.300	0.083
#8	**2**	**Time of Concentration:**					**0.327**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	3.82	35.00	916.01	1.950	0.130
		8. Large gullies, diversions, and low flowing streams	1.58	155.00	9,820.07	3.760	0.725
#9	**1**	**Time of Concentration:**					**0.855**
#9	2	5. Nearly bare and untilled, and alluvial valley fans	7.84	57.00	727.00	2.800	0.072
		8. Large gullies, diversions, and low flowing streams	2.26	220.00	9,732.00	4.510	0.599
#9	**2**	**Time of Concentration:**					**0.671**
#9	3	5. Nearly bare and untilled, and alluvial valley fans	4.73	165.00	3,491.02	2.170	0.446
		8. Large gullies, diversions, and low flowing streams	1.52	112.00	7,347.15	3.700	0.551
#9	**3**	**Time of Concentration:**					**0.997**
#9	4	5. Nearly bare and untilled, and alluvial valley fans	3.83	45.00	1,176.00	1.950	0.167
		8. Large gullies, diversions, and low flowing streams	1.28	31.00	2,416.00	3.390	0.197
#9	**4**	**Time of Concentration:**					**0.364**
#9	5	5. Nearly bare and untilled, and alluvial valley fans	5.87	56.00	954.00	2.420	0.109
		8. Large gullies, diversions, and low flowing streams	1.30	75.00	5,772.00	3.410	0.470
#9	**5**	**Time of Concentration:**					**0.579**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	1	5. Nearly bare and untilled, and alluvial valley fans	2.40	54.00	2,254.00	1.540	0.406
#4	**1**	**Muskingum K:**					**0.406**
#9	1	8. Large gullies, diversions, and low flowing streams	1.35	80.00	5,933.39	3.480	0.473
#9	**1**	**Muskingum K:**					**0.473**
#9	2	8. Large gullies, diversions, and low flowing streams	1.40	125.00	8,915.00	3.550	0.697
#9	**2**	**Muskingum K:**					**0.697**
#9	3	8. Large gullies, diversions, and low flowing streams	1.40	125.00	8,915.00	3.550	0.697
#9	**3**	**Muskingum K:**					**0.697**
#9	4	8. Large gullies, diversions, and low flowing streams	1.35	80.00	5,933.00	3.480	0.473

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	**4**	**Muskingum K:**					**0.473**

General Information

Storm Information:

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

Particle Size Distribution:

Size (mm)	Badland Premining	Badland Postmining	LoamySand Premining	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	100.000%
0.1000	83.500%	75.900%	30.000%	26.500%
0.0500	77.000%	70.000%	17.000%	14.000%
0.0020	56.000%	47.000%	11.000%	11.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#6	173.800	173.800	10.44	1.60	24.2	19,208	10.62	7.66
#7	81.500	255.300	14.72	2.36	37.0	22,318	12.63	8.12
#4	292.340	292.340	16.80	2.73	33.6	14,258	7.77	5.65
#3	144.950	144.950	8.09	1.35	10.2	9,501	5.13	3.75
#5	0.000	437.290	23.47	4.08	43.8	12,660	6.89	5.02
#8	155.930	848.520	86.35	13.46	335.7	47,354	8.33	3.96
#9	1,666.640	2,515.160	283.54	59.10	1,076.2	24,586	2.19	1.48

General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.600 inches

Particle Size Distribution:

Size (mm)	Badland Premining	Badland Postmining	LoamySand Premining	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	100.000%
0.1000	83.500%	75.900%	30.000%	26.500%
0.0500	77.000%	70.000%	17.000%	14.000%
0.0020	56.000%	47.000%	11.000%	11.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#6	173.800	173.800	23.65	3.16	55.9	23,180	13.35	9.34
#7	81.500	255.300	31.26	4.65	82.8	25,671	14.90	9.44
#4	292.340	292.340	36.72	5.36	76.0	16,856	9.52	6.80
#3	144.950	144.950	18.00	2.66	23.3	11,344	6.39	4.54
#5	0.000	437.290	50.51	8.02	99.4	14,974	8.45	6.05
#8	155.930	848.520	131.54	22.73	564.1	47,740	10.90	5.10
#9	1,666.640	2,515.160	448.44	93.13	1,767.4	24,955	3.19	2.19

General Information

Storm Information:

Storm Type:	NRCS Type II-60
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.000 inches

Particle Size Distribution:

Size (mm)	Badland Premining	Badland Postmining	LoamySand Premining	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	100.000%
0.1000	83.500%	75.900%	30.000%	26.500%
0.0500	77.000%	70.000%	17.000%	14.000%
0.0020	56.000%	47.000%	11.000%	11.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#6	173.800	173.800	46.65	5.80	115.0	26,091	15.45	10.74
#7	81.500	255.300	60.94	8.54	169.2	27,873	16.59	10.76
#4	292.340	292.340	72.13	9.83	155.8	18,887	10.98	7.78
#3	144.950	144.950	35.44	4.88	47.9	12,812	7.43	5.23
#5	0.000	437.290	98.10	14.71	203.7	16,802	9.76	6.94
#8	155.930	848.520	204.70	37.64	942.5	47,830	13.20	6.20
#9	1,666.640	2,515.160	702.54	145.32	2,902.0	25,563	4.29	2.99