APPENDIX 11-FF

AREA I SOUTH RECLAIMED CHANNELS

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Doby North Channel

The location and alignment of the channel is presented on Exhibit 11-85 in the Navajo Mine PAP. The hydrology model and drainage subdivisions are also presented on Exhibit 11-85.

September 2006

LR

BHP Navajo Coal Company
PO Box 1717
Fruitland, NM
87416

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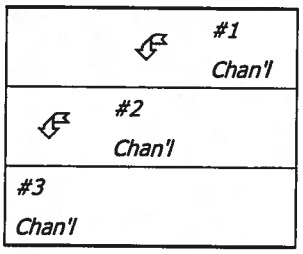
General Information

Storm Information:

Storm Type:	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	==>	#2	0.738	0.196	Doby Channel
Channel	#2	==>	#3	0.000	0.000	Doby Channel
Channel	#3	==>	End	0.000	0.000	Riprap



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	0.14	4.00	2,923.97	1.10	0.738
#1	**Muskingum K:**					**0.738**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	980.190	980.190	1.13	0.42
#2	590.520	1,570.710	1.73	0.67
#3	0.000	1,570.710	1.73	0.67

Structure Detail:

Structure #1 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Ordinary firm loam

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)
10.00	6.0:1	6.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.13 cfs	
Depth:	0.19 ft	
Top Width:	12.24 ft	
Velocity:	0.55 fps	
X-Section Area:	2.07 sq ft	
Hydraulic Radius:	0.169	
Froude Number:	0.23	

Structure #2 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Riprap

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)
10.00	4.0:1	8.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.73 cfs	
Depth:	0.24 ft	
Top Width:	12.86 ft	
Velocity:	0.63 fps	
X-Section Area:	2.73 sq ft	

	w/o Freeboard	w/ Freeboard
Hydraulic Radius:	0.211	
Froude Number:	0.24	

Structure #3 (Riprap Channel)

Riprap

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)
12.00	3.0:1	3.0:1	15.2	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.73 cfs	
Depth:	0.03 ft	1.03 ft
Top Width:	12.18 ft	18.18 ft
Velocity*:		
X-Section Area:	0.37 sq ft	
Hydraulic Radius:	0.030	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

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

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)
#1	1	980.190	2.472	0.000	0.000	75.000	M	1.13	0.419
	Σ	**980.190**						**1.13**	**0.419**
#2	1	590.520	2.776	0.000	0.000	75.000	M	0.64	0.252
	Σ	**1,570.710**						**1.73**	**0.671**
#3	Σ	**1,570.710**						**1.73**	**0.671**

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	1.09	96.00	8,778.34	1.040	2.344
		8. Large gullies, diversions, and low flowing streams	0.08	0.30	383.14	0.830	0.128
#1	**1**	**Time of Concentration:**					**2.472**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	119.00	9,155.25	1.140	2.230
		8. Large gullies, diversions, and low flowing streams	0.17	4.00	2,399.52	1.220	0.546
#2	**1**	**Time of Concentration:**					**2.776**

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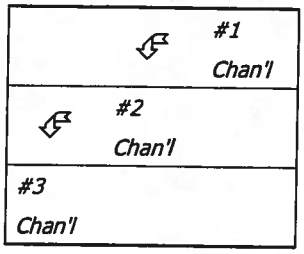
General Information

Storm Information:

Storm Type:	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	==>	#2	0.738	0.196	Doby Channel
Channel	#2	==>	#3	0.000	0.000	Doby Channel
Channel	#3	==>	End	0.000	0.000	Riprap



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	0.14	4.00	2,923.97	1.10	0.738
#1	**Muskingum K:**					**0.738**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	980.190	980.190	22.98	8.26
#2	590.520	1,570.710	34.86	13.24
#3	0.000	1,570.710	34.86	13.24

Structure Detail:

Structure #1 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Ordinary firm loam

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)
10.00	6.0:1	6.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	22.98 cfs	
Depth:	1.00 ft	
Top Width:	21.99 ft	
Velocity:	1.44 fps	
X-Section Area:	15.98 sq ft	
Hydraulic Radius:	0.721	
Froude Number:	0.30	

Structure #2 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Riprap

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)
10.00	4.0:1	8.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	34.86 cfs	
Depth:	1.24 ft	
Top Width:	24.85 ft	
Velocity:	1.62 fps	
X-Section Area:	21.55 sq ft	

	w/o Freeboard	w/ Freeboard
Hydraulic Radius:	0.860	
Froude Number:	0.31	

Structure #3 (Riprap Channel)

Riprap

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)
12.00	3.0:1	3.0:1	15.2	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	34.86 cfs	
Depth:	0.24 ft	1.24 ft
Top Width:	13.45 ft	19.45 ft
Velocity*:		
X-Section Area:	3.08 sq ft	
Hydraulic Radius:	0.228	
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.

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)
#1	1	980.190	2.472	0.000	0.000	75.000	M	22.98	8.260
	Σ	**980.190**						**22.98**	**8.260**
#2	1	590.520	2.776	0.000	0.000	75.000	M	12.81	4.976
	Σ	**1,570.710**						**34.86**	**13.236**
#3	Σ	**1,570.710**						**34.86**	**13.236**

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	1.09	96.00	8,778.34	1.040	2.344
		8. Large gullies, diversions, and low flowing streams	0.08	0.30	383.14	0.830	0.128
#1	**1**	**Time of Concentration:**					**2.472**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	119.00	9,155.25	1.140	2.230
		8. Large gullies, diversions, and low flowing streams	0.17	4.00	2,399.52	1.220	0.546
#2	**1**	**Time of Concentration:**					**2.776**

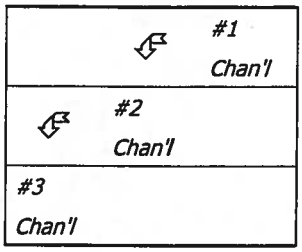
General Information

Storm Information:

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

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.738	0.196	Doby Channel
Channel	#2	==>	#3	0.000	0.000	Doby Channel
Channel	#3	==>	End	0.000	0.000	Riprap



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	0.14	4.00	2,923.97	1.10	0.738
#1	**Muskingum K:**					**0.738**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	980.190	980.190	48.29	16.68
#2	590.520	1,570.710	72.91	26.72
#3	0.000	1,570.710	72.91	26.72

Structure Detail:

Structure #1 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Ordinary firm loam

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)
10.00	6.0:1	6.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	48.29 cfs	
Depth:	1.46 ft	
Top Width:	27.48 ft	
Velocity:	1.77 fps	
X-Section Area:	27.29 sq ft	
Hydraulic Radius:	0.985	
Froude Number:	0.31	

Structure #2 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Riprap

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)
10.00	4.0:1	8.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	72.91 cfs	
Depth:	1.78 ft	
Top Width:	31.38 ft	
Velocity:	1.98 fps	
X-Section Area:	36.86 sq ft	

	w/o Freeboard	w/ Freeboard
Hydraulic Radius:	1.164	
Froude Number:	0.32	

Structure #3 (Riprap Channel)

Riprap

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)
12.00	3.0:1	3.0:1	15.2	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	72.91 cfs	
Depth:	0.44 ft	1.44 ft
Top Width:	14.64 ft	20.64 ft
Velocity*:		
X-Section Area:	5.85 sq ft	
Hydraulic Radius:	0.396	
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.

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)
#1	1	980.190	2.472	0.000	0.000	75.000	M	48.29	16.677
	Σ	**980.190**						**48.29**	**16.677**
#2	1	590.520	2.776	0.000	0.000	75.000	M	26.79	10.047
	Σ	**1,570.710**						**72.91**	**26.724**
#3	Σ	**1,570.710**						**72.91**	**26.724**

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	1.09	96.00	8,778.34	1.040	2.344
		8. Large gullies, diversions, and low flowing streams	0.08	0.30	383.14	0.830	0.128
#1	**1**	**Time of Concentration:**					**2.472**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	119.00	9,155.25	1.140	2.230
		8. Large gullies, diversions, and low flowing streams	0.17	4.00	2,399.52	1.220	0.546
#2	**1**	**Time of Concentration:**					**2.776**

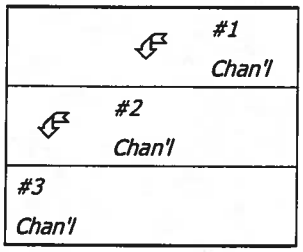
General Information

Storm Information:

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

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.738	0.196	Doby Channel
Channel	#2	==>	#3	0.000	0.000	Doby Channel
Channel	#3	==>	End	0.000	0.000	Riprap



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	0.14	4.00	2,923.97	1.10	0.738
#1	**Muskingum K:**					**0.738**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	980.190	980.190	93.15	31.12
#2	590.520	1,570.710	139.82	49.86
#3	0.000	1,570.710	139.82	49.86

Structure Detail:

Structure #1 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Ordinary firm loam

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)
10.00	6.0:1	6.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	93.15 cfs	
Depth:	2.00 ft	
Top Width:	34.04 ft	
Velocity:	2.11 fps	
X-Section Area:	44.11 sq ft	
Hydraulic Radius:	1.283	
Froude Number:	0.33	

Structure #2 (Erodible Channel)

Doby Channel

Trapezoidal Erodible Channel Inputs:

Material: Riprap

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)
10.00	4.0:1	8.0:1	0.1	0.0250				3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	139.82 cfs	
Depth:	2.42 ft	
Top Width:	39.09 ft	
Velocity:	2.35 fps	
X-Section Area:	59.50 sq ft	

	w/o Freeboard	w/ Freeboard
Hydraulic Radius:	1.507	
Froude Number:	0.34	

Structure #3 (Riprap Channel)

Riprap

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)
12.00	3.0:1	3.0:1	15.2	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	139.82 cfs	
Depth:	0.71 ft	1.71 ft
Top Width:	16.25 ft	22.25 ft
Velocity*:		
X-Section Area:	10.00 sq ft	
Hydraulic Radius:	0.607	
Froude Number*:		
Manning's n*:		
Dmin:	5.00 in	
D50:	15.00 in	
Dmax:	18.75 in	

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

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)
#1	1	980.190	2.472	0.000	0.000	75.000	M	93.15	31.117
	Σ	**980.190**						**93.15**	**31.117**
#2	1	590.520	2.776	0.000	0.000	75.000	M	51.45	18.747
	Σ	**1,570.710**						**139.82**	**49.864**
#3	Σ	**1,570.710**						**139.82**	**49.864**

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	1.09	96.00	8,778.34	1.040	2.344
		8. Large gullies, diversions, and low flowing streams	0.08	0.30	383.14	0.830	0.128
#1	**1**	**Time of Concentration:**					**2.472**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	119.00	9,155.25	1.140	2.230
		8. Large gullies, diversions, and low flowing streams	0.17	4.00	2,399.52	1.220	0.546
#2	**1**	**Time of Concentration:**					**2.776**