

DESIGN REPORT

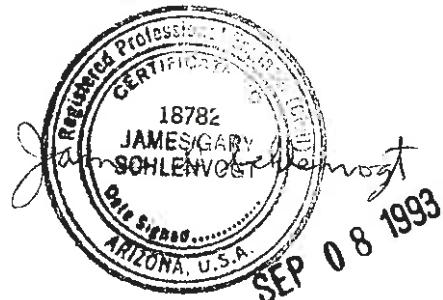
Sedimentation Structure

N11-G

Kayenta Mine

Navajo County, Arizona

PEABODY COAL COMPANY



DESIGN REPORT

Sedimentation Structure

N11-G

Black Mesa Complex

Navajo County, Arizona

PEABODY WESTERN COAL COMPANY

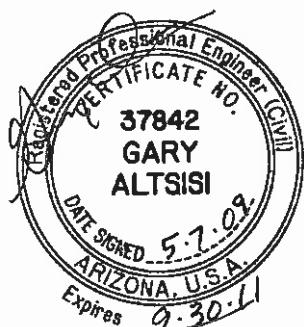


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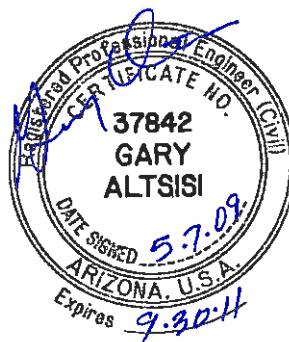
Appendix A - Hydrology, Hydraulic, and Sedimentation Calculations

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Exhibit 1 - N11-G and N11-G1 Sedimentation Ponds



Introduction

Sedimentation Structure N11-G is an earthen embankment, designed and constructed by Peabody Western Coal Company as a permanent impoundment structure to control runoff and sediment from the N-11 surface mining area at the Black Mesa Complex. The location of Structure N11-G and its watershed boundary is shown on Drawing No. 85400 (Sheet L-7), and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

This design report contains information specific to Structure N11-G located in series with upstream sedimentation structure N11-G1. In addition, the spillway design for N11-G was evaluated using the 100-year, 6-hour storm assuming the upstream structures have been reclaimed. This will be the condition in approximately 2015 when N11-G1 is reclaimed and N11-G remains as a permanent structure.

Prior to bond release by the regulatory authorities, Peabody Western Coal Company will utilize a qualified Registered Professional Engineer to review the performance standards required for N11-G. The engineer will recommend remedial work, if required, to modify or upgrade N11-G to assure compliance with the applicable permanent impoundment regulations, proposed postmining land use, and with the livestock and wildlife facility requirements in Chapter 23, Revegetation Plan, of the approved permit. The final permanent impoundment remedial plan for structure N11-G will be submitted to OSMRE approximately one year prior to final bond release.

Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Western Coal Company", December, 1985 (PAP), Chapter 6, Attachment D, Volume 2, along with the methods and results of analyses used for slope stability, hydrology, and hydraulics, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

Inspection

The construction site of Structure N11-G was inspected by a Registered Professional Engineer from Peabody Western Coal Company to ensure that the location was suitable and no adverse conditions existed to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6,

Attachment D was utilized for embankment design. A conservative embankment category of (B-3) with a 30-foot total embankment height was utilized for the design.

Site Description

Land Use

The two N11-G series structures have a 706.49-acre combined drainage area and are located on a tributary to Coal Mine Wash at the Black Mesa Complex. The watershed is classified as 15 percent disturbed, 77 percent pinon-juniper, and 8 percent sagebrush-grass. Prior to the reclamation of the upstream structures, structure N11-G will have a 39.39-acre drainage area.

Design Analyses

General

Structure N11-G was designed by a Registered Professional Engineer from Peabody Western Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of the Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Western Coal Company files includes topographic maps developed from aerial photography flown in 2008 and was used in the analyses of the structure.

Stability

A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 20 feet wide on top will be constructed. An upstream slope of 3:1 (horizontal to vertical) and a downstream slope of 5:1 were assumed. Based on a total embankment height of 30 feet, these slopes are equal to or flatter than the recommended slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable. The emergency spillway will be a minimum 80-foot wide riprap-lined trapezoidal channel.

Hydrology

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, B, and C). Structure N11-G is located downstream from structure N11-G1. Structure N11-G is classified as a low hazard structure. No coal mining activities will occur downstream of the embankment. In addition, the mine area is sparsely populated with no one living in the downstream flood plain. The structure will impound less than 20

acre-feet and be less than 20 feet in vertical height from the upstream toe of embankment of the natural stream elevation to the emergency spillway elevation. The two structures have a combined capacity that is greater than 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm for a permanent impoundment and for the downstream ponds in series. Structure N11-G1 was assumed to be reclaimed and structure N11-G was conservatively assumed to be full to the emergency spillway at the time of the 100-year storm. The storage capacity requirements of Structure N11-G was analyzed using the 10-year, 24-hour storm. The combined ponds in series were conservatively assumed to completely contain the 10-year, 24-hour storm without discharge downstream to Coal Mine Wash; plus, provide adequate sediment storage volume.

The following parameters were used in the hydrologic analysis:

	10-Year	100-Year
	<u>24-Hr Storm</u>	<u>6-Hr. Storm</u>
1. Water Course Length, L	0.125 mi	1.676 mi
2. Elevation Difference, H	29.68 ft	390.88 ft
3. Time of Concentration, Tc	0.064 hr	0.473 hr
4. SCS Curve Number	78	78
5. Rainfall Depth	2.1 in	2.4 in
6. Drainage Area	39.39 ac	706.49 ac

Hydraulics

The SEDCAD[†] and Dodson-Trapezoidal Channel computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure, and the resulting water surface elevations. The 10-year storm was routed through Structure N11-G1 into Structure N11-G as will be the worst-case scenario during mining and reclamation, and the 100-year storm was analyzed with Structure N11-G1 reclaimed. The initial conditions and results of the analysis are summarized in the following N11-G hydraulics table:

N11-G HYDRAULICS TABLE

	Units	10-Yr, 24-Hr	100-Yr, 6-Hr
		Storm	Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway elevation
Inflow			
Peak Flow	cfs	24.65	348.36
Volume	ac-ft	1.8*	34.0
Storage			
Peak Stage	msl	N/A	6748.6
Emerg. Spillway Elev.	msl	6747.2	6747.2
Peak Storage	ac-ft	N/A	23.0
Storage Capacity	ac-ft	19.98	19.98
Outflow			
Peak Flow	cfs	N/A	345.3
Spillway Elevation	msl	6747.2	6747.2
Embankment Crest Elev.	msl	6752.2	6752.2
Peak Stage	msl	---	6748.0
Freeboard	ft	---	4.2
Emergency Spillway Channel			
Flow Depth	ft	---	1.8
Critical Velocity	fps	---	5.0
Mannings "n"	---	---	0.048
Width	ft	---	84
Outflow Channel			
Slope	%	---	20.0
Normal Velocity	fps	---	7.3
Normal Depth	ft	---	1.6
Mannings "n"	---	---	0.061

*Inflow volume for the drainage area between Structures N11-G and N11-G1.

Emergency Spillway and Outlet Channel

The emergency spillway and outlet channel for N11-G will be a trapezoidal channel. The alignment and dimensions are shown on Exhibit 1 and includes the following dimensions:

A minimum 15-foot long riprap channel will be constructed beyond the toe of the embankment as a transition into the downstream natural channel.

Storage Capacity

The impoundment stage-capacity table (see Exhibit 1) is based on the 2008 aerial topographic mapping conducted for Peabody Western Coal Company. The total storage capacity of Structure N11-G is designed to contain approximately 19.98 acre-feet.

The calculations for the sediment load entering Structure N11-G were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

- | | | | |
|----|----------------------------|-------|-------|
| 1. | Rainfall Factor, R | | 40 |
| 2. | Soil Erodibility Factor, K | | 0.20 |
| 3. | Slope Factor, LS | | 11.87 |
| 4. | Cover Factor, C | | 0.69 |
| 5. | Erosion Control Factor, P | | 0.44 |

The hydrologic analysis gives the storage volume required to treat the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. Although Structure N11-G has sufficient storage by itself, the N11-G1 structure upstream from N11-G does not have sufficient storage and contributes excess runoff downstream to N11-G. Therefore, the combined sediment storage capacity was determined for the two structures in series. The results of the analysis are presented in the following table.

Combined Storage for Structures N11-G1 and N11-G

	<u>N11-G1</u>	<u>N11-G</u>	<u>Combined</u>
Total Storage Capacity	19.91	19.98	39.89 ac-ft
10-Year, 24-Hour Storm Inflow	24.02	1.78	25.80 ac-ft
Available Sediment			
Storage Capacity	-4.11	18.2	14.09 ac-ft
Sediment Inflow Rate/Yr	3.37	0.53	3.92 ac-ft/yr
Sediment Storage Life	---	---	3.6 yrs

The following appendices and drawing are attached and complete this design report.

Diversions

Due to the topography and the location of the surface mining disturbance, it will be necessary to construct a diversion (i.e., N11-G Terrace). The location of this diversion is shown on Exhibit 1 and Drawing 85400, Sheet L-7. The diversion will receive the overland runoff from the N-11 mining and reclamation area and divert runoff within Sedimentation Pond N11-G's watershed. This diversion will be constructed in accordance with the enclosed design (see Appendix D) and the typical cross sections and construction specifications for terraces and downdrains found in Chapter 26.

N11-G #1 Terrace Diversion Summary

Purpose: To divert approximately 39.39 acres of N-11 mining and reclamation area runoff within the Sedimentation Pond N11-G's watershed (see Drawing No. 85400, Sheet L-7 and Exhibit 1 for location; see Appendix D for calculations).

10-Year, 6-Hour Precipitation	=	1.60 inches
Area	=	39.39 ac
CN	=	78
Time of Concentration	=	0.064 hr
Peak Discharge (100-yr, 6-hr)	=	50.03 cfs
Critical Slope	=	1.00 %
V-Ditch Design Depth w/freeboard	=	2.8 ft

Therefore, two alternative V-ditch designs are recommended:

A. Earth-lined V-ditch (subcritical flow)

Average slope = 1.0 %
n = 0.03 (graded silts)
 d_n = 1.77 ft
Velocity = 5.31 fps
Minimum freeboard = 1.0 ft

B. Riprap-lined Trapezoidal-ditch (supercritical flow)

Maximum slope = 20 %
n = 0.054 (riprap)
Width = 5 ft
 d_n = 0.8 ft
Velocity = 8.60 fps
Riprap D_{max} = 9.0 in
Riprap D_{50} = 6.0 in
Minimum freeboard = 1.0 ft

Note: Minimum 20 ft. length of riprap ditch as a transitional channel between the two alternative designs.

See Chapter 26 for construction specifications and typical cross sections for terraces and downdrains.

In conclusion, the earth-lined V-ditch design will be utilized in the subcritical slope channel sections and the riprap-lined V-ditch design will be utilized in the supercritical slope sections.

The following appendices and drawing are attached and complete this design report.

Appendix A - Hydrology, Hydraulic, and Sedimentation Calculations

Appendix B - SEDCAD⁺ (Input and Output) 10-year, 24-hour Storm Event

Appendix C - SEDCAD⁺ (Input and Output) 100-year, 6-hour Storm Event

Appendix D - Diversion, N11-G #1 Terrace Calculations

Exhibit 1 - N11-G and N11-G1 Sedimentation Ponds

APPENDIX A

HYDROLOGY, HYDRAULIC, AND SEDIMENTATION CALCULATIONS

N11-G

Project: N11-G Pond (In-Series)

Time of Concentration:

Elevation Difference = 6760.8 - 6731.12 = 29.68 ft.

Watercourse Length = 500 ft. = 0.125 mi.

TC = [11.9(W.L.)³/(E.D.)]^{0.385} = 0.064 hr.

SCS Curve Number:

Cover Type	Soil Group	Area CN	(Acres)	CN*Area
Reclaimed	B	81	34.13	2764.5
Sage Brush	B	60	<u>5.26</u>	<u>315.6</u>
			39.39	3080.1

Weighted CN = 3080.1/39.39 = 78.2 = Use 78

Drainage Basin Area:

39.39 acres 0.06 sq. miles

SEDCAD Utility-Routing Parameters:

K = 0.000 hr

X = 0.000 hr

Project: N11-G Pond (Only)

Time of Concentration:

Elevation Difference = 7122 - 6731.12 = 390.88 ft.

Watercourse Length = 8846.54 ft. = 1.676 mi.

TC = [11.9 (W.L.)³]^{0.385} = 0.473 hr.

ED

SCS Curve Number:

Cover <u>Type</u>	Soil <u>Group</u>	Area		
		CN	(Acres)	CN x Area
Reclaimed	B	81	108.12	8,757.7
Sagebrush-Grass	B	60	52.93	3,175.8
Pinon-Juniper	B	65	130.62	8,490.3
Pinon-Juniper	D	83	<u>414.82</u>	<u>34,430.1</u>
			706.49	54,853.9

$$\text{Weighted CN} = 54,853.9 / 706.49 = 77.64 = \underline{\text{Use 78}}$$

Drainage Basin Area:

706.49 acres 1.104 sq. miles

Revised USLE Calculations:

Project: N11-G Pond (In-Series)

Soil Erodibility Factor:

Soil Type	Soil <u>Group</u>	K	Area (Acres)	K * Area
16F	B	0.05	1.36	0.068
15A	B	0.28	4.96	0.389
16E	B	0.05	3.61	0.181
3C	D	0.16	1.07	0.171
3D	D	0.15	3.53	0.530
3E	D	0.15	1.88	0.282
Graded Spoil	B	0.21	21.35	4.484
Newly Reclaimed	B	0.38	<u>1.63</u>	<u>0.619</u>
			39.39	7.723

$$\text{Weighted k} = 7.723 / 39.39 = 0.20$$

Slope Factor:

Length (ft)	Elev.	Slope (%)	M	Theta (Degrees)	LS $(L/72.6)^M * [17.2 \sin(\text{Theta}) - 0.55]$
700	195	27.86	0.6	15.57	15.84
450	90	20.00	0.6	11.31	8.44
850	150	17.65	0.6	10.01	10.68
850	172	20.24	0.6	11.44	12.52
Avg. LS = <u>11.87</u>					

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (Acres)	C	C * Area	P	P * Area
Sage Brush	40	25	5.26	0.3	1.58	1.0	5.26
Newly Reclaimed	--	--	<u>35.54</u>	0.725	<u>25.77</u>	0.336	<u>11.94</u>
			39.39		27.35		17.2

$$\text{Weighted C} = 27.35/39.39 = 0.69$$

$$\text{Weighted P} = 17.20/39.39 = 0.44$$

Rainfall Factor: R = 40

Revised USLE Calculations:

$$A = R * K * LS * C * P$$

$$A = 40 * 0.20 * 11.87 * 0.69 * 0.44 = 28.83 \text{ tons/acre}$$

Sediment Inflow Rate:

$$DA = 39.39$$

$$SDR = 0.95$$

$$SI = (A * DA * SDR * 94) / 192,400 = 0.53 \text{ ac-ft/yr}$$

APPENDIX B

N11-G SEDCAD+ (INPUT AND OUTPUT)

10-YEAR, 24-HOUR STORM EVENT

N11-G POND DESIGN

10YR-24HR STORM

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P.O. Box 650
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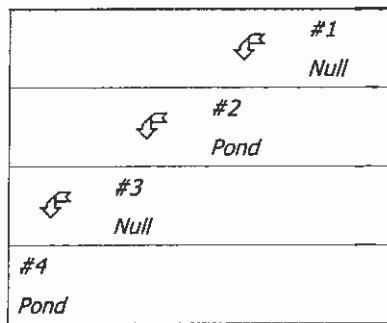
Phone: 928-677-3201

General Information***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	2.100 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	
Pond	#2	==>	#3	0.000	0.000	N11-G1 Spillway
Null	#3	==>	#4	0.000	0.000	
Pond	#4	==>	End	0.000	0.000	N11-G Spillway



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	667.100	667.100	166.43	24.02
#2	In	0.000	166.43	24.02
	Out	667.100	129.99	24.02
#3	39.390	706.490	135.31	25.80
#4	In	0.000	135.31	25.80
	Out	706.490	118.17	25.80

Structure Detail:Structure #1 (Null)Structure #2 (Pond)*N11-G1 Spillway*

Pond Inputs:

Initial Pool Elev:	6,760.80 ft
Initial Pool:	19.91 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,760.80	86.00	3.00:1	3.00:1	56.00

Pond Results:

Peak Elevation:	6,761.96 ft
Dewater Time:	0.64 days

*Dewatering time is calculated from peak stage to lowest spillway*Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,747.70	0.221	0.000	0.000	
6,748.20	0.334	0.138	0.000	
6,748.70	0.469	0.338	0.000	
6,749.20	0.628	0.611	0.000	
6,749.70	0.810	0.970	0.000	
6,750.00	0.930	1.230	0.000	
6,750.20	0.955	1.419	0.000	
6,750.70	1.017	1.912	0.000	
6,751.20	1.082	2.437	0.000	
6,751.70	1.149	2.994	0.000	
6,752.20	1.218	3.586	0.000	
6,752.70	1.289	4.213	0.000	
6,753.20	1.361	4.875	0.000	
6,753.70	1.436	5.574	0.000	
6,754.20	1.513	6.312	0.000	
6,754.70	1.592	7.088	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,755.00	1.640	7.572	0.000	
6,755.20	1.671	7.904	0.000	
6,755.70	1.750	8.759	0.000	
6,756.20	1.830	9.654	0.000	
6,756.70	1.912	10.589	0.000	
6,757.20	1.996	11.566	0.000	
6,757.70	2.082	12.586	0.000	
6,758.20	2.170	13.648	0.000	
6,758.70	2.259	14.756	0.000	
6,759.20	2.350	15.908	0.000	
6,759.70	2.443	17.106	0.000	
6,760.00	2.500	17.847	0.000	
6,760.20	2.540	18.352	0.000	
6,760.70	2.640	19.646	0.000	
6,760.80	2.660	19.910	0.000	Spillway #1
6,761.20	2.737	20.991	32.288	13.45
6,761.70	2.834	22.383	72.608	1.35
6,761.96	2.885	23.122	129.992	0.55 Peak Stage
6,762.20	2.933	23.825	184.716	
6,762.70	3.034	25.317	321.322	
6,763.20	3.137	26.860	486.730	
6,763.70	3.241	28.454	679.120	
6,764.20	3.347	30.101	916.498	
6,764.70	3.455	31.801	1,187.756	
6,765.00	3.520	32.847	1,357.870	
6,765.20	3.558	33.556	1,474.355	
6,765.70	3.655	35.359	1,812.423	
6,766.20	3.753	37.211	2,156.789	
6,766.70	3.852	39.112	2,519.017	
6,767.20	3.953	41.063	2,924.465	
6,767.70	4.055	43.065	3,362.280	
6,768.20	4.158	45.118	3,828.353	
6,768.70	4.262	47.223	4,322.835	
6,769.20	4.368	49.381	4,835.878	
6,769.70	4.475	51.592	5,374.009	
6,770.00	4.540	52.943	5,715.589	

Detailed Discharge Table

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Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,747.70	0.000	0.000
6,748.20	0.000	0.000
6,748.70	0.000	0.000
6,749.20	0.000	0.000
6,749.70	0.000	0.000
6,750.00	0.000	0.000
6,750.20	0.000	0.000
6,750.70	0.000	0.000
6,751.20	0.000	0.000
6,751.70	0.000	0.000
6,752.20	0.000	0.000
6,752.70	0.000	0.000
6,753.20	0.000	0.000
6,753.70	0.000	0.000
6,754.20	0.000	0.000
6,754.70	0.000	0.000
6,755.00	0.000	0.000
6,755.20	0.000	0.000
6,755.70	0.000	0.000
6,756.20	0.000	0.000
6,756.70	0.000	0.000
6,757.20	0.000	0.000
6,757.70	0.000	0.000
6,758.20	0.000	0.000
6,758.70	0.000	0.000
6,759.20	0.000	0.000
6,759.70	0.000	0.000
6,760.00	0.000	0.000
6,760.20	0.000	0.000
6,760.70	0.000	0.000
6,760.80	0.000	0.000
6,761.20	32.288	32.288
6,761.70	72.608	72.608
6,762.20	184.716	184.716
6,762.70	321.322	321.322
6,763.20	486.730	486.730
6,763.70	679.120	679.120
6,764.20	916.498	916.498
6,764.70	1,187.756	1,187.756
6,765.00	1,357.870	1,357.870
6,765.20	1,474.355	1,474.355

Elevation (ft)	Combined	
	Emergency Spillway (cfs)	Total Discharge (cfs)
6,765.70	1,812,423	1,812,423
6,766.20	2,156,789	2,156,789
6,766.70	2,519,017	2,519,017
6,767.20	2,924,465	2,924,465
6,767.70	3,362,280	3,362,280
6,768.20	3,828,353	3,828,353
6,768.70	4,322,835	4,322,835
6,769.20	4,835,878	4,835,878
6,769.70	5,374,009	5,374,009
6,770.00	5,715,589	5,715,589

Structure #3 (Null)Structure #4 (Pond)**N11-G Spillway**

Pond Inputs:

Initial Pool Elev:	6,747.20 ft
Initial Pool:	19.98 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,747.20	32.00	3.00:1	3.00:1	84.00

Pond Results:

Peak Elevation:	6,747.95 ft
Dewater Time:	0.64 days

*Dewatering time is calculated from peak stage to lowest spillway*Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,731.12	0.152	0.000	0.000	
6,731.62	0.218	0.092	0.000	
6,732.12	0.295	0.220	0.000	
6,732.62	0.384	0.389	0.000	
6,733.12	0.485	0.606	0.000	
6,733.62	0.598	0.877	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,734.12	0.723	1.206	0.000	
6,734.62	0.859	1.601	0.000	
6,735.00	0.970	1.948	0.000	
6,735.12	0.978	2.065	0.000	
6,735.62	1.014	2.563	0.000	
6,736.12	1.050	3.079	0.000	
6,736.62	1.086	3.613	0.000	
6,737.12	1.123	4.166	0.000	
6,737.62	1.161	4.737	0.000	
6,738.12	1.200	5.327	0.000	
6,738.62	1.239	5.937	0.000	
6,739.12	1.279	6.566	0.000	
6,739.62	1.319	7.216	0.000	
6,740.00	1.350	7.722	0.000	
6,740.12	1.361	7.885	0.000	
6,740.62	1.409	8.578	0.000	
6,741.12	1.457	9.294	0.000	
6,741.62	1.506	10.035	0.000	
6,742.12	1.556	10.801	0.000	
6,742.62	1.607	11.592	0.000	
6,743.12	1.659	12.408	0.000	
6,743.62	1.711	13.250	0.000	
6,744.12	1.764	14.119	0.000	
6,744.62	1.818	15.015	0.000	
6,745.00	1.860	15.714	0.000	
6,745.12	1.869	15.938	0.000	
6,745.62	1.904	16.881	0.000	
6,746.12	1.941	17.842	0.000	
6,746.62	1.977	18.821	0.000	
6,747.12	2.014	19.819	0.000	
6,747.20	2.020	19.981	0.000	Spillway #1
6,747.62	2.083	20.842	66.590	14.60
6,747.95	2.133	21.532	118.173	0.75 Peak Stage
6,748.12	2.160	21.903	145.879	
6,748.62	2.238	23.002	334.203	
6,749.12	2.317	24.141	558.491	
6,749.62	2.398	25.320	826.437	
6,750.00	2.460	26.242	1,080.447	
6,750.12	2.493	26.540	1,148.804	
6,750.62	2.636	27.822	1,514.154	
6,751.12	2.781	29.176	1,921.701	
6,751.62	2.931	30.604	2,359.219	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,752.12	3.085	32.108	2,834.735	
6,752.20	3.110	32.356	2,934.339	

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,731.12	0.000	0.000
6,731.62	0.000	0.000
6,732.12	0.000	0.000
6,732.62	0.000	0.000
6,733.12	0.000	0.000
6,733.62	0.000	0.000
6,734.12	0.000	0.000
6,734.62	0.000	0.000
6,735.00	0.000	0.000
6,735.12	0.000	0.000
6,735.62	0.000	0.000
6,736.12	0.000	0.000
6,736.62	0.000	0.000
6,737.12	0.000	0.000
6,737.62	0.000	0.000
6,738.12	0.000	0.000
6,738.62	0.000	0.000
6,739.12	0.000	0.000
6,739.62	0.000	0.000
6,740.00	0.000	0.000
6,740.12	0.000	0.000
6,740.62	0.000	0.000
6,741.12	0.000	0.000
6,741.62	0.000	0.000
6,742.12	0.000	0.000
6,742.62	0.000	0.000
6,743.12	0.000	0.000
6,743.62	0.000	0.000
6,744.12	0.000	0.000
6,744.62	0.000	0.000
6,745.00	0.000	0.000
6,745.12	0.000	0.000
6,745.62	0.000	0.000

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Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,746.12	0.000	0.000
6,746.62	0.000	0.000
6,747.12	0.000	0.000
6,747.20	0.000	0.000
6,747.62	66.590	66.590
6,748.12	145.879	145.879
6,748.62	334.203	334.203
6,749.12	558.491	558.491
6,749.62	826.437	826.437
6,750.00	1,080.447	1,080.447
6,750.12	1,148.804	1,148.804
6,750.62	1,514.154	1,514.154
6,751.12	1,921.701	1,921.701
6,751.62	2,359.219	2,359.219
6,752.12	2,834.735	2,834.735
6,752.20	2,934.339	2,934.339

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	667.100	0.481	0.000	0.000	78.000	M	166.43	24.020
	Σ	667.100						166.43	24.020
#2	Σ	667.100						166.43	24.020
#3	1	39.390	0.064	0.000	0.000	78.000	M	24.65	1.775
	Σ	706.490						135.31	25.796
#4	Σ	706.490						135.31	25.796

APPENDIX C

N11-G SEDCAD+ (INPUT AND OUTPUT)

100-YEAR, 6-HOUR STORM EVENT

N11-G POND DESIGN

100YR-6HR STORM

Gary Altsisi, P.E.

Peabody Western Coal Co.
P.O. Box 650
Kayenta, AZ 86033

Phone: 928-677-3201

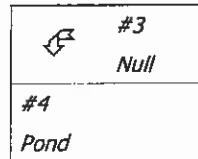
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#3	==>	#4	0.000	0.000	
Pond	#4	==>	End	0.000	0.000	N11-G Spillway



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	706.490	706.490	348.36	34.00
#4	In 0.000	706.490	348.36	34.00
	Out		331.99	34.00

Structure Detail:

Structure #3 (Null)

Structure #4 (Pond)

N11-G Spillway

Pond Inputs:

Initial Pool Elev:	6,747.20 ft
Initial Pool:	19.98 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,747.20	32.00	3.00:1	3.00:1	84.00

Pond Results:

Peak Elevation:	6,748.61 ft
Dewater Time:	0.23 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,731.12	0.152	0.000	0.000	
6,731.62	0.218	0.092	0.000	
6,732.12	0.295	0.220	0.000	
6,732.62	0.384	0.389	0.000	
6,733.12	0.485	0.606	0.000	
6,733.62	0.598	0.877	0.000	
6,734.12	0.723	1.206	0.000	
6,734.62	0.859	1.601	0.000	
6,735.00	0.970	1.948	0.000	
6,735.12	0.978	2.065	0.000	
6,735.62	1.014	2.563	0.000	
6,736.12	1.050	3.079	0.000	
6,736.62	1.086	3.613	0.000	
6,737.12	1.123	4.166	0.000	
6,737.62	1.161	4.737	0.000	
6,738.12	1.200	5.327	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,738.62	1.239	5.937	0.000	
6,739.12	1.279	6.566	0.000	
6,739.62	1.319	7.216	0.000	
6,740.00	1.350	7.722	0.000	
6,740.12	1.361	7.885	0.000	
6,740.62	1.409	8.578	0.000	
6,741.12	1.457	9.294	0.000	
6,741.62	1.506	10.035	0.000	
6,742.12	1.556	10.801	0.000	
6,742.62	1.607	11.592	0.000	
6,743.12	1.659	12.408	0.000	
6,743.62	1.711	13.250	0.000	
6,744.12	1.764	14.119	0.000	
6,744.62	1.818	15.015	0.000	
6,745.00	1.860	15.714	0.000	
6,745.12	1.869	15.938	0.000	
6,745.62	1.904	16.881	0.000	
6,746.12	1.941	17.842	0.000	
6,746.62	1.977	18.821	0.000	
6,747.12	2.014	19.819	0.000	
6,747.20	2.020	19.981	0.000	Spillway #1
6,747.62	2.083	20.842	66.590	3.70
6,748.12	2.160	21.903	145.879	1.15
6,748.61	2.237	22.989	331.994	0.55 Peak Stage
6,748.62	2.238	23.002	334.203	
6,749.12	2.317	24.141	558.491	
6,749.62	2.398	25.320	826.437	
6,750.00	2.460	26.242	1,080.447	
6,750.12	2.493	26.540	1,148.804	
6,750.62	2.636	27.822	1,514.154	
6,751.12	2.781	29.176	1,921.701	
6,751.62	2.931	30.604	2,359.219	
6,752.12	3.085	32.108	2,834.735	
6,752.20	3.110	32.356	2,934.339	

Detailed Discharge Table

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Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,731.12	0.000	0.000
6,731.62	0.000	0.000
6,732.12	0.000	0.000
6,732.62	0.000	0.000
6,733.12	0.000	0.000
6,733.62	0.000	0.000
6,734.12	0.000	0.000
6,734.62	0.000	0.000
6,735.00	0.000	0.000
6,735.12	0.000	0.000
6,735.62	0.000	0.000
6,736.12	0.000	0.000
6,736.62	0.000	0.000
6,737.12	0.000	0.000
6,737.62	0.000	0.000
6,738.12	0.000	0.000
6,738.62	0.000	0.000
6,739.12	0.000	0.000
6,739.62	0.000	0.000
6,740.00	0.000	0.000
6,740.12	0.000	0.000
6,740.62	0.000	0.000
6,741.12	0.000	0.000
6,741.62	0.000	0.000
6,742.12	0.000	0.000
6,742.62	0.000	0.000
6,743.12	0.000	0.000
6,743.62	0.000	0.000
6,744.12	0.000	0.000
6,744.62	0.000	0.000
6,745.00	0.000	0.000
6,745.12	0.000	0.000
6,745.62	0.000	0.000
6,746.12	0.000	0.000
6,746.62	0.000	0.000
6,747.12	0.000	0.000
6,747.20	0.000	0.000
6,747.62	66.590	66.590
6,748.12	145.879	145.879
6,748.62	334.203	334.203
6,749.12	558.491	558.491

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Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,749.62	826.437	826.437
6,750.00	1,080.447	1,080.447
6,750.12	1,148.804	1,148.804
6,750.62	1,514.154	1,514.154
6,751.12	1,921.701	1,921.701
6,751.62	2,359.219	2,359.219
6,752.12	2,834.735	2,834.735
6,752.20	2,934.339	2,934.339

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)
#3	1	706.490	0.473	0.000	0.000	78.000	M	348.36	34.000
	Σ	706.490						348.36	34.000
#4	Σ	706.490						348.36	34.000

N11-G SPILLWAY CHANNEL

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
84.00	3.0:1	3.0:1	20.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	348.36 cfs	
Depth:	0.56 ft	1.56 ft
Top Width:	87.34 ft	93.34 ft
Velocity:	7.29 fps	
X-Section Area:	47.76 sq ft	
Hydraulic Radius:	0.546 ft	
Froude Number:	1.74	
Manning's n:	0.0610	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

May 7, 2009

=====

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs).....	348.36
Channel Bottom Slope (ft/ft).....	0.0005
Manning's Roughness Coefficient (n-value).....	0.048
Channel Left Side Slope (horizontal/vertical).....	3.0
Channel Right Side Slope (horizontal/vertical).....	3.0
Channel Bottom Width (ft).....	84.0

=====

COMPUTATION RESULTS

DESCRIPTION	VALUE
Critical Depth (ft).....	0.8
Critical Slope (ft/ft).....	0.0366
Flow Velocity (fps).....	5.02
Froude Number.....	1.0
Velocity Head (ft).....	0.39
Energy Head (ft).....	1.19
Cross-Sectional Area of Flow (sq ft).....	69.45
Top Width of Flow (ft).....	88.82

=====

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APPENDIX D

N11-G TERRACE CALCULATIONS

Project: N11-G Terrace Diversion

Time of Concentration

$$\text{Elevation Difference} = 6747.7 - 6731.12 = 16.58 \text{ ft.}$$

$$\text{Watercourse Length} = 661 \text{ ft} = 0.125 \text{ mi.}$$

$$T_C = [11.9(W.L)^3/(E.D.)]^{0.385} = 0.080 \text{ hr.}$$

SCS Curve Number

Cover Type	Group	Soil CN	Area (Acres)	CN * Area
Reclaimed	B	81	34.13	2764.5
Sage Brush	B	60	<u>5.26</u>	<u>315.6</u>
			39.39	3080.1

$$\text{Weighted CN} = 3080.1/39.39 = 78.2 = \underline{\text{Use 78}}$$

Drainage Basin Area:

39.39 acres

0.06 sq. miles

N11-G TERRACE DIVERSION DESIGN

100YR-6HR STORM

Gary Altsisi, P.E.

Peabody Western Coal Co.
P.O. Box 650
Kayenta, AZ 86033

Phone: 928-677-3201

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	=>	End	0.000	0.000	

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	39.390	39.390	50.03	2.36

Structure Detail:

Structure #1 (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)
#1	1	39.390	0.080	0.000	0.000	78.000	M	50.03	2.365
Σ		39.390						50.03	2.365

N11-G TERRACE DIVERSIONMaterial: Shales and hardpans*Triangular Channel*

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.0	0.0250	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	50.03 cfs	
Depth:	1.77 ft	2.77 ft
Top Width:	10.63 ft	16.63 ft
Velocity:	5.31 fps	
X-Section Area:	9.42 sq ft	
Hydraulic Radius:	0.841 ft	
Froude Number:	0.99	

N11-G TERRACE DIVERSION

Material: Riprap

Trapezoidal Channel

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	20.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	50.03 cfs	
Depth:	0.79 ft	1.79 ft
Top Width:	9.74 ft	15.74 ft
Velocity:	8.60 fps	
X-Section Area:	5.82 sq ft	
Hydraulic Radius:	0.582 ft	
Froude Number:	1.96	
Manning's n:	0.0540	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	