DESIGN REPORT

Temporary Impoundment Structure

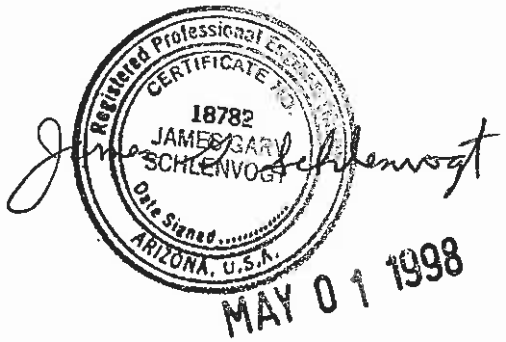
BM-T

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY



MAY 01 1998

TABLE OF CONTENTS

INTRODUCTION

Impoundment Structure BM-T is an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary impoundment structure to collect runoff from portions of facilities area at the Black Mesa Mine. The pond was constructed to minimize coal fines from washing down the undisturbed portions of the wash above sediment structure BM-A1. BM-T is not designed as a sediment control structure. The sediment control for the BM-T watershed is incorporated into the designs for downstream structure BM-A1 assuming BM-T is non-existent. The location of Structure BM-T and its watershed boundary are shown on Drawing No. 85400 (Sheet K-10) 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 BM-T. 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 the Structure BM-T was inspected in February, 1998 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist for this structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for embankment design.

SITE DESCRIPTION

LAND USE

Structure BM-T has a 3.2-acre tributary area and is located upstream of Pond BM-A1. The watershed is classified as 100% disturbed.

DESIGN ANALYSES

GENERAL

Structure BM-T was designed under the supervision of 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 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 1990 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure BM-T is a Category B-4 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and minimum 12 feet wide on top was constructed. A minimum upstream slope of 1.5:1 (horizontal to vertical) and a downstream slope of 2.5:1 were utilized. Based on the total embankment height of approximately 9 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A and B). Structure BM-T is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the emergency spillway invert elevation. The spillway for the BM-T pond was analyzed using the 25-year, 6-hour storm. Structure BM-T was conservatively assumed to be full to the emergency spillway prior to the time of the 25-year storm event.

The following parameters were used in the hydrologic analysis:

		25yr-6hr Storm	
1.	Water Course length, L	0.082	mi.
2.	Elevation Difference, H	29	ft
3.	Time of Concentration, T_c	0.040	hr
4.	SCS Curve Number	91	
5.	Rainfall Depth, 25-year, 6-hour storm	1.9	in
6.	Drainage Area	3.2	acres

HYDRAULICS

The SEDCAD+ and Flow Master computer programs were used to evaluate inflow to the impoundment structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendices A and B).

BM-T POND HYDRAULICS TABLE

	Units	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	5.1
Volume	ac-ft	0.3
Storage		
Storage Capacity	ac-ft	0.75
Outflow		
Peak Flow	cfs	4.35
Spillway Elevation	msl	6486
Embankment Crest Elev.	msl	6487.4
Peak Stage	msl	6486.2
Freeboard	ft	1.2
Emergency Spillway Channel		
Flow Depth	ft	0.2
Critical Velocity	fps	2.0
Mannings "n"	--	.031
Width	ft	18
Outflow Channel		
Slope	%	27
Normal Velocity	fps	3.9
Normal Depth	ft	0.1
Mannings "n"	--	0.031
Riprap D_{50}	in	coarse gravel

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for BM-T is a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway) (Outflow)	1.4 1.0	ft
Channel Width		18	ft
Channel Length	(Spillway) (Outflow)	27 50	ft ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	27	%
Spillway Elevation		6486	ft

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

* * *

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

Appendix A - Hydrology and Hydraulic Calculations

Appendix B - SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event

Exhibit # 1 - BM-T Temporary Impoundment Design

APPENDIX A

Hydrology and Hydraulic Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: TEMPORARY IMPOUNDMENT

STRUCTURE: BM-T

TIME OF CONCENTRATION:

Start Elevation (ft) =	6511
End Elevation (ft) =	6482
Elevation Difference, E (ft) =	29
Watercourse Length (ft) =	435
Watercourse Length, L (mi) =	0.082

Tc = (11.9L^3/E)^0.385 = 0.040 hours

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Disturbed	C	91	3.2	291.2
TOTAL:			3.2	291.2

Weighted CN = Total CN*Area/ Total Area = 91

DRAINAGE BASIN AREA:

3.2 Acres

BM-T temporary impoundment
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	BM-T temporary impoundment
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.031	
Channel Slope	0.028562	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	18.00	ft
Discharge	4.35	cfs

Results		
Depth	0.12	ft
Flow Area	2.22	ft²
Wetted Perimeter	18.77	ft
Top Width	18.73	ft
Critical Depth	0.12	ft
Critical Slope	0.028566	ft/ft
Velocity	1.96	ft/s
Velocity Head	0.06	ft
Specific Energy	0.18	ft
Froude Number	1.00	
Flow is subcritical.		

SEDCAD+ NONERODIBLE CHANNEL DESIGN

BM-T SPILLWAY

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	4.35 cfs	
Slope	27.00 %	
Sideslopes	3.00:1 (L)	3.00:1 (R)
Bottom Width	18.00 ft	
Manning's n	0.031	
Material	COARSE GRAVEL	
Freeboard	1 ft	

RESULTS:

Depth	0.06 ft
with Freeboard	1.06 ft
Top Width	18.37 ft
with Freeboard	24.37 ft
Velocity	3.87 fps
Cross Sectional Area	1.12 sq ft
Hydraulic Radius	0.06 ft
Froude Number	2.76

APPENDIX B

SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\1000\SEDCAD\BM-T

Date: 03-23-1998

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\BM-T User: D. GLEASON
Date: 03-23-1998 Time: 08:35:25
PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

BS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
11	1	3.20	91	F	0.040	0.000	0.000	0.0	0.29	5.09
		Type: Pond Label: POND BM-T								
11	Structure	3.20							0.29	
11	Total IN	3.20							0.29	5.09
11	Total OUT								0.29	4.35

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\BM-T User: D. GLEASON
Date: 03-23-1998 Time: 08:35:25
PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J1, B1, S1
POND BM-T

Drainage Area from J1, B1, S1, SWS(s)1: 3.2 acres
Total Contributing Drainage Area: 3.2 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
›ing's n of Pipe	----
lway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6486.0
Crest Length (ft)	27.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	18.0

POND RESULTS:

	Permanent Pool (ac-ft)
	0.7

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.29	5.09
OUT	0.29	4.35

Peak Elevation	Hydrograph Detention Time (hrs)
6486.1	0.00

****

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\BM-T User: D. GLEASON
Date: 03-23-1998 Time: 08:35:25
PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
POND BM-T

Drainage Area from J1, B1, S1, SWS(s)1: 3.2 acres
Total Contributing Drainage Area: 3.2 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6483.10	0.00	0.00	0.00	0.00	
6484.10	1.00	0.28	0.09	0.00	
6485.10	2.00	0.32	0.39	0.00	
6486.00	2.90	0.35	0.70	0.00	Stage of SW#1
6486.10	3.00	0.35	0.73	3.05	
[illegible].14	3.04	0.36	0.75	4.35	Peak Stage
[illegible].70	3.60	0.38	0.95	21.34	
6486.80	3.70	0.39	0.99	27.72	
6486.90	3.80	0.39	1.03	34.49	
6487.00	3.90	0.40	1.07	42.09	
6487.10	4.00	0.40	1.11	50.80	
6487.40	4.30	0.42	1.23	80.81	