DESIGN REPORT

Permanent Impoundment Structure

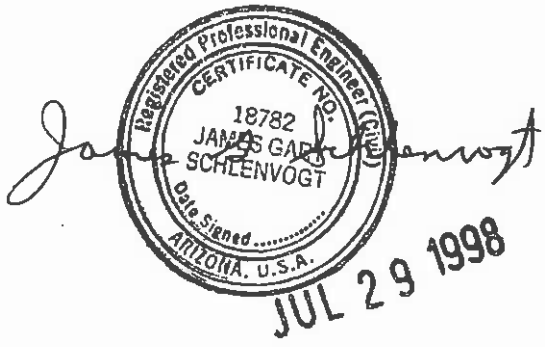
J27-RC

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY



# APPENDIX C

Water Persistence Calculations

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## INTRODUCTION

Structure J27-RC is an existing earthen embankment structure constructed by Peabody Western Coal Company in the J-27 reclamation area and proposed as a permanent structure. PWCC will add approximately 6 feet to the height of the existing embankment to increase the impoundment capacity to approximately 7.35 ac.-ft. The impoundment will collect runoff from the adjacent reclaimed areas of the Black Mesa Mine. The location of structure J27-RC and its watershed boundary are shown on Drawing No. 85400 (Sheet L-10) and Drawing No. 85405. The existing structure and the site-specific general construction plans are shown on the attached Exhibit I.

This design report contains information specific to structure J27-RC, which is in series with Structures J27-RA and J27-RB. 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 existing structure J27-RC was inspected by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the location was suitable and no adverse conditions existed to prevent the successful construction of the spillway structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized to evaluate embankment design.

## SITE DESCRIPTION

### LAND USE

Structures J27-RA, J27-RB and J27-RC have a combined tributary drainage area of 143.4 acre and are located on a tributary to Moenkopi Wash. The 143.4 acre watershed contributing to the J27-RC structure is classified as 32% Post-Law reclaimed and 68% Pre-Law reclaimed.

## DESIGN ANALYSES

### GENERAL

Structure J27-RC 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 1997 for Peabody Western Coal Company and was used in the analysis of the structure.

STABILITY

Structure J27-RC is conservatively assumed to be a Category A-5 embankment. A homogeneous earthen embankment approximately 12 feet wide on top currently exists. The upstream slope will be constructed to 3:1 (horizontal to vertical) or flatter slope and the downstream slope will be constructed to 4.5:1 or flatter slope. Based on the total embankment height of approximately 16 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. The emergency spillway will be a minimum 20-foot wide riprap-lined trapezoidal channel.

WATER PERSISTENCE

Pond J27-RC is a relatively small pond with an adequate contributing drainage area. As a result, there is standing water in the pond over a significant portion of the year with an average depth ranging from 3 to 6 feet. Both PWCC personnel and OSM Inspectors have observed water occurrence in the pond over a period of several years.

To determine water persistence for Structure J27-RC, runoff from average annual precipitation was compared to evaporation and infiltration rates on a monthly basis. Initially, the pond was assumed to be empty. Runoff for the first month was determined using the SCS Curve Number Method and the mean monthly precipitation for January, as presented in Appendices C and described in subsequent sections. The runoff volume was added to the pond and a water elevation and surface area were determined from the pond stage storage curve found on Appendix C. Once the water surface area was determined, the total evaporation and infiltration for the first month were calculated. The calculated evaporation and infiltration losses were subtracted from the total runoff for the first month to determined the average water increase or decrease to the pond. The final volume was then used as the starting volume for the next month and the same steps were repeated for each subsequent month. This analysis proceeded until the pond elevation and surface area stabilized, which occurred in year 2. The inputs and results are shown in Appendix C in both graphical and tabular formats. As shown by the

graph and table in Appendix C, the water elevation of the pond should stabilize between elevation 6471 and the spillway invert depending on the time of year. This is the point at which runoff rates equal the evaporation and infiltration rates and/or discharge through the spillway and corresponds to approximately 4.5 to 7.35 ac-ft of water in the impoundment.

In 1982 and 1983, Water, Waste and Land (WWL), Consultants, also prepared a study for PWCC and OSM which is included in Volume 27, Appendix E. They evaluated and determined these types of impoundments located in areas reclaimed in the late 1970's and early 1980's were stable.

## WATER QUALITY

Water in the proposed J27-RC Permanent Impoundment will come primarily from surface water runoff from the J27 reclamation area. Given that the spoils in the J27 area do not contain material which is potentially acid- or toxic-forming and could adversely impact surface runoff water quality, Peabody Western Coal Company does not anticipate any significant water quality problems. The structure has been containing water for many years and no adverse condition from the water has been noted in the wildlife or domestic animals observed in the area. In addition, between 1981 and 1997 approximately 22 water quality analyses have been performed on samples taken from ponds in the reclaimed J-27 area. The comparison between the pond water quality and the various proposed livestock and wildlife drinking water standards suggests the pond water quality is suitable for the intended postmining land use.

## HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, and B). Structure J27-RC is constructed in series with upstream Structures J-27-RA and J27-RB. Structure J27-RC is classified as a low hazard structure (see Drawing No. 85408). The mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and is less than 20 vertical feet in height from the upstream toe of embankment of the natural stream elevation to the emergency spillway invert elevation. The structure is located

downstream of Structures J27-RA and J27-RB; and although the cumulative capacity of these three impoundments is less than 20 acre-feet, the spillway was analyzed using the 100-year, 6-hour storm event. Structure J27-RC was conservatively assumed to be full to the invert of the emergency spillway at the time of 100-year storm event.

The following parameters were used in the hydrologic analysis for the 100-yr., 6-hr storm (see Appendix B):

| | | J27-RC | Null 1 | Null 2 |
|---|---|---|---|---|
| 1. | Water Course length, L | 0.256 mi. | 0.587 | 0.35 |
| 2. | Elevation Difference, H | 90 ft | 200 | 216 |
| 3. | Time of Concentration, $T_c$ | 0.095 hr | 0.182 | 0.098 |
| 4. | SCS Curve Number | 85 | 85 | 85 |
| 5. | Rainfall Depth, 100-year, 6-hour storm | 2.4 in | 2.4 | 2.4 |
| 6. | Drainage Area | 14.8 acres | 31.1 | 40.9 |

Values reported represent the watersheds, which drain directly to Pond J27-RC. Hydrologic input parameters for upstream structures J27-RA and J27-RB are presented in the Design Reports for J27-RA and J27-RB, respectively.

Muskingum routing parameters were utilized to route the 100-year hydrographs between structures using the SEDCAD+ computer program. The routing parameters are presented in Appendices A, and B, and are shown on a sub-watershed basis.

## HYDRAULICS

The SEDCAD+ and Flow Master computer programs were used to evaluate inflow to the sedimentation 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).

## J27-RC SEDIMENTATION POND HYDRAULICS TABLE

| | Units | 100-Yr, 6-Hr Storm |
|---|---|---|
| Initial Reservoir Volume Condition | | Full to emergency spillway |
| Inflow | | |
| Peak Flow | cfs | 188.3 |
| Volume | ac-ft | 13.2 |
| Outflow | | |
| Peak Flow | cfs | 145.6 |
| Spillway Elevation | msl | 6472.5 |
| Embankment Crest Elev. | msl | 6476.0 |
| Peak Stage | msl | 6474.4 |
| Freeboard | ft | 1.6 |
| Emergency Spillway Channel | | |
| Flow Depth | ft | 1.9 |
| Critical Velocity | fps | 5.6 |
| Mannings "n" | – | .035 |
| Width | ft | 20 |
| Outflow Channel | | |
| Maximum Slope | % | 16.7 |
| Normal Velocity | fps | 8.7 |
| Normal Depth | ft | 0.8 |
| Mannings "n" | -- | .054 |
| Riprap $D_{50}$ | in | 6 |

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J27-RC will be a trapezoidal channel, the alignment and dimensions are shown on Exhibit 1 and includes the following dimensions:

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway)<br>(Outflow) | 3.0<br>2.0 | ft<br>ft |
| Channel Width | | 20 | ft |
| Channel Length | (Spillway)<br>(Outflow) | 40<br>140 | ft<br>ft |
| Sideslopes (Horizontal to Vertical) | | 3:1 or flatter | |
| Average Slope | (Spillway) | 0.0 | % |
| Maximum Slope | (Outflow) | 16.7 | % |
| Spillway Elevation | | 6472.5 | ft |

A minimum 15-foot long riprap lined 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 1997 aerial topography mapping conducted for Peabody Western Coal Company. Structure J27-RC is designed to contain approximately 7.35 acre-feet.

The calculations for the sediment load entering structure J27-RC were made utilizing the Revised Universal Soil Loss Equation with the following input parameters:

| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.38 |
| 3. | Slope Factor, LS | 2.87 |
| 4. | Cover Factor, C | 0.21 |
| 5. | Erosion Control Factor, P | 1.00 |

To determine the potential life of the structure, the results of the sediment storage capacity evaluation for the J27-RC pond are presented in the following table.

J27-RC STORAGE

| | | |
|---|---|---|
| Total Available Storage Capacity | 7.35 | acre-feet |
| Sediment Inflow Rate/Year | 0.35 | acre-feet/year |
| Sediment Storage Life | 21 | years |

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) 100-Year, 6-Hour Storm Event

Appendix C -Water Persistence Calculations

Exhibit #1 - J27-RC Permanent Impoundment Design

# APPENDIX A

Hydrology, Hydraulic. and Sedimentation Calculations

# PEABODY WESTERN COAL COMPANY
# CALCULATED HYDROLOGIC DATA

## PROJECT: J27 AREA

## STRUCTURE: J27-RC

***TIME OF CONCENTRATION:***

| | |
|---|---|
| Start Elevation (ft) = | 6550 |
| End Elevation (ft) = | 6460 |
| Elevation Difference, E (ft) = | 90 |
| Watercourse Length (ft) = | 1350 |
| Watercourse Length, L (mi) = | 0.256 |
| Tc = (11.9L^3/E)^0.385 = | 0.095 Hours |

***ROUTING PARAMETERS:***

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD+. Input and output parameters are shown on the SEDCAD+ printouts in Appendices B and C.

***SCS CURVE NUMBER:***

| Cover Type | Soil Group | Curve Number | Area (acres) | CN*Area |
|---|---|---|---|---|
| Pre-Law Reclaimed | C | 87 | 9.7 | 843.9 |
| Post-Law Reclaimed | C | 81 | 5.1 | 413.1 |
| TOTAL: | | | 14.8 | 1257 |

Weighted CN = Total CN*Area/ Total Area = 85

***DRAINAGE BASIN AREA:***

14.8 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J27 AREA

STRUCTURE: NULL 1

*TIME OF CONCENTRATION:*

| | |
|---|---|
| Start Elevation (ft) = | 6680 |
| End Elevation (ft) = | 6480 |
| Elevation Difference, E (ft) = | 200 |
| Watercourse Length (ft) = | 3100 |
| Watercourse Length, L (mi) = | 0.587 |

Tc = (11.9L^3/E)^0.385 = 0.182 Hours

*ROUTING PARAMETERS:*

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD+. Input and output parameters are shown on the SEDCAD+ printouts in Appendices B and C.

*SCS CURVE NUMBER:*

| Cover Type | Soil Group | Curve Number | Area (acres) | CN*Area |
|---|---|---|---|---|
| .w Reclaimed | C | 87 | 22.7 | 1974.9 |
| Post-Law Reclaimed | C | 81 | 8.4 | 680.4 |
| TOTAL: | | | 31.1 | 2655.3 |

Weighted CN = Total CN*Area/ Total Area = 85

*DRAINAGE BASIN AREA:*

31.1 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J27 AREA

STRUCTURE: NULL 2

*TIME OF CONCENTRATION:*

| | |
|---|---|
| Start Elevation (ft) = | 6696 |
| End Elevation (ft) = | 6480 |
| Elevation Difference, E (ft) = | 216 |
| Watercourse Length (ft) = | 1850 |
| Watercourse Length, L (mi) = | 0.350 |

Tc = (11.9L^3/E)^0.385 = 0.098 Hours

*ROUTING PARAMETERS:*

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD+. Input and output parameters are shown on the SEDCAD+ printouts in Appendices B and C.

*SCS CURVE NUMBER:*

| Cover Type | Soil Group | Curve Number | Area (acres) | CN*Area |
|---|---|---|---|---|
| Law Reclaimed | C | 87 | 24 | 2088 |
| Post-Law Reclaimed | C | 81 | 16.9 | 1368.9 |
| TOTAL: | | | 40.9 | 3456.9 |

Weighted CN = Total CN*Area/ Total Area = 85

*DRAINAGE BASIN AREA:*

40.9 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J27-RC

*. ERODIBILITY FACTOR:*

| Soil Type | Erodibility Factor, K | Area (acres) | K*Area |
|---|---|---|---|
| EH#35 | 0.38 | 86.8 | 32.98 |
| TOTAL: | | 86.8 | 32.98 |

Weighted K = Total K*Area/ Total Area = 0.38

*SLOPE FACTOR:*

| Length (ft) | Elevation Change (ft) | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 550 | 45 | 8.2% | 0.5 | 4.7 | 2.51 |
| 550 | 50 | 9.1% | 0.5 | 5.2 | 2.81 |
| 400 | 35 | 8.8% | 0.5 | 5.0 | 2.28 |
| 200 | 15 | 7.5% | 0.5 | 4.3 | 1.39 |
| 500 | 25 | 5.0% | 0.5 | 2.9 | 1.49 |
| 350 | 25 | 7.1% | 0.5 | 4.1 | 1.76 |
| 250 | 65 | 26.0% | 0.6 | 14.6 | 7.83 |

Average LS = 2.87

*The LS Factor was calculated by:*

*LS = (Slope Length/72.6)^m*(10.8*sin(slope angle) + 0.03) for Slopes < 9%*

*LS = (Slope Length/72.6)^m*(16.8*sin(slope angle) - 0.5) for Slopes > 9%*

*Where:*

| | |
|---|---|
| *Slope < 3%* | *m = 0.3* |
| *Slope = 4%* | *m = 0.4* |
| *5% > Slope < 10%* | *m = 0.5* |
| *Slope > 10%* | *m = 0.6* |

*COVER AND PRACTICE FACTORS:*

| Cover Type | Cover (%) | Canopy (%) | Area (acres) | Cover Factor, C | C*Area | Practice Factor, P | P*Area |
|---|---|---|---|---|---|---|---|
| Pre Law | 20% | 0% | 56.4 | 0.24 | 13.54 | 1.00 | 56.40 |
| Post Law | 40% | 0% | 30.4 | 0.15 | 4.56 | 1.00 | 30.40 |
| TOTAL: | | | 86.8 | | 18.10 | | 86.80 |

Weighted C = Total C*Area/ Total Area = 0.21

Weighted P = Total P*Area/ Total Area = 1.00

*RAINFALL FACTOR:*

R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J27-RC

*The following spreadsheet calculates the predicted sediment yield for the project area. The gross sediment yield is determined according to the Revised Universal Soil Loss Equation.*

| PARAMETER DESCRIPTION | VALUE | |
|---|---|---|
| Annual Rainfall Factor | 40.00 | |
| Soil Erodibility Factor | 0.38 | |
| Length Slope Factor | 2.87 | |
| Cover Factor | 0.21 | |
| Practice Factor | 1.00 | |
| Gross Annual Sediment Yield | 9.08 | tons/acre/year |
| | | |
| Sediment Density | 94.00 | pcf |
| Gross Annual Sediment Yield | 0.0044 | acre-feet/acre/year |
| Sediment Delivery Ratio | 90% | |
| Estimated Annual Sediment Yield | 0.0040 | acre-feet/acre/year |
| | | |
| Watershed Area | 86.8 | acres |
| W[illegible]rshed Annual Sediment Yield | 0.35 | acre-feet/year |
| | | |
| [illegible] of years | 1 | years |
| [illegible]ed Sediment Volume | 0.35 | acre-feet |

SEDCAD+ RIPRAP CHANNEL DESIGN

POND J27-RC OUTFLOW

INPUT VALUES:

| | | |
|---|---|---|
| Shape | TRAPEZOIDAL | |
| Discharge | 145.60 cfs | |
| Slope | 16.70 % | |
| Sideslopes (L and R) | 3.00:1 | 3.00:1 |
| Bottom Width | 20.00 feet | |
| Freeboard | 1 ft | |

RESULTS:

Steep Slope Design - PADER Method

| | |
|---|---|
| Depth | 0.75 ft |
| with Freeboard | 1.75 ft |
| Top Width | 24.52 ft |
| with Freeboard | 30.52 ft |
| Velocity | 8.69 fps |
| Cross Sectional Area | 16.75 sq ft |
| Hydraulic Radius | 0.68 ft |
| Manning's n | 0.054 |
| Froude Number | 1.85 |
| Dmax | 0.625 ft ( 7.50 in) |
| D50 | 0.500 ft ( 6.00 in) |
| D10 | 0.167 ft ( 2.00 in) |

# J27-RC SPILLWAY
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Project File | untitled.fm2 |
| Worksheet | J27-RC SPILLWAY |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.035 | |
| Channel Slope | 0.018331 | ft/ft |
| Left Side Slope | 3.000000 | H : V |
| Right Side Slope | 3.000000 | H : V |
| Bottom Width | 20.00 | ft |
| Discharge | 145.60 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.11 | ft |
| Flow Area | 26.00 | $ft^2$ |
| Wetted Perimeter | 27.05 | ft |
| Top Width | 26.68 | ft |
| Critical Depth | 1.11 | ft |
| Critical Slope | 0.018331 | ft/ft |
| Velocity | 5.60 | ft/s |
| Velocity Head | 0.49 | ft |
| Specific Energy | 1.60 | ft |
| Froude Number | 1.00 | |
| Flow is subcritical. | | |

APPENDIX B

SEDCAD+ (Input and Output) 100-Year, 6-Hour Storm Event

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

J-27 AREA

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0500\J-27-2II

Date: 07-16-1998

Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

## GENERAL INPUT TABLE

Detailed Between Structure Routing:

| J | B | To S | Seg. # | Land Flow Condition | Distance (ft) | Slope (%) | Velocity (fps) | Segment Time (hr) | Muskingum K (hr) | Muskingum X |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 1 | 8 | 705.15 | 8.57 | 8.78 | 0.02 | 0.022 | 0.418 |
| 1 | 2 | 2 | 1 | 8 | 1304.92 | 6.15 | 7.44 | 0.05 | 0.048 | 0.406 |
| 2 | 1 | 1 | 1 | 8 | 52.00 | 20.00 | 13.42 | 0.00 | 0.001 | 0.443 |

Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

## SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

| JBS | SWS | Area (ac) | CN | UHS | Tc (hrs) | K (hrs) | X | Base-Flow (cfs) | Runoff Volume (ac-ft) | Peak Discharge (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|
| 111 | 1 | 45.80 | 86 | F | 0.156 | 0.000 | 0.000 | 0.0 | 4.44 | 73.66 |
| | | Type: Pond Label: J27-RA | | | | | | | | |
| 111 | Structure | 45.80 | | | | | | | 4.44 | |
| 111 | Total IN | 45.80 | | | | | | | 4.44 | 73.66 |
| 111 | Total OUT | | | | | | | | 4.44 | 59.70 |
| 112 | 1 | 31.10 | 84 | F | 0.182 | 0.000 | 0.000 | 0.0 | 2.69 | 44.08 |
| | | Type: Null Label: NULL 1 | | | | | | | | |
| | Structure | 31.10 | | | | | | | 7.13 | |
| | Total IN/OUT | 76.90 | | | | | | | 7.13 | 103.07 |
| 111 to 112 Routing | | | | | | 0.022 | 0.418 | | | |
| 121 | 1 | 10.80 | 84 | F | 0.078 | 0.000 | 0.000 | 0.0 | 0.94 | 17.78 |
| | | Type: Pond Label: J27-RB | | | | | | | | |
| 121 | Structure | 10.80 | | | | | | | 0.94 | |
| 121 | Total IN | 10.80 | | | | | | | 0.94 | 17.78 |
| 121 | Total OUT | | | | | | | | 0.94 | 10.35 |
| 122 | 1 | 40.90 | 85 | F | 0.098 | 0.000 | 0.000 | 0.0 | 3.75 | 70.35 |
| | | Type: Null Label: NULL 2 | | | | | | | | |
| 122 | Structure | 40.90 | | | | | | | 4.68 | |
| 122 | Total IN/OUT | 51.70 | | | | | | | 4.68 | 80.59 |
| 121 to 122 Routing | | | | | | 0.048 | 0.406 | | | |
| 211 | 1 | 14.80 | 85 | F | 0.095 | 0.000 | 0.000 | 0.0 | 1.36 | 25.46 |
| | | Type: Pond Label: J27-RC | | | | | | | | |
| 211 | Structure | 14.80 | | | | | | | 13.17 | |
| | Total IN | 143.40 | | | | | | | 13.17 | 188.24 |
| | Total OUT | | | | | | | | 13.17 | 145.63 |
| 112 to 211 Routing | | | | | | 0.001 | 0.443 | | | |

Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

## POND INPUT/OUTPUT TABLE

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

DISCHARGE OPTIONS:

| | Emergency Spillway |
|---|---|
| Riser Diameter (in) | ---- |
| Riser Height (ft) | ---- |
| Barrel Diameter (in) | ---- |
| arrel Length (ft) | ---- |
| arrel 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 | 6541.0 |
| Crest Length (ft) | 40.0 |
| Z:1 (Left and Right) | 3 3 |
| Bottom Width (ft) | 10.0 |

RESULTS:

| Permanent Pool (ac-ft) |
|---|
| 2.6 |

| | Runoff Volume (ac-ft) | Peak Discharge (cfs) |
|---|---|---|
| IN | 4.44 | 73.66 |
| OUT | 4.44 | 59.70 |

| Peak Elevation | Hydrograph Detention Time (hrs) |
|---|---|
| 6542.6 | 0.20 |

**********

J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

DISCHARGE OPTIONS:

| | Emergency Spillway |
|---|---|
| Riser Diameter (in) | ---- |
| iser Height (ft) | ---- |
| rel Diameter (in) | ---- |
| rrel Length (ft) | ---- |
| Barrel Slope (%) | ---- |
| Manning's n of Pipe | ---- |
| Spillway 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 | 6562.0 |
| Crest Length (ft) | 40.0 |
| Z:1 (Left and Right) | 3 3 |
| tom Width (ft) | 10.0 |

POND RESULTS:

| | Permanent Pool (ac-ft) |
|---|---|

| | |
|---|---|
| | 1.4 |

| | Runoff Volume (ac-ft) | Peak Discharge (cfs) |
|---|---|---|
| IN | 0.94 | 17.78 |
| OUT | 0.94 | 10.35 |

| Peak Elevation | Hydrograph Detention Time (hrs) |
|---|---|
| 6562.7 | 0.00 |

**********

J2, B1, S1
J27-RC

Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

DISCHARGE OPTIONS:

| | Emergency Spillway |
|---|---|
| er Diameter (in) | ---- |
| ıser Height (ft) | ---- |
| Barrel Diameter (in) | ---- |
| Barrel Length (ft) | ---- |
| Barrel Slope (%) | ---- |
| Manning's n of Pipe | ---- |
| Spillway 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 | 6472.5 |
| st Length (ft) | 40.0 |
| (Left and Right) | 3 3 |
| Bottom Width (ft) | 20.0 |

POND RESULTS:

Permanent

| Pool (ac-ft) |
|---|
| 7.3 |

| | Runoff Volume (ac-ft) | Peak Discharge (cfs) |
|---|---|---|
| IN | 13.17 | 188.24 |
| OUT | 13.17 | 145.63 |

| Peak Elevation | Hydrograph Detention Time (hrs) |
|---|---|
| 6474.4 | 0.18 |

**********

Civil Software Design -- SEDCAD+ Version 3.1


Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

## ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

SW#1: Emergency Spillway

| Elev | Stage (ft) | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | |
|---|---|---|---|---|---|
| 6532.00 | 0.00 | 0.01 | 0.00 | 0.00 | |
| 6533.00 | 1.00 | 0.07 | 0.04 | 0.00 | |
| 6534.00 | 2.00 | 0.17 | 0.16 | 0.00 | |
| 6535.00 | 3.00 | 0.22 | 0.36 | 0.00 | |
| 6536.00 | 4.00 | 0.27 | 0.61 | 0.00 | |
| 6537.00 | 5.00 | 0.32 | 0.91 | 0.00 | |
| 6538.00 | 6.00 | 0.37 | 1.25 | 0.00 | |
| 6539.00 | 7.00 | 0.43 | 1.66 | 0.00 | |
| 6540.00 | 8.00 | 0.48 | 2.11 | 0.00 | |
| 6541.00 | 9.00 | 0.55 | 2.63 | 0.00 | Stage of SW#1 |
| 6541.70 | 9.70 | 0.60 | 3.04 | 10.90 | |
| 6541.80 | 9.80 | 0.61 | 3.10 | 14.42 | |
| 6541.90 | 9.90 | 0.62 | 3.16 | 18.33 | |
| 6542.00 | 10.00 | 0.62 | 3.22 | 22.63 | |
| 6542.50 | 10.50 | 0.66 | 3.54 | 52.82 | |
| 6542.59 | 10.59 | 0.67 | 3.60 | 59.70 | Peak Stage |
| 6543.00 | 11.00 | 0.70 | 3.88 | 92.64 | |
| 6543.50 | 11.50 | 0.74 | 4.25 | 141.13 | |
| 6544.00 | 12.00 | 0.78 | 4.63 | 207.48 | |

J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

SW#1: Emergency Spillway

| Elev | Stage (ft) | Area (ac) | Capacity (ac-ft) | Discharge (cfs) |
|---|---|---|---|---|
| 6554.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6555.50 | 1.00 | 0.04 | 0.01 | 0.00 |
| 6556.50 | 2.00 | 0.10 | 0.08 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| 6557.50 | 3.00 | 0.15 | 0.21 | 0.00 | |
| 6558.50 | 4.00 | 0.20 | 0.39 | 0.00 | |
| 6559.50 | 5.00 | 0.25 | 0.61 | 0.00 | |
| [illegible].50 | 6.00 | 0.30 | 0.89 | 0.00 | |
| [illegible].50 | 7.00 | 0.34 | 1.21 | 0.00 | |
| 6562.00 | 7.50 | 0.37 | 1.39 | 0.00 | Stage of SW#1 |
| 6562.50 | 8.00 | 0.41 | 1.58 | 7.79 | |
| 6562.66 | 8.16 | 0.43 | 1.65 | 10.35 | Peak Stage |
| 6562.70 | 8.20 | 0.43 | 1.67 | 10.90 | |
| 6562.80 | 8.30 | 0.44 | 1.71 | 14.42 | |
| 6562.90 | 8.40 | 0.45 | 1.76 | 18.33 | |
| 6563.00 | 8.50 | 0.46 | 1.80 | 22.63 | |
| 6563.50 | 9.00 | 0.51 | 2.05 | 52.82 | |
| 6564.00 | 9.50 | 0.58 | 2.32 | 92.64 | |
| 6564.50 | 10.00 | 0.64 | 2.62 | 141.13 | |
| 6565.00 | 10.50 | 0.71 | 2.96 | 207.48 | |

**********

J2, B1, S1
J27-RC

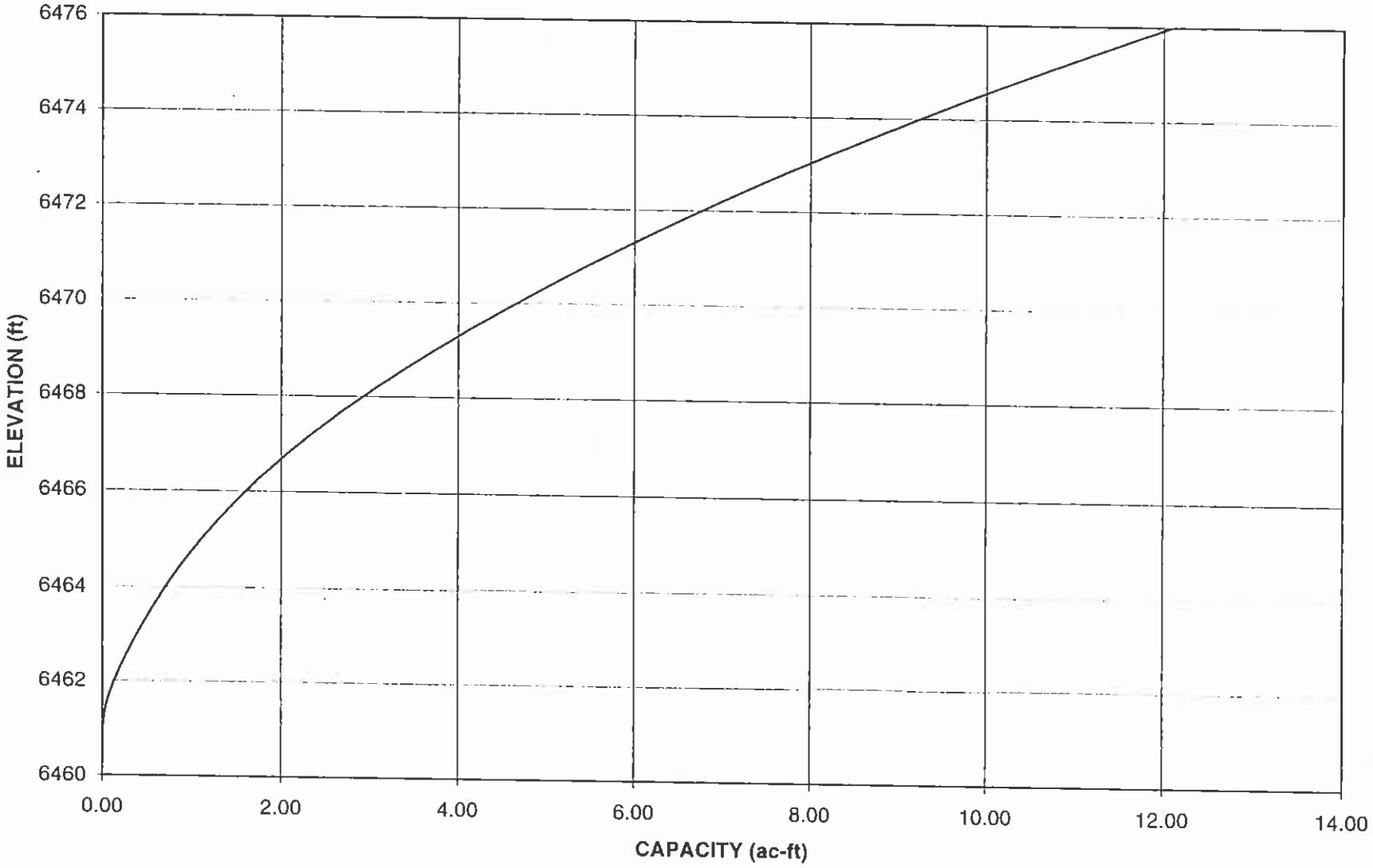
Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

SW#1: Emergency Spillway

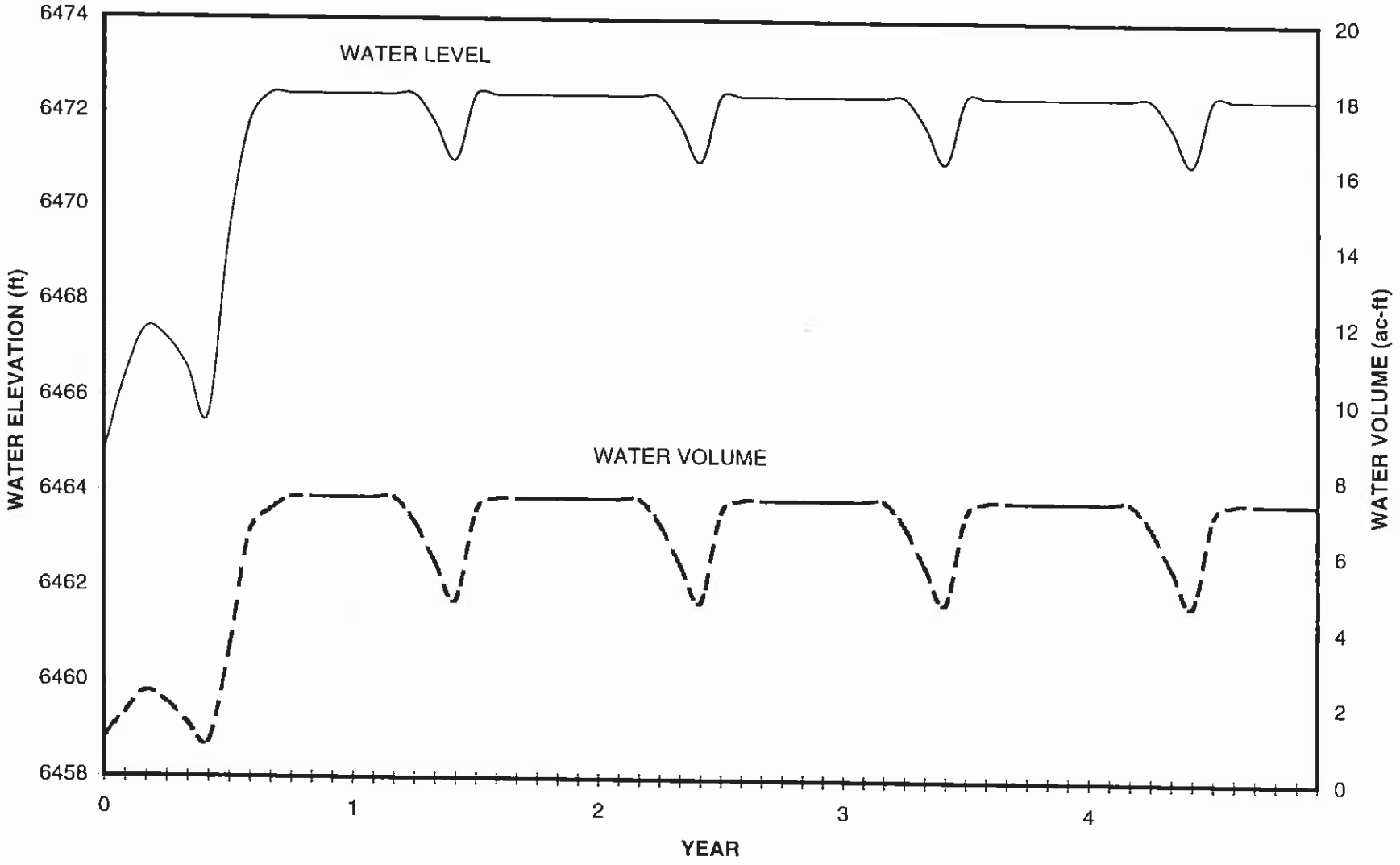
| Elev | Stage (ft) | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | |
|---|---|---|---|---|---|
| [illegible].80 | 0.00 | 0.00 | 0.00 | 0.00 | |
| [illegible].80 | 1.00 | 0.17 | 0.06 | 0.00 | |
| 6462.80 | 2.00 | 0.27 | 0.28 | 0.00 | |
| 6463.80 | 3.00 | 0.34 | 0.58 | 0.00 | |
| 6464.80 | 4.00 | 0.43 | 0.97 | 0.00 | |
| 6465.80 | 5.00 | 0.52 | 1.44 | 0.00 | |
| 6466.80 | 6.00 | 0.63 | 2.02 | 0.00 | |
| 6467.80 | 7.00 | 0.75 | 2.71 | 0.00 | |
| 6468.80 | 8.00 | 0.85 | 3.51 | 0.00 | |
| 6469.80 | 9.00 | 0.94 | 4.40 | 0.00 | |
| 6470.80 | 10.00 | 1.03 | 5.39 | 0.00 | |
| 6471.80 | 11.00 | 1.13 | 6.47 | 0.00 | |
| 6472.50 | 11.70 | 1.19 | 7.28 | 0.00 | Stage of SW#1 |
| 6472.80 | 12.00 | 1.22 | 7.64 | 8.93 | |
| 6473.20 | 12.40 | 1.25 | 8.14 | 20.85 | |
| 6473.30 | 12.50 | 1.26 | 8.26 | 27.35 | |
| 6473.40 | 12.60 | 1.27 | 8.39 | 34.50 | |
| 6473.50 | 12.70 | 1.28 | 8.52 | 42.27 | |
| 6473.80 | 13.00 | 1.31 | 8.91 | 71.77 | |
| 6474.00 | 13.20 | 1.33 | 9.17 | 94.82 | |
| 6474.39 | 13.59 | 1.37 | 9.69 | 145.63 | Peak Stage |
| 6474.50 | 13.70 | 1.38 | 9.85 | 160.74 | |
| 6474.80 | 14.00 | 1.40 | 10.27 | 205.34 | |
| 6475.00 | 14.20 | 1.42 | 10.55 | 237.78 | |
| 6475.50 | 14.70 | 1.47 | 11.27 | 339.41 | |
| [illegible].80 | 15.00 | 1.50 | 11.72 | 408.58 | |
| [illegible].00 | 15.20 | 1.52 | 12.02 | 458.15 | |

**********

PERMANENT IMPOUNDMENTJ27-RC
ELEVATION /CAPACITY CURVE



## J27-RC PERMANENT IMPOUNDMENT
## WATER PERSISTENCE EVALUATION



PEABODY WESTERN COAL COMPANY
PERMANENT IMPOUNDMENT POND WATER PERSISTENCE EVALUATION

| | January | February | March | April | May | June | July | August | September | October | November | December | End of Year2 | End Of Year 3 | End Of Year 4 | End Of Year 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Precipitation (inch) | 0.95 | 0.86 | 0.89 | 0.58 | 0.45 | 0.46 | 1.49 | 1.49 | 0.95 | 1.09 | 0.98 | 1.08 | 1.08 | 1.08 | 1.08 | 1.08 |
| Area (acres) | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 |
| Curve Number | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| S | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| Run-Off (inches) | 0.15 | 0.11 | 0.13 | 0.03 | 0.01 | 0.01 | 0.45 | 0.45 | 0.15 | 0.22 | 0.16 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 |
| Run-Off (ac-ft) | 1.09 | 0.82 | 0.91 | 0.19 | 0.04 | 0.04 | 3.22 | 3.22 | 1.09 | 1.57 | 1.19 | 1.53 | 1.53 | 1.53 | 1.53 | 1.53 |
| Starting Pond Volume (ac-ft) | 0 | 1.02 | 1.66 | 2.23 | 1.94 | 1.39 | 0.93 | 3.32 | 6.44 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 |
| Pond Volume + Runoff (ac-ft) | 1.09 | 1.84 | 2.57 | 2.42 | 1.98 | 1.43 | 4.15 | 6.55 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 |
| Water Elevation (ft) | 6464.8 | 6466.4 | 6467.4 | 6467.2 | 6466.6 | 6465.6 | 6469.4 | 6471.8 | 6472.5 | 6472.5 | 6472.5 | 6472.5 | 6472.5 | 6472.5 | 6472.5 | 6472.5 |
| Water Surface Area (acres) | 0.43 | 0.59 | 0.70 | 0.68 | 0.62 | 0.51 | 0.90 | 1.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Evaporation Rate (inches/month) | 0.87 | 2.63 | 4.68 | 7.38 | 10.54 | 10.77 | 9.95 | 8.49 | 7.08 | 4.68 | 2.82 | 1.46 | 1.46 | 1.46 | 1.46 | 1.46 |
| Evaporation (ac-ft) | 0.03 | 0.13 | 0.27 | 0.42 | 0.54 | 0.46 | 0.75 | 0.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Infiltration Rate (inches/month) | 1.054 | 0.952 | 1.054 | 1.02 | 1.054 | 1.02 | 1.054 | 1.054 | 1.02 | 1.054 | 1.02 | 1.054 | 1.054 | 1.054 | 1.054 | 1.054 |
| Infiltration (ac-ft) | 0.04 | 0.05 | 0.06 | 0.06 | 0.05 | 0.04 | 0.08 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Water Loss (ac-ft) | 0.07 | 0.18 | 0.34 | 0.48 | 0.60 | 0.50 | 0.83 | 0.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Water Change (ac-ft) | 1.02 | 0.64 | 0.57 | -0.29 | -0.56 | -0.46 | 2.39 | 2.32 | 1.09 | 1.57 | 1.19 | 1.53 | 1.53 | 1.53 | 1.53 | 1.53 |
| Run-off From J27-RC | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.79 | 0.29 | 0.67 | 0.54 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| Ending Pond Volume | 1.02 | 1.66 | 2.23 | 1.94 | 1.39 | 0.93 | 3.32 | 6.44 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 | 7.35 |

Notes:

1) Run-off volumes based on SCS Runoff Curve Number method: $Q = (P-0.2S)^2/(P+0.8S)$

P= Accumulative Precipitation
S= (1000/CN)-10

2) Evaporation and infiltration rates based on data presented in the report entitled " Hydrologic and Engineering Studies at the Peabody Coal Company Mines" in Permit AZ-0001, Volume 27.

3) Maximum Pond Volume 7.35 ac-ft

Need Map