DESIGN REPORT

Sedimentation Structure

N8-B1

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

INTRODUCTION

Structure N8-RA is an existing incised internal impoundment structure constructed by Peabody Western Coal Company (PWCC) in 1980 in the N-8 post-law reclamation area and is proposed as a permanent impoundment structure. PWCC plans to utilize structure N8-RA as one of the original AZ-0001-D Permit impoundments to mitigate post-mining livestock and wildlife watering sources, see Chapter 6, Permanent Impoundment section. The location of structure N8-RA and its watershed boundary is shown on Drawing No. 85400 (sheet K-6) 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 N8-RA. 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 site of the existing structure N8-RA was inspected in July 2000 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. A detailed geotechnical investigation was not performed since the impoundment is incised, with no embankment. Information in Chapter 6, Attachment D was utilized to confirm the stability of the re-graded incised slopes.

SITE DESCRIPTION

LAND USE

Structure N8-RA has a 305.3-acre drainage area and is located in a tributary to Yellow Water Canyon Wash in the N7/N8 reclamation area at the Kayenta Mine. The watershed is classified as 66% undisturbed and 34% reclaimed mined land.

DESIGN ANALYSES

GENERAL

Structure N8-RA 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 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N8-RA is completely incised and does not incorporate an embankment. All regraded (incised) slopes are equal to or flatter than 4.0:1(horizontal to vertical). Given that the graded, reclaimed side slopes are equal to or flatter than the recommended final reclamation slopes, the slopes will be stable.

WATER PERSISTENCE

Pond N8-RA has existed since 1980. The pond has been observed holding water by PWCC and OSM personnel on a seasonal basis. The observed water levels indicate that the pond holds water on a seasonal basis and will serve to mitigate post-mining wildlife and livestock watering sources.

To determine water persistence for Structure N8-RA, run-off volume calculated from average annual precipitation was compared to annual evaporation and infiltration. This comparison was performed on a monthly basis. The analysis was performed beginning on the first month of the year (January) with the pond assumed to be empty. Runoff for each month was determined using the NRCS Curve Number Method and the mean monthly precipitation. To simulate conservative runoff and water persistence conditions, a curve number of 77 was used in the analysis. The curve number was determined in the following manner. Precipitation occurs at the site under antecedent I and antecedent II conditions. Antecedent I represents a condition when the soils and subsoils are dry, and antecedent II represents average conditions. It was assumed that antecedent I occurs 1/4 of the time, and antecedent II occurs 3/4 of the time. Using a curve number of 81 for antecedent II (see Appendix A) and a curve number 64 for antecedent I, a weighted average results in a curve number of 77. The run-off volume was calculated for

each month and added to the pond. A water elevation and surface area for each month was determined from the pond Stage Storage curve (see Appendix B). Total evaporation and infiltration rates were calculated based on the monthly pond surface areas. The calculated evaporation and infiltration values were subtracted from the total runoff to determined the water volume increase or decrease to the pond. The pond volume calculated for the first month (January) was used as the starting volume for the next month (February). The same steps were repeated for each month. This analysis was conducted for 8 years. The inputs and results are shown in Appendix B in graphical and tabular format. As shown in Appendix B, the final surface water elevation of the pond should stabilize between an elevation of 6726 (low seasonal mark – pond bottom) and 6729 (high seasonal mark). The final pond surface water elevation corresponds to a volume of between 0.0 ac-ft and 6.7 ac-ft. The spreadsheet model indicates that on a typical year that the pond will go dry in June of each year and then begin to collect water until reaching its maximum volume in December (refer to Appendix B).

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 contained in the N8-RA impoundment will originate from surface water runoff from reclaimed spoil areas and undisturbed areas. Given that the top four feet of material (either a combination of spoil and topsoil or all topsoil) does not contain material that could adversely affect the water quality of the surface runoff, PWCC does not anticipate water quality problems in the N8-RA impoundment. Three full suite water quality analyses have been performed on water samples collected from the N8-RA impoundment to substantiate this. A statistical analysis of the water quality parameters analyzed is presented in Table 1. In addition, a comparison of the chemical concentrations versus livestock drinking water standards is presented in Table 2. None of the livestock standards for any toxic constituent were exceeded. The only standard exceeded was that for aluminum. The exceedences are due to sediment entrained with the water sample because aluminum will not dissolve in water at the

neutral pH that was measured. The impoundment water quality is quite suitable for use as stock or wildlife drinking water.

DIMINUTION OF ADJACENT WATER QUANTITY AND QUALITY

Peabody believes sufficient information has been submitted and evaluated by OSM in Hydrology Reports, Permits, and other documents to demonstrate that this impoundment will not result in the diminution of the quantity and quality of water utilized by adjacent or surrounding landowners. Chapter 17 (Protection of the Hydrologic Balance) of the AZ-0001D Permit presents detailed descriptions of pre-existing water sources within the leasehold, including those proximate to the N-8 reclamation area. No pre-existing ponds or wells have been documented adjacent or immediately downstream of the N8-RA Impoundment. Plans for mitigation or replacement of pre-existing water sources that have been or may be affected by mining are presented in Chapter 17. There is very minimal potential for Permanent Impoundment N8-RA to directly impact (positively or negatively) the adjacent downgradient water quality because it has a large storage volume in relation to its impounded watershed area. Historic monitoring indicates this pond has never discharged. The size rainfall event necessary to cause the pond to discharge would also produce a very large flow in the receiving channel, which would completely mask any chemical difference in the discharge from the pond.

The Pond N8-RA watershed of 305.3 acres represents approximately 2.8% of the drainage area of the encompassing watershed which drains this portion of Yazzie Wash. Based on this, any water quantity diminution due to Permanent Impoundment N8-RA is negligible. Water levels in alluvial wells (see Appendix D, Figures 1-3) immediately downgradient in the alluvium from the pond show normal fluctuations in response to low and high stream flow years. There is no evidence of persistent diminished recharge to the alluvium from runoff, which could be potentially affected by the loss of watershed area associated with Pond N8-RA. In addition, Peabody has no evidence that flood irrigation has been practiced along this tributary to Coal Mine Wash below the N8-RA Impoundment. Monitoring of stream flows in the main channels on Black Mesa since 1980 have shown extremely high sediment concentrations, which would preclude flood irrigation practices due to high maintenance costs.

Chapter 18 (Probable Hydrologic Consequences) of the AZ-0001D Permit present analyses of the potential impacts of the mining operation, including a section that discusses the effects of dams, sediment pounds, and permanent impoundments on downstream users. Although some localized decreases in receiving stream runoff may result after mining areas are reclaimed, these localized decreases will become less pronounced and unmeasurable further downstream, as lateral inflows from undisturbed basins will provide additional contributions to downstream runoff volumes. Channel transmission, evapotranspiration, and other losses in the main channels to the Little Colorado River would completely mask any runoff reductions from the smaller reclaimed areas on the leasehold.

OSM's Cumulative Hydrologic Impact Assessment (CHIA) and Environmental Impact Statement (EIS) which was written for the Black Mesa PAP in 1990, concluded that short- and long-term impacts from proposed permanent impoundments would be minor. Short- and long-term impacts of mining proposed in the PAP on the surface water quantity at Moenkopi Wash would be negligible. Based on the above summaries, Peabody maintains this impoundment will not result in the diminution of the quantity or quality of water utilized by adjacent or surrounding landowners.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendix C). Structure N8-RA is classified as a low hazard structure (see Drawing No. 85408). In addition, the Kayenta mine area is sparsely populated with no people living in the downstream floodplain. The impoundment is incised and contains no embankment. However, an emergency spillway will be constructed through a ridge on the eastern side of the pond and discharge downstream. The spillway will be designed to pass the peak flow from the 100-year, 6-hour storm

The following parameters were used in the hydrologic analysis:

		N8-RA 100-Year, 6-Hour	
1.	Water Course length, L	1.193	mi.

2.	Elevation Difference, H	639	ft.
3.	Time of Concentration, T_c	0.265	hr.
4.	NRCS Curve Number	82	
5.	100-Year, 6-Hour Storm Rainfall Depth	2.4	in.
6.	Drainage Area	305.3	ac.

HYDRAULICS

The SEDCAD4 computer program was used to evaluate inflow to Structure N8-RA 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 Appendix C).

POND N8-RA HYDRAULICS TABLE

	Units	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	332.9
Volume	ac-ft	23.5
Storage		
Peak Stage	msl	6733.8
Emerg. Spillway Elev.	msl	6732.0
Peak Storage	ac-ft	27.3
Storage Capacity	ac-ft	18.4
Outflow		
Peak Flow	cfs	129.3
Spillway Elevation	msl	6732.0
Embankment Crest Elev.	msl	6735.0
Peak Stage	msl	6733.8
Freeboard	ft	1.2
Emergency Spillway Channel		

	Units	100-Yr, 6-Hr Storm
Flow Depth	ft	1.8
Critical Velocity	fps	5.4
Mannings "n"	--	.03
Width	ft	20
Outflow Channel		
Slope	%	1.5
Normal Velocity	fps	5.6
Normal Depth	ft	1.0
Mannings "n"	--	0.030
Riprap D_{50}	in	NA

INLET CHANNEL

One inlet channel was constructed in the northeast corner of the pond to control erosion (see Channel N8RA-1c on Exhibit 1). The channel was designed to control the flows produced by the 100-year, 6-hour storm event.

Input Parameters	Inlet Channel N8-RA-1c
Design Storm	100-year, 6-hour
Precipitation (in)	2.4
Watershed Area (ac)	245.6
Curve Number	83

Channel Design

Refer to Table 3, Channel N8RA-1c, for channel design at various slopes, for Hydrology printouts, and for SEDCAD4 printouts.

EMERGENCY SPILLWAY and OUTFLOW CHANNEL

The Emergency spillway and outlet channels for N8RA-1c are trapezoidal channels with dimensions listed below. The alignment is shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	1.8
	(Outflow)	1.0
Channel Width	(Spillway)	20
	(Outflow)	20
Channel Length	(Spillway)	40
	(Outflow)	75
Sideslopes		
Average Slope	(Spillway)	0 %
Maximum Slope	(Outflow)	1.5 %
Spillway Elevation		6732 msl

STORAGE CAPACITY

The impoundment stage-capacity table (see Appendix C) is based on the proposed regrading plan for N8-RA developed by Peabody Western Coal Company.

The calculations for the sediment load entering structure N8-RA were made utilizing the Revised Universal Soil Loss Equation (RUSLE) using the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.24
3.	Slope Factor, LS	6.73
4.	Cover Factor, C	0.20
5.	Erosion Control Factor, P	0.93

The storage capacity for N8-RA is shown in Appendix C and the results of the sediment inflow analysis are summarized in the following table.

N8-RA STORAGE

Total Storage Volume	18.4	ac-ft
Volume Available for Sediment Storage	18.4	ac-ft
Sediment Inflow Rate	1.56	ac-ft/yr.
Sediment Storage Life	11.8	years

See Appendix A for sediment inflow calculations.

* * *

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

TABLE 1 – Water Quality Statistics
TABLE 2 – Comparison of N8-Ra Water Quality versus Livestock Standards
TABLE 3 – N8RA-1c Channel Design

Appendix A - Hydrology and Sedimentology Calculations
Appendix B -Water Persistence Calculations
Appendix C - SEDCAD 4 (Input and Output)
Appendix D - Alluvial Wells Hydrograph
Exhibit #1 - N8-RA Permanent Impoundment Design

Table ...

Peabody Wester ...ack Mesa Complex
Paradox Hyurology System
Water Quality Statistics

Sample Point : N8-RA-P PERM INT IMPOUND
Location:
Elevation.

	Uncensored Data					Censored Data				
	No of Obs	Mean	StDv	Min	Max	No of Obs		Min		Max
Field Parameters										
Field Ph S.U.	3	8.02		7.58	8.47					
Temperature C	3	17.23	10.42	6.50	27.30					
Conductivity UMHOS/CM	3	179.67	65.68	117.00	248.00					
Field Salinity 0/00	3	.10		.10	.10					
Laboratory Parameters										
Alk As CaCO3, Ph 4.5 MG/L	3	56.00	8.89	49.00	66.00					
Alk, Bicarb As CaCO3 MG/L	3	56.00	8.89	49.00	66.00					
Alk, Carb As CaCO3 MG/L						3	<	2.00	<	2.00
Alk, Hydrox As CaCO3 MG/L						3	<	2.00	<	2.00
Boron, Dissolved UG/L	3	20.00		10.00	30.00					
Calcium, Dissolved MG/L	3	26.40	10.07	17.10	37.10					
Chloride MG/L	2	3.50		2.00	5.00					
Conductivity UMS/CM2	3	192.33	67.72	131.00	265.00	1	<	1.00	<	1.00
Fluoride MG/L	3	.70	.79	.10	1.60					
Hardness As CaCO3 MG/L	3	83.00	32.42	54.00	118.00					
Iron, Total MG/L	3	5.70	4.37	1.14	9.85					
Iron, Dissolved MG/L	3	.15	.04	.10	.18					
Magnesium, Dissolved MG/L	3	4.17	1.72	2.80	6.10					
Manganese, Total MG/L	3	.10	.05	.06	.16					
Manganese, Dissolved MG/L	2	.03	.00	.02	.04					
Nitrate Nitrogen_N MG/L	3	.64	.47	.18	1.11	1	<	.01	<	.01
Nitrite Nitrogen_N MG/L	3	.04		.02	.05					
NO3_NO2 Nitrogen_N MG/L	3	.67	.47	.22	1.16					
Ph At 25 Deg. Cent. S.U.	3	6.90		6.70	7.10					
Potassium, Dissolved MG/L	3	6.23	1.62	5.20	8.10					
Silica, Dissolved MG/L	3	6.47	1.72	4.60	8.00					
Sodium, Dissolved MG/L	3	1.90	1.41	.60	3.50					
Solids, Dissolved MG/L	3	133.33	49.33	100.00	190.00					
Solids, Suspended MG/L	3	476.33	473.64	48.00	985.00					
Sulfate MG/L	3	34.33	23.80	13.00	60.00					
Bicarbonate As HCO3 MG/L	3	68.33	10.41	60.00	80.00					
Carbonate As CO3 MG/L						3	<	2.00	<	2.00
Hydroxide As OH MG/L						3	<	2.00	<	2.00
Cation_Anion Balance PERCENT	3	-2.39	.54	-2.86	-1.80					

Conditions: From: 01/01/1980...To: 12/31/1999...Sites: N8-RA-P...

Table 1. (cont.)

Peabody Western - Black Mesa Complex
Paradox Hydrology System
Water Quality Statistics

Sample Point : N8-RA-P PERM INT IMPOUND
Location:
Elevation:

	Uncensored Data				Censored Data				
	No of Obs	Mean	StDv	Min	Max	No of Obs		Min		Max
Laboratory Parameters										
SAR RATIO	3	.08		.03	.14					
Solids, Diss. (Calc) MG/L	3	119.23	49.43	74.00	172.00					
Sum Of Anions MEQ/L	3	1.87	.90	1.00	2.80					
Sum Of Cations MEQ/L	3	1.90	.75	1.20	2.70					
Total Recoverable Al MG/L	3	20.96	25.44	1.69	49.80					
Total Recoverable As UG/L	2	6.00	5.29	2.00	10.00	1	<	10.00	<	10.00
Total Recoverable Cd UG/L						3	<	3.00	<	6.00
Total Recoverable Cr UG/L	2	30.00		20.00	40.00	1	<	10.00	<	10.00
Total Recoverable Cu UG/L	1	40.00		40.00	40.00	2	<	10.00	<	20.00
Total Recoverable Pb UG/L	1	40.00		40.00	40.00	2	<	40.00	<	80.00
Total Recoverable Hg UG/L	1	.20		.20	.20	2	<	.20	<	.20
Total Recoverable Se UG/L	1	1.00		1.00	1.00	2	<	1.00	<	1.00
Total Recoverable Zn MG/L	3	.07	.06	.01	.15					
TDS Ratio ANAL/CALC	3	1.14	.19	.98	1.35					
Total Recoverable V UG/L	2	64.00	37.58	30.00	98.00	1	<	5.00	<	5.00

Conditions: From: 01/01/1980...To: 12/31/1999...Sites: N8-RA-P...

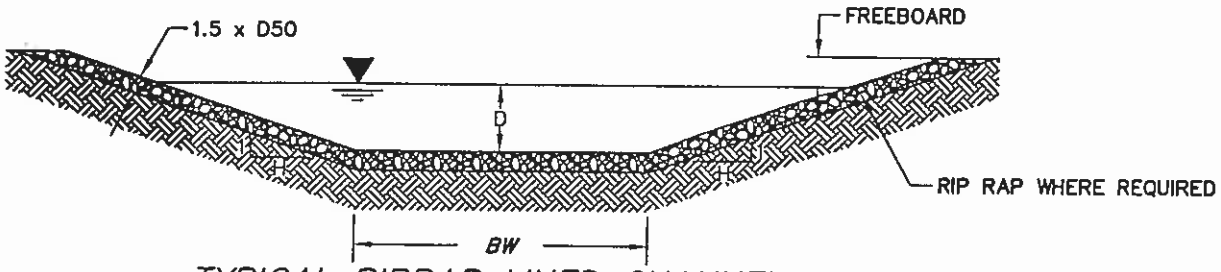
Tal . Comparison of N8-RA Water Quality Versus I ock Standards

---- Excursion Summary Report ----

Analyte	Standard	No. Sites	Sites	Frequency	Exceedence Date Range	Exceedence Value Range	Exceedence Median
Aluminum, Dissolved	0.0000 - 5.0000	0	none				
Arsenic, Dissolved	0.0000 - 200.0000	0	none				
Boron, Dissolved	0.0000 - 5000.0000	0	none				
Cadmium, Dissolved	0.0000 - 50.0000	0	none				
Chloride	0.0000 - 2000.0000	0	none				
Chromium, Dissolved	0.0000 - 1000.0000	0	none				
Copper, Dissolved	0.0000 - 500.0000	0	none				
Fluoride	0.0000 - 2.0000	0	none				
Lead, Dissolved	0.0000 - 100.0000	0	none				
Mercury, Dissolved	0.0000 - 10.0000	0	none				
Nitrate Nitrogen N	0.0000 - 100.0000	0	none				
Nitrite Nitrogen N	0.0000 - 10.0000	0	none				
Ph At 25 Deg. Cent.	6.5000 - 8.5000	0	none				
Selenium, Dissolved	0.0000 - 50.0000	0	none				
Solids, Dissolved	0.0000 - 5000.0000	0	none				
Sulfate	0.0000 - 3000.0000	0	none				
Total Recoverable Al	0.0000 - 5.0000	1	N8-RA-P	2/3	08/05/97-09/01/99	11.4000 - 49.8000	30.6000
Total Recoverable As	0.0000 - 200.0000	0	none				
Total Recoverable Cd	0.0000 - 50.0000	0	none				
Total Recoverable Cr	0.0000 - 1000.0000	0	none				

Total Recoverable Cu	0.0000 -	500.0000	0	none
Total Recoverable Hg	0.0000 -	10.0000	0	none
Total Recoverable Pb	0.0000 -	100.0000	0	none
Total Recoverable Se	0.0000 -	50.0000	0	none
Total Recoverable V	0.0000 -	100.0000	0	none
Total Recoverable Zn	0.0000 -	25.0000	0	none
Vanadium, Dissolved	0.0000 -	100.0000	0	none
Zinc, Dissolved	0.0000 -	25.0000	0	none

* = Sample below detection limit and detection limit greater than standard.



TYPICAL RIPRAP LINED CHANNEL

Channel	Flow Q (cfs)	Slope (%)	Bottom Width (BW) (ft)	SIDESLOPE H:1V (ft)	Depth of Flow (D) (ft)	Velocity (fps)	Freeboard (ft)	Total Depth (ft)	Rip Rap (in)
N8RA–1c Q100	284.4	0.5–1.2	15	3	2.5	7.1	1.0	3.5	Spoil
	284.4	1.3–5.1	15	3	2.1	8.9	1.0	3.1	6"
	284.4	5.2–10.2	15	3	1.6	10	1.0	2.6	9"
	284.4	10.3–14.1	20	3	1.3	10	1.0	2.3	9"
	284.4	14.2–18.5	25	3	1.1	10	1.0	2.1	9"
	284.4	18.6–25	30	3	0.9	10	1.0	1.9	9"

Channel	Flow Q (cfs)	Slope (%)	Bottom Width (BW) (ft)	SIDESLOPE H:1V (ft)	Depth of Flow (D) (ft)	Velocity (fps)	Freeboard (ft)	Total Depth (ft)	Rip Rap (in)
N8RA–1c Q100	284.4	0.5–1.2	20	3	2.2	6.7	1.0	3.2	Spoil
	284.4	1.3–1.4	20	3	1.8	6.4	1.0	2.8	3"
	284.4	1.5–6.6	20	3	1.7	9.0	1.0	2.7	6"
	284.4	6.7–14.1	20	3	1.3	10	1.0	2.3	9"
	284.4	14.2–18.6	25	3	1.1	10	1.0	2.1	9"
	284.4	18.7–25	30	3	0.9	10	1.0	1.9	9"

NOTES: Critical Slope at w=15' is 1.2% (Q100), at w=20' is 1.2% (Q100)

NOTES: Depth of Flow Based on Minimum Grade
Velocity Based On Maximum Grade

REV. No.	REVISIONS	REV. DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
DRAFT					
0	DRAFT	12/99	D. Keuscher	D. Keuscher	D. Gleason

MONTGOMERY WATSON

PROJECT No.: 052 – Task 18
AutoCAD FILE: N8RA–1c-SUM
SCALE: NOT TO SCALE
FIGURE No.: 1

PEABODY WESTERN COAL COMPANY

TABLE 3 8RA–1c CHANNEL DESIGNS

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: N8RA POND

STRUCTURE: Channel N8RA-1c

TIME OF CONCENTRATION:

Start Elevation (ft) =	7365
End Elevation (ft) =	6726
Elevation Difference, E (ft) =	639
Watercourse Length (ft) =	6300
Watercourse Length, L (mi) =	1.193

Tc = (11.9L^3/E)^0.385 = 0.265 hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland Method In SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Reclaimed	C	81	45.5	3685.5
Undisturbed - Pinon Juniper	D	83	200.1	16608.3
TOTAL:			245.6	20293.8

Weighted CN = Total CN*Area/ Total Area = 83

DRAINAGE BASIN AREA:

245.6 Acres

RAINFALL FACTOR:

R = 40

PEABODY WESTERN KAYENTA MINE CHANNEL N8RA-1c

100-Year, 6-Hour

DJK

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, CO. 80526

Phone: 303 763-5140

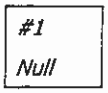
General Information

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	Channel N8RA-1c



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	245.600	245.600	284.43	20.08

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	245.600	0.265	0.000	0.000	83.000	F	284.43	20.076
	Σ	**245.600**						**284.43**	**20.076**

APPENDIX A

Hydrology and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: N7N8 AREA

STRUCTURE: N8-RA Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	7365
End Elevation (ft) =	6726
Elevation Difference, E (ft) =	639
Watercourse Length (ft) =	6300
Watercourse Length, L (mi) =	1.193

Tc = (11.9L^3/E)^0.385 = 0.265 hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Reclaimed	C	81	105.2	8521.2
Undisturbed - Pinon Juniper	C	83	200.1	16608.3
TOTAL:			305.3	25129.5

Weighted CN = Total CN*Area/ Total Area = 82

DRAINAGE BASIN AREA:

305.3 Acres

RAINFALL FACTOR:

R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: N8-RA Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
35	0.38	105.2	39.98
42	0.16	200.1	32.02
TOTAL:		305.3	71.99

Weighted K = Total K*Area/ Total Area = 0.24

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
560	100	17.9%	0.6	10.1	8.36
365	70	19.2%	0.6	10.9	7.02
200	40	20.0%	0.6	11.3	5.13
230	70	30.4%	0.6	16.9	8.77
240	70	29.2%	0.6	16.3	8.61
330	70	21.2%	0.6	12.0	7.41
120	40	33.3%	0.6	18.4	6.51
360	30	8.3%	0.5	4.8	2.06

Average LS = 6.73

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
Reclaimed (Post-Law)	40%	0%	105.2	0.15	15.78	0.80	84.16
Undisturbed - PJ	35%	25%	200.1	0.22	44.02	1.00	200.10
TOTAL:			305.3		59.80		284.26

Weighted C = Total C*Area/ Total Area = 0.196

Weighted P = Total P*Area/ Total Area = 0.931

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: N8-RA POND

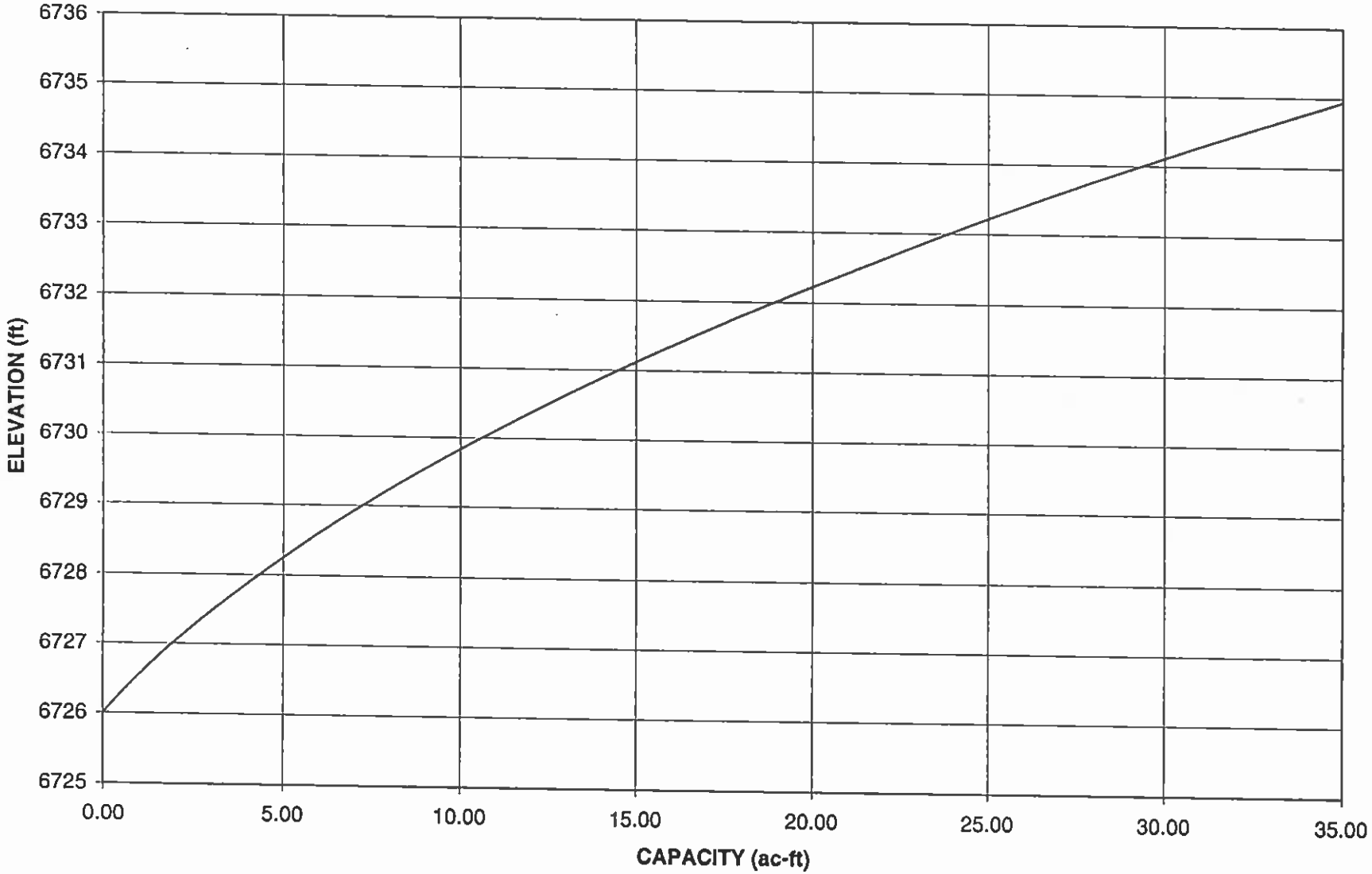
The following spreadsheet calculates the predicted sediment yield for the project area. The gross sediment yield is determined according to the Revised Universal Soil Loss Equation.

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.24	
Length Slope Factor	6.73	
Cover Factor	0.20	
Practice Factor	0.93	
Gross Annual Sediment Yield	11.59	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0057	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0051	acre-feet/acre/year
Watershed Area	305.3	acres
Watershed Annual Sediment Yield	1.56	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	1.56	acre-feet

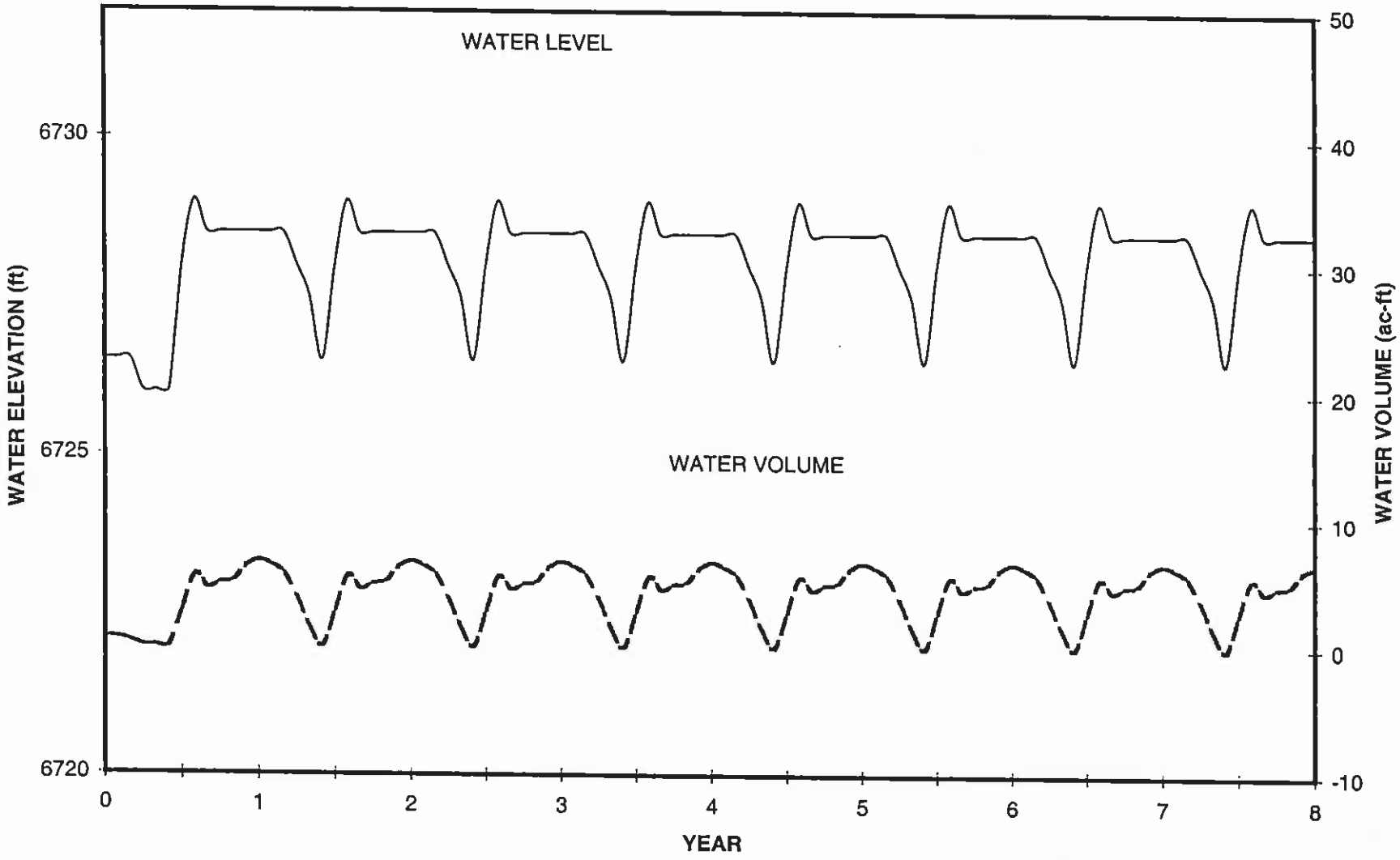
APPENDIX B

Water Persistence Calculations

PERMANENT IMPOUNDMENT N8RA
ELEVATION /CAPACITY CURVE



N8RA PERMANENT IMPOUNDMENT
WATER PERSISTENCE EVALUATION



PEABODY WESTERN COAL COMPANY
N8RA PERMANENT IMPOUNDMENT POND WATER PERSISTENCE EVALUATION

	0 January	February	March	April	May	June	July	August	September	October	November	December	1 January	2 End Of Year 2	3 End Of Year 3	4 End Of Year 4	5 End Of Year 5	6 End Of Year 6	7 End Of Year 7	8 End Of Year 8
Average Precipitation (inch)	0 95	0 88	0 89	0 58	0.45	0 46	1 49	1.49	0 95	1.09	0 88	1 08	0 95	0 95	0 95	0 95	0 95	0 95	0 95	0 95
Area (acres)	305 3	305 3	305 3	305 3	305 3	305 3	305 3	305 3	305.3	305 3	305 3	305.3	305 3	305 3	305 3	305 3	305 3	305 3	305 3	305 3
Curve Number	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
S	2.99	2 99	2 99	2 99	2.99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99	2 99
Run-Off (inches)	0 04	0 02	0 03	0 00	0 00	0 00	0 21	0 21	0 04	0 07	0 04	0 07	0 04	0 04	0 04	0 04	0 04	0 04	0 04	0 04
Run-Off (ac-ft)	0 95	0 54	0 66	0 00	0 00	0 00	5 22	5 22	0 95	1.77	1 11	1.71	0 95	0 95	0 95	0 95	0 95	0.95	0 95	0 95
Starting Pond Volume (ac-ft)	0	0 84	0 81	0 36	0.00	0 00	0 00	2 79	5 52	4 52	4 91	5.08	6 19	6 19	6 19	6 19	6.19	6 19	6 19	6.19
Pond Volume + Runoff (ac-ft)	0 95	1 18	1 27	0 36	0 00	0 00	5 22	8 02	6.47	6 29	6 01	6.79	6.19	6 19	6 19	6.19	6.19	6 19	6 19	6.19
Water Elevation (ft)	6726 5	6726.5	6726 5	6726	6726	6726	6726	6729	6726 5	6726 5	6726 5	6726.5	6726 5	6726 5	6726 5	6726 5	6726.5	6726 5	6726 5	6726.5
Water Surface Area (acres)	1 92	1.92	1 92	1 67	1 67	1 67	2.85	3.14	2 90	2.90	2.90	2 90	2.90	2.90	2 90	2 90	2.90	2.90	2 90	2.90
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	1.48	0.87	0 87	0 87	0 87	0 87	0.87	0 87	0 87
Evaporation (ac-ft)	0 14	0 42	0.75	1 03	1 47	1 50	2.20	2 22	1.71	1 13	0.68	0.35	0.21	0 21	0 21	0 21	0 21	0.21	0 21	0 21
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	1 054	1.054	1 054	1.054
Infiltration (ac-ft)	0 17	0.15	0 17	0 14	0.15	0 14	0.23	0 28	0.25	0 25	0 25	0.25	0 25	0.25	0 25	0 25	0 25	0 25	0 25	0 25
Total Water Loss (ac-ft)	0 31	0 57	0 92	1 17	1 61	1 64	2.43	2.50	1.95	1 38	0 93	0 61	0 46	0 46	0 46	0 46	0.46	0 46	0 46	0.46
Total Water Change (ac-ft)	0 64	-0 03	-0 25	-1.17	-1.61	-1 64	2.79	2.73	-1 01	0.39	0.18	1.10	0 48	0 48	0 48	0 48	0.48	0 48	0 48	0.48
Ending Pond Volume	0 64	0 61	0 36	0 00	0 00	0 00	2.79	5 52	4 52	4 91	5 08	6 19	6 67	6 67	6 67	6 67	6 67	6.67	6 67	6 67

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.

0 1 2 3 4 5 6 7 8

8/24/00

N8RAWline

APPENDIX C

SEDCAD4 (Input and Output)

PEABODY WESTERN
KAYENTA MINE
POND N8-RA

100-Year, 6-Hour Storm

DJK

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

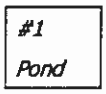
General Information

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
Pond	#1	==>	End	0.000	0.000	Pond N8-RA



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	305.300	305.300	332.86	23.54
	Out			129.34	23.54

Structure Detail:

Structure #1 (Pond)

Pond N8-RA

Pond Inputs:

Initial Pool Elev:	6,732.00
Initial Pool:	18.38 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,732.00	40.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	6,733.76
Dewater Time:	0.61 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)	
6,726.00	1.670	0.000	0.000		
6,726.50	1.855	0.881	0.000		
6,727.00	2.050	1.857	0.000		
6,727.50	2.255	2.933	0.000		
6,728.00	2.470	4.114	0.000		
6,728.50	2.739	5.416	0.000		
6,729.00	3.022	6.855	0.000		
6,729.50	3.319	8.440	0.000		
6,730.00	3.630	10.177	0.000		
6,730.50	3.859	12.049	0.000		
6,731.00	4.096	14.038	0.000		
6,731.50	4.339	16.146	0.000		
6,732.00	4.590	18.378	0.000		Spillway #1
6,732.50	4.838	20.735	21.134	11.30	
6,733.00	5.092	23.217	42.268	1.70	
6,733.50	5.353	25.828	94.819	1.20	
6,733.76	5.494	27.264	129.342	0.55	Peak Stage

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,734.00	5.620	28.571	160.744	
6,734.50	5.936	31.459	237.784	
6,735.00	6.260	34.508	339.408	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,726.00	0.000	0.000
6,726.50	0.000	0.000
6,727.00	0.000	0.000
6,727.50	0.000	0.000
6,728.00	0.000	0.000
6,728.50	0.000	0.000
6,729.00	0.000	0.000
6,729.50	0.000	0.000
6,730.00	0.000	0.000
6,730.50	0.000	0.000
6,731.00	0.000	0.000
6,731.50	0.000	0.000
6,732.00	0.000	0.000
6,732.50	21.134	21.134
6,733.00	42.268	42.268
6,733.50	94.819	94.819
6,734.00	160.744	160.744
6,734.50	237.784	237.784
6,735.00	339.408	339.408

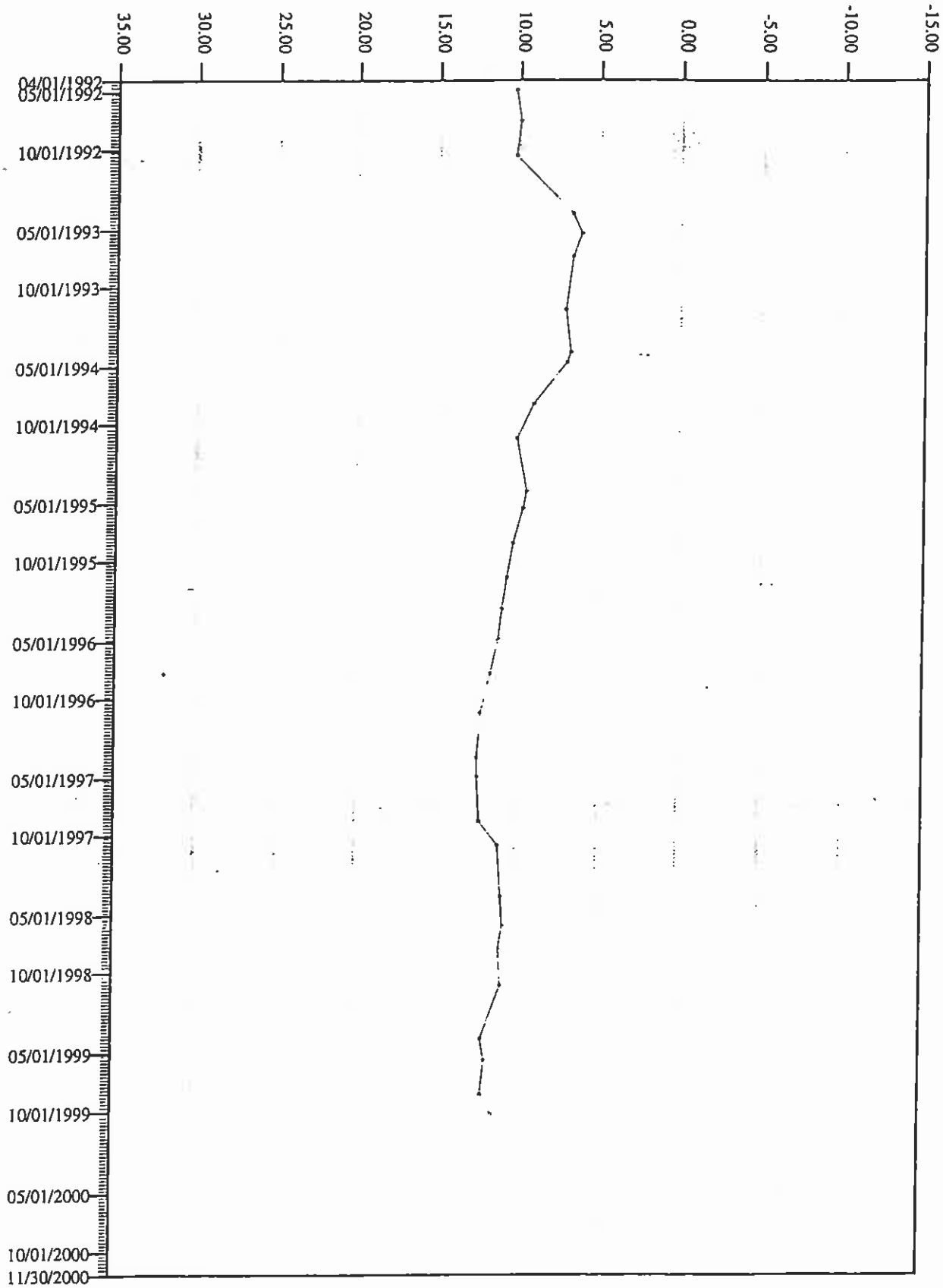
Subwatershed Hydrology Detail:

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	305.300	0.265	0.000	0.000	82.000	F	332.86	23.540
	$\sum$	**305.300**						**332.86**	**23.540**

APPENDIX D

Alluvial Wells Hydrograph

WATER LEVEL HYDROGRAPH



UV180

Figure 1.

WATER LEVEL HYDROGRAPH

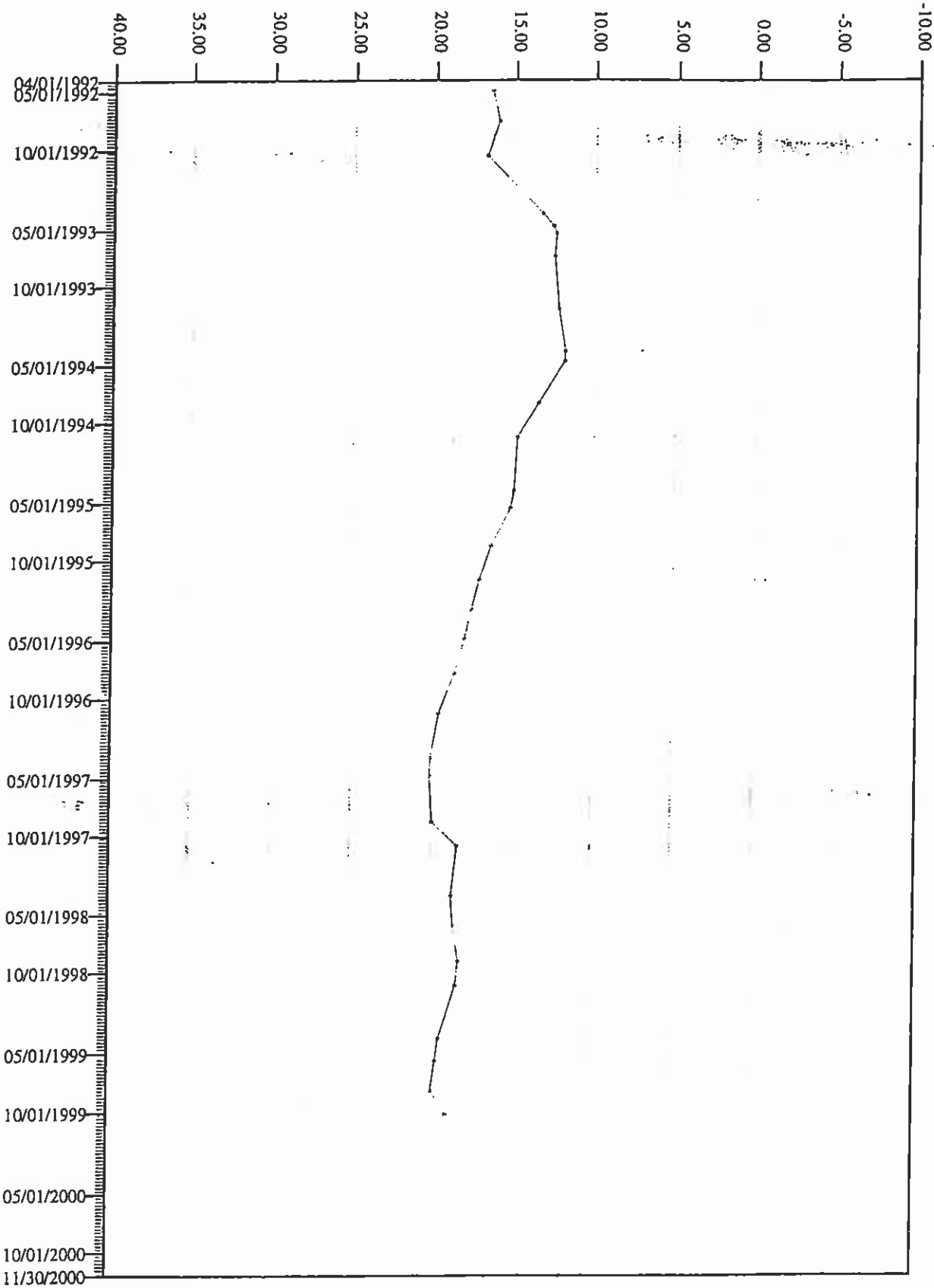


Figure 2.

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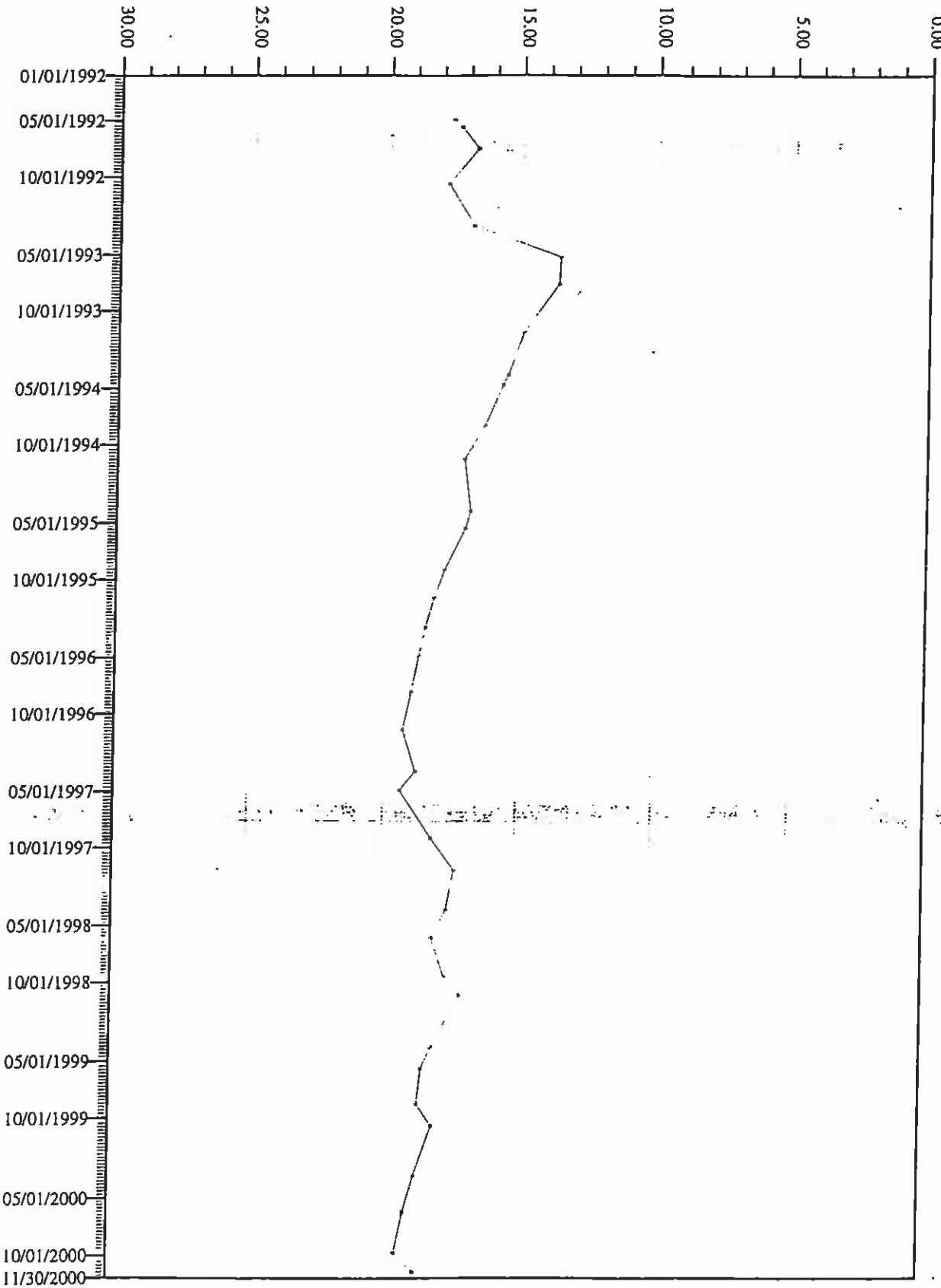
WATER LEVEL HYDROGRAPH

Figure 3.



UV182