DESIGN REPORT

Permanent Impoundment Structure

N1-RA

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

Revised 12/18/00

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INTRODUCTION

Structure N1-RA is an existing incised internal impoundment structure constructed by Peabody Western Coal Company (PWCC) in 1979 in the N-1 post-law reclamation area and is proposed as a permanent impoundment structure. PWCC plans to utilize structure N1-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 N1-RA and its watershed boundary are shown on Drawing No. 85400 (sheet K-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 N1-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 existing structure N1-RA was inspected in July 2000 by a Registered Professional Engineer from PWCC, to assure that the site is suitable and no adverse conditions exist to prevent the successful operation of this structure. A detailed geotechnical investigation was not performed since the impoundment is incised, with no embankments or emergency spillway required. Information in Chapter 6, Attachment D was utilized to confirm the stability of the re-graded incised slopes.

In addition to the visual observation of water in Pond N1-RA, an analytical method was used to show water persistence. The method used and results are described as follows. Runoff volume from the watershed was calculated from average annual precipitation and 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 NRCS Curve Number Method and the mean monthly precipitation for January, as presented in Appendix 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 in 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 about year 5. 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 would stabilize between elevation 6553 and 6554 depending on the time of the 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 22.5 ac-ft of water.

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 N1-RA impoundment will originate from surface water runoff from reclaimed spoil 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 N1-RA impoundment. Seventeen full suite water quality analyses have been performed on water samples collected form the N1-RA impoundment

loss of watershed area associated with Pond N1-RA. In addition, Peabody has no evidence that flood irrigation has been practice along this tributary to Coal Mine Wash below the N1-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 presents 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 SEDCAD 4 (see Appendix B). Structure N1-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. Since the structure is completely incised and is

Inflow

Peak Flow		cfs	1,939.7
Volume		ac-ft	154
Starting Volume (observed high water mark)	ac-ft	20	
Starting Elevation	ft	6554	
Peak Volume (high water mark + PMP)		ac-ft	174
Peak Elevation		ft	6570
Pond Crest Elevation		ft	6600
Freeboard		ft	30

EMERGENCY SPILLWAY and OUTFLOW CHANNEL

Structure N1-RA is not required to have a spillway or outflow channel because the impoundment is designed to contain all of the PMP storm event runoff with adequate freeboard and no discharge.

STORAGE CAPACITY

Table 1.

Peabody Western ...k Mesa Complex
Paradox Hydrology System
Water Quality Statistics

Sample Point : N1-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.	12	9.45		8.08	10.61			
Temperature C	12	11.19	7.63	2.10	23.00			
Conductivity UMHOS/CM	12	664.17	565.79	219.00	2050.00			
Field Salinity 0/00	12	.20	.29	0.00	1.00			
Laboratory Parameters								
Acidity MG/L	14	0.00		0.00	0.00	3 <	2.00 <	2.00
Alk As CaCO3, Ph 4.5 MG/L	18	139.89	126.91	55.00	618.00			
Alk, Bicarb As CaCO3 MG/L	8	152.75	167.65	35.00	551.00	1 <	2.00 <	2.00
Alk, Carb As CaCO3 MG/L	7	47.14	57.92	0.00	164.00	2 <	1.00 <	2.00
Alk, Hydrox As CaCO3 MG/L						4 <	2.00 <	2.00
Aluminum, Total MG/L	5	.45	.36	.21	1.07			
Aluminum, Dissolved MG/L	3	.17	.08	.08	.22	14 <	.03 <	.05
Antimony, Total UG/L						5 <	1.00 <	1.00
Antimony, Dissolved UG/L	1	9.00		9.00	9.00	16 <	1.00 <	10.00
Arsenic, Total UG/L	5	4.20	2.59	1.00	8.00	1 <	1.00 <	1.00
Arsenic, Dissolved UG/L	12	3.00	1.83	1.00	8.00	5 <	1.00 <	1.00
Barium, Total UG/L	5	54.00	32.09	10.00	80.00			
Barium, Dissolved UG/L	17	66.35	57.54	10.00	268.00			
Boron, Total UG/L	4	40.00	11.55	30.00	50.00	1 <	20.00 <	20.00
Boron, Dissolved UG/L	16	66.25	53.34	30.00	240.00	2 <	20.00 <	20.00
Cadmium, Total UG/L						5 <	5.00 <	5.00
Cadmium, Dissolved UG/L						17 <	3.00 <	5.00
Calcium, Total MG/L	5	54.80	42.61	18.00	115.00			
Calcium, Dissolved MG/L	18	34.43	23.73	9.00	105.00			
C O.D. MG/L	17	55.76	47.85	15.00	210.00			
Chloride MG/L	15	6.53	9.92	1.00	41.00	3 <	1.00 <	1.00
Chromium, Total UG/L						5 <	10.00 <	10.00
Chromium, Dissolved UG/L						17 <	10.00 <	10.00
Conductivity UMS/CM2	18	621.39	574.10	191.00	2510.00			
Copper, Total UG/L	2	15.00	7.07	10.00	20.00	3 <	10.00 <	10.00
Copper, Dissolved UG/L	3	13.33	5.77	10.00	20.00	14 <	10.00 <	10.00
Fluoride MG/L	18	.83	.48	.40	1.80			
Hardness As CaCO3 MG/L	18	186.89	130.25	77.00	536.00			
Iron, Total MG/L	18	.61	1.01	.02	3.63			

Conditions: From: 01/01/1980...To: 12/31/1999...Sites: N1-RA-P...

Table 1. ıt.)

Peabody Weste ıck Mesa Complex
Paradox Hydrology System
Water Quality Statistics

Sample Point : N1-RA-P PERM INT IMPOUND
Location:
Elevation.

Laboratory Parameters	Uncensored Data No of Obs	Mean	StDv	Min	Max	Censored Data No of Obs		Min		Max
Zinc, Total MG/L	1	.02		.02	.02	4	<	.01	<	.01
Zinc, Dissolved MG/L	5	.02	.01	.01	.04	12	<	.01	<	.01
Bicarbonate As HCO3 MG/L	17	142.31	145.32	35.00	672.00	1	<	2.00	<	2.00
Carbonate As CO3 MG/L	17	17.47	24.91	0.00	98.00	1	<	2.00	<	2.00
Hydroxide As OH MG/L						4	<	2.00	<	2.00
Phosphate As PO4 MG/L						12	<	.02	<	.10
Cation_Anion Balance PERCENT	13	-.63	2.18	-4.73	2.03					
SAR RATIO	13	2.32	2.50	.44	8.09					
Solids, Diss. (Calc) MG/L	13	446.10	487.06	136.00	1850.00					
Sum Of Anions MEQ/L	4	14.88	11.36	3.20	30.30					
Sum Of Cations MEQ/L	4	14.70	11.44	3.20	30.50					
Total Recoverable Al MG/L	12	.60	1.01	.06	2.83					
Total Recoverable As UG/L	10	4.00	1.76	2.00	9.00	1	<	.03	<	.03
Total Recoverable Ba UG/L	11	90.27	80.63	29.00	315.00	3	<	1.00	<	2.00
Total Recoverable Cd UG/L						13	<	3.00	<	5.00
Total Recoverable Cr UG/L						13	<	10.00	<	10.00
Total Recoverable Cu UG/L	2	10.00		10.00	10.00	11	<	10.00	<	10.00
Total Recoverable Fe MG/L	12	.59	.98	.03	3.04					
Total Recoverable Pb UG/L						13	<	20.00	<	40.00
Total Recoverable Mn MG/L	11	.09	.11	.01	.40	1	<	.01	<	.01
Total Recoverable Hg UG/L	1	.50		.50	.50	12	<	.10	<	.20
Total Recoverable Mo UG/L	2	2.50	2.12	1.00	4.00	10	<	1.00	<	5.00
Total Recoverable Ni UG/L	1	10.00		10.00	10.00	11	<	10.00	<	20.00
Total Recoverable Se UG/L	3	2.00	1.73	1.00	4.00	10	<	1.00	<	1.00
Total Recoverable Ag UG/L						12	<	5.00	<	10.00
Total Recoverable Zn MG/L	5	.04	.03	.01	.08	8	<	.01	<	.01
TDS Ratio ANAL/CALC	13	1.03	.08	.93	1.19					
Total Recoverable Sb UG/L	1	1.00		1.00	1.00	11	<	1.00	<	10.00
Total Recoverable V UG/L	2	8.00		5.00	11.00	11	<	5.00	<	10.00

Conditions: From: 01/01/1980...To: 12/31/1999...Sites: N1-RA-P...

Table 2. arison of N1-RA Water Quality Versus Livestoc lards

---- 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	1	N1-RA-P	13/18	05/28/87-10/20/99	8.6000 - 10.6000	9.1000
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	0	none				
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				

APPENDIX A

Hydrology and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: N1 POND

STRUCTURE: N1-RA Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6820
End Elevation (ft) =	6550
Elevation Difference, E (ft) =	270
Watercourse Length (ft) =	6260
Watercourse Length, L (mi) =	1.180
Tc = (11.9L^3/E)^0.385 =	0.364 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(Fair)	81	276	22356
Reclaimed - PreLaw	C(Poor)	87	339.6	29545.2
TOTAL:			615.6	51901.2

Weighted CN = Total CN*Area/ Total Area = 84

DRAINAGE BASIN AREA: 615.6 Acres

RAINFALL FACTOR:

R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: N1-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	0.38	
Length Slope Factor	4.38	
Cover Factor	0.31	
Practice Factor	0.91	
Gross Annual Sediment Yield	18.81	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0092	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0083	acre-feet/acre/year
Watershed Area	615.6	acres
Watershed Annual Sediment Yield	5.09	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	5.09	acre-feet

APPENDIX B

SEDCAD4 (Input and Output)

PEABODY WESTERN KAYENTA MINE POND N1-RA

General 6 Hour PMP

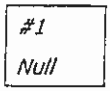
DJK

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

Phone: 303 763-5140

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Pond N1-RA

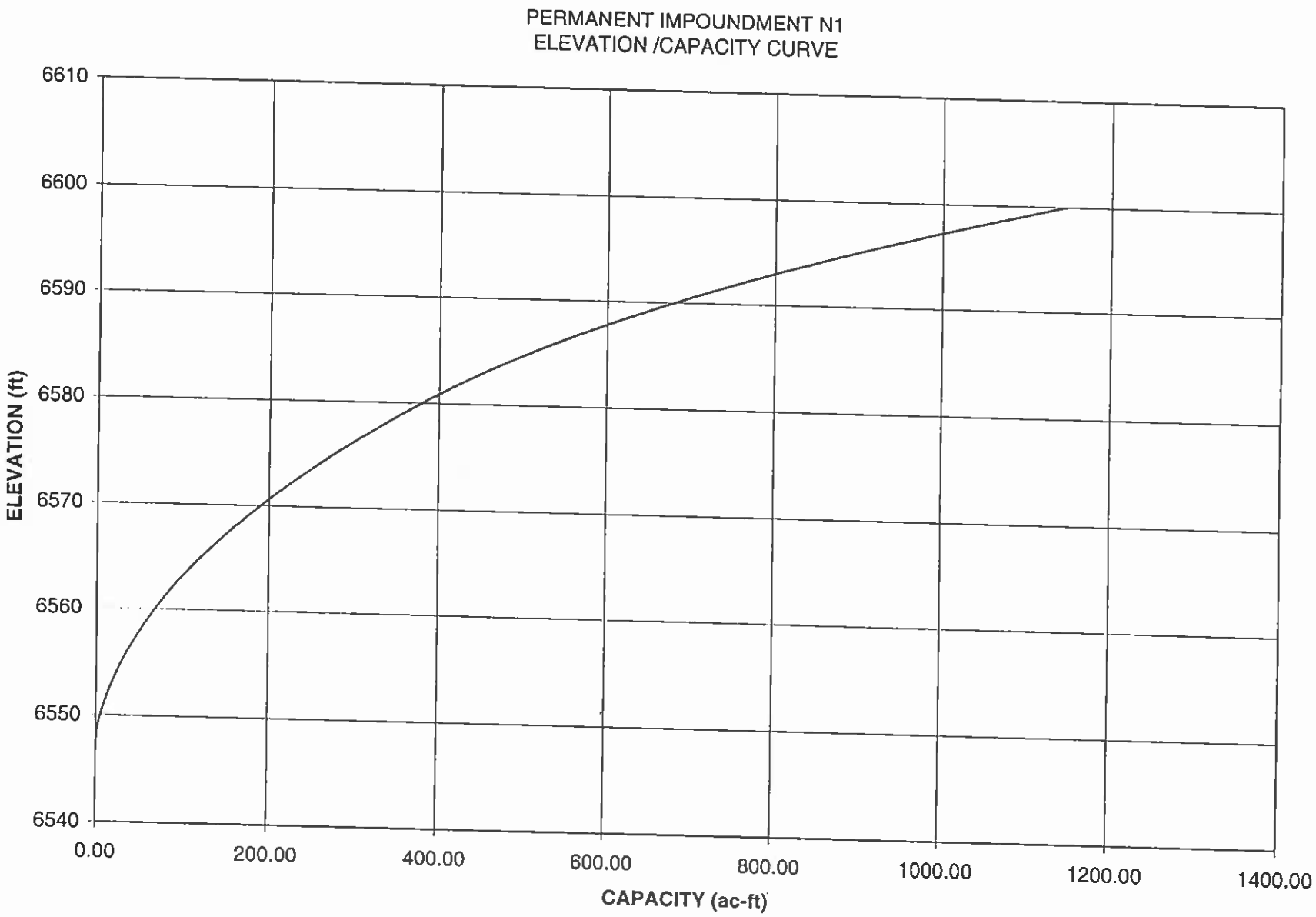


Subwatershed Hydrology Detail:

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	615.600	0.364	0.000	0.000	84.000	F	1,939.69	153.758
	Σ	**615.600**						**1,939.69**	**153.758**

APPENDIX C

Water Persistence Calculations


PERMANENT IMPOUNDMENT N1
ELEVATION /CAPACITY CURVE
6610
6600
6590
6580
6570
6560
6550
6540
ELEVATION (ft)
0.00
200.00
400.00
600.00
800.00
1000.00
1200.00
1400.00
CAPACITY (ac-ft)

	0												1	2	3	4	5	6	7	8
	January	February	March	April	May	June	July	August	September	October	November	December	January	End Of Year 2	End Of Year 3	End Of Year 4	End Of Year 5	End Of Year 6	End Of Year 7	End Of Year 8	End Of Year 9
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	0 95	0 95	0 95	0 95	0.95	0.95	0.95	0.95	1 08
Area (acres)	615 6	615 6	615.6	615 6	615 6	615 6	615 6	615 6	615.6	615 6	615.6	615 6	615 6	615 6	615 6	615.6	615 6	615 6	615 6	615 6	615 6
Curve Number	77	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	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	0 07
Run-Off (ac-ft)	1.91	1.09	1 34	0 00	0.00	0.00	10.54	10.54	1 91	3 58	2 23	3 44	1.91	1.91	1 91	1.91	1 91	1 91	1 91	1 91	3 44
Starting Pond Volume (ac-ft)	0	1.64	2 05	2 31	0.73	0 00	0.00	6 90	13.80	12 26	13 53	14.22	18 65	19.76	21 00	21 84	22 20	22.58	22 64	22 73	20 28
Pond Volume + Runoff (ac-ft)	1 91	2.73	3 39	2 31	0.73	0 00	0.00	6 90	13.80	12 26	13 53	14.22	18 65	19.76	21 00	21 84	22 20	22.58	22 64	22 73	20 28
Water Elevation (ft)	6548 5	6549	6549	6549	6548	6547	6551	6552.5	6552 5	6552.5	6552.5	6552 5	6552.5	6553	6553 5	6553 5	6553 5	6553 5	6553 5	6553 5	6554
Water Surface Area (acres)	1.70	2 26	2.26	2.26	1.13	0 00	3 96	4.82	4 82	4 82	4 82	4 82	4 82	5 11	5 39	5.39	5 39	5.39	5 39	5.39	5 68
Evaporation Rate (inches/month)	0 87	2 63	4 68	7 38	10.54	10.77	9.95	8 49	7.06	4 68	2 82	1 48	0 87	0 87	0 87	0 87	0 87	0.87	0 87	0.87	1 48
Evaporation (ac-ft)	0 12	0 50	0 88	1.39	0 99	0 00	3.29	3.41	2.84	1.88	1.13	0.59	0 35	0.37	0 39	0 39	0 39	0.39	0 39	0.39	0 69
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	1 054
Infiltration (ac-ft)	0 15	0.18	0 20	0.19	0.10	0 00	0.35	0.42	0 41	0 42	0 41	0 42	0 42	0 45	0 47	0 47	0 47	0 47	0 47	0 47	0 50
Total Water Loss (ac-ft)	0.27	0 67	1.08	1 58	1 09	0 00	3 63	3 83	3 25	2 30	1 54	1 01	0 77	0 82	0 86	0 86	0 86	0 86	0 86	0 86	1 19
Total Water Change (ac-ft)	1 64	0 41	0 26	-1 58	-1.09	0 00	6 90	6.70	-1 34	1 27	0 69	2 43	1 14	1 09	1 05	1 05	1 05	1 05	1 05	1 05	2 25
Ending Pond Volume	1 64	2 05	2 31	0 73	0 00	0 00	6 90	13 80	12 26	13 53	14 22	18 65	17 79	20 85	22 04	22.89	23 25	23 61	23 69	23 77	22 53

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

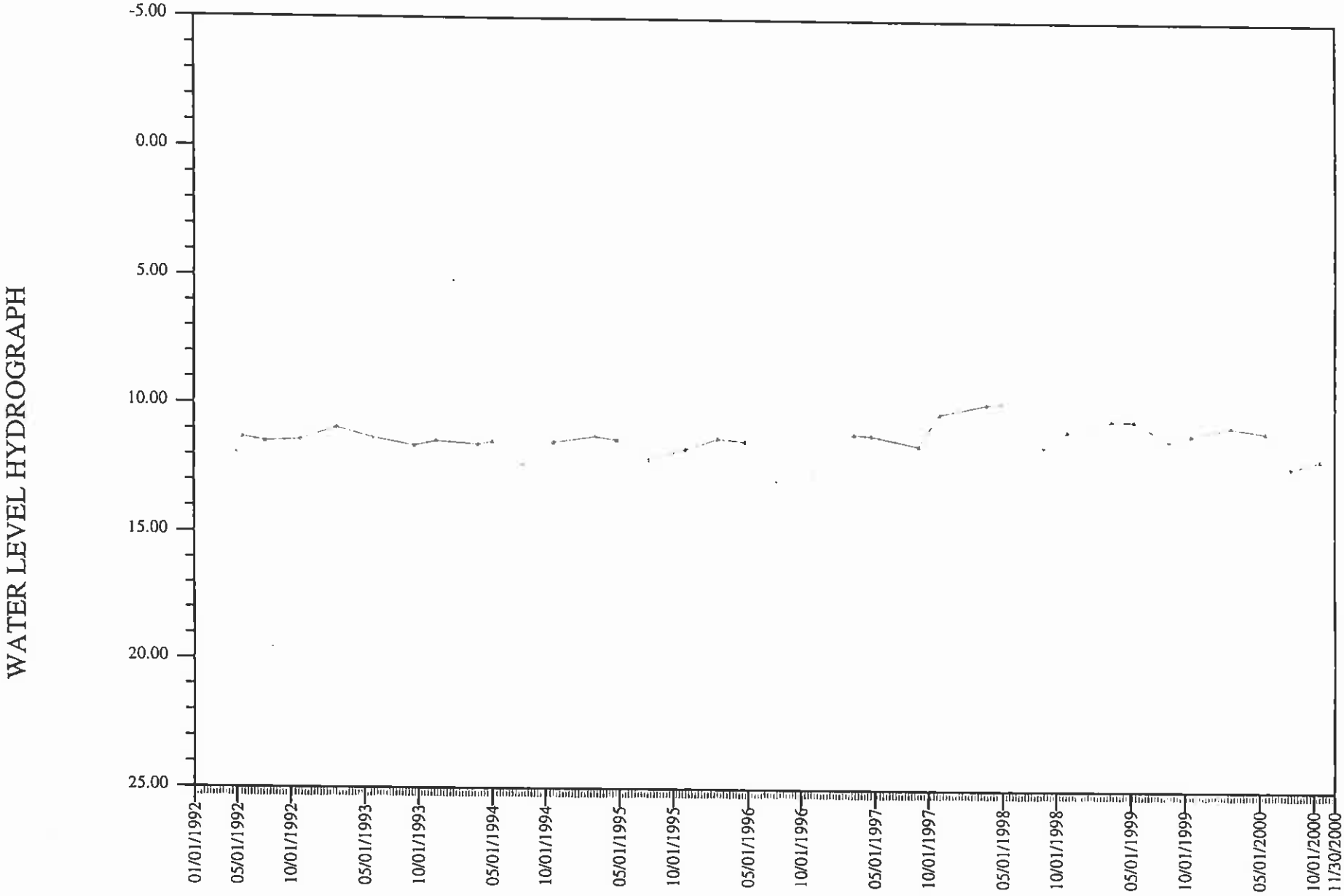
8/28/00

N1WLine

APPENDIX D

Alluvial Wells Hydrograph

Fi[illegible]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10.00
15.00
20.00
25.00
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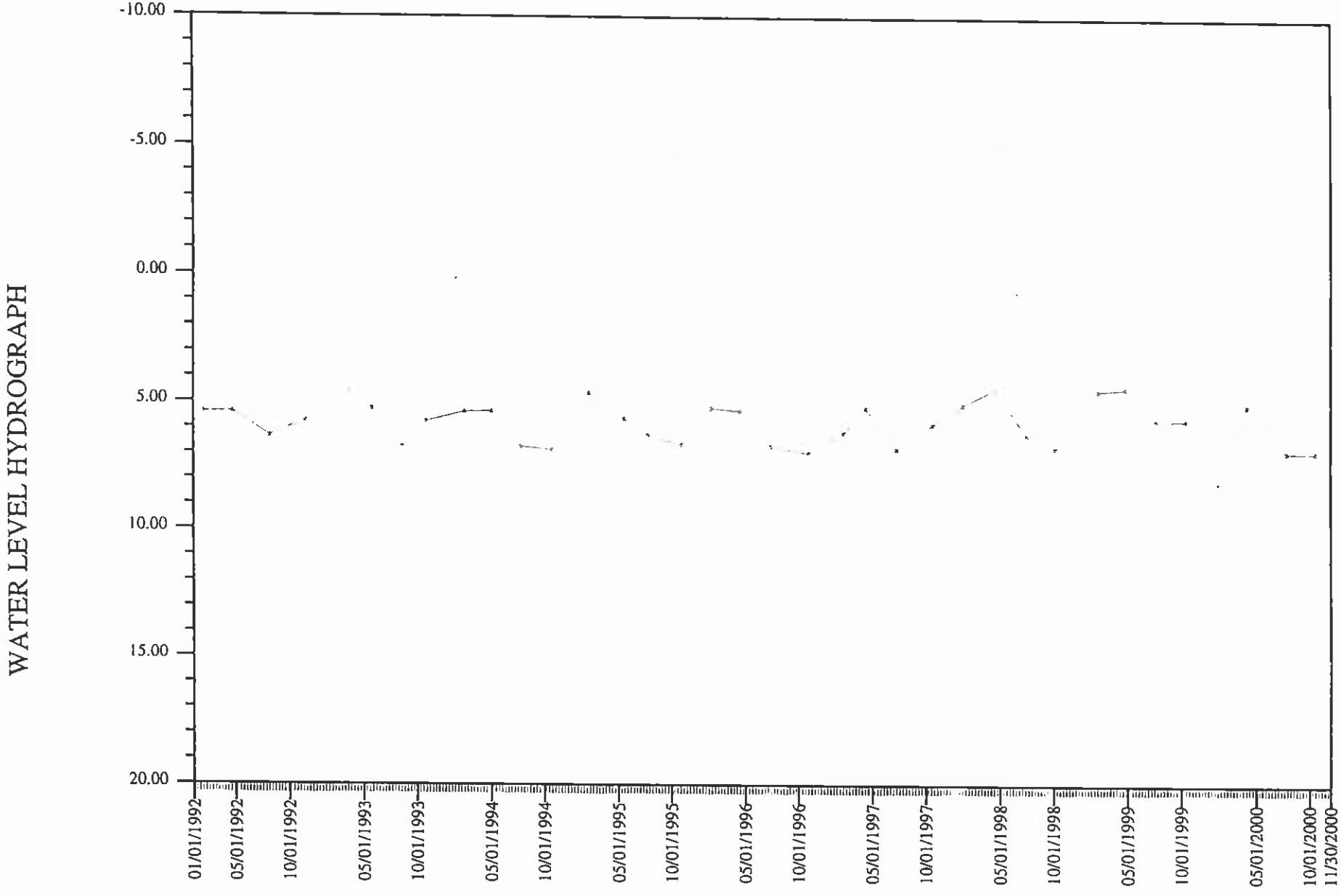
ALUV193

Figur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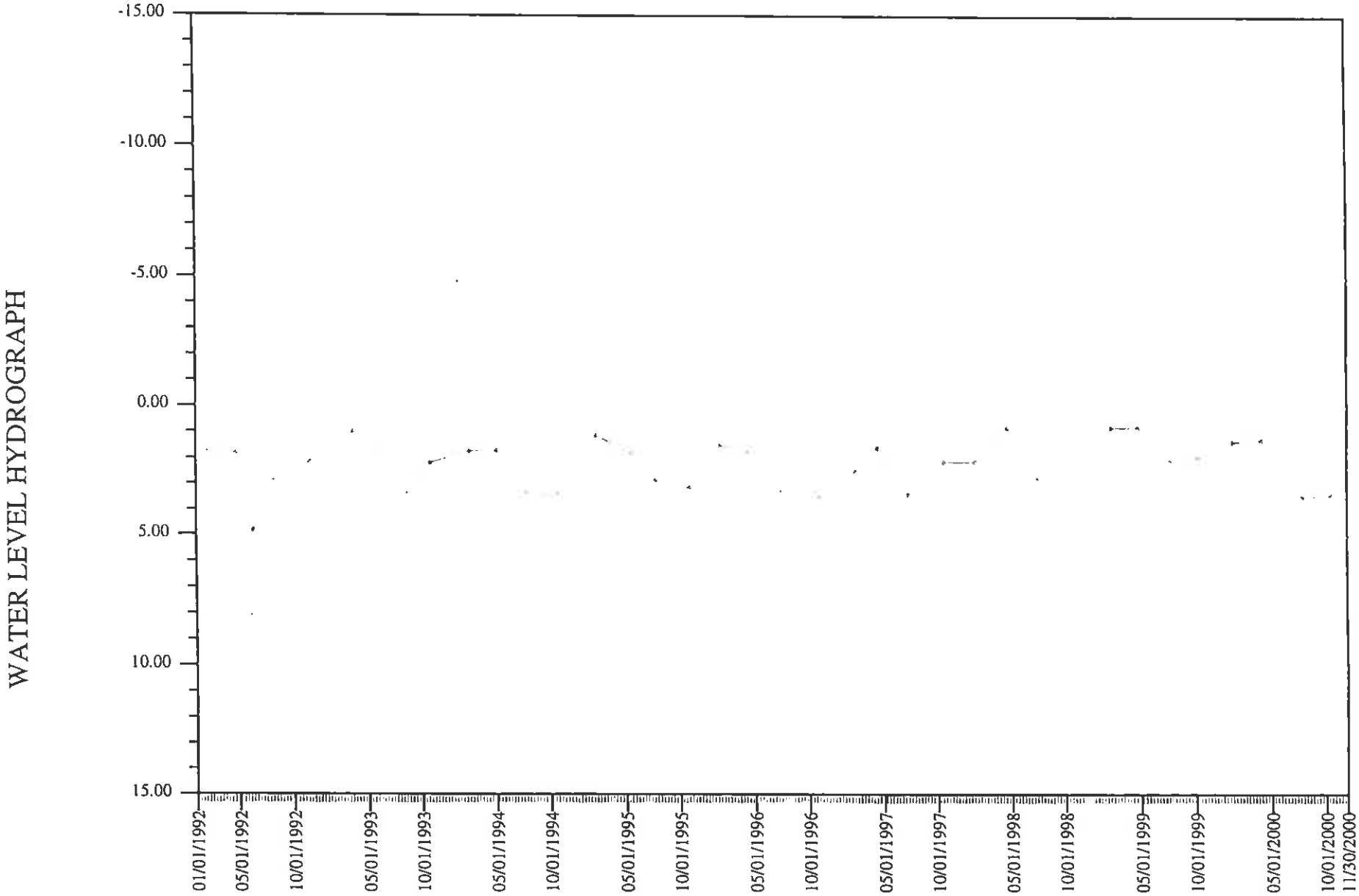
11/30/2000
ALUV82

Figu



Need Map

ALUV83