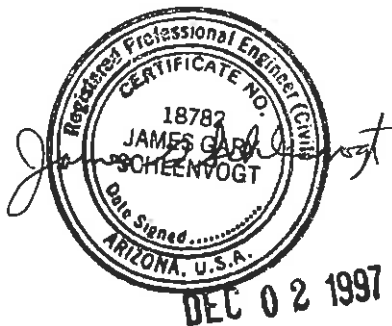


REMEDIAL PLAN
&
DESIGN REPORT
Sedimentation Structure
N10-B1
Kayenta Mine
Navajo County, Arizona

For
PEABODY WESTERN COAL COMPANY



Revised 12/02/97

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INTRODUCTION

Sedimentation structure N10-B1 is an existing earthen embankment, designed and constructed in 1981 and modified in 1995 to conform to the permanent program regulations by Peabody Western Coal Company as a temporary sedimentation structure. The structure is designed to control runoff and sediment from portions of the haul road, conveyor belt line and Transfer 24/25 facilities at the Kayenta Mine. During August, 1997, heavy "monsoon" thunderstorms created significant runoff and sediment inflow into Structure, N10-B1. The storage capacity is no longer adequate; therefore, following is Peabody's remedial design plan to restore adequate storage capacity. The location of Structure N10-B1 and its watershed boundary are shown on Drawing No. 85400 (Sheets L-7 and L-8) 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 N10-B1. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western Coal Company", December, 1985 (PAP), Chapter 6, Attachment D, Volume 2, along with the methods and results of analyses used for slope stability, hydrology, and hydraulics, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

INSPECTION

The construction site of Structure N10-B1 was inspected in August, 1997 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 implementation of this remedial design. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design and will be utilized during construction to construct a stable embankment.

SITE DESCRIPTION

LAND USE

Structure N10-B1 has a 38.9-acre tributary drainage area and is located on a tributary upstream of Coal Mine Wash at the Kayenta Mine. The watershed is classified as 73% haul road, 14% reclaimed and 13% undisturbed.

DESIGN ANALYSES

GENERAL

Structure N10-B1 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 1995 and 1997 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N10-B1 is a category A-1 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 12 feet wide on top will be constructed over the existing embankment. An upstream slope of 2:1 (horizontal to vertical) and a downstream slope of 4.5:1 were assumed. Based on the total embankment height of approximately 14 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.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, B, and C). Structure N10-B1 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 flood plain. 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 N10-B1 pond was analyzed using the 25-year, 6-hour storm. Structure N10-B1 was conservatively assumed to be full to the emergency spillway prior to the time of the 25-year storm event. The storage capacity of structure N10-B1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	1.68	mi.
2.	Elevation Difference, H	354	ft
3.	Time of Concentration, T _c	0.494	hr
4.	SCS Curve Number	89	
5.	Rainfall Depth, 10-year, 24-hour storm	2.1	in
	25-year, 6-hour storm	1.9	in
6.	Drainage Area	38.9	acres

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, B, and C).

N10-B1 SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
Inflow			
Peak Flow	cfs	30.3	35.1
Volume	ac-ft	3.6	3.1
Storage			
Peak Stage	msl	N/A	6589.8
Emerg. Spillway Elev.	msl	6589	6589
Peak Storage	ac-ft	N/A	7.6
Storage Capacity	ac-ft	6.9	7.05
Outflow			
Peak Flow	cfs	N/A	28.2
Spillway Elevation	msl	6589	6589
Embankment Crest Elev.	msl	6592	6592
Peak Stage	msl	--	6589.8
Freeboard	ft	--	2.2
Emergency Spillway Channel			
Flow Depth	ft	--	0.8
Critical Velocity	fps	--	3.5
Mannings "n"	--	--	.031
Width	ft	--	20
Outflow Channel			
Slope	%	--	28.6
Normal Velocity	fps	--	5.4
Normal Depth	ft	--	0.3
Mannings "n"	--	--	.057
Riprap D ₅₀	in		3

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N10-B1 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	2.0	ft
	(Outflow)	2.0	ft
Channel Width		20	ft
Channel Length	(Spillway)	35	ft
	(Outflow)	80	ft
Side Slopes (Horizontal to Vertical)		3:1 or flatter	
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	28.6	%
Spillway Elevation		6589.0	
		ft	

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

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1995 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N10-B1 is designed to contain approximately 7.05 acre-feet.

The calculations for the sediment load entering structure N10-B1 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.22
3.	Slope Factor, LS	2.5
4.	Cover Factor, C	0.77
5.	Erosion Control Factor, P	0.92

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. The storage capacity for N10-B1 is shown on Exhibit 1, N10-B1 Stage Capacity Table, and the results of the sediment inflow analysis are summarized in the following table.

N10-B1 STORAGE

Total Storage Capacity	7.05	acre-ft
10-year, 24-hour Storm Inflow	3.6	acre-ft
Available Sediment Storage Capacity	3.45	acre-ft
Sediment Inflow Rate	0.26	acre-ft/yr.
Sediment Storage Life	13.3	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) 10-Year, 24-Hour Storm Event
Appendix C	- SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event
Exhibit 1	- N10-B1 Temporary Sedimentation Pond Remedial Design

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: N10-B1 Pond

TIME OF CONCENTRATION (Haul Road):

Start Elevation (ft) = 6945
End Elevation (ft) = 6591
Elevation Difference, E (ft) = 354

Watercourse Length (ft) = 8878
Watercourse Length, L (mi) = 1.681

$$T_c = (11.9L^{0.385}/E)^{0.385} = \underline{\underline{0.494 \text{ hours}}}$$

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Pinion - Juniper	D	83	5.2	431.6
Reclaimed	C	81	5.4	437.4
Haul Road/Disturbed	D	91	28.28	2573.48
TOTAL:			38.88	3442.48

$$\text{Weighted CN} = \text{Total CN*Area} / \text{Total Area} = \underline{\underline{89}}$$

DRAINAGE BASIN AREA:

38.88 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: N10-B1 Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Soil Group	Erodibility Factor, K	Area (acres)	K*Area
25	D	0.19	5.2	0.988
Reclaimed	C	0.38	5.4	2.052
Haul Road	D	0.19	28.28	5.3732
TOTAL:			38.88	8.41
Erodibility factor average of spoil to reclaimed condition to simulate various stages of reclamation.				

Weighted K = Total K*Area/ Total Area = 0.216

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
80	5	6.3%	0.5	3.6	0.74
75	5	6.7%	0.5	3.8	0.76
120	5	4.2%	0.4	2.4	0.59
300	70	23.3%	0.6	13.1	7.77

Average LS = 2.46

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 > or = 9%

Where:

Slope < or = 3%	m = 0.3
Slope = 4%	m = 0.4
5% > Slope < 10%	m = 0.5
Slope > 10%	m = 0.6

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: N10-B1 Pond

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pinion - Juniper	40%	25%	5.2	0.14	0.728	1.00	5.2
Reclaimed	40%	0%	5.4	0.15	0.81	0.40	2.16
Haul Road	0%	0%	28.28	1.00	28.28	1.00	28.28
TOTAL:			38.88		29.818		35.64

$$\text{Weighted C} = \text{Total C*Area} / \text{Total Area} = \underline{\underline{0.77}}$$

$$\text{Weighted P} = \text{Total P*Area} / \text{Total Area} = \underline{\underline{0.92}}$$

RAINFALL FACTOR:

$$R = 40$$

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: N10-B1 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	0.22
Length Slope Factor	2.46
Cover Factor	0.77
Practice Factor	0.92
Gross Annual Sediment Yield	15.00 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0073 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0066 acre-feet/acre/year
Watershed Area	38.88 acres
Watershed Annual Sediment Yield	0.2563 acre-feet/year
Number of years	1 years
Required Pond Sediment Storage	0.256 acre-feet

12/1/97

N10-B1 STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6575.0	0.0	0.31	0.00	0.00	BOTTOM OF POND
6576.0	1.0	0.34	0.33	0.33	
6578.0	3.0	0.39	0.73	1.06	
6580.0	5.0	0.44	0.83	1.89	
6582.0	7.0	0.50	0.94	2.83	
6584.0	9.0	0.55	1.05	3.88	
6586.0	11.0	0.62	1.17	5.05	
6588.0	13.0	0.68	1.30	6.35	
6589.0	14.0	0.72	0.70	7.05	EMERGENCY SPILLWAY
6590.0	15.0	0.78	0.75	7.80	
6592.0	17.0	0.90	1.68	9.48	TOP OF EMBANKMENT

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

December 3, 1997
N10-B1 SPILLWAY
25-YEAR, 6-HOUR STORM

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	28.2
Manning's Roughness Coefficient (n-value).....	0.0310
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	20.0

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	0.39
Critical Slope (feet per foot).....	0.0197
Flow Velocity (feet per second).....	3.44
Froude Number.....	1.000
Velocity Head (feet).....	0.18
Energy Head (feet).....	0.57
Cross-Sectional Area of Flow (square feet).....	8.20
Top Width of Flow (feet).....	22.32

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ RIPRAP CHANNEL DESIGN

N10-B1 SPILLWAY

INPUT VALUES:

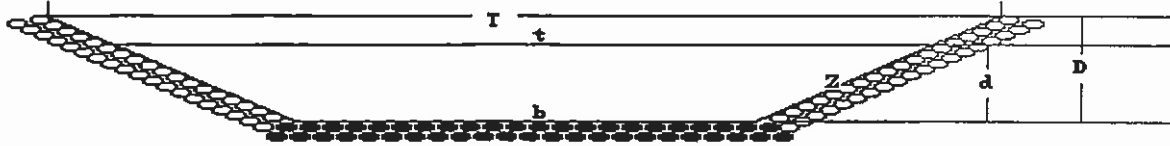
Shape	TRAPEZOIDAL	
Discharge	28.19 cfs	
Slope	28.60 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	20.00 feet	
Freeboard	1 ft	

RESULTS:

Steep Slope Design - PADER Method

Depth	0.25 ft
with Freeboard	1.25 ft
Top Width	21.50 ft
with Freeboard	27.50 ft
Velocity	5.42 fps
Cross Sectional Area	5.21 sq ft
Hydraulic Radius	0.24 ft
Manning's n	0.057
Froude Number	1.94
Dmax	0.313 ft (3.75 in)
D50	0.250 ft (3.00 in)
D10	0.083 ft (1.00 in)

SEDCAD+ CHANNEL DESIGN
N10-B1 SPILLWAY



Riprap - Steep Slope Design - PADER Method

Discharge	=	28.19	cfs	Depth (d)	=	0.25	ft	w/ Freeboard:
Bottom (b)	=	20.00	ft	Top Width (t)	=	21.50	ft	(D = 1.25) ft
Side slopes (Z)	=	3.0:1(L)	3.0:1(R)	Velocity	=	5.42	fps	(T = 27.50) ft
Bed Slope	=	28.60	%	Hydraulic Radius	=	0.24	ft	
Manning's n	=	0.057		Froude number	=	1.94		
		D _{max}	= 0.31 ft (3.75 in)					
		D ₅₀	= 0.25 ft (3.00 in)					
		D ₁₀	= 0.08 ft (1.00 in)					

APPENDIX B

SEDCAD+ (Input and Output) 10-Year, 24-Hour Storm Event

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N10-B1 POND, 10-YEAR, 24-HOUR STORM

by

Name: JGS

Company Name: PEABODY WESTERN COAL COMPANY

File Name: C:\SEDCAD3\KMINE\N10B1A

Date: 09-18-1997

Civil Software Design -- SEDCAD+ Version 3.1
 Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY WESTERN COAL COMPANY
 Filename: C:\SEDCAD3\KMINE\N10B1A User: JGS
 Date: 09-18-1997 Time: 10:13:28
 N10-B1 POND, 10-YEAR, 24-HOUR STORM
 Storm: 2.10 inches, 10 year-24 hour, SCS Type II
 Hydrograph Convolution Interval: 0.1 hr

=====

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

=====

-Hydrology-

SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
1 1	38.88	89	F	0.494	0.000	0.000	0.0	3.60	30.24
				Type: Null		Label: N10-B1 POND			
1 Structure	38.88							3.60	
1 Total IN/OUT	38.88							3.60	30.24

=====

APPENDIX C

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

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N10-B1 POND, 25-YEAR, 6-HOUR STORM

by

Name: JGS

Company Name: PEABODY WESTERN COAL COMPANY

File Name: C:\SEDCAD3\BMC\N10B1B

Date: 12-03-1997

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY WESTERN COAL COMPANY
Filename: C:\SEDCAD3\BMC\N10B1B User: JGS
Date: 12-03-1997 Time: 09:59:51
N10-B1 POND, 25-YEAR, 6-HOUR STORM
Storm: 1.90 inches, 25 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	38.88	89	F	0.494	0.000	0.000	0.0	3.06	35.13
					Type: Pond	Label: N10-B1 POND				
111	Structure	38.88							3.06	
111	Total IN	38.88							3.06	35.13
111	Total OUT								3.06	28.19

Company Name: PEABODY WESTERN COAL COMPANY
 Filename: C:\SEDCAD3\BMC\N10B1B User: JGS
 Date: 12-03-1997 Time: 09:59:51
 N10-B1 POND, 25-YEAR, 6-HOUR STORM
 Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
 Hydrograph Convolution Interval: 0.1 hr

=====

POND INPUT/OUTPUT TABLE

=====

J1, B1, S1
 N10-B1 POND

Drainage Area from J1, B1, S1, SWS(s)1: 38.9 acres
 Total Contributing Drainage Area: 38.9 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
st 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	6589.0
Crest Length (ft)	35.0
Z:1 (Left and Right)	3.0 3.0
Bottom Width (ft)	20.0

POND RESULTS:

Permanent
 Pool
 (ac-ft)

=====

7.0

Runoff Peak
 Volume Discharge
 (ac-ft) (cfs)

=====

IN 3.06 35.13

OUT 3.06 28.19

Peak Elevation	Hydrograph Detention Time (hrs)
6589.8	0.00

Company Name: PEABODY WESTERN COAL COMPANY
Filename: C:\SEDCAD3\BMC\N10B1B User: JGS
Date: 12-03-1997 Time: 09:59:51
N10-B1 POND, 25-YEAR, 6-HOUR STORM
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====

ELEVATION-DISCHARGE TABLE

=====

J1, B1, S1
N10-B1 POND

Drainage Area from J1, B1, S1, SWS(s)1: 38.9 acres
Total Contributing Drainage Area: 38.9 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
6575.00	0.0	0.0
6576.00	0.0	0.0
6577.00	0.0	0.0
6578.00	0.0	0.0
6579.00	0.0	0.0
6580.00	0.0	0.0
6581.00	0.0	0.0
6582.00	0.0	0.0
6583.00	0.0	0.0
6584.00	0.0	0.0
6585.00	0.0	0.0
6586.00	0.0	0.0
6587.00	0.0	0.0
6588.00	0.0	0.0
6589.00	0.0	0.0
6589.70	21.9	21.9
6589.80	28.5	28.5
6589.90	35.8	35.8
6590.00	43.6	43.6
6590.50	97.3	97.3
6591.00	162.3	162.3
6591.50	242.5	242.5
6592.00	344.9	344.9

Company Name: PEABODY WESTERN COAL COMPANY
 Filename: C:\SEDCAD3\BMC\N10B1B User: JGS
 Date: 12-03-1997 Time: 09:59:51
 N10-B1 POND, 25-YEAR, 6-HOUR STORM
 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
 N10-B1 POND

Drainage Area from J1, B1, S1, SWS(s)1: 38.9 acres
 Total Contributing Drainage Area: 38.9 acres

SW#1: Emergency Spillway

Elev	Stage	Area	Capacity	Discharge	
(ft)	(ft)	(ac)	(ac-ft)	(cfs)	
5575.00	0.00	0.31	0.00	0.00	
5576.00	1.00	0.34	0.32	0.00	
5577.00	2.00	0.36	0.68	0.00	
5578.00	3.00	0.39	1.05	0.00	
5579.00	4.00	0.41	1.46	0.00	
5580.00	5.00	0.44	1.88	0.00	
5581.00	6.00	0.47	2.34	0.00	
5582.00	7.00	0.50	2.82	0.00	
5583.00	8.00	0.52	3.34	0.00	
5584.00	9.00	0.55	3.87	0.00	
5585.00	10.00	0.58	4.44	0.00	
5586.00	11.00	0.62	5.04	0.00	
5587.00	12.00	0.65	5.68	0.00	
5588.00	13.00	0.68	6.34	0.00	
5589.00	14.00	0.72	7.04	0.00	Stage of SW#1
5589.70	14.70	0.76	7.56	21.89	
5589.80	14.80	0.77	7.63	28.19	Peak Stage
5589.80	14.80	0.77	7.64	28.50	
5589.90	14.90	0.77	7.71	35.75	
5590.00	15.00	0.78	7.79	43.62	
5590.50	15.50	0.81	8.19	97.32	
5591.00	16.00	0.84	8.60	162.31	
5591.50	16.50	0.87	9.03	242.46	
5592.00	17.00	0.90	9.47	344.94	
