Inflow Design Flood Control System Plan

Scrubber Ponds

Lewis & Clark Station

Prepared for
Montana-Dakota Utilities Co.

November 2018

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Certification

I hereby certify that this Inflow Design Flood Control System Plan at the Lewis & Clark Station, Sidney, Montana, meet the requirements of the Coal Combustion Residual Rule 40 CFR 257 Subp. D, § 257.82 Hydrologic and hydraulic capacity requirements for CCR surface impoundments.

Revision	Date	Summary of Revisions
0	October 17, 2016	Initial Plan
1	November 20, 2018	Retrofit Plan

Paul T. Swenson
Barr Engineering Co.
MT Registration Number 12805PE

Dated this 28th day of November, 2018

1.0 Introduction

Montana-Dakota Utilities Co. (MDU) operates the Lewis & Clark Station (Lewis & Clark), a coal-fired steam-electric generating plant, near Sidney, Montana. Operation of the plant results in production of coal combustion residuals (CCR) that must be managed in accordance with the requirements of 40 CFR 257 Subpart D, Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments (CCR Rule).

The CCR Rule, § 257.82 Hydrologic and hydraulic capacity requirements for CCR surface impoundments, establishes design criteria for management of surface water inflow into CCR surface impoundments. The Scrubber Ponds that receive flue gas desulfurization solids and other CCR materials at Lewis & Clark Station are defined by the CCR Rule to be existing surface impoundments, and therefore a plan is required for these impoundments to satisfy the rule.

2.0 Description of Lewis & Clark Station CCR Units

CCR from plant operations is slurried to the Scrubber Ponds. Each of the Scrubber Ponds has an area of approximately 2.09 acres. A berm has been constructed within each of the Scrubber Ponds to separate each into a CCR solids settling cell with an area of approximately 1.52 acres, and an effluent polishing cell with an area of approximately 0.57 acres. Water from the effluent polishing cells is returned back to the plant for reuse or discharged through a Montana Pollutant Discharge Elimination System (MPDES) permitted outfall.

See Figures 1 and 2 for the site layout and locations of the Scrubber Ponds.

3.0 Inflow Design Flood Control System Plan

This section describes the hydrologic modeling and plan development for the Inflow Design Flood Control System Plan for the Scrubber Ponds.

CCR Rule § 257.82(a) requires that "the owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section." Paragraph (a)(3) defines the storm event that the inflow design flood control system must accommodate. The Scrubber Ponds were previously determined to have a low hazard potential classification (Hazard Potential Classification, Lewis & Clark Station, Barr Engineering Co., August 2016, revised November 2018). Under the rule, surface impoundments with a low hazard potential classification must have an inflow design flood control system that will accommodate a 100-year flood (design flood event). For the Scrubber Ponds, this design requirement was determined to be represented by run-off from the 100-year, 24-hour rainstorm.

The Scrubber Ponds have no tributary area outside of the limits of their containment dikes. Therefore, the only inflow flood flowage that the system must accommodate is direct precipitation.

3.1.1 Model Inputs

Hydrologic modeling of the site for the Inflow Design Flood Control System Plan was performed with HydroCAD 10.00 software. The input data and results of the modeling are described in this section. Detailed model inputs and results are provided in Appendix B-1.

Rainfall data for the site was acquired from the National Oceanic and Atmospheric Administration (NOAA), Technical Paper No. 40 (TP-40). The 100-year, 24-hour map from TP-40, showing the depth of rainfall in the vicinity of Lewis & Clark Station is provided in Appendix B-2. The 100-year, 24-hour rainfall depth identified for the Lewis & Clark Station location is shown in Table 1.

Table 1 Scrubber Ponds Design Storm Event Rainfall Data

Storm Event	Rainfall
100 year, 24-hour	4.3 inches

The Scrubber Ponds are nearly identical in area and storage capacity, so one hydrologic model was completed, and it is considered representative of conditions in each Scrubber Pond. A weir in the separation berm provides unrestricted conveyance during high flow from the settling cell to the effluent polishing cell. During these conditions, the cells act as a single pond, and so the settling cell and polishing cell areas were evaluated as one subwatershed area (S2), as shown on Figure 3.

The settling cell was assumed to be at maximum CCR solids storage capacity for the model. Since CCR solids are slurried to the Scrubber Ponds, and because the slurry pipe spigot is located on the northeast side of the Scrubber Ponds, the CCR solids form a delta that slopes toward the effluent polishing cell of the Scrubber Pond. Surface water draining over the weir in the separation berm accumulates in the effluent polishing pond until it is pumped back to the generating plant or to a MPDES permitted outfall. The Scrubber Pond storage capacity was modeled assuming the settling cell was filled with water to the weir elevation.

Since either Scrubber Pond may be in use and nearing capacity at any given time, the model was used to determine what the maximum operating elevation of the water in the effluent polishing cell can be while still providing a freeboard of approximately one foot after the design flood event.

3.1.2 Model Results

Modeled run-off for the design storm event is summarized in Table 2.

Table 2 Modeled Scrubber Ponds Watershed Run-off

Scrubber Pond Subwatershed	Area	Run-off Volume*
Subwatershed 2S (CCR solids settling cell and effluent polishing cell)	2.09 acres	0.63 acre-feet

* Run-off volumes rounded to the nearest hundredth acre-foot

The hydrologic modeling results of the Scrubber Pond area are summarized in Table 3.

Table 3 Scrubber Ponds Hydrologic Modeling Results

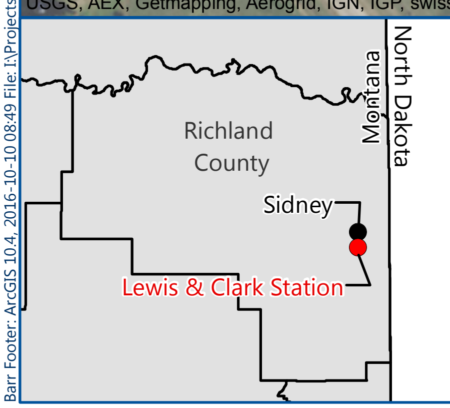
Effluent Polishing Cell Condition	Storage Area Maximum Water Elevation
Maximum operating level	Elevation 1930.50 feet
100-year, 24-hour	Elevation 1931.00 feet
Minimum perimeter dike (spillway)	Elevation 1932.00 feet

The total run-off volume for the design event can be stored in the Scrubber Pond, assuming that the Scrubber Pond is maintained with a maximum operating level no higher than the elevation identified in the Table 3. Storage of the design flood event will result in freeboard of approximately one foot.

4.0 Conclusion

As demonstrated by the topographic map shown on Figure 2, potential run-on around the Scrubber Ponds drains away from the Scrubber Ponds. The hydrologic model and the analysis presented in this document demonstrate that the Scrubber Ponds are adequately designed to properly manage the 100-year, 24-hour inflow flood.

Figures



Lewis & Clark Station

Temporary CCR Storage Pad

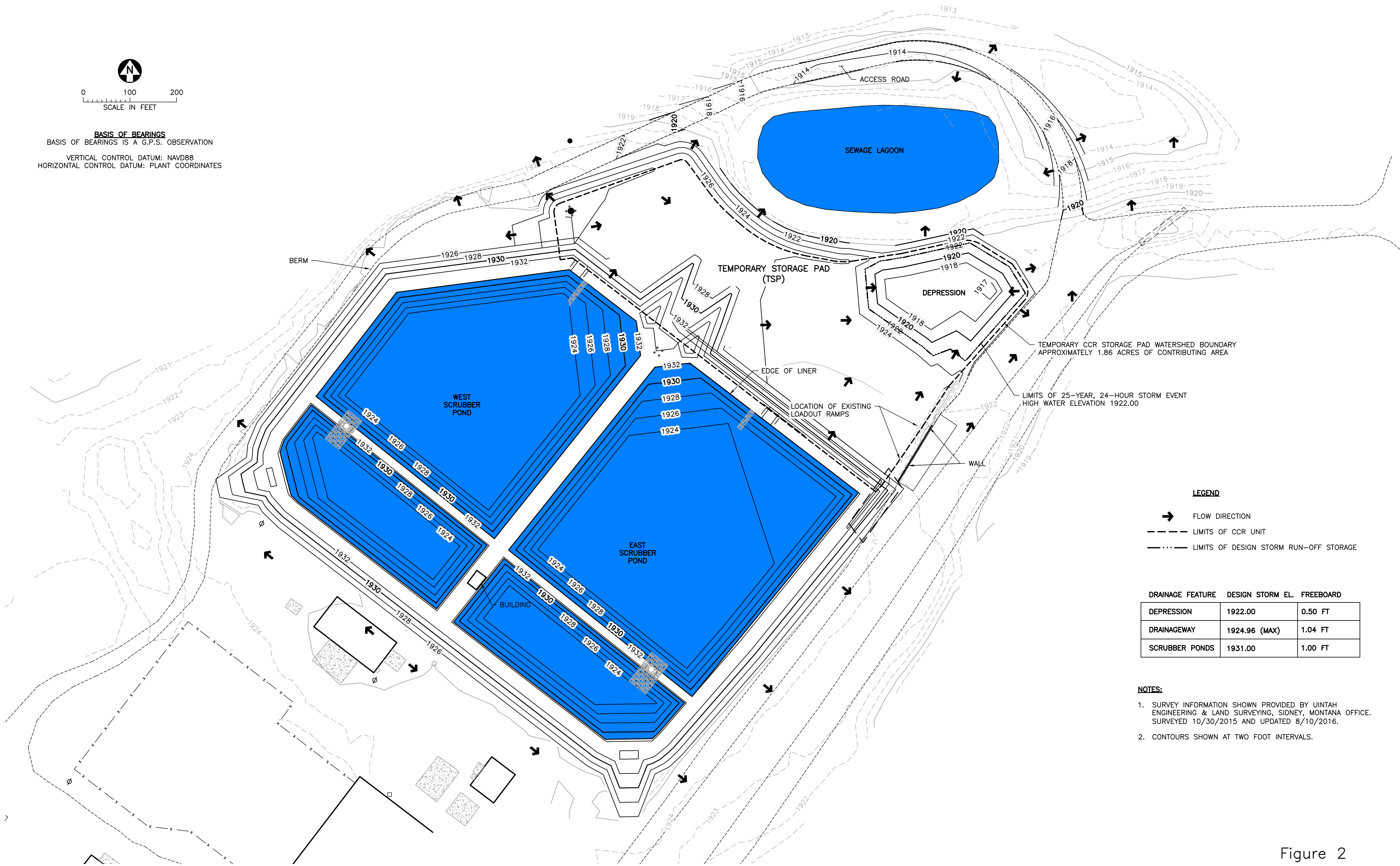
0 400 800

Feet

BARR

Lewis & Clark Station
Montana-Dakota Utilities
Richland County, Montana

FIGURE 1 - SITE PLAN



LEGEND

- ➔ FLOW DIRECTION
- — — — — LIMITS OF CCR UNIT
- —···— LIMITS OF DESIGN STORM RUN-OFF STORAGE

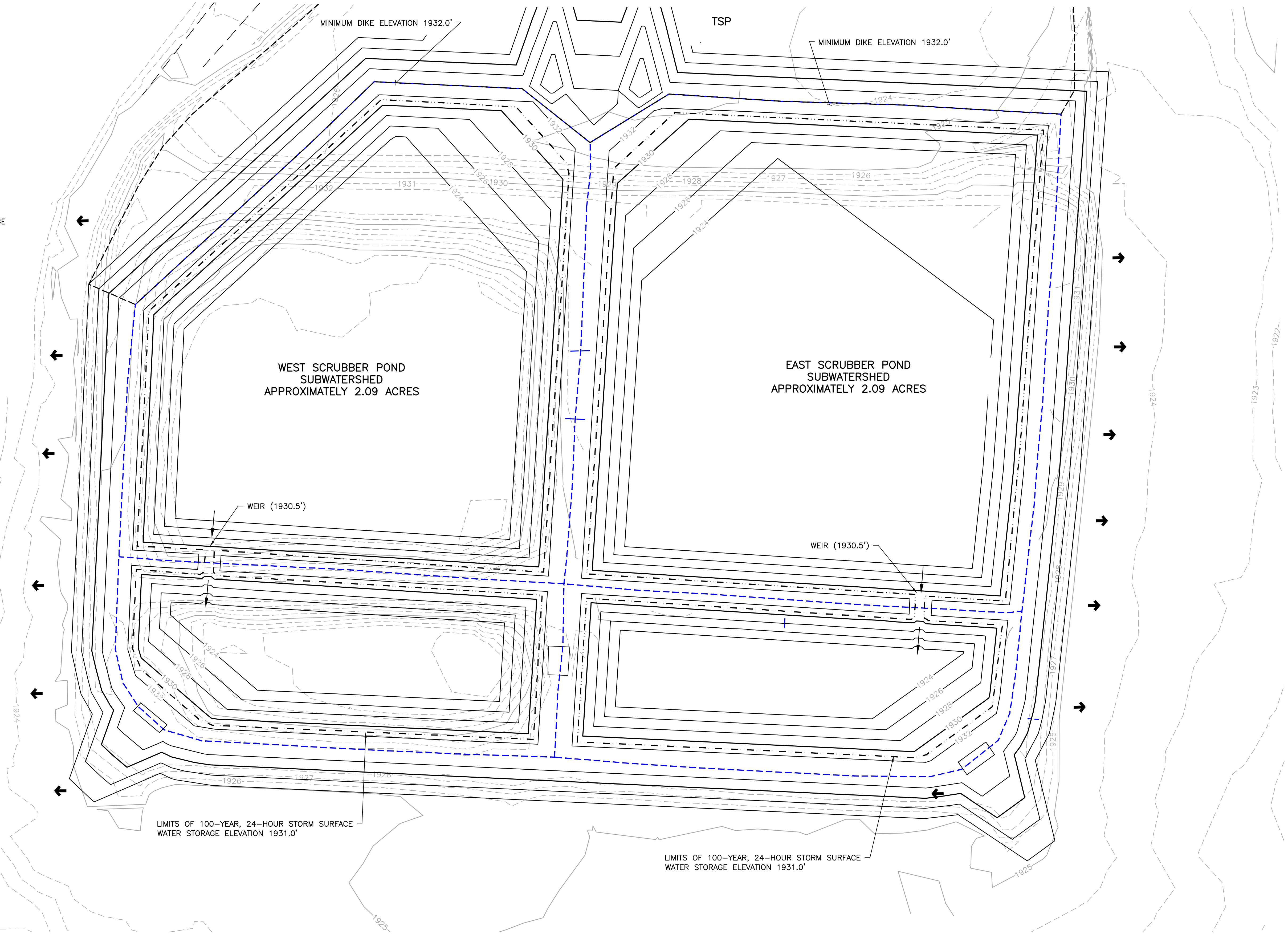
DRAINAGE FEATURE	DESIGN STORM EL.	FREEBOARD
DEPRESSION	1922.00	0.50 FT
DRAINAGEWAY	1924.96 (MAX)	1.04 FT
SCRUBBER PONDS	1931.00	1.00 FT

NOTES:

1. SURVEY INFORMATION SHOWN PROVIDED BY UINTAH ENGINEERING & LAND SURVEYING, SIDNEY, MONTANA OFFICE. SURVEYED 10/30/2015 AND UPDATED 8/10/2016.
2. CONTOURS SHOWN AT TWO FOOT INTERVALS.

Figure 2

SITE TOPOGRAPHY
LEWIS & CLARK STATION
MONTANA-DAKOTA UTILITIES CO.



BASIS OF BEARINGS

BASIS OF BEARINGS IS A G.P.S. OBSERVATION

VERTICAL CONTROL DATUM: NAVD88
HORIZONTAL CONTROL DATUM: PLANT COORDINATES

LEGEND

- DRAINAGEWAY FLOW DIRECTION
- LIMITS OF 100-YEAR, 24-HOUR RUN-OFF STORAGE
- SUBWATERSHED BOUNDARIES

NOTES:

1. SURVEY INFORMATION SHOWN PROVIDED BY UINTAH ENGINEERING & LAND SURVEYING, SIDNEY, MONTANA OFFICE. SURVEYED 10/30/2015 AND UPDATED 8/10/2016.
2. CONTOURS SHOWN AT TWO FOOT INTERVALS.
3. MAXIMUM OPERATING LEVEL OF SCRUBBER PONDS: 1930.5'

Figure 3

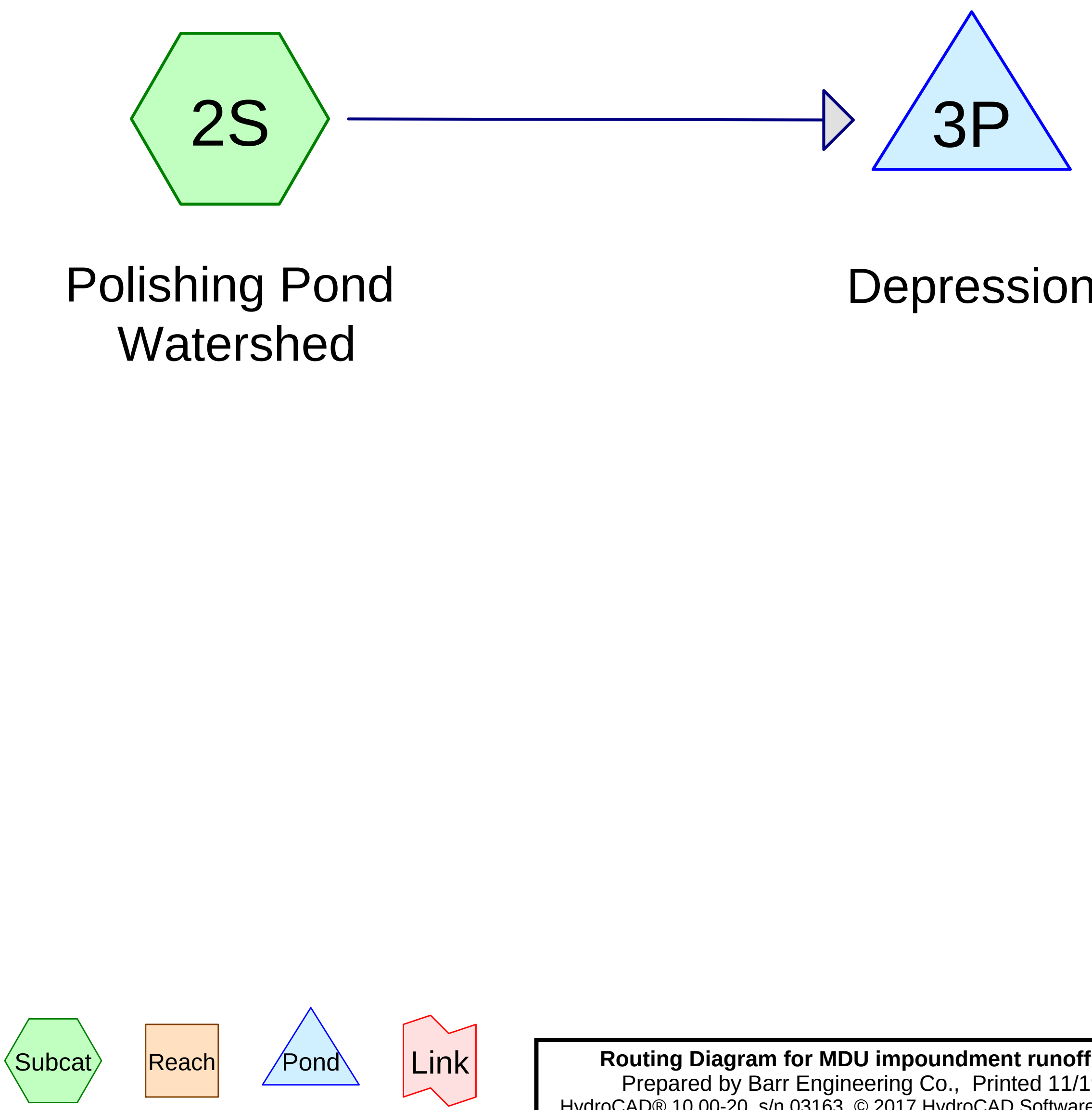
SCRUBBER PONDS INFLOW
DESIGN FLOOD CONTROL
SYSTEM PLAN
LEWIS & CLARK STATION
MONTANA-DAKOTA UTILITIES CO.

Appendix A

Scrubber Pond Hydrology

Appendix A-1

Scrubber Pond Hydrologic Model



Routing Diagram for MDU impoundment runoff - rv2018-3
Prepared by Barr Engineering Co., Printed 11/19/2018

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.089	88	Row crops, straight row, Poor, HSG C (2S)
0.432	100	pond area (2S)

Summary for Subcatchment 2S: Polishing Pond Watershed

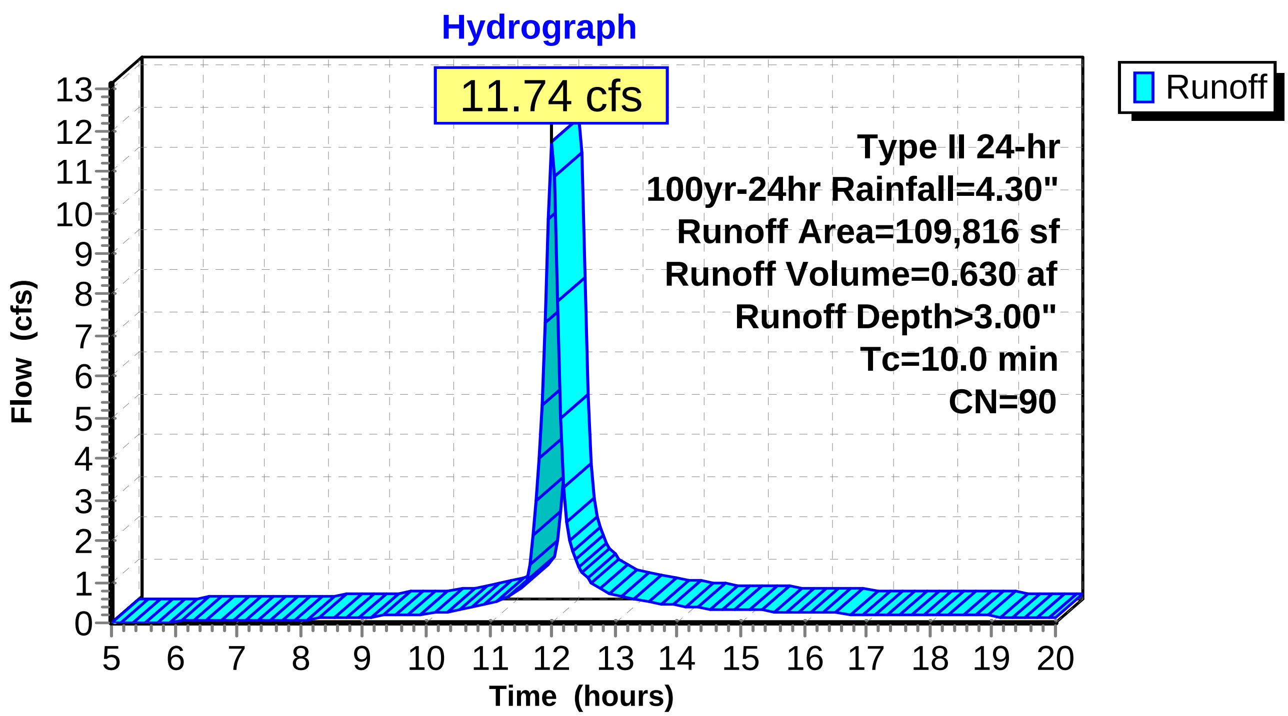
Runoff = 11.74 cfs @ 12.01 hrs, Volume= 0.630 af, Depth> 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr-24hr Rainfall=4.30"

	Area (sf)	CN	Description
	91,016	88	Row crops, straight row, Poor, HSG C
*	18,800	100	pond area
	109,816	90	Weighted Average
	91,016		82.88% Pervious Area
	18,800		17.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2S: Polishing Pond Watershed



Summary for Pond 3P: Depression

Inflow Area = 2.521 ac, 17.12% Impervious, Inflow Depth > 3.00" for 100yr-24hr event
Inflow = 11.74 cfs @ 12.01 hrs, Volume= 0.630 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

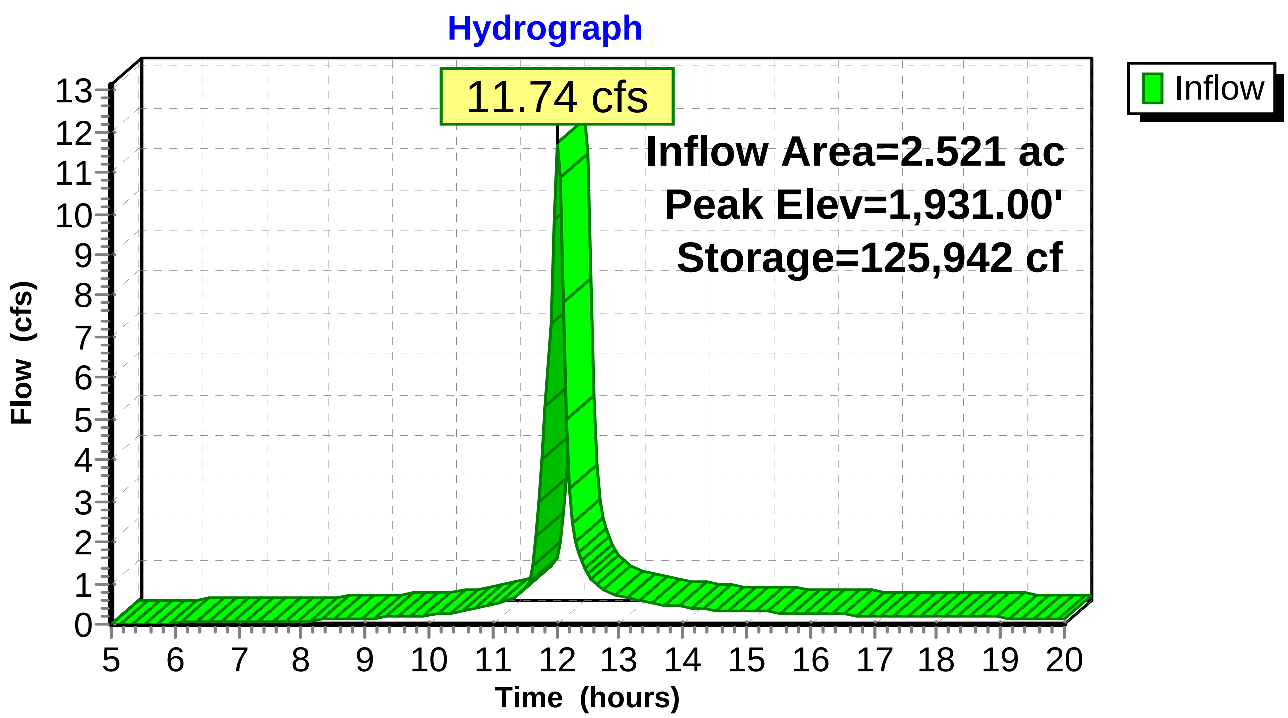
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,930.50' Surf.Area= 0 sf Storage= 98,502 cf
Peak Elev= 1,931.00' @ 20.00 hrs Surf.Area= 0 sf Storage= 125,942 cf (27,440 cf above start)
Flood Elev= 1,932.00' Surf.Area= 0 sf Storage= 181,391 cf (82,889 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,922.50'	181,391 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
1,922.50	0
1,924.00	4,115
1,926.00	23,469
1,928.00	49,026
1,930.00	81,289
1,930.50	98,502
1,932.00	181,391

Pond 3P: Depression

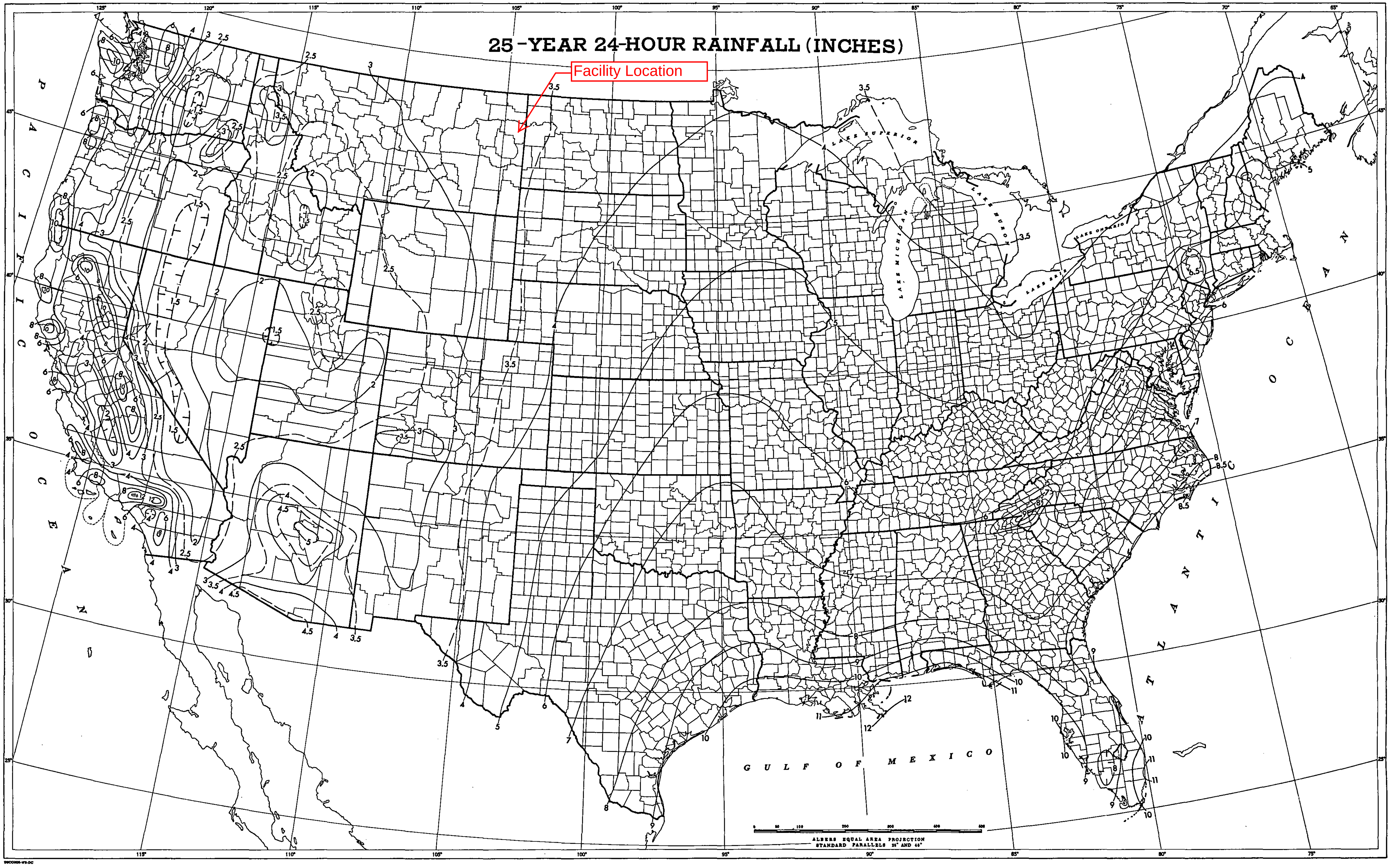


Stage-Area-Storage for Pond 3P: Depression

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
1,922.50	0	1,927.80	46,470
1,922.60	274	1,927.90	47,748
1,922.70	549	1,928.00	49,026
1,922.80	823	1,928.10	50,639
1,922.90	1,097	1,928.20	52,252
1,923.00	1,372	1,928.30	53,865
1,923.10	1,646	1,928.40	55,479
1,923.20	1,920	1,928.50	57,092
1,923.30	2,195	1,928.60	58,705
1,923.40	2,469	1,928.70	60,318
1,923.50	2,743	1,928.80	61,931
1,923.60	3,018	1,928.90	63,544
1,923.70	3,292	1,929.00	65,158
1,923.80	3,566	1,929.10	66,771
1,923.90	3,841	1,929.20	68,384
1,924.00	4,115	1,929.30	69,997
1,924.10	5,083	1,929.40	71,610
1,924.20	6,050	1,929.50	73,223
1,924.30	7,018	1,929.60	74,836
1,924.40	7,986	1,929.70	76,450
1,924.50	8,954	1,929.80	78,063
1,924.60	9,921	1,929.90	79,676
1,924.70	10,889	1,930.00	81,289
1,924.80	11,857	1,930.10	84,732
1,924.90	12,824	1,930.20	88,174
1,925.00	13,792	1,930.30	91,617
1,925.10	14,760	1,930.40	95,059
1,925.20	15,727	1,930.50	98,502
1,925.30	16,695	1,930.60	104,028
1,925.40	17,663	1,930.70	109,554
1,925.50	18,631	1,930.80	115,080
1,925.60	19,598	1,930.90	120,606
1,925.70	20,566	1,931.00	126,132
1,925.80	21,534	1,931.10	131,658
1,925.90	22,501	1,931.20	137,184
1,926.00	23,469	1,931.30	142,709
1,926.10	24,747	1,931.40	148,235
1,926.20	26,025	1,931.50	153,761
1,926.30	27,303	1,931.60	159,287
1,926.40	28,580	1,931.70	164,813
1,926.50	29,858	1,931.80	170,339
1,926.60	31,136	1,931.90	175,865
1,926.70	32,414	1,932.00	**181,391**
1,926.80	33,692		
1,926.90	34,970		
1,927.00	36,248		
1,927.10	37,525		
1,927.20	38,803		
1,927.30	40,081		
1,927.40	41,359		
1,927.50	42,637		
1,927.60	43,915		
1,927.70	45,192		

Appendix A-2

TP-40: 100-Year, 24-Hour Rainfall


25-YEAR 24-HOUR RAINFALL (INCHES)
Facility Location
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS 29° AND 45°