Run-on and Run-off Control System Plan

CCR Temporary Storage Pad

Lewis and Clark Station

Prepared for
Montana-Dakota Utilities Co.

October 2016

Paul T.
Swenson
2016.10.13
18:30:03 -05'00'

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October 2016

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Certification

I hereby certify that this Run-on and Run-off Control System Plan for the CCR Temporary Storage Pad at the Lewis & Clark Station, Sidney, Montana, meet the requirements of the Coal Combustion Residual Rule 40 CFR 257 Subp. D, § 257.81 Run-on and run-off controls for CCR landfills.

Revision	Date	Summary of Revisions
0	October 17, 2016	Initial Plan

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Barr Engineering Co.
MT Registration Number 12805PE

Dated this 13th day of October, 2016

1.0 Introduction

Montana-Dakota Utilities Co. (MDU) operates the Lewis & Clark Station (Lewis & Clark), near Sidney, Montana, a coal-fired steam-electric generating plant that produces coal combustion residuals (CCR). CCR management is subject to 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, § 257.81 Run-on and run-off controls for CCR landfills, establishes design criteria for control of surface water around CCR landfills. While MDU does not operate a landfill at the Lewis & Clark Station, CCR is temporarily placed in a pile on a temporary storage pad (TSP) to stage the material for subsequent disposal in an off-site facility. The CCR Rule requires that CCR piles meet appropriate requirements for landfills; one of the appropriate requirements is preparation of a plan for control of run-on and run-off. This plan, which documents how the run-on and run-off control systems have been designed and constructed to meet applicable requirements, has been developed to satisfy the requirements of §257.81.

2.0 Description of Lewis and Clark Station CCR Units

CCR from plant operations is slurried to two surface impoundments, referred to as the Scrubber Ponds. MDU excavates CCR from the Scrubber Ponds as needed to support plant operating conditions. The excavated CCR is stockpiled on the TSP located north of the Scrubber Ponds until it can be transported to an off-site permanent ash disposal facility. Appropriate CCR Rule requirements for existing CCR landfills apply to the TSP because the TSP was in place prior to the effective date of the CCR Rule.

The TSP consists of an area of approximately 2.12 acres, defined by a perimeter berm. Elevations in the TSP range from approximately elevation 1921.5 to 1926.0. See Figures 1 and 2 for the site layout.

3.0 Run-On and Run-Off Control Systems Plan

This section describes the hydrologic and site analyses and plan development for the run-on and run-off control systems plan for the TSP.

3.1 Run-On Control System

The CCR Rule § 257.81(a)(1) requires implementation of a "run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm." The run-on control system for the TSP consists of a perimeter berm that diverts surface water away from the TSP. Ground surface outside of the TSP perimeter drains away to other drainage features surrounding the facility. Rainfall from a storm event will drain away from the TSP, preventing flow of stormwater onto the TSP. Drainage patterns of potential run-on water around the TSP are shown on Figure 2.

3.2 Run-Off Control System

The CCR Rule § 257.81(a)(2) requires implementation of a "run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm," (the design storm event). The CCR Rule § 257.81(b) states that "run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3." § 257.3–3 prohibits "discharge of pollutants into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act, as amended." The US EPA has delegated authority for the NPDES program to the State of Montana. Montana Department of Environmental Quality (DEQ) has issued Montana Pollutant Discharge Elimination System (MPDES) Permit No. MT0000302 to MDU for Lewis & Clark Station. The MPDES permit requires that process water discharge through a permitted and monitored outfall.

The run-off control system for the TSP consists of a berm at the perimeter of the TSP that prevents run-off from leaving the TSP and a depression located in the northeast corner of the TSP to temporarily store run-off. The CCR is placed in the TSP in a manner so that it does not obstruct drainage of run-off to the depression as shown on Figure 2. Due to local climatic conditions, run-off water stored in this depression will normally evaporate in a short period. If required, a portable pump will be placed in the depression to transfer run-off water to the active Scrubber Pond, from which the water will eventually discharge through the plant's (MPDES) permitted outfall. Lewis & Clark staff will regularly inspect the depression for water level to maintain adequate capacity to store water from the design storm event.

The documentation and figures provided in this report along with the attached model output provide a summary of the hydrologic analysis of run-off controls to demonstrate that the CCR Rule requirement for run-off control at the TSP is met.

3.2.1 Model Inputs

Hydrologic modeling of the site as part of the run-off 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 A-1.

Rainfall data for the site was acquired from the National Oceanic and Atmospheric Administration (NOAA), Technical Paper No. 40 (TP-40). The 25-year, 24-hour map from TP-40, showing the depth of rainfall in the vicinity of Lewis & Clark Station is provided in Appendix A-2. The 25-year, 24-hour rainfall depth identified for the Lewis & Clark Station location is shown in Table 1.

Table 1 TSP Design Storm Event Rainfall Data

Storm Event	Rainfall
25 year, 24-hour	3.4 inches

The TSP was evaluated as two subwatershed areas, as shown on Figure 3. TSP subwatershed 1 consists of an area with a full CCR stockpile pad with a perimeter drainageway that routes run-off to the depression area. The full CCR stockpile condition assumes that a CCR stockpile is in place in TSP subwatershed 1 with maximum fill limits as shown on Figure 3, and a height at or above the perimeter berm elevation of 1926.0. The full stockpile condition is critical for the evaluation of the perimeter water conveyance during a storm event. The perimeter drainageway will be maintained as "V" shaped with minimum dimensions of two feet of channel depth and maximum side slopes of 3H:1V (horizontal to vertical). The drainageway will be maintained with positive drainage toward the depression at all times. TSP subwatershed 2 consists of the depression area and surrounding tributary area.

3.2.2 Model Results

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

Table 2 Modeled TSP Watershed Run-off

TSP Subwatershed	Area	Run-off Volume*
Subwatershed 1 (CCR Stockpile)	1.46 acres	0.24 acre-feet
Subwatershed 2 (Depression Area)	0.66 acres	0.11 acre-feet

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

The perimeter drainageway conveys the run-off volume from TSP subwatershed 1 with an average flow depth of 0.96 feet at the outlet of the subwatershed and a maximum water elevation of approximately 1924.96. This provides over one foot of freeboard to the top of the perimeter berm at elevation 1926.0. CCR will not be placed within 6 feet of the interior crest of the perimeter berm to maintain drainageway dimensions and modeled freeboard. The hydrologic modeling results of the TSP are summarized in Table 3.

Table 3 TSP Hydrologic Modeling Results

Design Storm Event	Storage Area Maximum Water Elevation
25 year, 24-hour	Elevation 1923.1 feet

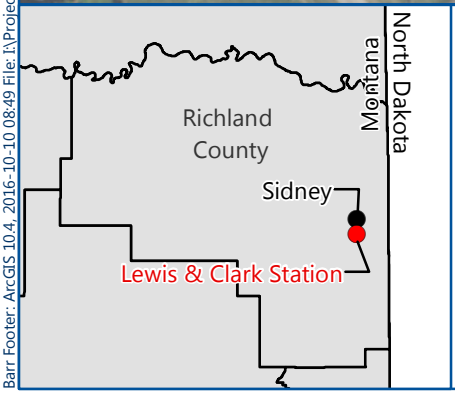
The total run-off volume for the design event can be stored in the depression area. The run-off control system design provides a minimum of 2.9 feet of freeboard from the maximum water elevation in the depression storage area and the perimeter berm crest elevation.

4.0 Conclusion

As demonstrated by the topographic map shown on Figure 2, potential run-on water drains away from the TSP. The hydrologic model and the analysis presented in this document demonstrate that the TSP has the hydraulic capacity to safely manage and store the run-off from the design storm event without discharge.

Figures

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Lewis & Clark Station

Temporary CCR Storage Pad

N

0 400 800

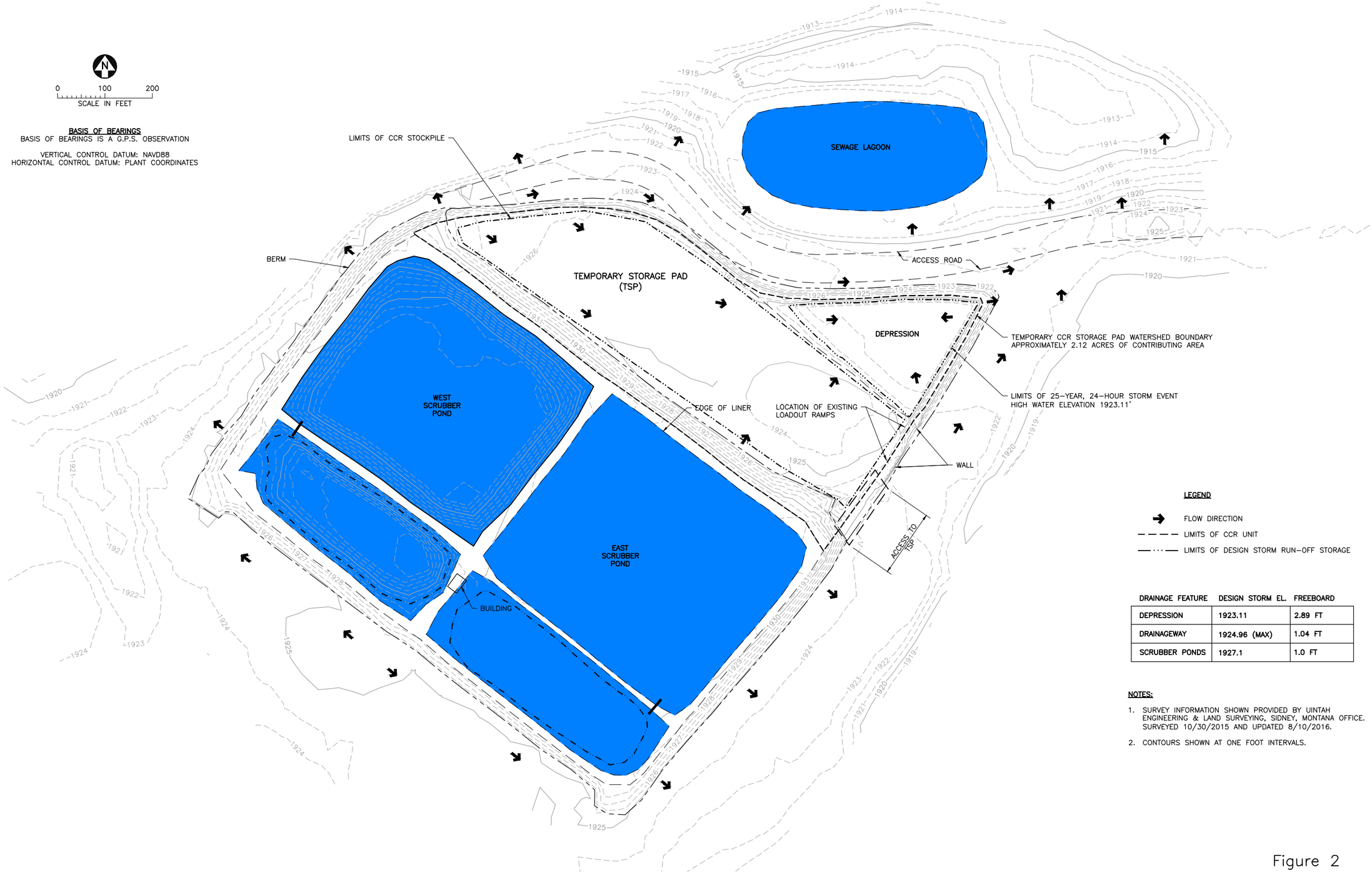
Feet

BARR

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

FIGURE 1 - SITE PLAN

Barr Footer: ArcGIS 10.4, 2016-10-10 08:49 File: I:\Projects\26\41\1007\Maps\Reports\Task_II_4A\Figure01 Site Plan.mxd User: MRQ



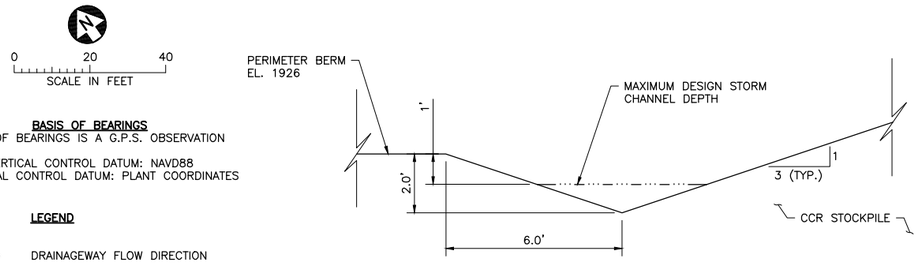
DRAINAGE FEATURE	DESIGN STORM EL.	FREEBOARD
DEPRESSION	1923.11	2.89 FT
DRAINAGEWAY	1924.96 (MAX)	1.04 FT
SCRUBBER PONDS	1927.1	1.0 FT

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 ONE FOOT INTERVALS.

Figure 2

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



1 – SECTION: PERIMETER DRAINAGEWAY
NOT TO SCALE

0 20 40
SCALE IN FEET

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 25-YEAR, 24-HOUR STORM EVENT
- TSP DEPRESSION SUBWATERSHED 2 BOUNDARY
- TSP SUBWATERSHED 1 BOUNDARY

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 ONE FOOT INTERVALS.

SEWAGE LAGOON

LIMITS OF 25-YEAR, 24-HOUR STORM SURFACE WATER STORAGE ELEVATION 1923.13'

DEPRESSION

TSP SUBWATERSHED 2
APPROXIMATELY 0.66 ACRES

ACCESS ROAD

CCR STOCKPILE PERIMETER DRAINAGEWAY

LIMITS OF CCR STOCKPILE

TSP SUBWATERSHED 1
CCR PILE AREA
APPROXIMATELY 1.46 ACRES

ACCESS TO TSP

WEST SCRUBBER POND

EAST SCRUBBER POND

1922 1923 1924 1925 1926 1927 1928 1929 1930 1931

Figure 3

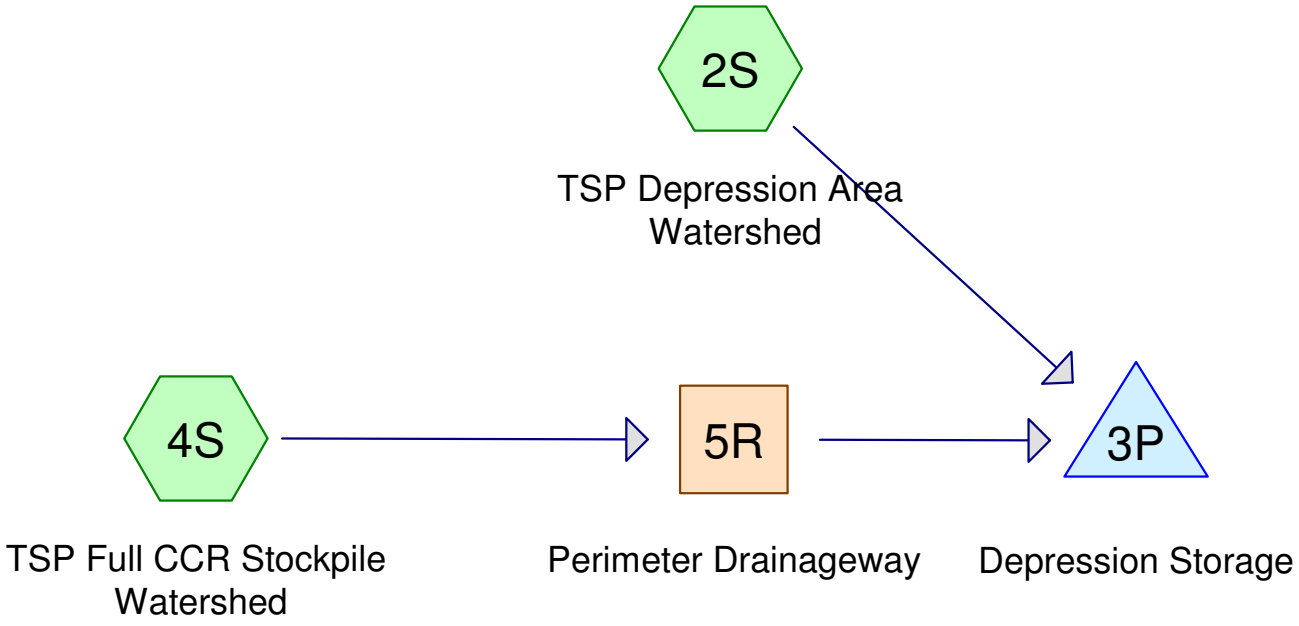
TSP RUN-ON AND RUN-OFF
CONTROL PLAN
LEWIS & CLARK STATION
MONTANA-DAKOTA UTILITIES CO.

Appendix A

TSP Hydrology

Appendix A-1

TSP Hydrologic Model



HydroCAD software uses the term "Pond" to identify locations where surface water is temporarily stored. Use of the term does not imply that a CCR surface impoundment is included in the model or at the site.

Subcat Reach Pond Link

Routing Diagram for Run-On Run-Off Model
Prepared by {enter your company name here}, Printed 9/6/2016

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.12	87	Dirt roads, HSG C (2S, 4S)
2.12	**87**	**TOTAL AREA**

Summary for Subcatchment 2S: TSP Depression Area Watershed

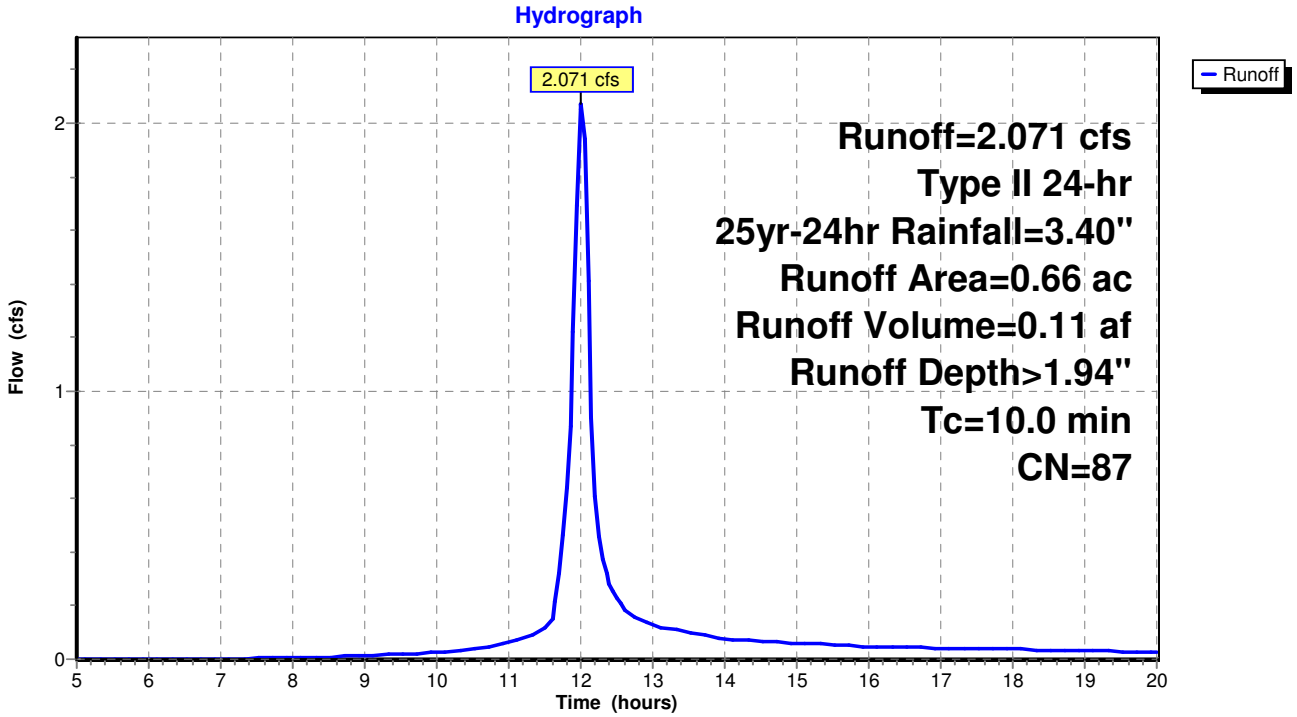
Runoff = 2.071 cfs @ 12.01 hrs, Volume= 0.11 af, Depth> 1.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr-24hr Rainfall=3.40"

Area (ac)	CN	Description
0.66	87	Dirt roads, HSG C
0.66		100.00% Pervious Area

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

Subcatchment 2S: TSP Depression Area Watershed



Summary for Subcatchment 4S: TSP Full CCR Stockpile Watershed

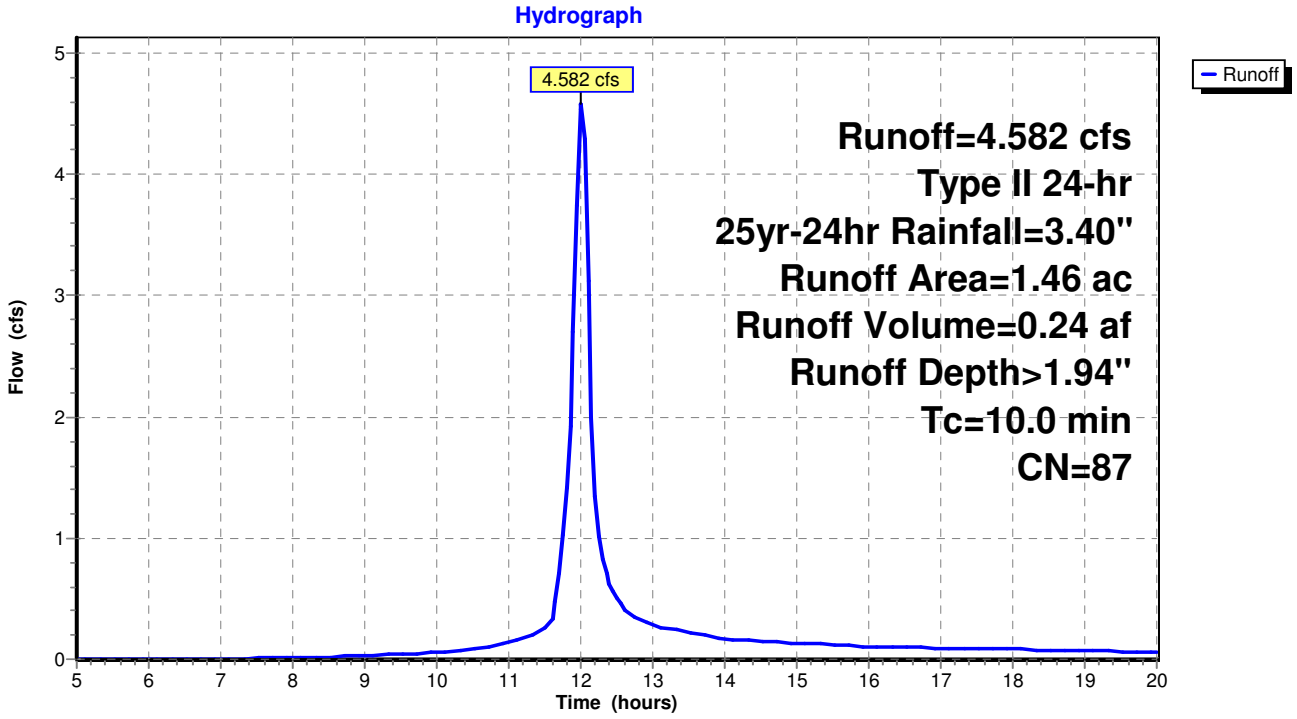
Runoff = 4.582 cfs @ 12.01 hrs, Volume= 0.24 af, Depth> 1.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr-24hr Rainfall=3.40"

Area (ac)	CN	Description
1.46	87	Dirt roads, HSG C
1.46		100.00% Pervious Area

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

Subcatchment 4S: TSP Full CCR Stockpile Watershed



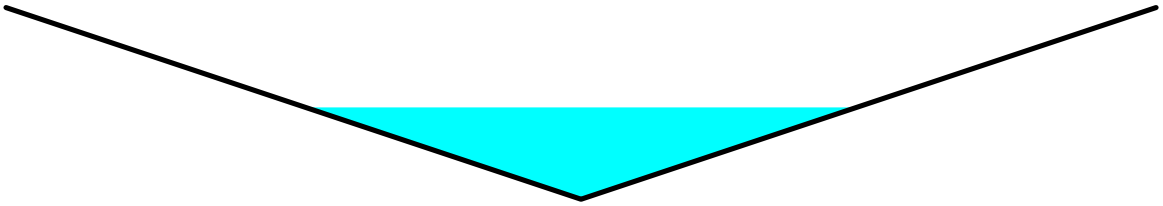
Summary for Reach 5R: Perimeter Drainageway

Inflow Area = 1.46 ac, 0.00% Impervious, Inflow Depth > 1.94" for 25yr-24hr event
Inflow = 4.582 cfs @ 12.01 hrs, Volume= 0.24 af
Outflow = 2.744 cfs @ 12.38 hrs, Volume= 0.23 af, Atten= 40%, Lag= 21.9 min

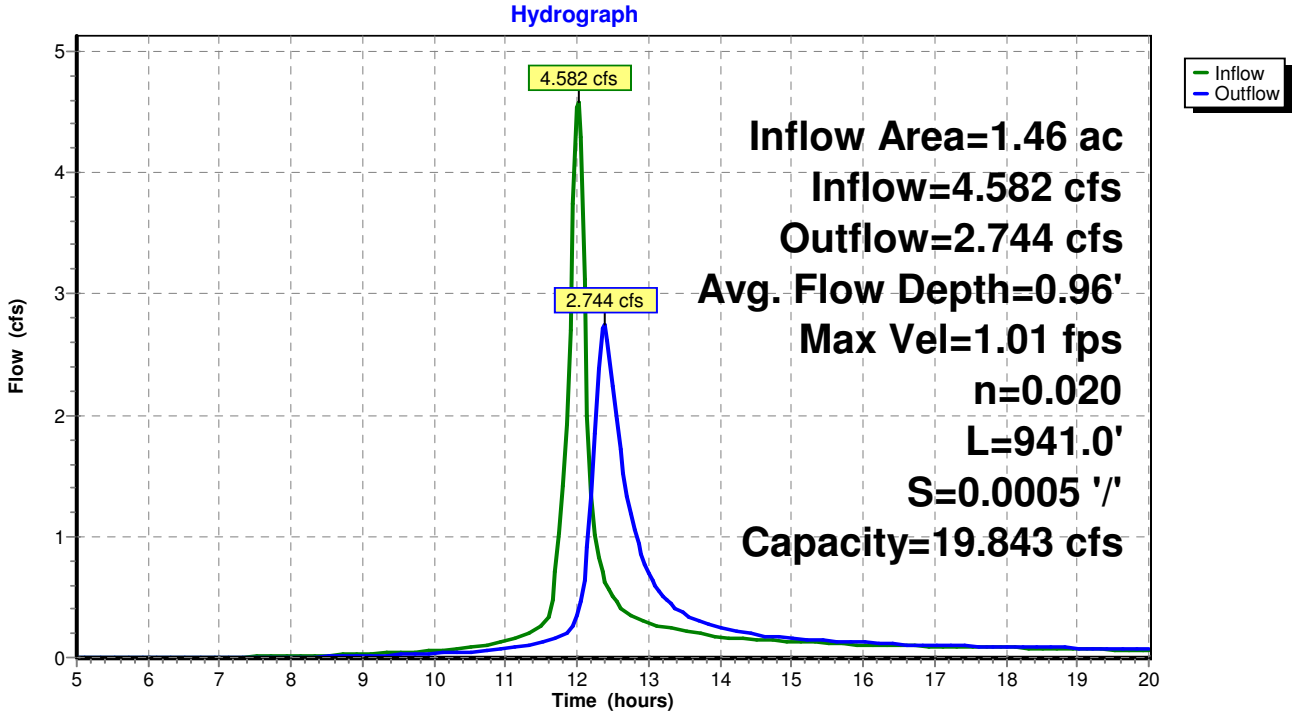
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.01 fps, Min. Travel Time= 15.5 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 36.2 min

Peak Storage= 2,586.75 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.96'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 19.843 cfs

0.00' x 2.00' deep channel, n= 0.020
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 941.0' Slope= 0.0005 '/'
Inlet Invert= 1,924.00', Outlet Invert= 1,923.50'



Reach 5R: Perimeter Drainageway



Stage-Area-Storage for Reach 5R: Perimeter Drainageway

Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)
1,924.00	0.0	0.00
1,924.02	0.0	1.13
1,924.04	0.0	4.52
1,924.06	0.0	10.16
1,924.08	0.0	18.07
1,924.10	0.0	28.23
1,924.12	0.0	40.65
1,924.14	0.1	55.33
1,924.16	0.1	72.27
1,924.18	0.1	91.47
1,924.20	0.1	112.92
1,924.22	0.1	136.63
1,924.24	0.2	162.60
1,924.26	0.2	190.83
1,924.28	0.2	221.32
1,924.30	0.3	254.07
1,924.32	0.3	289.08
1,924.34	0.3	326.34
1,924.36	0.4	365.86
1,924.38	0.4	407.64
1,924.40	0.5	451.68
1,924.42	0.5	497.98
1,924.44	0.6	546.53
1,924.46	0.6	597.35
1,924.48	0.7	650.42
1,924.50	0.8	705.75
1,924.52	0.8	763.34
1,924.54	0.9	823.19
1,924.56	0.9	885.29
1,924.58	1.0	949.66
1,924.60	1.1	1,016.28
1,924.62	1.2	1,085.16
1,924.64	1.2	1,156.30
1,924.66	1.3	1,229.70
1,924.68	1.4	1,305.36
1,924.70	1.5	1,383.27
1,924.72	1.6	1,463.44
1,924.74	1.6	1,545.87
1,924.76	1.7	1,630.56
1,924.78	1.8	1,717.51
1,924.80	1.9	1,806.72
1,924.82	2.0	1,898.19
1,924.84	2.1	1,991.91
1,924.86	2.2	2,087.89
1,924.88	2.3	2,186.13
1,924.90	2.4	2,286.63
1,924.92	2.5	2,389.39
1,924.94	2.7	2,494.40
1,924.96	2.8	2,601.68
1,924.98	2.9	2,711.21
1,925.00	3.0	2,823.00
1,925.02	3.1	2,937.05
1,925.04	3.2	3,053.36
1,925.06	3.4	3,171.92
1,925.08	3.5	3,292.75
1,925.10	3.6	3,415.83
1,925.12	3.8	3,541.17
1,925.14	3.9	3,668.77
1,925.16	4.0	3,798.63
1,925.18	4.2	3,930.75
1,925.20	4.3	4,065.12
1,925.22	4.5	4,201.75
1,925.24	4.6	4,340.64
1,925.26	4.8	4,481.79
1,925.28	4.9	4,625.20
1,925.30	5.1	4,770.87
1,925.32	5.2	4,918.80
1,925.34	5.4	5,068.98
1,925.36	5.5	5,221.42
1,925.38	5.7	5,376.12
1,925.40	5.9	5,533.08
1,925.42	6.0	5,692.30
1,925.44	6.2	5,853.77
1,925.46	6.4	6,017.51
1,925.48	6.6	6,183.50
1,925.50	6.8	6,351.75
1,925.52	6.9	6,522.26
1,925.54	7.1	6,695.03
1,925.56	7.3	6,870.05
1,925.58	7.5	7,047.34
1,925.60	7.7	7,226.88
1,925.62	7.9	7,408.68
1,925.64	8.1	7,592.74
1,925.66	8.3	7,779.06
1,925.68	8.5	7,967.64
1,925.70	8.7	8,158.47
1,925.72	8.9	8,351.56
1,925.74	9.1	8,546.91
1,925.76	9.3	8,744.52
1,925.78	9.5	8,944.39
1,925.80	9.7	9,146.52
1,925.82	9.9	9,350.91
1,925.84	10.2	9,557.55
1,925.86	10.4	9,766.45
1,925.88	10.6	9,977.61
1,925.90	10.8	10,191.03
1,925.92	11.1	10,406.71
1,925.94	11.3	10,624.64
1,925.96	11.5	10,844.84
1,925.98	11.8	11,067.29
1,926.00	**12.0**	**11,292.00**

Summary for Pond 3P: Depression Storage

Inflow Area = 2.12 ac, 0.00% Impervious, Inflow Depth > 1.91" for 25yr-24hr event
Inflow = 3.057 cfs @ 12.37 hrs, Volume= 0.34 af
Outflow = 0.000 cfs @ 5.00 hrs, Volume= 0.00 af, Atten= 100%, Lag= 0.0 min

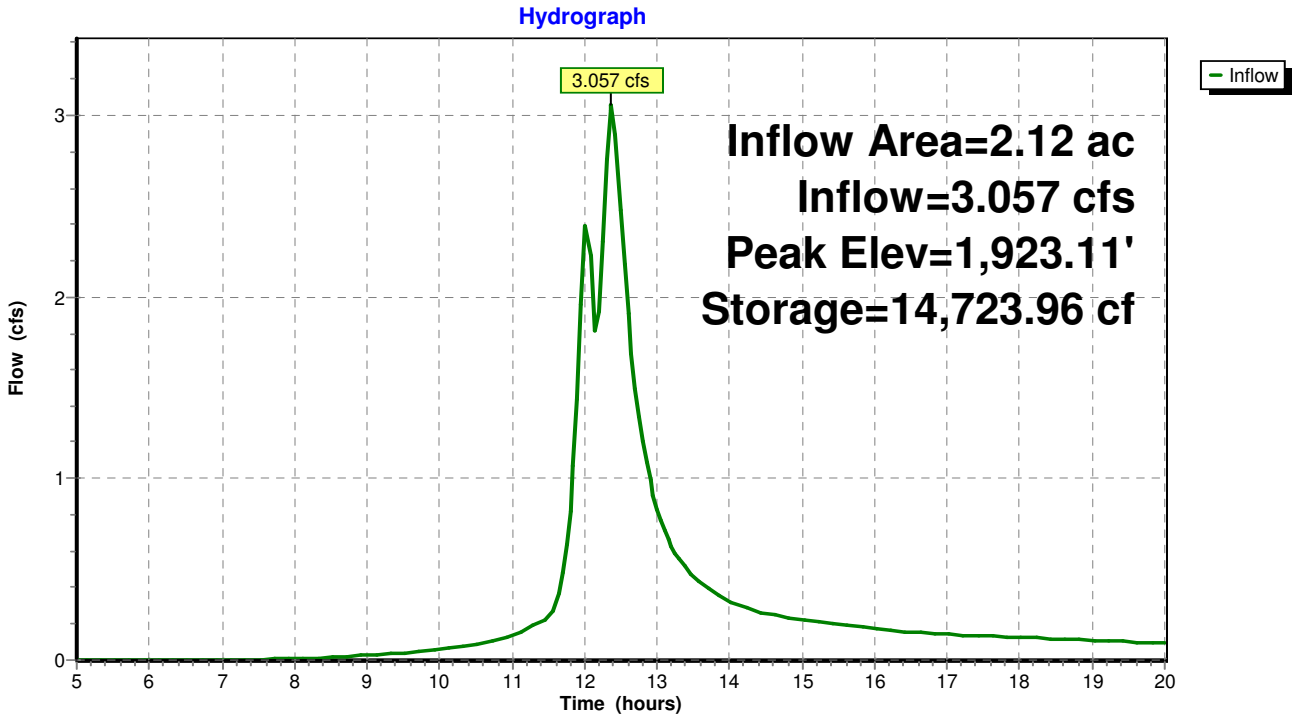
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,923.11' @ 20.00 hrs Surf.Area= 0.00 sf Storage= 14,723.96 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	1,921.50'	26,055.00 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
1,921.50	0.00
1,922.00	2,916.00
1,923.00	13,338.00
1,924.00	26,055.00

Pond 3P: Depression Storage



Stage-Area-Storage for Pond 3P: Depression Storage

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
1,921.50	0.00	1,922.54	8,543.88	1,923.58	20,713.86
1,921.52	116.64	1,922.56	8,752.32	1,923.60	20,968.20
1,921.54	233.28	1,922.58	8,960.76	1,923.62	21,222.54
1,921.56	349.92	1,922.60	9,169.20	1,923.64	21,476.88
1,921.58	466.56	1,922.62	9,377.64	1,923.66	21,731.22
1,921.60	583.20	1,922.64	9,586.08	1,923.68	21,985.56
1,921.62	699.84	1,922.66	9,794.52	1,923.70	22,239.90
1,921.64	816.48	1,922.68	10,002.96	1,923.72	22,494.24
1,921.66	933.12	1,922.70	10,211.40	1,923.74	22,748.58
1,921.68	1,049.76	1,922.72	10,419.84	1,923.76	23,002.92
1,921.70	1,166.40	1,922.74	10,628.28	1,923.78	23,257.26
1,921.72	1,283.04	1,922.76	10,836.72	1,923.80	23,511.60
1,921.74	1,399.68	1,922.78	11,045.16	1,923.82	23,765.94
1,921.76	1,516.32	1,922.80	11,253.60	1,923.84	24,020.28
1,921.78	1,632.96	1,922.82	11,462.04	1,923.86	24,274.62
1,921.80	1,749.60	1,922.84	11,670.48	1,923.88	24,528.96
1,921.82	1,866.24	1,922.86	11,878.92	1,923.90	24,783.30
1,921.84	1,982.88	1,922.88	12,087.36	1,923.92	25,037.64
1,921.86	2,099.52	1,922.90	12,295.80	1,923.94	25,291.98
1,921.88	2,216.16	1,922.92	12,504.24	1,923.96	25,546.32
1,921.90	2,332.80	1,922.94	12,712.68	1,923.98	25,800.66
1,921.92	2,449.44	1,922.96	12,921.12	1,924.00	**26,055.00**
1,921.94	2,566.08	1,922.98	13,129.56		
1,921.96	2,682.72	1,923.00	13,338.00		
1,921.98	2,799.36	1,923.02	13,592.34		
1,922.00	2,916.00	1,923.04	13,846.68		
1,922.02	3,124.44	1,923.06	14,101.02		
1,922.04	3,332.88	1,923.08	14,355.36		
1,922.06	3,541.32	1,923.10	14,609.70		
1,922.08	3,749.76	1,923.12	14,864.04		
1,922.10	3,958.20	1,923.14	15,118.38		
1,922.12	4,166.64	1,923.16	15,372.72		
1,922.14	4,375.08	1,923.18	15,627.06		
1,922.16	4,583.52	1,923.20	15,881.40		
1,922.18	4,791.96	1,923.22	16,135.74		
1,922.20	5,000.40	1,923.24	16,390.08		
1,922.22	5,208.84	1,923.26	16,644.42		
1,922.24	5,417.28	1,923.28	16,898.76		
1,922.26	5,625.72	1,923.30	17,153.10		
1,922.28	5,834.16	1,923.32	17,407.44		
1,922.30	6,042.60	1,923.34	17,661.78		
1,922.32	6,251.04	1,923.36	17,916.12		
1,922.34	6,459.48	1,923.38	18,170.46		
1,922.36	6,667.92	1,923.40	18,424.80		
1,922.38	6,876.36	1,923.42	18,679.14		
1,922.40	7,084.80	1,923.44	18,933.48		
1,922.42	7,293.24	1,923.46	19,187.82		
1,922.44	7,501.68	1,923.48	19,442.16		
1,922.46	7,710.12	1,923.50	19,696.50		
1,922.48	7,918.56	1,923.52	19,950.84		
1,922.50	8,127.00	1,923.54	20,205.18		
1,922.52	8,335.44	1,923.56	20,459.52		

Appendix A-2

TP-40: 25-Year, 24-Hour Rainfall

25-YEAR 24-HOUR RAINFALL (INCHES)