

# **Appendix D - Technical Reports**

- Stormwater Report**
- Traffic Impact Analysis (TIA)**
- Parking Analysis**

## STORM WATER REPORT

Clackamas County Fairgrounds Multi-Purpose Building  
694 NE 4<sup>th</sup> Avenue  
Canby, OR

May 4, 2023

Owner/Applicant:

Clackamas County Fairgrounds  
694 NE 4<sup>th</sup> Avenue  
Canby, Oregon 97013



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Project No: 22799  
KEF

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I hereby certify that this Stormwater Management Report for the proposed event center at the Clackamas County Fairgrounds has been prepared by me or under my supervision and meets minimum standards of the City of Canby normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.



## **EXECUTIVE SUMMARY**

The Clackamas County Fairgrounds project is located at 694 NE 4<sup>th</sup> Avenue in Canby, Oregon. The project site is within the jurisdiction of the City of Canby. Design and analysis pertaining to stormwater management will be in accordance with the City of Canby Public Works Design Standards, December 2019 (PWDS).

The project proposes the construction of a multi-purpose space with surrounding asphalt. Per the City, frontage improvements for the project are not required. The project site has a cumulative area of 38.76 acres with an area of disturbance of 91,051 sf. The proposed work is expected to generate 88,917 sf of new and replaced impervious area. All stormwater runoff from the project is required to be treated and infiltrated onsite since there is no public stormwater system surrounding the site to discharge to.

An upstream basin drains runoff towards the project site and will be captured in the proposed storm system for treatment and infiltration.

As a result of the anticipated new and redeveloped impervious area, the City of Canby requires the implementation of stormwater management approach will be addressed as follows:

- **Water Quality Approach**
  - A Low Impact Development Approach (LIDA) will be constructed to filter and infiltrate stormwater runoff. The LIDA will be an infiltration rain garden.
- **Water Quantity Approach**
  - The proposed LIDA has been designed to infiltrate all stormwater runoff up through and including the 100-year, 24-hour stormwater event. An emergency overflow will convey stormwater east into an existing pond.

The purpose of this report is to accomplish the following.

- Describe pre- and post-development basins and drainage;
- Describe the design and analysis of the proposed stormwater management facilities; and,
- Demonstrate compliance with the PWDS pertaining to stormwater management.

## PROJECT DESCRIPTION

The Clackamas County Fairgrounds project is located at 694 NE 4<sup>th</sup> Avenue in Canby, Oregon. The project site is within the jurisdiction of the City of Canby. Design and analysis pertaining to stormwater management will be in accordance with the City of Canby Public Works Design Standards, December 2019 (PWDS).

The project proposes the construction of a multi-purpose space with surrounding asphalt. Per the City, frontage improvements for the project are not required. The project site has a cumulative area of 38.76 acres; the proposed work is expected to generate 88,917 sf of new and replaced impervious area.



**Figure 1 - Canby Locator Map**



Figure 2 – City of Canby Aerial Map

## EXISTING CONDITIONS

### **Project Location**

The project site is located within the confines of the Clackamas County Fairgrounds. See Figure 2 above. The existing site is bare with gravel and grass but previously contained a livestock barn.

**Site size and tax lot:** The project site has an area of 37.91 acres, on tax lots: 31E33: 100, AC2400, AD500, AD600, AD700, DA101, DA500, AD1601, AD1604.

**Land use/zoning:** The site is zoned “R-1” (Low Density Residential).

**Topography:** Onsite surveying was performed by Centerline Concepts Land Surveying in July 2022. Onsite topography is flat with a gentle slope towards the east.

**Drainage & Stormwater Systems:** Stormwater runoff from the project site either infiltrates or is conveyed to an existing pond to the north; there is no public stormwater management system intercepting runoff from the property.

### **Flood Map**

The site is located within Zone X (un-shaded) per flood insurance rate map (FIRM) number 41005C0264D & 41005C0268D. FEMA's definition of Zone X (un-shaded) is an area of minimal flood hazard (See Technical Appendix: Exhibits – National Flood Hazard Layer FIRMette).

### **Site Geology**

The soil type as classified by the United States Department of Agriculture Soil Survey of Clackamas County is Latourell loam with a corresponding hydrologic group rating of B (See Technical Appendix: H&H Modeling - Hydrologic Soil Group for Clackamas County Area, Oregon).

### **Geotechnical Report & Infiltration Testing**

A geotechnical engineering investigation was completed by Landslide Technology on December 13, 2022 (See Technical Appendix: Geotechnical Infiltration Testing Letter Report). Two test pits were explored to a depth of 6.9 and 6.7 feet with corresponding infiltration rates of >40 and 17 in/hr, respectively. The Geotechnical Engineer recommends using the lesser of the two rates with a factor of safety of two (2); therefore, the proposed LIDA was design with an infiltration rate of 8.50 in/hr.

Static groundwater was observed at approximately 18 feet below ground surface.

### **Onsite Basin Areas**

The proposed area to be disturbed is approximately 91,051 sf. The project area was considered 100 percent pervious.

### **Upstream Basin Areas**

An upstream basin drains runoff towards the project site and will be captured in the proposed storm system for treatment and infiltration.

Table 1 shows the existing and upstream basin areas (See Technical Appendix: Exhibits – Existing Site Conditions).

<b>Existing Onsite Basin Area</b>	<b>Sq. ft.</b>	<b>Acres</b>
Impervious Area	0	0.000
Pervious Area:	91,051	2.090
<b>Upstream Basin Area</b>		
Impervious Area	5,894	0.135
Pervious Area:	9,191	0.211
<b>Total Area</b>	<b>106,136</b>	<b>2.436</b>

**Table 1 – Onsite and Upstream Basin Areas**

## **POST-DEVELOPED CONDITIONS**

### **Post-Developed Site**

The project proposes the construction of a multi-purpose space with surrounding asphalt. Runoff from the new building and surrounding asphalt and concrete will drain to a proposed storm system that will discharge to a LIDA infiltration facility to be located north of the new building. Emergency overflow discharges will be conveyed east into an existing pond.

### **Basin Area**

Table 2 shows the anticipated post-developed impervious and pervious areas (See Technical Appendix: Exhibits – Post-Developed Site Conditions). The upstream basin will not be revised; refer to Table 1 for the basin properties.

<b>Post-Developed Basin Area</b>	<b>Sq. ft.</b>	<b>Acres</b>
Impervious Area:	88,917	2.041
Pervious Area:	2,134	0.049
<b>Total Area</b>	<b>91,051</b>	<b>2.090</b>

**Table 2 – Post-Developed Basin Areas**

## **HYDROLOGIC ANALYSIS DESIGN GUIDELINES**

### **Design Guidelines**

The stormwater facility has been designed to comply with the City of Canby Public Works Design Standards, December 2019 (PWDS). The requirements are as follows:

- Infiltrate all runoff from storm events up through the 10-year, 24-hour.
- Capture and treat runoff following chapter 4.6 of Clean Water Services Design Manual.
  - Precede treatment facility with a water quality manhole designed for the 25-year, 24-hour storm event.
- Design conveyance system to pass the 10-year storm event without surcharge, and a 25-year event with surcharge but keeping the hydraulic grade line below the manhole lids.

### Hydrograph Method

Naturally occurring rainstorms dissipate over long periods of time. An effective way of estimating storm rainfall is by using the hydrograph method. The Santa Barbara Urban Hydrograph (SBUH) method was used to develop runoff rates. The computer software program XPSTORM was used in modeling the hydrology and hydraulics to size the proposed stormwater facilities.

### Design Storm

The rainfall distribution to be used for this area is the design storm of 24-hour duration based on the standard Type 1A rainfall distribution. Table 3 shows total precipitation depths for the various storm events, which were used as multipliers for the Type 1A 24-hour rainfall distribution (See Technical Appendix: H&H Modeling – Oregon NOAA Atlas 2 Isopluvials).

Recurrence Interval (years)	Precipitation Depth (inches)
2	2.50
5	3.00
10	3.50
25	4.00
100	4.50

**Table 3 – Design Storms**

### Curve Number

The major factors for determining the CN values are hydrologic soil group, cover type, treatment, hydrologic condition, and antecedent runoff condition. The curve number represents runoff potential from the ground. Table 2-2a in the TR-55 manual were used to determine the appropriate curve numbers (See Technical Appendix: H&H Modeling – Table 2-2a Runoff Curve Numbers).

The pervious curve number used for existing and post-developed conditions is 61, corresponding to open space in good condition. A curve number of 98 was used for all impervious areas.

### Time of Concentration

The time of concentration was calculated using the TR-55 method and contours onsite. Land coverage for the existing and upstream basin was assumed to be grass, which has a Manning's n of 0.15. The calculated time of concentration for the existing and upstream basin is 28 and 18 minutes, respectively. The post-developed time of concentration for the onsite area is assumed to be 5 minutes.

### Basin Runoff

The existing, upstream and post-developed runoff rates area shown in Table 4 below (See Technical Appendix: H&H Modeling - Hydrographs).

Recurrence Interval (years)	Existing Runoff Rate (cfs)	Upstream Runoff Rate (cfs)	Post-Developed Runoff Rate (cfs)
2	0.033	0.066	1.175
5	0.055	0.080	1.424
10	0.080	0.098	1.672
25	0.125	0.120	1.921
100	0.196	0.144	2.170

**Table 4 – Runoff Rates**

## WATER QUALITY

### **Rain Garden Characteristics**

The proposed rain garden will be constructed with 18" of growing medium, 3:1 side slopes and a total depth of 2.50 feet.

A pretreatment manhole following Clean Water Services Drawing No. 250 and 270 will precede the rain garden. Per the CWS D&C, the following equation was used to size the pretreatment area of the structure:

Sump Volume = ( 20 cf / 1 cfs ) x ( 25-yr Peak Flow )

25-yr Peak Flow = 2.04 cfs (Post-Developed Runoff + Upstream Runoff)

Required Sump Volume = 40.8 cf

The diameter of the manhole will be 60" with a sump of 36" measured below the snout (18" below the invert out of the manhole).

## WATER QUANTITY

### **Design Guidelines**

Per Section 4.301 in the PWDS, the 10 year storm event is required to be infiltrated onsite; however, there is no public storm system to connect to. Therefore, the proposed rain garden has been designed to infiltrate all storm events. An emergency overflow will convey high flows along the east side of the rain garden which will drain east into the existing pond. Table 5 below shows the volume capacity of the proposed rain garden.

Elevation (ft)	Surface Area (ft <sup>2</sup> )	Average Surface Area (ft <sup>2</sup> )	Sectional Volume (ft <sup>3</sup> )	Total Volume (ft <sup>3</sup> )
133.25	925			
		1,108	1,108	
134.25	1,292			1,108
		1,503	1,503	
135.25	1,715			2,611
		1,831	916	
135.75	1,948			3,527

**Table 5 – Rain Garden Volume Capacity**



### Rip Rap Sizing

Outfall protection was designed to prevent scouring at the outfall into the rain garden. The velocity at the pipe's outfall was determined using the XPSTORM model during the 100-year storm event (See Technical Appendix: H&H Modeling XPSTORM Output – Conveyance Data). The design of the outfall protection follows ODOT's riprap calculations (See Technical Appendix: Calculations – Riprap Sizing). Table 6 shows the minimum rip rap dimensions.

Diameter of Pipe (inches)	Velocity of Pipe Outfall when Flowing Full (fps)	Rip Rap Class	Depth (ft)	Width @ Outfall (ft)	Width @ Bottom (ft)	Length (ft)
12	2.76	50	1.00	3	7	8

**Table 6 – Minimum Riprap Dimensions**

## HYDRAULIC ANALYSIS

The private storm drain systems have been sized to convey all storm events up to and including the 25-yr with a minimum freeboard of 1 ft of freeboard.

### Methodology

As with the hydrologic analysis, XPSTORM was used to perform a dynamic routing analysis based off runoff rates derived via the SBUH method. An XPSTORM model was developed and evaluated for the post-developed basin (See Technical Appendix: H&H Modeling – Hydraulic Layout).

### System Performance

In post-developed conditions, the proposed storm drain systems are expected to sufficiently convey flows for up to and including the 25-yr storm event with at least one foot of freeboard except for the trench drain which will have a minimum 0.27 feet (Technical Appendix: XPSTORM Output – Conveyance Data).

## OPERATIONS & MAINTENANCE

An Operations & Maintenance Plan (OMP) was prepared to provide a single-source document to explain the maintenance requirements for the proposed stormwater management facilities onsite, which will all be maintained by the Clackamas County Fairgrounds. The OMP is included in the Technical Appendix.

## DOWNSTREAM ANALYSIS

A downstream analysis has not been conducted since all stormwater runoff is being infiltrated onsite.

## SUMMARY

The proposed stormwater facility has been designed to meet and exceed the requirements of the City of Canby.



## **TECHNICAL APPENDIX**

### **Exhibits**

- National Flood Hazard Layer FIRMette
- Existing Site Conditions
- Post-Developed Site Conditions

### **Calculations**

- Time of Concentration Calculation
- Riprap Sizing

### **H&H Modeling**

- Hydrologic Soil Group-Clackamas County Area, Oregon
- Oregon NOAA Atlas 2 Isopluvials (2, 5, 10, 25, 100-YR 24-HR Precipitation)
- Table 2-2a & 2-2c Runoff Curve Numbers
- XPSTORM Runoff Data – Input for XPSTORM: Existing and Post-Developed
- Hydrographs (Existing, Upstream and Post-Developed Basin Runoff)
- Post-Developed Conveyance Basins
- XPSTORM Hydraulic Layout
- XPSTORM Runoff Data – Contributing Conveyance Basin
- XPSTORM Conveyance Data – Post-Developed Conditions (2-100 Year)

### **Operations and Maintenance Plan**

### **Geotechnical Report**

- Geotechnical Infiltration Testing Letter Report by Central Geotechnical Services, LLC, December 13, 2022

## **REFERENCES**

1. City of Canby Public Works Standards, December 2019
2. Clean Water Services Low Impact Development Handbook 2021
3. Soil Survey of Clackamas County Area. National Resource Conservation Service
4. City of Canby Overview Maps <https://www.canbyoregon.gov/dev-services/page/overview-maps>

# EXHIBITS

# National Flood Hazard Layer FIRMette



## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, X, AD9
	With BFE or Depth Zone AE, AO, AH, V1, V2
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee. See Notes. Zone X
	Area with Flood Risk due to Levee Zone X
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard Zone X
	Effective LOMRs
GENERAL STRUCTURES	Area of Undetermined Flood Hazard Zone X
	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
	17.5 Coastal Transect
	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary
	Coastal Transect Baseline
	Profile Baseline
MAP PANELS	Hydrographic Feature
	Digital Data Available
	No Digital Data Available
	Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/27/2022 at 4:34 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

122°41'27"W 45°16'17"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000  
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

122°40'49"W 45°15'52"N

**3J CONSULTING**  
CIVIL ENGINEERING • WATER RESOURCES • COMMUNITY PLANNING

"CANBY GARDENS"

7]

[AP26]

LEGEND



POST-DEVELOPED AREA TOTAL AREA =  
91,051 SF (2.090 ACRES)  
IMPERVIOUS AREA = 88,917 SF (2.041 ACRES)  
PERVIOUS AREA = 2,134 SF (0.049 ACRES)



SCALE: 1" = 80'  
0 80 FT  
MAY 2023

**CLACKAMAS COUNTY FAIRGROUNDS  
MULTI-PURPOSE BUILDING**

CLACKAMAS COUNTY FAIRGROUNDS

POST-DEVELOPED SITE CONDITIONS

**3J CONSULTING**  
CIVIL ENGINEERING - WATER RESOURCES - COMMUNITY PLANNING

# CALCULATIONS



# TIME OF CONCENTRATION

PROJECT NO.	CCFG	BY KEF	DATE 4/1/2023
-------------	------	--------	---------------

SHEET FLOW			
INPUT	Onsite	Upstream Basin	
Surface Description	Type <b>5</b> Grass (short prairie)	Type <b>5</b> Grass (short prairie)	Type <b>5</b> Grass (short prairie)
Manning's "n"	0.15	0.15	0.15
Flow Length, L	<b>300</b> ft	<b>222</b> ft	ft
2-Yr 24 Hour Rainfall, P <sub>2</sub>	<b>2.5</b> in	<b>2.5</b> in	<b>2.5</b> in
Land Slope, s	<b>0.0173</b> ft/ft	<b>0.0277</b> ft/ft	<b>0.0410</b> ft/ft
OUTPUT			
Travel Time	0.47 hr	0.31 hr	0.00 hr
SHALLOW CONCENTRATED FLOW			
INPUT	VALUE	VALUE	VALUE
Surface Description	<b>Unpaved</b>	<b>Unpaved</b>	<b>Unpaved</b>
Flow Length, L	<b>34</b> ft	ft	ft
Watercourse Slope*, s	<b>0.029</b> ft/ft	<b>0</b> ft/ft	<b>0</b> ft/ft
OUTPUT			
Average Velocity, V	2.75 ft/s	9.99 ft/s	1.91 ft/s
Travel Time	0.003 hr	0.000 hr	0.000 hr
CHANNEL FLOW			
INPUT	VALUE	VALUE	VALUE
Cross Sectional Flow Area, a	<b>0</b> ft <sup>2</sup>	<b>0</b> ft <sup>2</sup>	<b>0</b> ft <sup>2</sup>
Wetted Perimeter, P <sub>w</sub>	<b>0</b> ft	<b>0</b> ft	<b>0</b> ft
Channel Slope, s	<b>0</b> ft/ft	<b>0</b> ft/ft	<b>0</b> ft/ft
Manning's "n"	<b>0.24</b>	<b>0.24</b>	<b>0.24</b>
Flow Length, L	<b>0</b> ft	<b>0</b> ft	<b>0</b> ft
OUTPUT			
Average Velocity	0.00 ft/s	0.00 ft/s	0.00 ft/s
Hydraulic Radius, r = a / P <sub>w</sub>	1.00 ft	1.00 ft	1.00 ft
Travel Time	0.00 hr	0.00 hr	0.00 hr
Watershed or Subarea T <sub>c</sub> =	<b>0.47 hr</b>	<b>0.31 hr</b>	<b>0.00 hr</b>
Watershed or Subarea T <sub>c</sub> =	<b>28 minutes</b>	<b>18 minutes</b>	<b>0 minutes</b>






# RIPRAP SIZING

PROJECT NAME		CCFG		BY KEF		DATE 5/1/2023	
PROJECT NO.		22799					
Input						Values	
V		Average velocity				2.76 ft/s	
Do		Culvert diameter				12 in	
g		gravity				32.2 ft/s <sup>2</sup>	
Output						Values	
Riprap Class		Riprap Class				50	
Description		Formula		Value			
F <sub>o</sub> Value		$F_o = \frac{v}{\sqrt{g * D_o}}$		0.49			
Riprap size (d <sub>s</sub> )		$d_s = .25 * D_o * F_o$ Min ds = 0.50 ft		0.50 ft		6.00 in	
Apron length (L <sub>sp</sub> )		$L_{sp} = D_o \left( 8 + 17 \log F_o \right)$ Min Fo = 1.00		8.00 ft		96.00 in	
Riprap depth		$Depth = 2 * d_s$		1.00 ft		12.00 in	
Riprap width at outfall (W <sub>t</sub> )		$W_t = 3 * D_o$		3.00 ft		36.00 in	
Riprap Width at bottom (W <sub>b</sub> )		$W_b = L_{sp} \times \frac{1}{5} \times 2 + W_t$		7.00 ft		84.00 in	
Discharge Flow Velocity (fps)		Required Protection (Minimum Dimensions)					
Type		Depth	Width	Length		Height	
0 to 5	Riprap	2 x (max stone size)	Diameter + 6 ft	As Calculated		Crown + 1 ft	
6 to 10	Riprap	2 x (max stone size)	Diameter + 6ft. Or 3x Diameter which ever is greater	As Calculated		Crown + 1 ft	
11 to 20	Riprap or Gabion	2 x (max stone size)	Diameter + 6ft. Or 4x Diameter which ever is greater	As Calculated		Crown + 1 ft	
Over 20		Engineered Energy Dissipater Required					
Note: U.S. Army Corp. Of Engineers design formulas for erosion and riprap requirements at culvert and storm-drain outlets.							




# H&H MODELING



**MAP LEGEND****Area of Interest (AOI)**
 Area of Interest (AOI)
**Soils****Soil Rating Polygons**





-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available


**Soil Rating Lines**




-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Points**

-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

**Water Features**
 Streams and Canals
**Transportation**

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

**Background**
 Aerial Photography
**MAP INFORMATION**

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon

Survey Area Data: Version 18, Oct 27, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2019—Sep 12, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



Natural Resources  
Conservation Service

Web Soil Survey  
National Cooperative Soil Survey

5/3/2022  
Page 2 of 4

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
53A	Latourell loam, 0 to 3 percent slopes	B	32.7	100.0%
<b>Totals for Area of Interest</b>			<b>32.7</b>	<b>100.0%</b>

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

### Rating Options

*Aggregation Method: Dominant Condition*

*Component Percent Cutoff: None Specified*



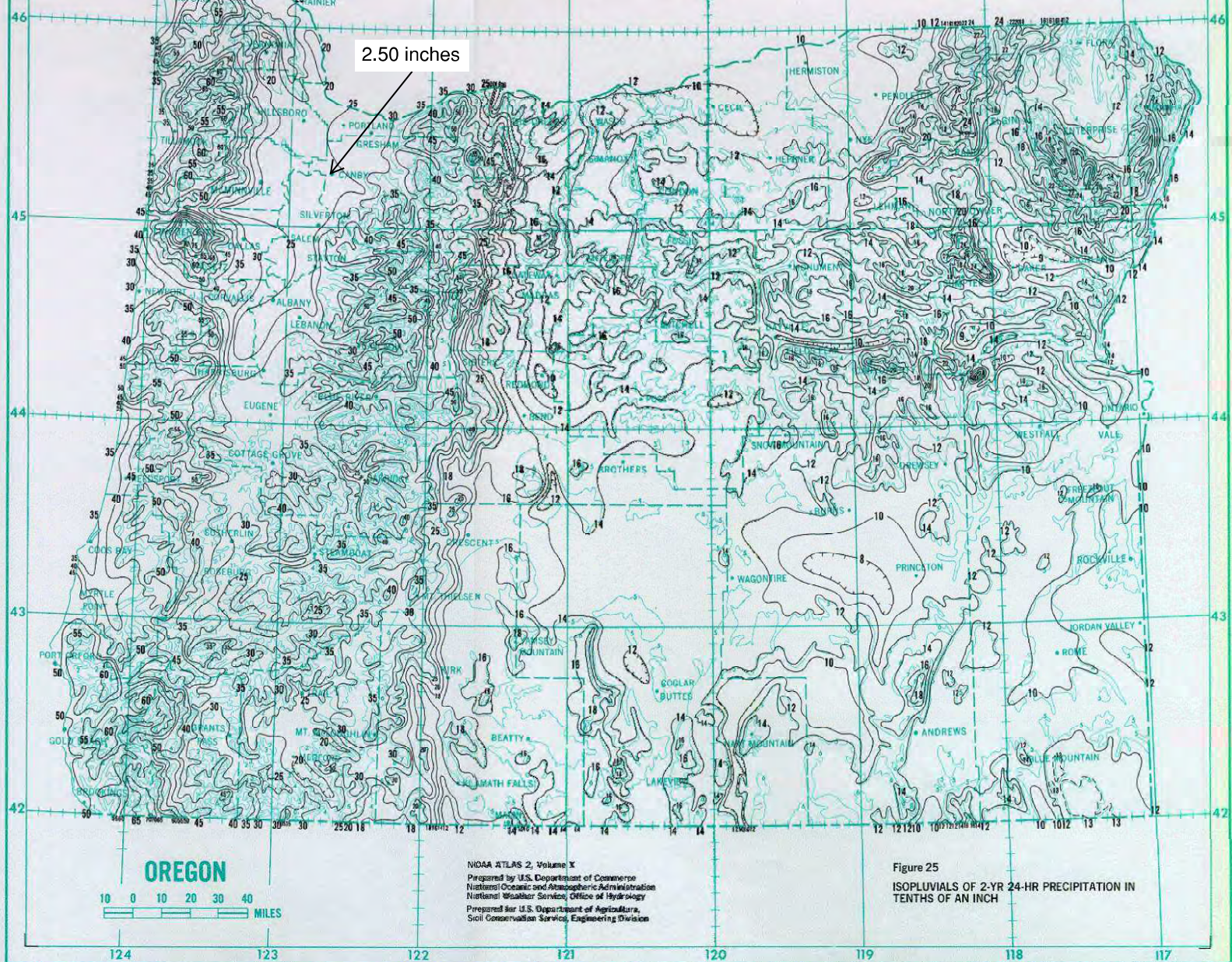
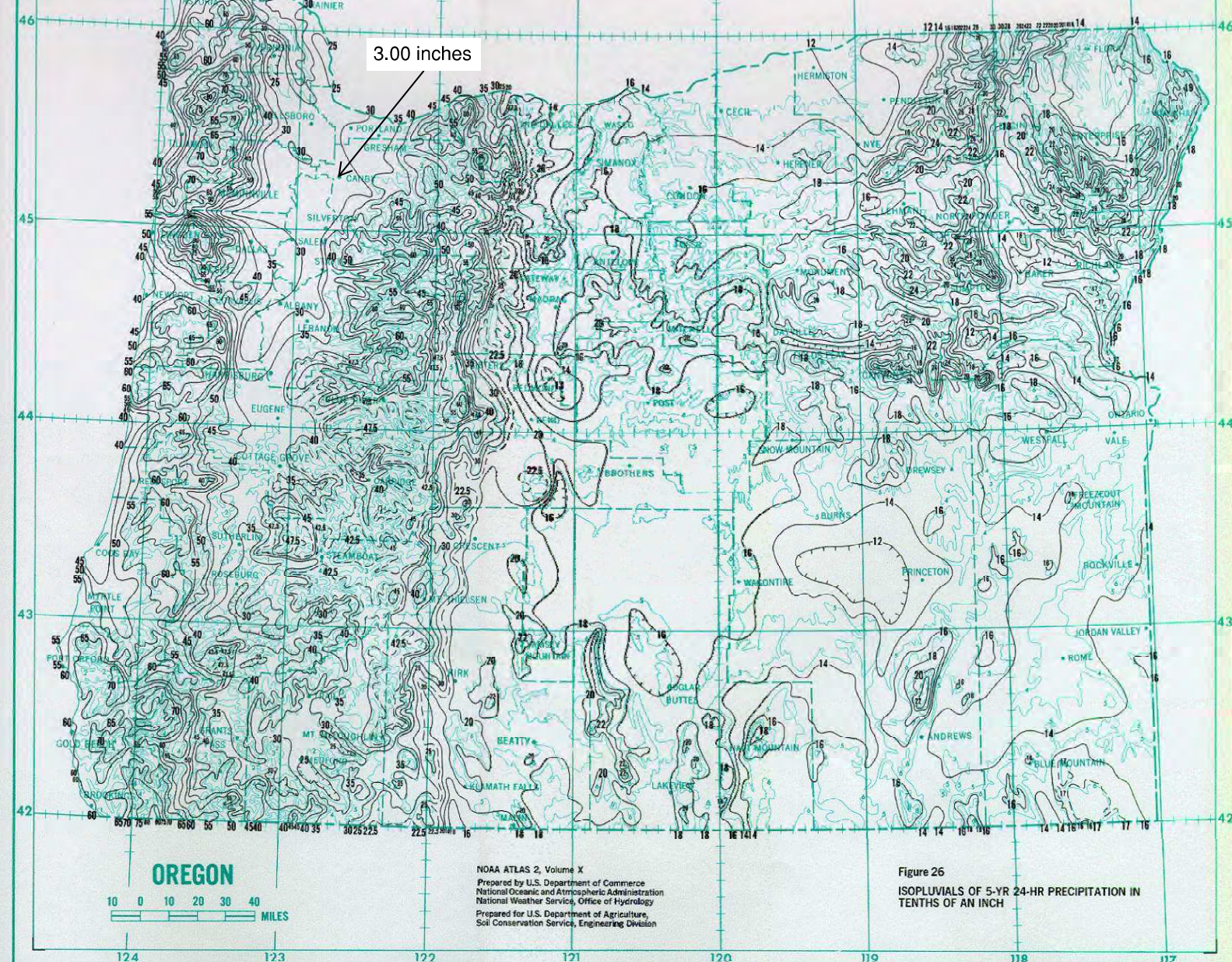
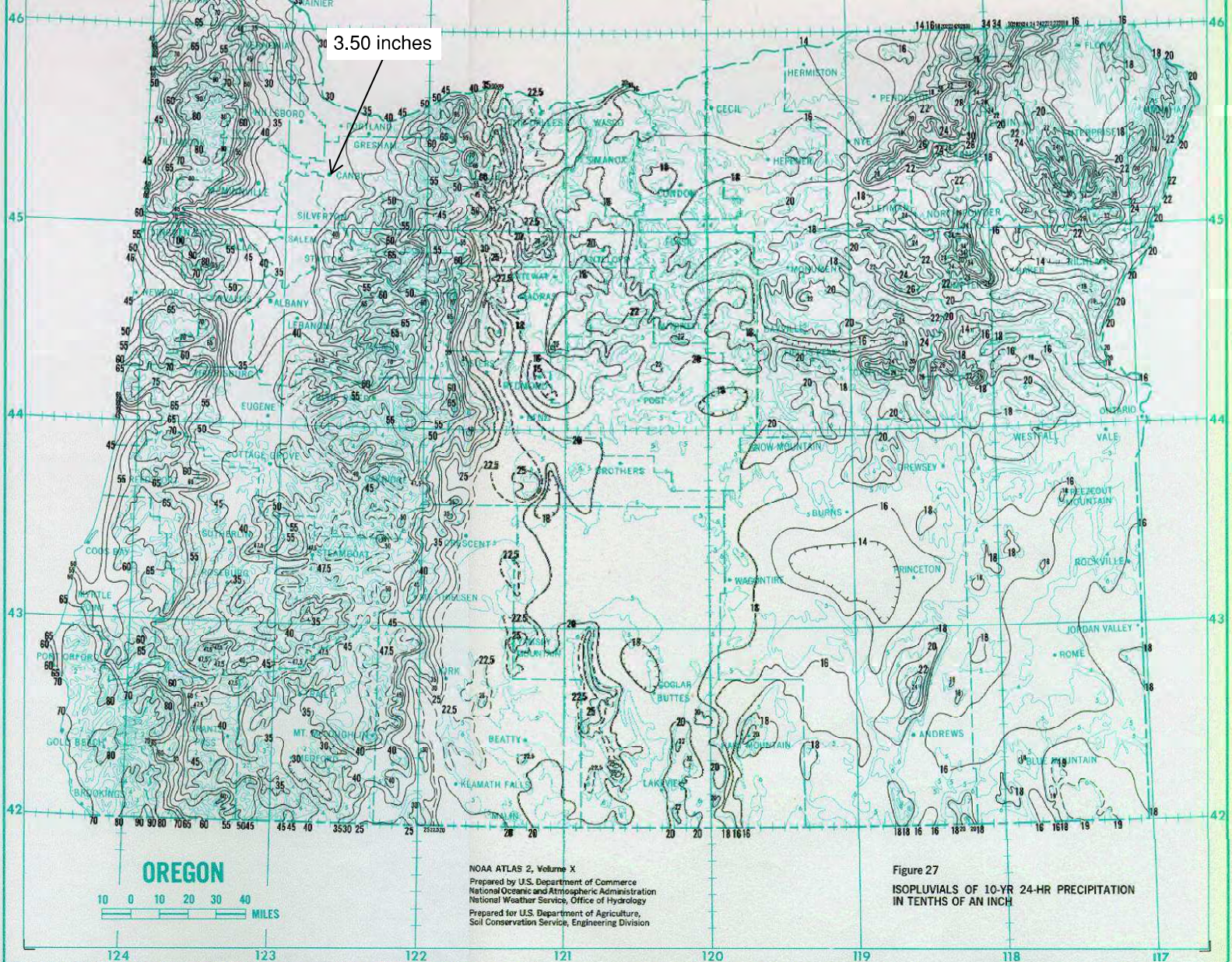


Figure 25  
 ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN  
 TENTHS OF AN INCH

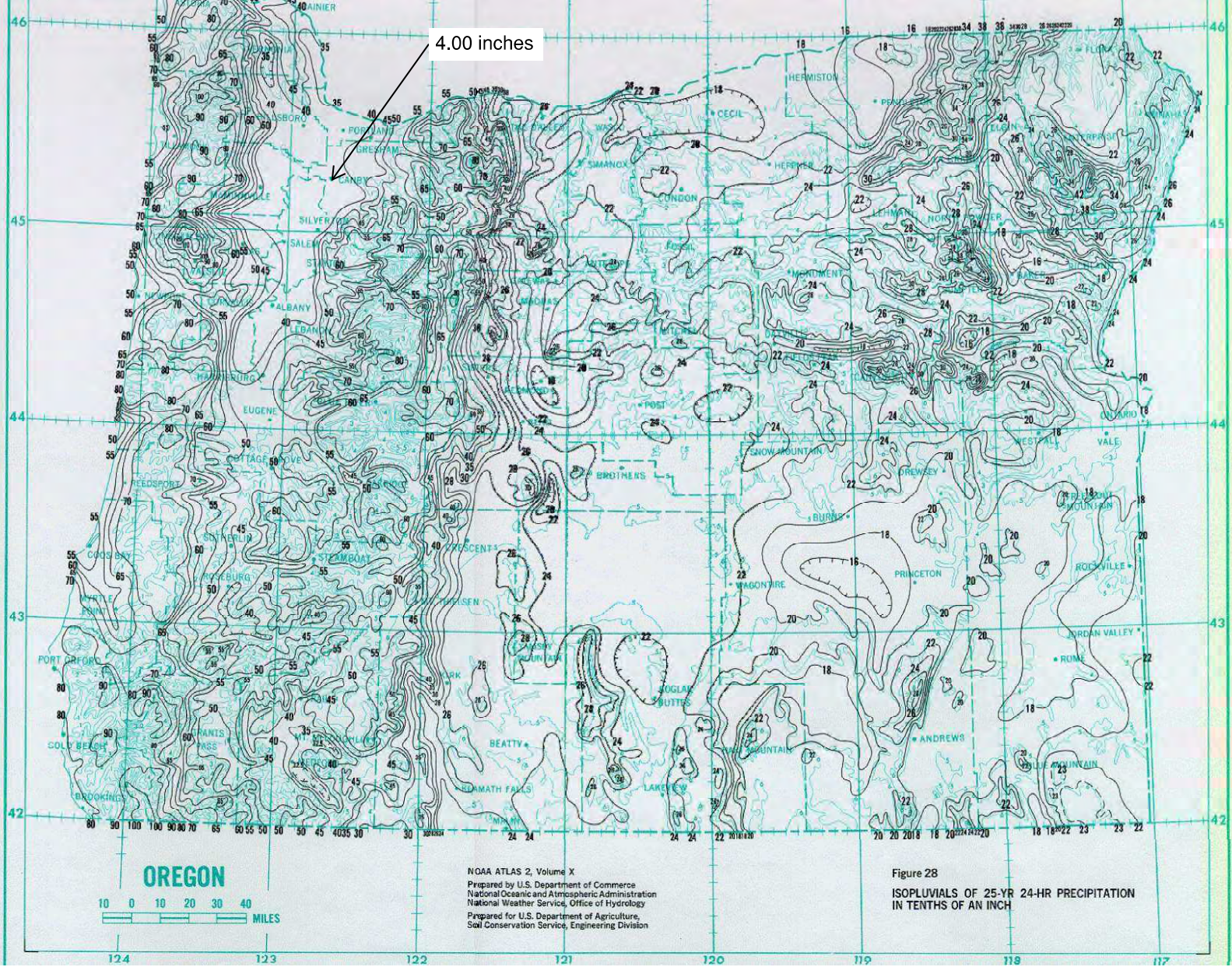














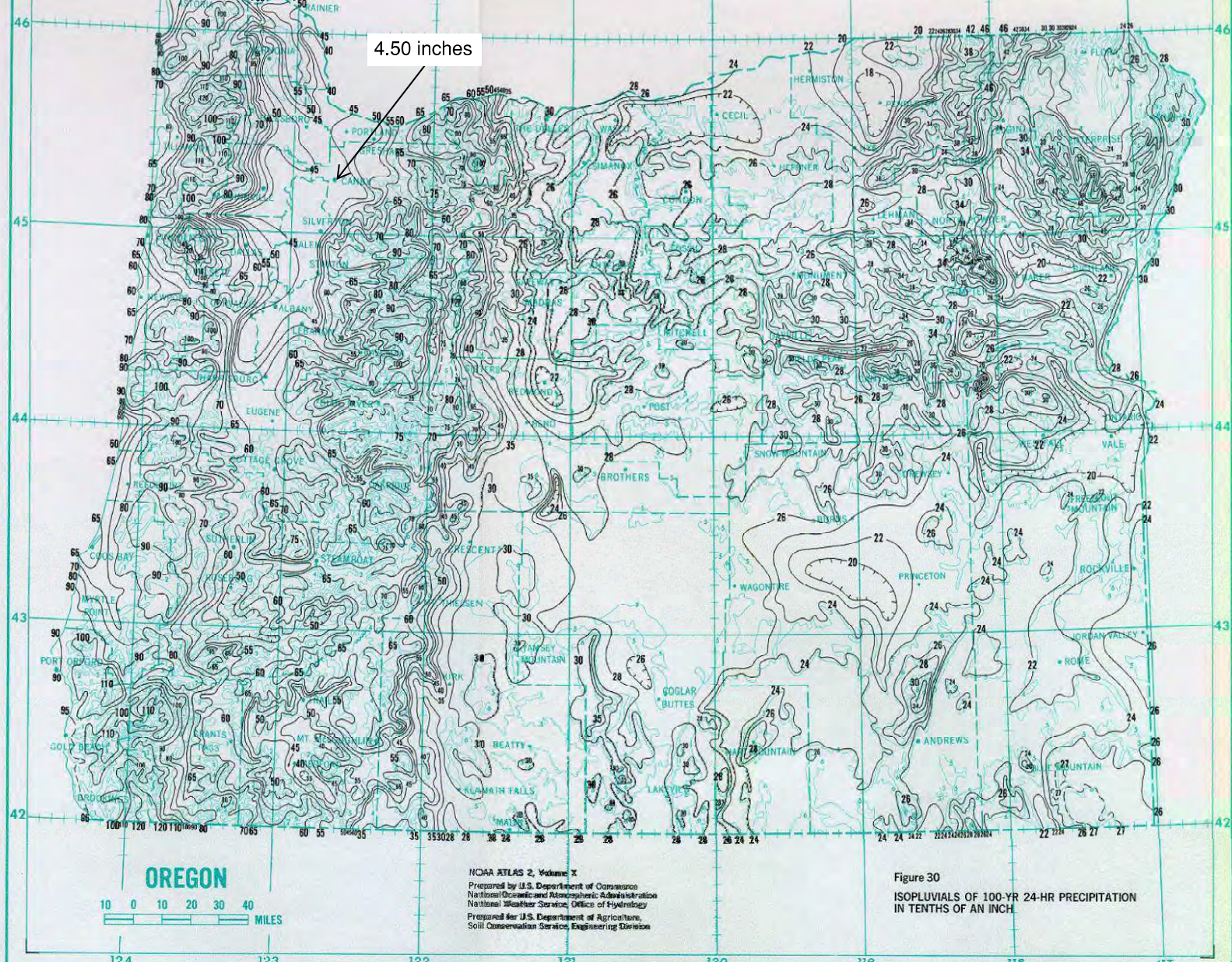




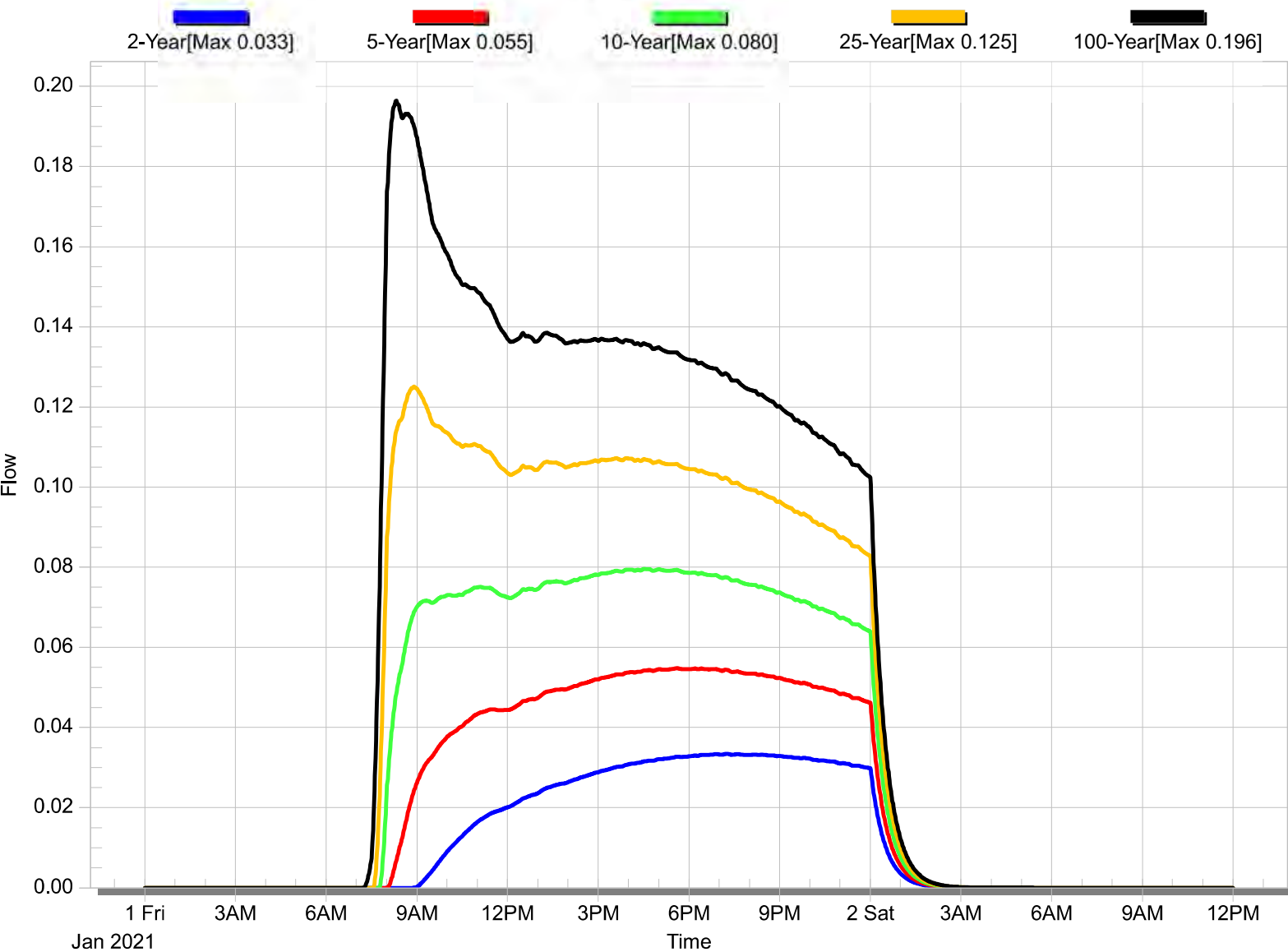
Table 2-2a Runoff curve numbers for urban areas <sup>1/</sup>

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area <sup>2/</sup>	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) <sup>3/</sup> :					
Poor condition (grass cover < 50%) .....		68	79	86	89
Fair condition (grass cover 50% to 75%) .....		49	69	79	84
Good condition (grass cover > 75%) .....		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way) .....		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way) .....		98	98	98	98
Paved; open ditches (including right-of-way) .....		83	89	92	93
Gravel (including right-of-way) .....		76	85	89	91
Dirt (including right-of-way) .....		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) <sup>4/</sup> .....		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) .....		96	96	96	96
Urban districts:					
Commercial and business .....	85	89	92	94	95
Industrial .....	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses) .....	65	77	85	90	92
1/4 acre .....	38	61	75	83	87
1/3 acre .....	30	57	72	81	86
1/2 acre .....	25	54	70	80	85
1 acre .....	20	51	68	79	84
2 acres .....	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) <sup>5/</sup> .....		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

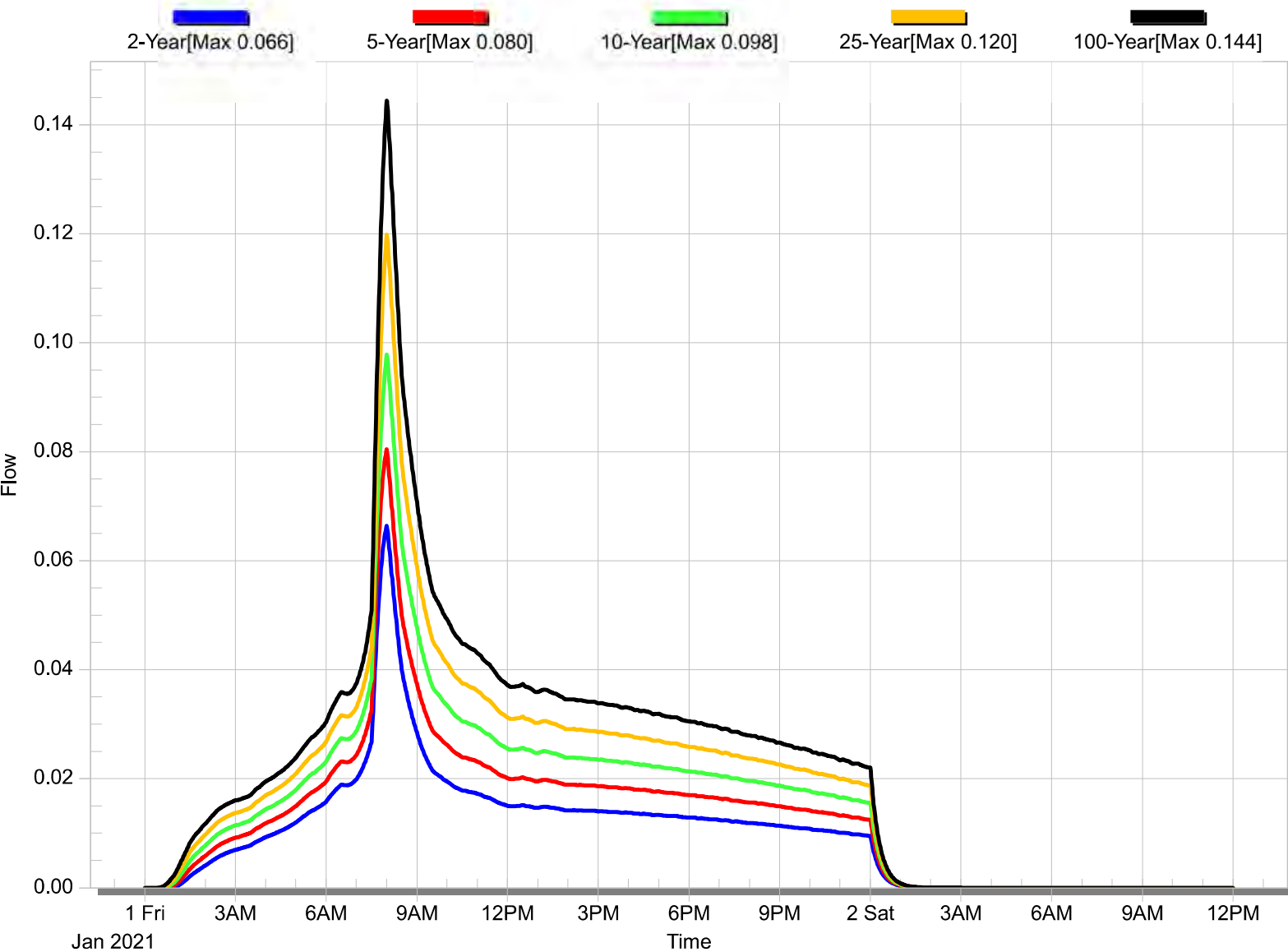
<sup>1</sup> Average runoff condition, and  $I_a = 0.2S$ .<sup>2</sup> The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.<sup>3</sup> CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.<sup>4</sup> Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.<sup>5</sup> Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

XPSTORM RUNOFF DATA - CCFG - HYDRAULIC ANALYSIS														
INPUT FOR XPSTORM: EXISTING, UPSTREAM AND POST-DEVELOPED														
Node Name	Runoff Parameters (Input)				2-yr Storm Event		5-yr Storm Event		10-yr Storm Event		25-yr Storm Event		100-yr Storm Event	
	Area	Imp	CN	Tc	Precip	Peak	Precip	Peak	Precip	Peak	Precip	Peak	Precip	Peak
	ac	%		min.	in	cfs	in	cfs	in	cfs	in	cfs	in	cfs
Existing	2.09	0	61	28	2.50	0.03	3.00	0.06	3.50	0.08	4.00	0.13	4.50	0.20
Total	2.09													
Upstream	0.14	100	61	18	2.50	0.07	3.00	0.08	3.50	0.10	4.00	0.12	4.50	0.14
	0.21	0	61	18										
Total	0.35													
Post	2.04	100	98	5	2.50	1.18	3.00	1.42	3.50	1.67	4.00	1.92	4.50	2.17
	0.05	0	61	5										
Total	2.09													

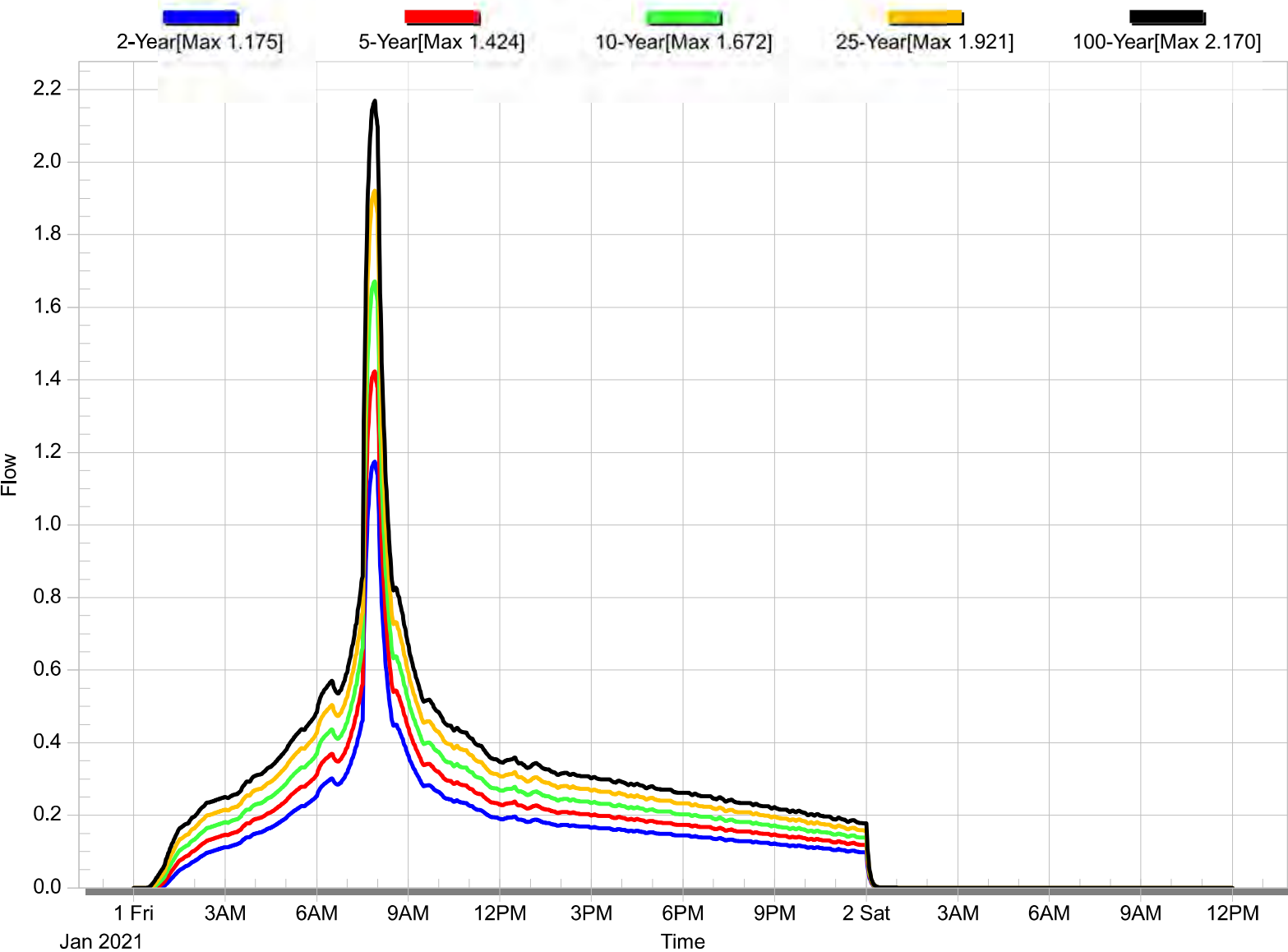
# EXISTING BASIN RUNOFF HYDROGRAPH

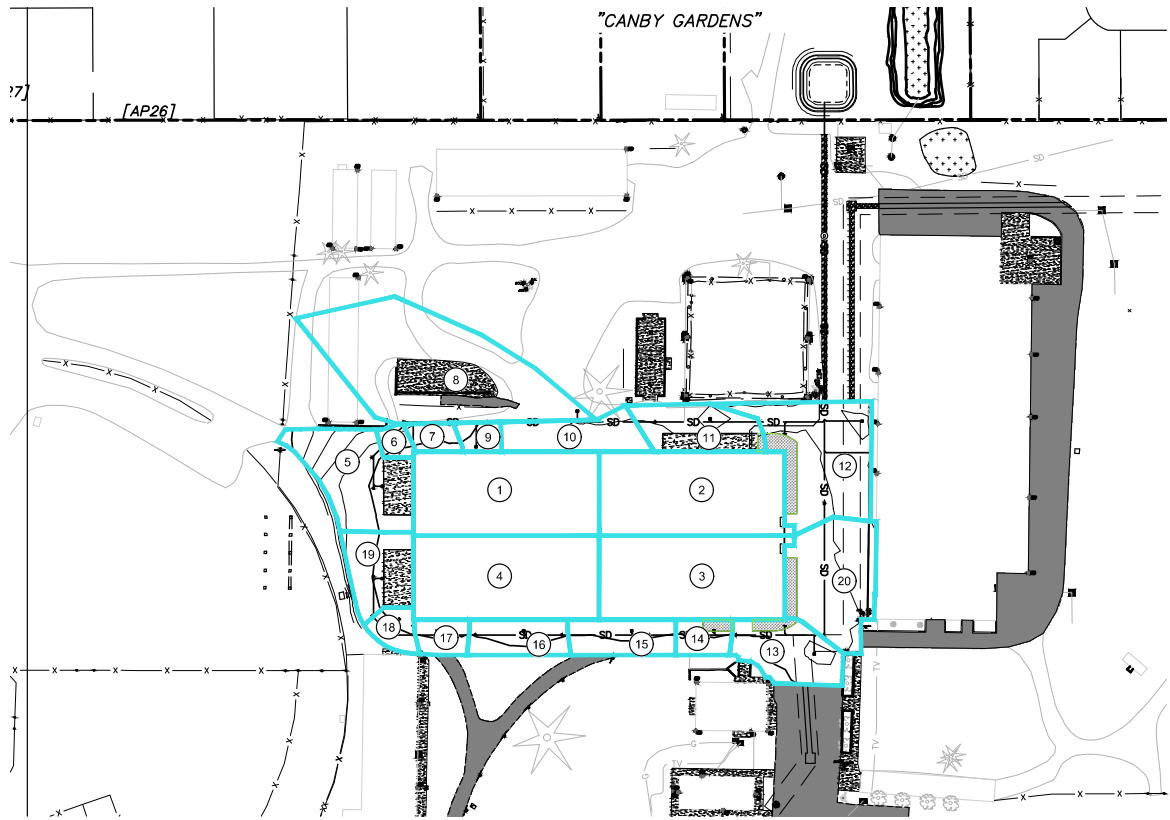


# UPSTREAM BASIN RUNOFF HYDROGRAPH



POST-DEVELOPED BASIN RUNOFF  
HYDROGRAPH





BASIN	IMP AREA (AC)	PERV AREA (AC)	DRAINS TO
1	0.248	0.000	SDRD 01
2	0.250	0.000	SDRD 02
3	0.250	0.000	SDRD 03
4	0.249	0.000	SDRD 04
5	0.147	0.000	SDCB 01
6	0.015	0.000	SDCB 02
7	0.022	0.000	SDCB 03
8	0.211	0.135	SDCB 05
9	0.020	0.000	SDCB 04
10	0.076	0.000	SDCB 05
11	0.086	0.000	SDCB 06
12	0.169	0.022	SCB 07
13	0.084	0.007	SDCB 08
14	0.026	0.005	SDCB 09
15	0.060	0.000	SDCB 10
16	0.056	0.000	SDCB 11
17	0.029	0.000	SBCB 12
18	0.028	0.000	SDCB 13
19	0.082	0.000	SDCB 14
20	0.146	0.012	SDTD01- END

IMPERVIOUS CN = 98  
PERVIOUS CN = 61  
TIME OF CONCENTRATION = 5 MIN

N

W

E

S

SCALE: 1" = 80'  
0 80 FT

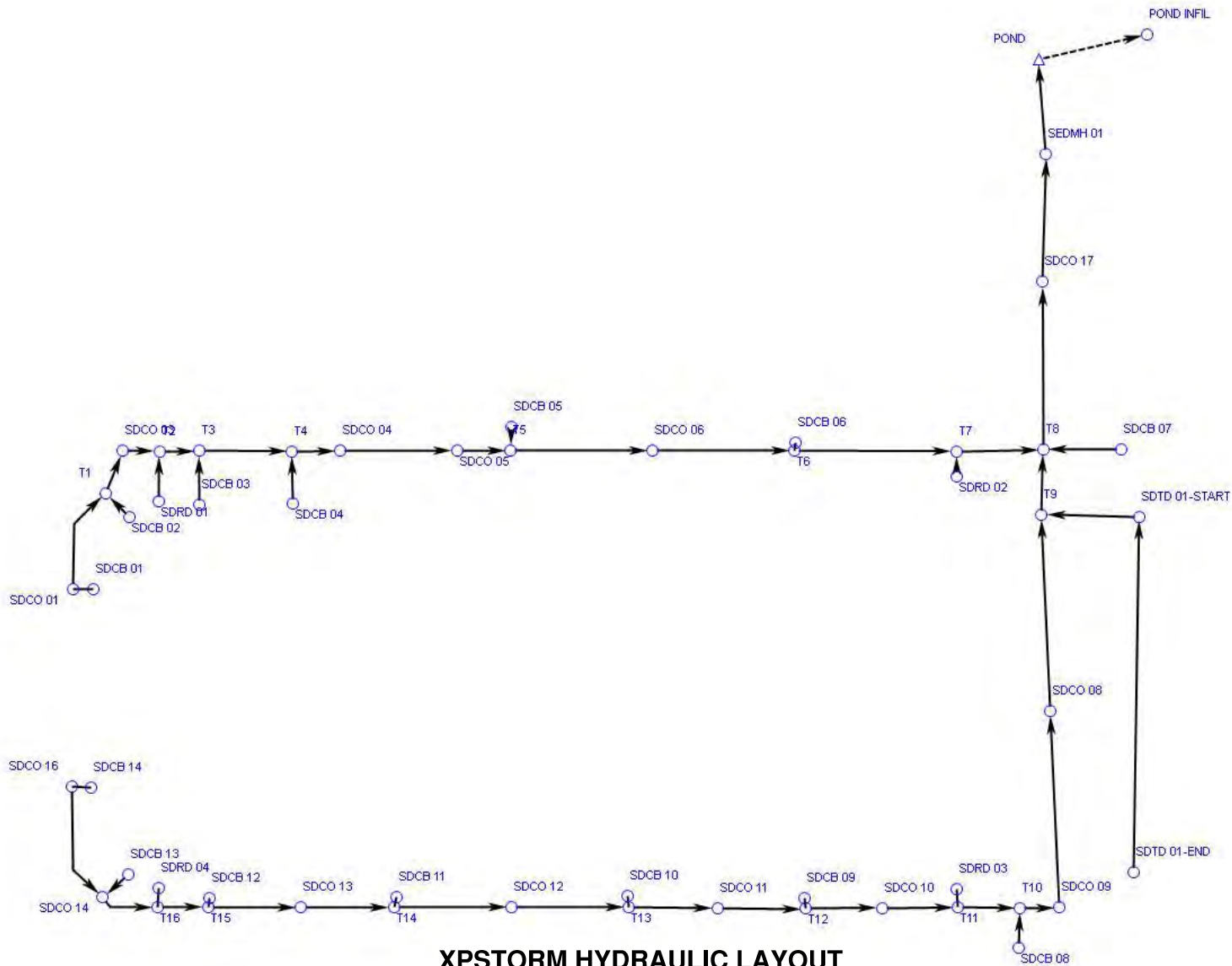
MAY 2023

**CLACKAMAS COUNTY FAIRGROUNDS  
MULTI-PURPOSE BUILDING**

CLACKAMAS COUNTY FAIRGROUNDS

POST-DEVELOPED CONVEYANCE BASINS

**3J CONSULTING**  
ENVIRONMENTAL ENGINEERING • WATER RESOURCES • COMMUNITY PLANNING





XPSTORM RUNOFF DATA: CONTRIBUTING CONVEYANCE BASIN														
INPUT FOR XPSTORM: POST-DEVELOPED														
Node Name	Runoff Parameters (Input)				2-yr Storm Event		5-yr Storm Event		10-yr Storm Event		25-yr Storm Event		100-yr Storm Event	
	Area	Imp	CN	Tc	Precip	Peak	Precip	Peak	Precip	Peak	Precip	Peak	Precip	Peak
	ac	%		min.	in	cfs	in	cfs	in	cfs	in	cfs	in	cfs
<b>SDCB 01</b>	0.15	100	98	5	2.5	0.09	3	0.10	3.50	0.12	4.00	0.14	4.50	0.16
<b>SDCB 02</b>	0.02	100	98	5	2.5	0.01	3	0.01	3.50	0.01	4.00	0.01	4.50	0.02
<b>SDRD 01</b>	0.25	100	98	5	2.5	0.14	3	0.17	3.50	0.20	4.00	0.23	4.50	0.26
<b>SDCB 03</b>	0.02	100	98	5	2.5	0.01	3	0.02	3.50	0.02	4.00	0.02	4.50	0.02
<b>SDCB 04</b>	0.02	100	98	5	2.5	0.01	3	0.01	3.50	0.02	4.00	0.02	4.50	0.02
<b>SDCB 05</b>	0.29	100	98	5	2.5	0.17	3	0.20	3.50	0.24	4.00	0.28	4.50	0.32
	0.14	0	61	5										
<b>SDCB 06</b>	0.09	100	98	5	2.5	0.05	3	0.06	3.50	0.07	4.00	0.08	4.50	0.09
<b>SDRD 02</b>	0.25	100	98	5	2.5	0.14	3	0.17	3.50	0.21	4.00	0.24	4.50	0.27
<b>SDCB 07</b>	0.17	100	98	5	2.5	0.10	3	0.12	3.50	0.14	4.00	0.16	4.50	0.18
	0.02	0	61	5										
<b>SDCB 14</b>	0.08	100	98	5	2.5	0.05	3	0.06	3.50	0.07	4.00	0.08	4.50	0.09
<b>SDTD 01-END</b>	0.15	100	98	5	2.5	0.08	3	0.10	3.50	0.12	4.00	0.14	4.50	0.16
	0.01	0	61	5										
<b>SDCB 13</b>	0.03	100	98	5	2.5	0.02	3	0.02	3.50	0.02	4.00	0.03	4.50	0.03
<b>SDRD 04</b>	0.25	100	98	5	2.5	0.14	3	0.17	3.50	0.20	4.00	0.23	4.50	0.26
<b>SDCB 12</b>	0.03	100	98	5	2.5	0.02	3	0.02	3.50	0.02	4.00	0.03	4.50	0.03
<b>SDCB 11</b>	0.06	100	98	5	2.5	0.03	3	0.04	3.50	0.05	4.00	0.05	4.50	0.06
<b>SDCB 10</b>	0.06	100	98	5	2.5	0.04	3	0.04	3.50	0.05	4.00	0.06	4.50	0.06
<b>SDCB 09</b>	0.03	100	98	5	2.5	0.02	3	0.02	3.50	0.03	4.00	0.03	4.50	0.03
	0.01	0	61	5										
<b>SDRD 03</b>	0.25	100	98	5	2.5	0.14	3	0.17	3.50	0.21	4.00	0.24	4.50	0.27
<b>SDCB 08</b>	0.08	100	98	5	2.5	0.05	3	0.06	3.50	0.07	4.00	0.08	4.50	0.09
	0.01	0	61	5										

XPSTORM CONVEYANCE DATA - CCFG - HYDRAULIC ANALYSIS POST-DEVELOPED CONDITIONS - 2-YEAR STORM EVENT																	
Location			Conduit Properties			Conduit Results						Conduit Profile					
Link	Station		Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max How Depth	y/d0	US Grnd	DS Grnd	US IE	DS IE	US Fb	DS Fb
	From	To	ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft
Link96	SDCB 01	SDCO 01	0.67	7.19	11.3	4.11	0.02	0.09	8.71	0.13	0.19	139.24	139.88	137.6	136.74	1.62	3.01
Link97	SDCO 01	T1	1.00	44.00	0.5	2.52	0.03	0.09	1.49	0.13	0.13	139.88	140.79	136.7	136.52	3.01	4.15
Link136	T1	SDCO 03	1.00	22.00	0.5	2.52	0.04	0.09	1.34	0.17	0.17	140.79	138.45	136.5	136.41	4.15	1.87
Link99	T2	T3	1.00	15.92	0.5	2.52	0.09	0.24	1.98	0.21	0.21	141.13	140.71	136.4	136.29	4.55	4.21
Link100	T3	T4	1.00	36.06	0.5	2.52	0.10	0.25	2.01	0.22	0.22	140.71	140.05	136.3	136.11	4.21	3.72
Link101	T4	SDCO 04	1.00	10.00	0.5	2.52	0.10	0.26	2.07	0.22	0.22	140.05	138.10	136.1	136.06	3.72	1.82
Link102	T5	SDCO 06	1.00	64.00	0.5	2.52	0.17	0.43	2.39	0.28	0.28	138.95	137.40	135.7	135.36	2.99	1.76
Link103	T6	T7	1.00	62.00	0.5	2.52	0.19	0.47	2.06	0.38	0.38	137.78	138.63	135.1	134.82	2.36	3.43
Link104	T7	T8	1.00	32.00	0.5	2.52	0.25	0.62	1.86	0.51	0.51	138.63	138.50	134.8	134.66	3.43	3.33
Link105	T8	SDCO 17	1.00	44.00	0.5	2.52	0.51	1.30	3.21	0.60	0.60	138.50	137.83	134.7	134.44	3.33	2.79
Link106	SDCB 02	T1	0.67	12.79	9.9	3.86	0.00	0.01	5.67	0.12	0.18	139.06	140.79	137.8	136.52	1.25	4.15
Link107	SDRD 01	T2	0.50	19.83	8.2	1.61	0.09	0.14	4.76	0.21	0.41	140.00	141.13	138.0	136.37	1.90	4.55
Link108	SDCB 03	T3	0.67	20.75	7.2	3.28	0.00	0.01	4.27	0.21	0.32	138.97	140.71	137.8	136.29	1.16	4.21
Link109	SDCB 04	T4	0.67	20.77	8.1	3.49	0.00	0.01	6.21	0.22	0.32	139.79	140.05	137.8	136.11	1.96	3.72
Link110	SDCB 05	T5	0.67	9.00	11.4	4.14	0.04	0.17	11.63	0.28	0.42	139.32	138.95	136.7	135.68	2.52	2.99
Link111	SDCB 06	T6	0.67	2.60	0.4	0.76	0.07	0.05	0.39	0.29	0.44	138.74	137.78	135.1	135.13	3.32	2.36
Link112	SDRD 02	T7	0.50	9.76	0.5	0.40	0.36	0.14	1.11	0.38	0.77	138.86	138.63	134.9	134.82	3.65	3.43
Link113	SDCB 07	T8	0.67	31.34	3.4	2.25	0.04	0.10	0.67	0.51	0.77	137.05	138.50	135.7	134.66	1.24	3.33
Link114	SDCB 14	SDCO 16	0.67	7.27	0.6	0.91	0.05	0.05	1.31	0.11	0.16	140.06	140.71	137.7	137.62	2.30	2.98
Link115	SDCO 16	SDCO 14	1.00	34.65	0.5	2.50	0.02	0.05	1.25	0.10	0.10	140.71	140.21	137.6	137.32	2.98	2.73
Link116	SDCO 14	T16	1.00	20.78	0.5	2.52	0.03	0.06	0.86	0.19	0.19	140.21	139.98	137.3	137.27	2.73	2.52
Link117	T16	T15	1.00	19.22	0.5	2.52	0.08	0.21	1.89	0.20	0.20	139.98	139.84	137.3	137.17	2.52	2.47
Link118	T15	SDCO 13	1.00	32.00	0.5	2.52	0.09	0.22	1.98	0.20	0.20	139.84	139.03	137.2	137.01	2.47	1.82
Link119	T14	SDCO 12	1.00	32.00	0.5	2.52	0.10	0.26	2.06	0.22	0.22	139.62	138.67	136.8	136.65	2.60	1.81
Link120	T13	SDCO 11	1.00	16.00	0.5	2.52	0.12	0.29	2.14	0.23	0.23	139.70	138.31	136.4	136.28	3.11	1.80
Link121	T12	SDCO 10	1.00	18.00	0.5	2.52	0.12	0.31	2.17	0.24	0.24	139.88	137.95	136.0	135.92	3.63	1.79
Link122	T11	T10	1.00	24.56	0.5	2.52	0.18	0.45	2.32	0.31	0.31	139.59	139.21	135.7	135.60	3.58	3.31
Link144	T10	SDCO 09	1.00	9.44	0.5	2.52	0.20	0.50	2.43	0.31	0.31	139.21	138.40	135.6	135.55	3.31	2.54
Link124	T9	T8	1.00	26.02	0.5	2.52	0.23	0.58	1.70	0.51	0.51	138.94	138.50	134.8	134.66	3.75	3.33
Link125	SDTD 01-END	SDTD 01-START	0.33	138.55	0.0	0.13	0.64	0.08	1.55	0.28	0.84	137.02	136.33	135.7	134.98	1.18	1.07
Link126	SDTD 01-START	T9	0.33	37.87	0.5	0.13	0.64	0.08	1.03	0.40	1.22	136.33	138.94	135.0	134.79	1.07	3.75
Link127	SDCB 13	SDCO 14	0.67	14.01	2.3	1.85	0.01	0.02	1.10	0.10	0.15	139.69	140.21	137.7	137.32	1.95	2.73
Link128	SDRD 04	T16	0.50	7.54	8.5	1.64	0.09	0.14	3.11	0.19	0.38	140.09	139.98	137.9	137.27	2.08	2.52
Link129	SDCB 12	T15	0.67	3.24	0.5	0.86	0.02	0.02	0.22	0.20	0.29	139.42	139.84	137.2	137.17	2.05	2.47
Link130	SDCB 11	T14	0.67	3.24	0.6	0.96	0.03	0.03	0.37	0.22	0.32	139.06	139.62	136.8	136.81	2.04	2.60
Link131	SDCB 10	T13	0.67	3.28	0.6	0.96	0.04	0.03	0.42	0.23	0.34	138.69	139.70	136.4	136.36	2.10	3.11
Link132	SDCB 09	T12	0.67	3.25	0.6	0.96	0.02	0.02	0.29	0.24	0.35	138.90	139.88	136.0	136.01	2.65	3.63
Link133	SDRD 03	T11	0.50	7.54	0.5	0.41	0.35	0.14	1.39	0.29	0.57	139.28	139.59	135.8	135.72	3.26	3.58
Link134	SDCB 08	T10	0.67	15.81	7.1	3.27	0.02	0.05	3.00	0.30	0.45	137.92	139.21	136.7	135.60	1.13	3.31
Link135	SDCO 03	T2	1.00	7.99	0.5	2.52	0.04	0.09	0.93	0.21	0.21	138.45	141.13	136.4	136.37	1.87	4.55
Link101.1	SDCO 04	SDCO 05	1.00	69.81	0.5	2.52	0.10	0.26	1.85	0.26	0.26	138.10	137.75	136.1	135.71	1.82	1.79
Link101.1.1	SDCO 05	T5	1.00	6.00	0.5	2.52	0.10	0.26	1.57	0.28	0.28	137.75	138.95	135.7	135.68	1.79	2.99
Link102.1	SDCO 06	T6	1.00	46.00	0.5	2.52	0.17	0.43	2.30	0.29	0.29	137.40	137.78	135.4	135.13	1.76	2.36
Link118.1	SDCO 13	T14	1.00	40.00	0.5	2.52	0.09	0.22	1.89	0.22	0.22	139.03	139.62	137.0	136.81	1.82	2.60
Link119.1	SDCO 12	T13	1.00	57.99	0.5	2.52	0.10	0.26	1.98	0.23	0.23	138.67	139.70	136.7	136.36	1.81	3.11
Link120.1	SDCO 11	T12	1.00	54.00	0.5	2.52	0.12	0.29	2.10	0.24	0.24	138.31	139.88	136.3	136.01	1.80	3.63
Link121.1	SDCO 10	T11	1.00	40.82	0.5	2.49	0.12	0.31	1.90	0.29	0.29	137.95	139.59	135.9	135.72	1.79	3.58
Link145	SDCO 09	SDCO 08	1.00	111.47	0.5	2.53	0.20	0.50	2.50	0.30	0.30	138.40	137.03	135.6	135.00	2.54	1.73
Link145.1	SDCO 08	T9	1.00	41.97	0.5	2.52	0.20	0.50	2.07	0.40	0.40	137.03	138.94	135.0	134.79	1.73	3.75
Link105.1	SDCO 17	SEDMH 01	1.00	112.00	0.5	2.52	0.51	1.28	2.36	1.01	1.01	137.83	137.23	134.4	130.68	2.79	2.34
Link105.1.1	SEDMH 01	POND	1.00	112.00	0.4	2.21	0.58	1.27	1.57	1.52	1.52	137.23	135.75	130.7	133.25	2.34	0.98

XPSTORM CONVEYANCE DATA - CCFG - HYDRAULIC ANALYSIS POST-DEVELOPED CONDITIONS - 5-YEAR STORM EVENT																	
Location			Conduit Properties			Conduit Results						Conduit Profile					
Link	Station		Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max How Depth	y/d0	US Grnd	DS Grnd	US IE	DS IE	US Fb	DS Fb
	From	To	ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft
Link96	SDCB 01	SDCO 01	0.67	7.19	11.3	4.11	0.03	0.10	8.80	0.14	0.21	139.24	139.88	137.6	136.74	1.62	3.00
Link97	SDCO 01	T1	1.00	44.00	0.5	2.52	0.04	0.10	1.57	0.14	0.14	139.88	140.79	136.7	136.52	3.00	4.14
Link136	T1	SDCO 03	1.00	22.00	0.5	2.52	0.05	0.11	1.38	0.19	0.19	140.79	138.45	136.5	136.41	4.14	1.85
Link99	T2	T3	1.00	15.92	0.5	2.52	0.11	0.29	2.09	0.23	0.23	141.13	140.71	136.4	136.29	4.53	4.19
Link100	T3	T4	1.00	36.06	0.5	2.52	0.12	0.30	2.13	0.24	0.24	140.71	140.05	136.3	136.11	4.19	3.70
Link101	T4	SDCO 04	1.00	10.00	0.5	2.52	0.13	0.32	2.19	0.24	0.24	140.05	138.10	136.1	136.06	3.70	1.80
Link102	T5	SDCO 06	1.00	64.00	0.5	2.52	0.20	0.52	2.52	0.31	0.31	138.95	137.40	135.7	135.36	2.96	1.73
Link103	T6	T7	1.00	62.00	0.5	2.52	0.23	0.57	2.10	0.51	0.51	137.78	138.63	135.1	134.82	2.33	3.30
Link104	T7	T8	1.00	32.00	0.5	2.52	0.29	0.74	1.89	0.65	0.65	138.63	138.50	134.8	134.66	3.30	3.19
Link105	T8	SDCO 17	1.00	44.00	0.5	2.52	0.61	1.54	3.29	0.79	0.79	138.50	137.83	134.7	134.44	3.19	2.60
Link106	SDCB 02	T1	0.67	12.79	9.9	3.86	0.00	0.01	5.67	0.14	0.20	139.06	140.79	137.8	136.52	1.25	4.14
Link107	SDRD 01	T2	0.50	19.83	8.2	1.61	0.11	0.17	4.72	0.23	0.46	140.00	141.13	138.0	136.37	1.89	4.53
Link108	SDCB 03	T3	0.67	20.75	7.2	3.28	0.01	0.02	5.48	0.23	0.35	138.97	140.71	137.8	136.29	1.16	4.19
Link109	SDCB 04	T4	0.67	20.77	8.1	3.49	0.00	0.01	4.83	0.24	0.36	139.79	140.05	137.8	136.11	1.96	3.70
Link110	SDCB 05	T5	0.67	9.00	11.4	4.14	0.05	0.20	5.32	0.31	0.46	139.32	138.95	136.7	135.68	2.51	2.96
Link111	SDCB 06	T6	0.67	2.60	0.4	0.76	0.08	0.06	0.40	0.33	0.49	138.74	137.78	135.1	135.13	3.29	2.33
Link112	SDRD 02	T7	0.50	9.76	0.5	0.40	0.43	0.17	1.15	0.51	1.02	138.86	138.63	134.9	134.82	3.53	3.30
Link113	SDCB 07	T8	0.67	31.34	3.4	2.25	0.05	0.12	0.72	0.65	0.97	137.05	138.50	135.7	134.66	1.23	3.19
Link114	SDCB 14	SDCO 16	0.67	7.27	0.6	0.91	0.06	0.06	1.39	0.12	0.18	140.06	140.71	137.7	137.62	2.29	2.97
Link115	SDCO 16	SDCO 14	1.00	34.65	0.5	2.50	0.02	0.06	1.32	0.11	0.11	140.71	140.21	137.6	137.32	2.97	2.72
Link116	SDCO 14	T16	1.00	20.78	0.5	2.52	0.03	0.08	0.91	0.21	0.21	140.21	139.98	137.3	137.27	2.72	2.50
Link117	T16	T15	1.00	19.22	0.5	2.52	0.10	0.25	2.00	0.22	0.22	139.98	139.84	137.3	137.17	2.50	2.45
Link118	T15	SDCO 13	1.00	32.00	0.5	2.52	0.11	0.27	2.09	0.22	0.22	139.84	139.03	137.2	137.01	2.45	1.80
Link119	T14	SDCO 12	1.00	32.00	0.5	2.52	0.12	0.31	2.18	0.24	0.24	139.62	138.67	136.8	136.65	2.57	1.78
Link120	T13	SDCO 11	1.00	16.00	0.5	2.52	0.14	0.35	2.26	0.25	0.25	139.70	138.31	136.4	136.28	3.09	1.78
Link121	T12	SDCO 10	1.00	18.00	0.5	2.52	0.15	0.37	2.29	0.26	0.26	139.88	137.95	136.0	135.92	3.61	1.77
Link122	T11	T10	1.00	24.56	0.5	2.52	0.22	0.55	2.48	0.34	0.34	139.59	139.21	135.7	135.60	3.55	3.28
Link144	T10	SDCO 09	1.00	9.44	0.5	2.52	0.24	0.61	2.67	0.34	0.34	139.21	138.40	135.6	135.55	3.28	2.51
Link124	T9	T8	1.00	26.02	0.5	2.52	0.28	0.70	1.71	0.65	0.65	138.94	138.50	134.8	134.66	3.62	3.19
Link125	SDTD 01-END	SDTD 01-START	0.33	138.55	0.0	0.13	0.76	0.10	1.58	0.45	1.35	137.02	136.33	135.7	134.98	1.13	0.90
Link126	SDTD 01-START	T9	0.33	37.87	0.5	0.13	0.75	0.10	1.15	0.53	1.62	136.33	138.94	135.0	134.79	0.90	3.62
Link127	SDCB 13	SDCO 14	0.67	14.01	2.3	1.85	0.01	0.02	1.10	0.11	0.17	139.69	140.21	137.7	137.32	1.94	2.72
Link128	SDRD 04	T16	0.50	7.54	8.5	1.64	0.11	0.17	3.30	0.21	0.42	140.09	139.98	137.9	137.27	2.07	2.50
Link129	SDCB 12	T15	0.67	3.24	0.5	0.86	0.02	0.02	0.22	0.22	0.32	139.42	139.84	137.2	137.17	2.03	2.45
Link130	SDCB 11	T14	0.67	3.24	0.6	0.96	0.04	0.04	0.38	0.24	0.35	139.06	139.62	136.8	136.81	2.01	2.57
Link131	SDCB 10	T13	0.67	3.28	0.6	0.96	0.04	0.04	0.44	0.25	0.38	138.69	139.70	136.4	136.36	2.08	3.09
Link132	SDCB 09	T12	0.67	3.25	0.6	0.96	0.02	0.02	0.30	0.26	0.39	138.90	139.88	136.0	136.01	2.63	3.61
Link133	SDRD 03	T11	0.50	7.54	0.5	0.41	0.43	0.17	1.45	0.32	0.63	139.28	139.59	135.8	135.72	3.23	3.55
Link134	SDCB 08	T10	0.67	15.81	7.1	3.27	0.02	0.06	2.92	0.33	0.50	137.92	139.21	136.7	135.60	1.13	3.28
Link135	SDCO 03	T2	1.00	7.99	0.5	2.52	0.05	0.11	0.97	0.23	0.23	138.45	141.13	136.4	136.37	1.85	4.53
Link101.1	SDCO 04	SDCO 05	1.00	69.81	0.5	2.52	0.13	0.32	1.95	0.28	0.28	138.10	137.75	136.1	135.71	1.80	1.76
Link101.1.1	SDCO 05	T5	1.00	6.00	0.5	2.52	0.13	0.32	1.64	0.31	0.31	137.75	138.95	135.7	135.68	1.76	2.96
Link102.1	SDCO 06	T6	1.00	46.00	0.5	2.52	0.20	0.52	2.43	0.33	0.33	137.40	137.78	135.4	135.13	1.73	2.33
Link118.1	SDCO 13	T14	1.00	40.00	0.5	2.52	0.11	0.27	2.00	0.24	0.24	139.03	139.62	137.0	136.81	1.80	2.57
Link119.1	SDCO 12	T13	1.00	57.99	0.5	2.52	0.12	0.31	2.09	0.25	0.25	138.67	139.70	136.7	136.36	1.78	3.09
Link120.1	SDCO 11	T12	1.00	54.00	0.5	2.52	0.14	0.35	2.21	0.26	0.26	138.31	139.88	136.3	136.01	1.78	3.61
Link121.1	SDCO 10	T11	1.00	40.82	0.5	2.49	0.15	0.37	2.01	0.32	0.32	137.95	139.59	135.9	135.72	1.77	3.55
Link145	SDCO 09	SDCO 08	1.00	111.47	0.5	2.53	0.24	0.61	2.63	0.36	0.36	138.40	137.03	135.6	135.00	2.51	1.67
Link145.1	SDCO 08	T9	1.00	41.97	0.5	2.52	0.24	0.61	2.10	0.53	0.53	137.03	138.94	135.0	134.79	1.67	3.62
Link105.1	SDCO 17	SEDMH 01	1.00	112.00	0.5	2.52	0.61	1.53	2.45	1.19	1.19	137.83	137.23	134.4	130.68	2.60	2.16
Link105.1.1	SEDMH 01	POND	1.00	112.00	0.4	2.21	0.69	1.52	1.93	1.64	1.64	137.23	135.75	130.7	133.25	2.16	0.86

XPSTORM CONVEYANCE DATA - CCFG - HYDRAULIC ANALYSIS POST-DEVELOPED CONDITIONS - 10-YEAR STORM EVENT																	
Location			Conduit Properties			Conduit Results						Conduit Profile					
Link	Station		Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max How Depth	y/d0	US Grnd	DS Grnd	US IE	DS IE	US Fb	DS Fb
	From	To	ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft
Link96	SDCB 01	SDCO 01	0.67	7.19	11.3	4.11	0.03	0.12	11.39	0.15	0.22	139.24	139.88	137.6	136.74	1.61	2.99
Link97	SDCO 01	T1	1.00	44.00	0.5	2.52	0.05	0.12	1.60	0.16	0.16	139.88	140.79	136.7	136.52	2.99	4.11
Link136	T1	SDCO 03	1.00	22.00	0.5	2.52	0.05	0.13	1.37	0.21	0.21	140.79	138.45	136.5	136.41	4.11	1.83
Link99	T2	T3	1.00	15.92	0.5	2.52	0.13	0.34	2.19	0.25	0.25	141.13	140.71	136.4	136.29	4.51	4.17
Link100	T3	T4	1.00	36.06	0.5	2.52	0.14	0.35	2.23	0.26	0.26	140.71	140.05	136.3	136.11	4.17	3.68
Link101	T4	SDCO 04	1.00	10.00	0.5	2.52	0.15	0.37	2.29	0.26	0.26	140.05	138.10	136.1	136.06	3.68	1.78
Link102	T5	SDCO 06	1.00	64.00	0.5	2.52	0.24	0.61	2.64	0.33	0.33	138.95	137.40	135.7	135.36	2.94	1.71
Link103	T6	T7	1.00	62.00	0.5	2.52	0.27	0.67	2.13	0.75	0.75	137.78	138.63	135.1	134.82	2.19	3.06
Link104	T7	T8	1.00	32.00	0.5	2.52	0.34	0.85	1.92	0.90	0.90	138.63	138.50	134.8	134.66	3.06	2.94
Link105	T8	SDCO 17	1.00	44.00	0.5	2.52	0.69	1.74	3.32	1.04	1.04	138.50	137.83	134.7	134.44	2.94	2.35
Link106	SDCB 02	T1	0.67	12.79	9.9	3.86	0.00	0.01	5.65	0.16	0.23	139.06	140.79	137.8	136.52	1.24	4.11
Link107	SDRD 01	T2	0.50	19.83	8.2	1.61	0.13	0.20	6.27	0.25	0.49	140.00	141.13	138.0	136.37	1.88	4.51
Link108	SDCB 03	T3	0.67	20.75	7.2	3.28	0.01	0.02	4.30	0.25	0.38	138.97	140.71	137.8	136.29	1.16	4.17
Link109	SDCB 04	T4	0.67	20.77	8.1	3.49	0.01	0.02	6.19	0.26	0.39	139.79	140.05	137.8	136.11	1.96	3.68
Link110	SDCB 05	T5	0.67	9.00	11.4	4.14	0.06	0.24	5.12	0.33	0.50	139.32	138.95	136.7	135.68	2.50	2.94
Link111	SDCB 06	T6	0.67	2.60	0.4	0.76	0.09	0.07	0.40	0.46	0.69	138.74	137.78	135.1	135.13	3.15	2.19
Link112	SDRD 02	T7	0.50	9.76	0.5	0.40	0.50	0.20	1.16	0.75	1.50	138.86	138.63	134.9	134.82	3.28	3.06
Link113	SDCB 07	T8	0.67	31.34	3.4	2.25	0.06	0.14	0.76	0.90	1.34	137.05	138.50	135.7	134.66	1.22	2.94
Link114	SDCB 14	SDCO 16	0.67	7.27	0.6	0.91	0.07	0.07	1.47	0.13	0.19	140.06	140.71	137.7	137.62	2.28	2.96
Link115	SDCO 16	SDCO 14	1.00	34.65	0.5	2.50	0.03	0.07	1.39	0.12	0.12	140.71	140.21	137.6	137.32	2.96	2.70
Link116	SDCO 14	T16	1.00	20.78	0.5	2.52	0.04	0.09	0.93	0.23	0.23	140.21	139.98	137.3	137.27	2.70	2.48
Link117	T16	T15	1.00	19.22	0.5	2.52	0.12	0.29	2.09	0.24	0.24	139.98	139.84	137.3	137.17	2.48	2.43
Link118	T15	SDCO 13	1.00	32.00	0.5	2.52	0.13	0.32	2.19	0.24	0.24	139.84	139.03	137.2	137.01	2.43	1.78
Link119	T14	SDCO 12	1.00	32.00	0.5	2.52	0.14	0.36	2.28	0.26	0.26	139.62	138.67	136.8	136.65	2.55	1.76
Link120	T13	SDCO 11	1.00	16.00	0.5	2.52	0.16	0.41	2.36	0.27	0.27	139.70	138.31	136.4	136.28	3.07	1.76
Link121	T12	SDCO 10	1.00	18.00	0.5	2.52	0.17	0.44	2.40	0.28	0.28	139.88	137.95	136.0	135.92	3.59	1.75
Link122	T11	T10	1.00	24.56	0.5	2.52	0.25	0.64	2.56	0.37	0.37	139.59	139.21	135.7	135.60	3.53	3.25
Link144	T10	SDCO 09	1.00	9.44	0.5	2.52	0.28	0.71	2.69	0.37	0.37	139.21	138.40	135.6	135.55	3.25	2.48
Link124	T9	T8	1.00	26.02	0.5	2.52	0.31	0.79	1.71	0.90	0.90	138.94	138.50	134.8	134.66	3.37	2.94
Link125	SDTD 01-END	SDTD 01-START	0.33	138.55	0.0	0.13	0.87	0.11	1.61	0.72	2.18	137.02	136.33	135.7	134.98	0.83	0.63
Link126	SDTD 01-START	T9	0.33	37.87	0.5	0.13	0.84	0.11	1.27	0.78	2.36	136.33	138.94	135.0	134.79	0.63	3.37
Link127	SDCB 13	SDCO 14	0.67	14.01	2.3	1.85	0.01	0.02	1.29	0.13	0.19	139.69	140.21	137.7	137.32	1.94	2.70
Link128	SDRD 04	T16	0.50	7.54	8.5	1.64	0.13	0.20	3.48	0.23	0.45	140.09	139.98	137.9	137.27	2.06	2.48
Link129	SDCB 12	T15	0.67	3.24	0.5	0.86	0.03	0.02	0.28	0.24	0.35	139.42	139.84	137.2	137.17	2.01	2.43
Link130	SDCB 11	T14	0.67	3.24	0.6	0.96	0.05	0.05	0.40	0.26	0.38	139.06	139.62	136.8	136.81	1.99	2.55
Link131	SDCB 10	T13	0.67	3.28	0.6	0.96	0.05	0.05	0.44	0.27	0.41	138.69	139.70	136.4	136.36	2.06	3.07
Link132	SDCB 09	T12	0.67	3.25	0.6	0.96	0.03	0.03	0.30	0.28	0.42	138.90	139.88	136.0	136.01	2.61	3.59
Link133	SDRD 03	T11	0.50	7.54	0.5	0.41	0.50	0.21	1.51	0.35	0.69	139.28	139.59	135.8	135.72	3.20	3.53
Link134	SDCB 08	T10	0.67	15.81	7.1	3.27	0.02	0.07	2.86	0.37	0.55	137.92	139.21	136.7	135.60	1.12	3.25
Link135	SDCO 03	T2	1.00	7.99	0.5	2.52	0.05	0.13	1.00	0.25	0.25	138.45	141.13	136.4	136.37	1.83	4.51
Link101.1	SDCO 04	SDCO 05	1.00	69.81	0.5	2.52	0.15	0.37	2.03	0.31	0.31	138.10	137.75	136.1	135.71	1.78	1.73
Link101.1.1	SDCO 05	T5	1.00	6.00	0.5	2.52	0.15	0.37	1.70	0.33	0.33	137.75	138.95	135.7	135.68	1.73	2.94
Link102.1	SDCO 06	T6	1.00	46.00	0.5	2.52	0.24	0.61	2.54	0.46	0.46	137.40	137.78	135.4	135.13	1.71	2.19
Link118.1	SDCO 13	T14	1.00	40.00	0.5	2.52	0.13	0.32	2.10	0.26	0.26	139.03	139.62	137.0	136.81	1.78	2.55
Link119.1	SDCO 12	T13	1.00	57.99	0.5	2.52	0.14	0.36	2.19	0.27	0.27	138.67	139.70	136.7	136.36	1.76	3.07
Link120.1	SDCO 11	T12	1.00	54.00	0.5	2.52	0.16	0.41	2.32	0.28	0.28	138.31	139.88	136.3	136.01	1.76	3.59
Link121.1	SDCO 10	T11	1.00	40.82	0.5	2.49	0.18	0.44	2.09	0.35	0.35	137.95	139.59	135.9	135.72	1.75	3.53
Link145	SDCO 09	SDCO 08	1.00	111.47	0.5	2.53	0.28	0.71	2.67	0.58	0.58	138.40	137.03	135.6	135.00	2.48	1.45
Link145.1	SDCO 08	T9	1.00	41.97	0.5	2.52	0.27	0.69	2.12	0.78	0.78	137.03	138.94	135.0	134.79	1.45	3.37
Link105.1	SDCO 17	SEDMH 01	1.00	112.00	0.5	2.52	0.69	1.73	2.49	1.35	1.35	137.83	137.23	134.4	130.68	2.35	2.00
Link105.1.1	SEDMH 01	POND	1.00	112.00	0.4	2.21	0.78	1.72	2.18	1.75	1.75	137.23	135.75	130.7	133.25	2.00	0.75

XPSTORM CONVEYANCE DATA - CCFG - HYDRAULIC ANALYSIS POST-DEVELOPED CONDITIONS - 25-YEAR STORM EVENT																	
Location			Conduit Properties			Conduit Results						Conduit Profile					
Link	Station		Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max How Depth	y/d0	US Grnd	DS Grnd	US IE	DS IE	US Fb	DS Fb
	From	To	ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft
Link96	SDCB 01	SDCO 01	0.67	7.19	11.3	4.11	0.03	0.14	11.37	0.16	0.24	139.24	139.88	137.6	136.74	1.61	2.98
Link97	SDCO 01	T1	1.00	44.00	0.5	2.52	0.06	0.14	1.67	0.17	0.17	139.88	140.79	136.7	136.52	2.98	4.10
Link136	T1	SDCO 03	1.00	22.00	0.5	2.52	0.06	0.15	1.41	0.23	0.23	140.79	138.45	136.5	136.41	4.10	1.81
Link99	T2	T3	1.00	15.92	0.5	2.52	0.15	0.39	2.28	0.27	0.27	141.13	140.71	136.4	136.29	4.50	4.15
Link100	T3	T4	1.00	36.06	0.5	2.52	0.16	0.41	2.32	0.28	0.28	140.71	140.05	136.3	136.11	4.15	3.66
Link101	T4	SDCO 04	1.00	10.00	0.5	2.52	0.17	0.42	2.39	0.28	0.28	140.05	138.10	136.1	136.06	3.66	1.76
Link102	T5	SDCO 06	1.00	64.00	0.5	2.52	0.28	0.70	2.74	0.57	0.57	138.95	137.40	135.7	135.36	2.91	1.48
Link103	T6	T7	1.00	62.00	0.5	2.52	0.29	0.73	2.15	1.08	1.08	137.78	138.63	135.1	134.82	1.87	2.74
Link104	T7	T8	1.00	32.00	0.5	2.52	0.38	0.95	1.94	1.22	1.22	138.63	138.50	134.8	134.66	2.74	2.62
Link105	T8	SDCO 17	1.00	44.00	0.5	2.52	0.78	1.97	3.32	1.30	1.30	138.50	137.83	134.7	134.44	2.62	2.09
Link106	SDCB 02	T1	0.67	12.79	9.9	3.86	0.00	0.01	5.66	0.17	0.25	139.06	140.79	137.8	136.52	1.24	4.10
Link107	SDRD 01	T2	0.50	19.83	8.2	1.61	0.15	0.23	6.26	0.27	0.53	140.00	141.13	138.0	136.37	1.87	4.50
Link108	SDCB 03	T3	0.67	20.75	7.2	3.28	0.01	0.02	5.48	0.27	0.41	138.97	140.71	137.8	136.29	1.15	4.15
Link109	SDCB 04	T4	0.67	20.77	8.1	3.49	0.01	0.02	4.89	0.28	0.41	139.79	140.05	137.8	136.11	1.96	3.66
Link110	SDCB 05	T5	0.67	9.00	11.4	4.14	0.07	0.28	5.08	0.36	0.54	139.32	138.95	136.7	135.68	2.49	2.91
Link111	SDCB 06	T6	0.67	2.60	0.4	0.76	0.10	0.08	0.42	0.78	1.17	138.74	137.78	135.1	135.13	2.83	1.87
Link112	SDRD 02	T7	0.50	9.76	0.5	0.40	0.57	0.23	1.16	1.08	2.15	138.86	138.63	134.9	134.82	2.95	2.74
Link113	SDCB 07	T8	0.67	31.34	3.4	2.25	0.08	0.17	0.88	1.22	1.82	137.05	138.50	135.7	134.66	1.18	2.62
Link114	SDCB 14	SDCO 16	0.67	7.27	0.6	0.91	0.09	0.08	1.54	0.14	0.20	140.06	140.71	137.7	137.62	2.27	2.96
Link115	SDCO 16	SDCO 14	1.00	34.65	0.5	2.50	0.03	0.08	1.45	0.13	0.13	140.71	140.21	137.6	137.32	2.96	2.69
Link116	SDCO 14	T16	1.00	20.78	0.5	2.52	0.04	0.10	0.95	0.25	0.25	140.21	139.98	137.3	137.27	2.69	2.47
Link117	T16	T15	1.00	19.22	0.5	2.52	0.13	0.34	2.18	0.26	0.26	139.98	139.84	137.3	137.17	2.47	2.41
Link118	T15	SDCO 13	1.00	32.00	0.5	2.52	0.15	0.36	2.28	0.26	0.26	139.84	139.03	137.2	137.01	2.41	1.76
Link119	T14	SDCO 12	1.00	32.00	0.5	2.52	0.17	0.42	2.37	0.28	0.28	139.62	138.67	136.8	136.65	2.54	1.75
Link120	T13	SDCO 11	1.00	16.00	0.5	2.52	0.19	0.47	2.46	0.29	0.29	139.70	138.31	136.4	136.28	3.05	1.74
Link121	T12	SDCO 10	1.00	18.00	0.5	2.52	0.20	0.50	2.49	0.30	0.30	139.88	137.95	136.0	135.92	3.57	1.73
Link122	T11	T10	1.00	24.56	0.5	2.52	0.29	0.74	2.65	0.40	0.40	139.59	139.21	135.7	135.60	3.50	3.21
Link144	T10	SDCO 09	1.00	9.44	0.5	2.52	0.32	0.82	2.80	0.42	0.42	139.21	138.40	135.6	135.55	3.21	2.43
Link124	T9	T8	1.00	26.02	0.5	2.52	0.36	0.92	1.70	1.22	1.22	138.94	138.50	134.8	134.66	3.05	2.62
Link125	SDTD 01-END	SDTD 01-START	0.33	138.55	0.0	0.13	0.99	0.13	1.57	1.08	3.27	137.02	136.33	135.7	134.98	0.32	0.27
Link126	SDTD 01-START	T9	0.33	37.87	0.5	0.13	0.96	0.13	1.45	1.10	3.34	136.33	138.94	135.0	134.79	0.27	3.05
Link127	SDCB 13	SDCO 14	0.67	14.01	2.3	1.85	0.01	0.03	1.29	0.14	0.22	139.69	140.21	137.7	137.32	1.93	2.69
Link128	SDRD 04	T16	0.50	7.54	8.5	1.64	0.14	0.23	3.64	0.24	0.49	140.09	139.98	137.9	137.27	2.05	2.47
Link129	SDCB 12	T15	0.67	3.24	0.5	0.86	0.03	0.03	0.28	0.25	0.38	139.42	139.84	137.2	137.17	1.99	2.41
Link130	SDCB 11	T14	0.67	3.24	0.6	0.96	0.06	0.05	0.41	0.28	0.41	139.06	139.62	136.8	136.81	1.98	2.54
Link131	SDCB 10	T13	0.67	3.28	0.6	0.96	0.06	0.06	0.44	0.29	0.44	138.69	139.70	136.4	136.36	2.04	3.05
Link132	SDCB 09	T12	0.67	3.25	0.6	0.96	0.03	0.03	0.30	0.30	0.45	138.90	139.88	136.0	136.01	2.59	3.57
Link133	SDRD 03	T11	0.50	7.54	0.5	0.41	0.58	0.24	1.57	0.37	0.75	139.28	139.59	135.8	135.72	3.17	3.50
Link134	SDCB 08	T10	0.67	15.81	7.1	3.27	0.03	0.08	3.92	0.40	0.60	137.92	139.21	136.7	135.60	1.12	3.21
Link135	SDCO 03	T2	1.00	7.99	0.5	2.52	0.06	0.15	1.03	0.27	0.27	138.45	141.13	136.4	136.37	1.81	4.50
Link101.1	SDCO 04	SDCO 05	1.00	69.81	0.5	2.52	0.17	0.42	2.09	0.34	0.34	138.10	137.75	136.1	135.71	1.76	1.70
Link101.1.1	SDCO 05	T5	1.00	6.00	0.5	2.52	0.17	0.42	1.75	0.36	0.36	137.75	138.95	135.7	135.68	1.70	2.91
Link102.1	SDCO 06	T6	1.00	46.00	0.5	2.52	0.28	0.69	2.59	0.78	0.78	137.40	137.78	135.4	135.13	1.48	1.87
Link118.1	SDCO 13	T14	1.00	40.00	0.5	2.52	0.15	0.36	2.18	0.28	0.28	139.03	139.62	137.0	136.81	1.76	2.54
Link119.1	SDCO 12	T13	1.00	57.99	0.5	2.52	0.17	0.42	2.28	0.29	0.29	138.67	139.70	136.7	136.36	1.75	3.05
Link120.1	SDCO 11	T12	1.00	54.00	0.5	2.52	0.19	0.47	2.41	0.30	0.30	138.31	139.88	136.3	136.01	1.74	3.57
Link121.1	SDCO 10	T11	1.00	40.82	0.5	2.49	0.20	0.50	2.17	0.37	0.37	137.95	139.59	135.9	135.72	1.73	3.50
Link145	SDCO 09	SDCO 08	1.00	111.47	0.5	2.53	0.32	0.82	2.69	0.91	0.91	138.40	137.03	135.6	135.00	2.43	1.12
Link145.1	SDCO 08	T9	1.00	41.97	0.5	2.52	0.31	0.78	2.12	1.10	1.10	137.03	138.94	135.0	134.79	1.12	3.05
Link105.1	SDCO 17	SEDMH 01	1.00	112.00	0.5	2.52	0.78	1.96	2.49	1.53	1.53	137.83	137.23	134.4	130.68	2.09	1.82
Link105.1.1	SEDMH 01	POND	1.00	112.00	0.4	2.21	0.89	1.96	2.48	1.86	1.86	137.23	135.75	130.7	133.25	1.82	0.64

XPSTORM CONVEYANCE DATA - CCFG - HYDRAULIC ANALYSIS POST-DEVELOPED CONDITIONS - 100-YEAR STORM EVENT																			
Location			Conduit Properties			Conduit Results						Conduit Profile							
Link	Station		Diameter ft	Length ft	Slope %	Design Capacity cfs	Qmax/ Qdesign	Max Flow cfs	Max Velocity ft/s	Max Flow Depth ft	y/d0	US Grnd ft	DS Grnd ft	US IE ft	DS IE ft	US Fb ft	DS Fb ft	US HGL ft	DS HGL ft
	From	To																	
Link96	SDCB 01	SDCO 01	0.67	7.19	11.3	4.11	0.04	0.16	11.39	0.17	0.25	139.24	139.88	137.6	136.74	1.60	2.97	137.64	136.91
Link97	SDCO 01	T1	1.00	44.00	0.5	2.52	0.06	0.16	1.72	0.18	0.18	139.88	140.79	136.7	136.52	2.97	4.09	136.91	136.70
Link136	T1	SDCO 03	1.00	22.00	0.5	2.52	0.07	0.17	1.45	0.25	0.25	140.79	138.45	136.5	136.41	4.09	1.80	136.70	136.66
Link99	T2	T3	1.00	15.92	0.5	2.52	0.17	0.43	2.36	0.29	0.29	141.13	140.71	136.4	136.29	4.48	4.13	136.65	136.58
Link100	T3	T4	1.00	36.06	0.5	2.52	0.18	0.46	2.40	0.30	0.30	140.71	140.05	136.3	136.11	4.13	3.65	136.58	136.41
Link101	T4	SDCO 04	1.00	10.00	0.5	2.52	0.19	0.48	2.47	0.30	0.30	140.05	138.10	136.1	136.06	3.65	1.75	136.41	136.36
Link102	T5	SDCO 06	1.00	64.00	0.5	2.52	0.32	0.79	2.80	0.87	0.87	138.95	137.40	135.7	135.36	2.70	1.17	136.25	136.23
Link103	T6	T7	1.00	62.00	0.5	2.52	0.33	0.82	2.18	1.36	1.36	137.78	138.63	135.1	134.82	1.57	2.45	136.21	136.18
Link104	T7	T8	1.00	32.00	0.5	2.52	0.42	1.06	1.98	1.49	1.49	138.63	138.50	134.8	134.66	2.45	2.35	136.18	136.15
Link105	T8	SDCO 17	1.00	44.00	0.5	2.52	0.87	2.19	3.28	1.55	1.55	138.50	137.83	134.7	134.44	2.35	1.84	136.15	135.99
Link106	SDCB 02	T1	0.67	12.79	9.9	3.86	0.00	0.02	5.66	0.18	0.26	139.06	140.79	137.8	136.52	1.24	4.09	137.82	136.70
Link107	SDRD 01	T2	0.50	19.83	8.2	1.61	0.16	0.26	4.80	0.28	0.56	140.00	141.13	138.0	136.37	1.86	4.48	138.14	136.65
Link108	SDCB 03	T3	0.67	20.75	7.2	3.28	0.01	0.02	4.15	0.29	0.43	138.97	140.71	137.8	136.29	1.15	4.13	137.82	136.58
Link109	SDCB 04	T4	0.67	20.77	8.1	3.49	0.01	0.02	6.19	0.30	0.44	139.79	140.05	137.8	136.11	1.95	3.65	137.84	136.41
Link110	SDCB 05	T5	0.67	9.00	11.4	4.14	0.08	0.32	6.54	0.57	0.85	139.32	138.95	136.7	135.68	2.48	2.70	136.84	136.25
Link111	SDCB 06	T6	0.67	2.60	0.4	0.76	0.12	0.09	0.44	1.08	1.62	138.74	137.78	135.1	135.13	2.53	1.57	136.21	136.21
Link112	SDRD 02	T7	0.50	9.76	0.5	0.40	0.66	0.27	1.34	1.36	2.72	138.86	138.63	134.9	134.82	2.66	2.45	136.20	136.18
Link113	SDCB 07	T8	0.67	31.34	3.4	2.25	0.10	0.22	0.99	1.49	2.23	137.05	138.50	135.7	134.66	0.90	2.35	136.15	136.15
Link114	SDCB 14	SDCO 16	0.67	7.27	0.6	0.91	0.10	0.09	1.61	0.14	0.21	140.06	140.71	137.7	137.62	2.26	2.95	137.80	137.76
Link115	SDCO 16	SDCO 14	1.00	34.65	0.5	2.50	0.04	0.09	1.50	0.13	0.13	140.71	140.21	137.6	137.32	2.95	2.67	137.76	137.54
Link116	SDCO 14	T16	1.00	20.78	0.5	2.52	0.05	0.12	0.97	0.26	0.26	140.21	139.98	137.3	137.27	2.67	2.45	137.54	137.53
Link117	T16	T15	1.00	19.22	0.5	2.52	0.15	0.38	2.25	0.27	0.27	139.98	139.84	137.3	137.17	2.45	2.40	137.53	137.44
Link118	T15	SDCO 13	1.00	32.00	0.5	2.52	0.16	0.41	2.36	0.27	0.27	139.84	139.03	137.2	137.01	2.40	1.75	137.44	137.28
Link119	T14	SDCO 12	1.00	32.00	0.5	2.52	0.19	0.47	2.45	0.29	0.29	139.62	138.67	136.8	136.65	2.52	1.73	137.10	136.94
Link120	T13	SDCO 11	1.00	16.00	0.5	2.52	0.21	0.53	2.54	0.31	0.31	139.70	138.31	136.4	136.28	3.03	1.72	136.67	136.59
Link121	T12	SDCO 10	1.00	18.00	0.5	2.52	0.23	0.57	2.58	0.37	0.37	139.88	137.95	136.0	135.92	3.54	1.66	136.34	136.29
Link122	T11	T10	1.00	24.56	0.5	2.52	0.33	0.82	2.72	0.66	0.66	139.59	139.21	135.7	135.60	3.32	2.96	136.27	136.25
Link144	T10	SDCO 09	1.00	9.44	0.5	2.52	0.36	0.91	2.88	0.70	0.70	139.21	138.40	135.6	135.55	2.96	2.15	136.25	136.25
Link124	T9	T8	1.00	26.02	0.5	2.52	0.40	1.00	1.67	1.49	1.49	138.94	138.50	134.8	134.66	2.77	2.35	136.17	136.15
Link125	SDTD 01-END	SDTD 01-START	0.33	138.55	0.0	0.13	1.10	0.14	1.65	1.35	4.09	137.02	136.33	135.7	134.98	0.00	0.00	137.02	136.33
Link126	SDTD 01-START	T9	0.33	37.87	0.5	0.13	1.04	0.14	1.57	1.38	4.19	136.33	138.94	135.0	134.79	0.00	2.77	136.33	136.17
Link127	SDCB 13	SDCO 14	0.67	14.01	2.3	1.85	0.02	0.03	1.29	0.16	0.24	139.69	140.21	137.7	137.32	1.93	2.67	137.76	137.54
Link128	SDRD 04	T16	0.50	7.54	8.5	1.64	0.16	0.26	3.78	0.26	0.52	140.09	139.98	137.9	137.27	2.04	2.45	138.05	137.53
Link129	SDCB 12	T15	0.67	3.24	0.5	0.86	0.04	0.03	0.29	0.27	0.40	139.42	139.84	137.2	137.17	1.98	2.40	137.44	137.44
Link130	SDCB 11	T14	0.67	3.24	0.6	0.96	0.06	0.06	0.42	0.29	0.44	139.06	139.62	136.8	136.81	1.96	2.52	137.10	137.10
Link131	SDCB 10	T13	0.67	3.28	0.6	0.96	0.07	0.06	0.46	0.31	0.47	138.69	139.70	136.4	136.36	2.02	3.03	136.67	136.67
Link132	SDCB 09	T12	0.67	3.25	0.6	0.96	0.03	0.03	0.31	0.33	0.49	138.90	139.88	136.0	136.01	2.56	3.54	136.34	136.34
Link133	SDRD 03	T11	0.50	7.54	0.5	0.41	0.64	0.26	1.64	0.55	1.09	139.28	139.59	135.8	135.72	3.00	3.32	136.28	136.27
Link134	SDCB 08	T10	0.67	15.81	7.1	3.27	0.03	0.09	3.89	0.65	0.98	137.92	139.21	136.7	135.60	1.11	2.96	136.81	136.25
Link135	SDCO 03	T2	1.00	7.99	0.5	2.52	0.07	0.17	1.06	0.28	0.28	138.45	141.13	136.4	136.37	1.80	4.48	136.66	136.65
Link101.1	SDCO 04	SDCO 05	1.00	69.81	0.5	2.52	0.19	0.48	2.15	0.54	0.54	138.10	137.75	136.1	135.71	1.75	1.50	136.36	136.25
Link101.1.1	SDCO 05	T5	1.00	6.00	0.5	2.52	0.19	0.48	1.78	0.57	0.57	137.75	138.95	135.7	135.68	1.50	2.70	136.25	136.25
Link102.1	SDCO 06	T6	1.00	46.00	0.5	2.52	0.30	0.76	2.64	1.08	1.08	137.40	137.78	135.4	135.13	1.17	1.57	136.23	136.21
Link118.1	SDCO 13	T14	1.00	40.00	0.5	2.52	0.16	0.41	2.26	0.29	0.29	139.03	139.62	137.0	136.81	1.75	2.52	137.28	137.10
Link119.1	SDCO 12	T13	1.00	57.99	0.5	2.52	0.19	0.47	2.35	0.31	0.31	138.67	139.70	136.7	136.36	1.73	3.03	136.94	136.67
Link120.1	SDCO 11	T12	1.00	54.00	0.5	2.52	0.21	0.53	2.49	0.33	0.33	138.31	139.88	136.3	136.01	1.72	3.54	136.59	136.34
Link121.1	SDCO 10	T11	1.00	40.82	0.5	2.49	0.23	0.57	2.23	0.55	0.55	137.95	139.59	135.9	135.72	1.66	3.32	136.29	136.27
Link145	SDCO 09	SDCO 08	1.00	111.47	0.5	2.53	0.36	0.90	2.71	1.20	1.20	138.40	137.03	135.6	135.00	2.15	0.83	136.25	136.20
Link145.1	SDCO 08	T9	1.00	41.97	0.5	2.52	0.34	0.87	2.12	1.38	1.38	137.03	138.94	135.0	134.79	0.83	2.77	136.20	136.17
Link105.1	SDCO 17	SEDMH 01	1.00	112.00	0.5	2.52	0.87	2.18	2.77	1.71	1.71	137.83	137.23	134.4	130.68	1.84	1.65	135.99	135.59
Link105.1.1	SEDMH 01	POND	1.00	112.00	0.4	2.21	0.99	2.18	2.76	1.96	1.96	137.23	135.75	130.7	133.25	1.65	0.54	135.59	135.21

# OPERATIONS & MAINTENANCE PLAN



Fowler Middle School, Tigard

If the Non-Structural Infiltration planter has side slopes (basin without vertical walls), soil conditions will vary from wet to relatively dry; several planting zones should be considered. The flat bottom area will be moist-to-wet, and the side slopes will vary from moist at the bottom to relatively dry near the top where inundation rarely occurs. The moisture gradient will depend upon the designed maximum water depth, total depth of the planter, and steepness of the side slopes. This moisture gradient is a transition zone and should be planted with species that tolerate occasional standing water, with hard plants that prefer drier conditions toward the top of the slope. Areas above the side slopes, immediately adjacent to the basin, and above the designed high-water line will not be inundated and should be planted with self-sustaining, low-maintenance grasses, perennials, and shrubs suitable for the local climate.

Native plants are encouraged, but non-invasive ornamentals that add aesthetic and functional value are acceptable with approval. All vegetation should be planted densely and evenly to ensure proper hydrological function of the Non-Structural Infiltration planter. For a complete list of allowable plants refer to page 76.

Quantities per 100 square feet:

- 115 herbaceous plants, 1' on center spacing, ½-gal container size; or
- 100 herbaceous plants, 1' on center, and 4 shrubs, 1-gal container size 2' on center.

Small trees are allowed in rain gardens and should be selected based on their adaptability to wet-to-moist conditions and full size at maturity. Trees should be placed along the side slopes of the facility rather than at the bottom. Trees should be a minimum 2 gallon by 2 feet tall. Dig planting area twice the width of tree rootball and the depth of the rootball plus 12" (or total depth of 30",— whichever is greater) should be backfilled with amended soil for optimal growth, with no sub-surface rock layer.

## Required Maintenance Period

- Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the Non-Structural Infiltration planter for a minimum of two years following construction and acceptance of the facility.

## Long-Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 88 for example maintenance agreement).

For detailed Operation and Maintenance Plans that describe proper maintenance activities, please refer to page 91.

All publicly maintained facilities not located in the public right-of-way must have a public easement to ensure access for maintenance.





## References

Clean Water Services Design and Construction Standards.


















## Infiltration Planter / Rain Garden Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✓ Task Complete Comments
Invasive Vegetation as outlined in Appendix A	Invasive vegetation found in facility. Examples include: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom	Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment.	 SPRING SUMMER FALL	
Obstructed Inlet/Outlet	Material such as vegetation, trash, sediment is blocking more than 10% of the inlet pipe or basin opening	Remove blockages from facility	 WINTER SPRING Inspect after major storm (1-inch in 24 hours)	
Excessive Vegetation	Vegetation grows so tall it competes with or shades approved emergent wetland grass/shrubs; interferes with access or becomes a fire danger	Cut tall grass 4" to 6" and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.	 SPRING Ideal time to prune emergent wetland grass is spring. Cut grass during dry months	
Tree/Shrub Growth	Tree/shrub growth shades out wetland/emergent grass in treatment area. Interferes with access for maintenance/inspection	Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City.	 WINTER Ideal timing for pruning trees is winter	





## Infiltration Planter / Rain Garden Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✓ Task Complete Comments
Hazard Trees	Observe dead, dying or diseased trees	Remove hazard trees. A certified arborist may need to determine health of tree or removal requirements	As Needed	
Poor Vegetation Coverage	80% survival of approved vegetation and no bare areas large enough to affect function of facility.	Determine cause of poor growth and correct the condition. Replant per the approved planting plan and applicable standards at the time of construction. Remove excessive weeds and all invasive plants.	 SPRING  FALL Ideal time to plant is spring and fall seasons	
Trash and Debris	Visual evidence of trash, debris or dumping	Remove trash and debris from facility. Dispose of properly	 SPRING  SUMMER  FALL  WINTER	
Contaminants and Pollution	Evidence of oil, gasoline, contaminants or other pollutants. Look for sheens, odor or signs of contamination.	If contaminants or pollutants are present, coordinate removal/cleanup with local jurisdiction	 SPRING  SUMMER  FALL  WINTER	
Erosion	Erosion or channelization that impacts or effects the function of the facility or creates a safety concern	Repair eroded areas and stabilize using proper erosion control measures. Establish appropriate vegetation as needed.	 FALL  WINTER  SPRING	
Flow Not Distributed Evenly	Flows unevenly distributed through planter width due to uneven or clogged flow spreader	Level the spreader and clean so that flows spread evenly over entire planter width	 WINTER  SPRING	

## Infiltration Planter / Rain Garden Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✓ Task Complete Comments
Vector Control	Evidence of rodents or water piping through facility via rodent holes. Insects such as wasps and hornets interfere with maintenance/inspection activities	Repair facility if damaged. Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options	As Needed	
Sediment Accumulation in Treatment Area	Sediment depth in treatment area exceeds 3 inches	Remove sediment from treatment area. Ensure planter is level from side to side and drains freely toward outlet; no standing water within 24 hours after any major storm (1-inch in 24 hours)	 SUMMER  FALL Ideally in the dry season	
Standing Water	Standing water in the planter between storms that does not drain freely. Water should drain after 24 hours of dry weather	Remove sediment or trash blockages; improve end to end grade so there is no standing water 24 hours after any major storm (1-inch in 24 hours)	 WINTER  SPRING Inspect after major storm (1-inch in 24 hours)	
Grate Damaged, Missing or Not in Place	Grate is missing or only partially in place may have missing or broken grate members	Grate must be in place and meets design standards. Replace or repair any open structure	As Needed	