COLLIER COUNTY RESOURCE RECOVERY BUSINESS PARK

ENGINEERING REPORT AND CALCULATIONS

PROJECT SUMMARY
SITE DEVELOPMENT PLAN AND CNSTR DESIGN CALCULATIONS

LOCATED IN SECTION 25 AND 36, TOWNSHIP 49 SOUTH, RANGE 26 EAST

COLLIER COUNTY, FLORIDA

PREPARED FOR:

COLLIER COUNT YSOLID AND HAZARDOUS WASTE MANAGEMENT
3339 TAMIAMI TRAIL EAST, SUITE 301
NAPLES, FLORIDA 34112

PREPARED BY:

Davidson Engineering, Inc.
4365 Radio Road, Suite 201
Naples, FL 34104

September 30, 2016
Revised February 22, 2017
Revised March 21, 2017

This item has been electronically signed and sealed by Ryan White P.E. using a SHA-1 authentication code.Printed copies of this document are not considered signed and sealed and the SHA-1 authentication code verified on any electronic copies.

Digitally signed by Ryan White, P.E. #67400
DN: cn=Ryan White, P.E. #67400, o=Davidson Engineering, Inc., ou, email=ryan@davidsonengineering.com, c=US
Date: 2017.03.30 13:55:32 -04'00'

JEFF L. DAVIDSON, P.E., Registration No. 47161
RYAN A. WHTIE, P.E., Registration No. 67400
ANDREW E. RATH, P.E., Registration No. 73996

TABLE OF CONTENTS

General & Existing Conditions

Collier County Resource Recovery Business Park is located north and west of the existing Collier County Landfill, Parcel ID 00289720004 and 00298560200, in Section 25 and 36, Township 49 South, Range 26 East, Collier County. The primary purpose for the development of the park is to establish additional services for the landfill and associated industrial uses. Currently the project is zoned Planned Unit Development under Ordinance #17-01 (Parcel ID 00289720004) and Rural Agricultural (Parcel ID 00298560200).

The proposed improvements will be directly connected to two other developments, Collier County Landfill and City Gate Industrial Park. The aforementioned existing developments will provide access to the site via City Gate Boulevard North and the extension of a 6" leachate line directing discharge from the landfill leachate line to the proposed deep injection well.

The Resource Recovery Business Park was originally permitted in 2012 under Florida Department of Environmental Protection (FDEP) through permit No. 11-0285328-002. The permit includes ±344 acres with a ±155-acre drainage basin being treated through dry detention conveyance swales (±4.96 acres) and three wet detention ponds (±24.32 acres). In 2014, File No. 11-285328-003 authorized phased construction of the surface water management system and phased mitigation within the ±344-acre boundary. Currently, the ±344 acres has ±40 acres cleared within Phase 1 of mitigation and clearing boundaries as shown within the modified FDEP permit. Since the ±40 acres were cleared per Phase One mitigation, ±16 acres of land has been added to the Resource Recovery Business Park stormwater management basin providing a total of ±360 acres. The additional ±16 acres are currently unimproved agricultural land that has not been permitted. The proposed ±16-acre expansion area has no wetlands. Additionally, the ±360-acre stormwater management basin has ±167.2 acres of conservation easements per Federal Department of Environmental Protection requirements as recorded per OR 5,066, Page 3,442. Per Collier County requirements there are ±172.2 acres of preserves within the 344-acre PUD zoned site per Ord. 17-01.

Plan of Construction

The Collier County Resource Recovery Business Park (RRBP) was originally permitted through Florida Department of Environmental Protection in 2009 as a ±344.22-acre property for landfill services. This original permit has been modified to allow for phased mitigation and development within in the property (File No. 11-285328-003 Modification of 11-285328-002). Since this revelation, an additional ±16 acres of property has been included into the site's storm water management basin creating an updated boundary area of ±360.22 acres.

The original permit provides a stormwater management system for the ±344.22-acre property within a ±153.78-acre drainage basin; refer to *Table 1.1 Land Use Summary Permit 11-0285328-002*.

Table 1.1 Land Use Summary Existing Permit 11-0285328-002

Land Use	Total Area	Impervious Pavement	Roof Area	Lake Area @ Control			Dry Pre-Treatment	Pervious Open Space	% Impervious (1)
				Lake #1	Lake #2	Lake #3			
Total Site	344.22	54.94	5.39	7.95	10.97	5.40	4.96	251.61	25%
Project Area (2)	155.03	54.94	5.39	7.95	10.97	5.40	4.96	65.42	55%
Drainage Basin	153.78	54.94	5.39	7.95	10.97	5.40	4.96	64.17	55%
Site Not Included (3)	189.19	Notes:							
		(1) % Impervious includes roof area and lake area							
		(2) Project area includes open space outside the drainage basin to be temporarily impacted by regrading and replanting to restore offsite drainage paths. Water quality is provided for the regraded space.							
		(3) Site not included is buffers, easements, setbacks, and preserves.							

The proposed improvements will utilize a similar water management system with the addition of ±16 acres of property creating a ±360.22-acre boundary. Analysis of the proposed stormwater management system will identify the required water quality and quantity volumes on site as well as the appropriate nutrient loading requirements for the overall master stormwater management system; refer to *Table 1.2 Proposed Land Use Summary*.

Table 1.2 Proposed Land Use Summary									
Land Use	Total Area	Impervious Pavement	Roof Area	Lake Area @ Control			Dry Pre-Treatment	Pervious Open Space	% Impervious (1)
				Lake #1	Lake #2	Lake #3			
Total Site	360.22	60.52	6.78	7.95	10.97	5.40	8.12	260.48	25%
Project Area (2)	167.71	60.52	6.78	7.95	10.97	5.40	8.12	67.97	55%
Drainage Basin	166.46	60.52	6.78	7.95	10.97	5.40	8.12	66.72	55%
Site Not Included (3)	193.76	Notes:							
		(1) % Impervious includes roof area and lake area							
		(2) Project area includes open space outside the drainage basin to be temporarily impacted by regrading and replanting to restore offsite drainage paths. Water quality is provided for the regraded space.							
		(3) Site not included is buffers, easements, setbacks, and preserves.							

Currently the ±360.22-acre property has a ±40 acre cleared portion per the approved phased mitigation plan. The proposed improvements to occur during this phase of construction will include the clearing of phase two mitigation and the construction of a proposed access road, phased stormwater management system, and a deep injection well servicing the existing landfill. Analysis of the proposed phased stormwater management system will identify the required water quality and quantity volumes as well as the appropriate nutrient loading requirements for the modified drainage basin; refer to *Table 1.3 Phased Proposed Land Use Summary*.

Table 1.3 Phased Proposed Land Use Summary									
Land Use	Total Area	Impervious Pavement*	Roof Area*	Lake Area @ Control			Dry Pre-Treatment	Pervious Open Space	% Impervious (1)*
				Lake #1	Lake #2	Lake #3			
Total Site	360.22	30.11	3.01	0	0	0	8.03	44.87	25%
Drainage Basin	82.76	30.11	3.01	0	0	0	8.03	41.61	40%
Site Not Included (2)	277.46	Notes:							
		(1) % Impervious includes impervious pavement, roof area, and lake area							
		(2) Site not included is buffers, easements, setbacks, Mitigation Phases 3-5, and preserves.							

*Modeling of the site within HydroCAD® identifies a larger amount of allowed impervious within the proposed storm water management system. To provide a factor of safety and to match the approved FDEP ERP (11-0285328-004) the areas located within Table 1.3 have been identified throughout the permit plans as the allowable impervious areas.

There will be additional offsite improvements that are associated with the construction of the Deep Injection Well and storm water management facilities. The improvements will include the installation of a 6-inch leachate line through the Collier County Landfill connecting into the existing landfill leachate system and an access road through the adjacent City Gate Commerce Park property. Both of these off-site improvements will be permitted under separate applications.

It should be noted, the proposed inter-connect roadway through the 16-acre site will be permitted separately from the 344-acre Resource Recovery Business Park to meet the intent of all zoning requirements. However, all modeling and design for the 366-acre stormwater management basin will occur as though it is a unified site.

Potable Water Supply

General Use and Irrigation:

Water service will be provided through Collier County Utilities. Potable water will be provided through the extension of the 12-inch water main from the City Gate Commerce Park development. The proposed ±2,802 LF of extended 12-inch water main will provide eight (8) proposed 8-inch blow-offs and hydrants with temporary sampling points, two (2) 10-inch water main stub-outs for future expansion, a permanent bacteria sampling point and an automatic flushing device at the mains termination.

Irrigation for the site will be provided via a water use permit through approval by South Florida Water Management District.

Chlorine Dissipation Analysis:

The potable water distribution system within the project is required to have a minimum chlorine level of 0.6 parts per million (PPM) per Collier County Utility Standards Manual. The analysis begins by assuming a static chlorine level of 2.0 PPM at the connection point in front of the project. Using a decay rate of 0.012 ppm per hour and solving for the elapsed time from the initial chlorine level to the minimum chlorine level results in the following:

$$C = C_o * e^{(-k*t)}$$

Where: C =0.6 ppm (minimum level)

C_o =2.0 ppm (initial level)

k = 0.012 ppm (decay rate)

t = time (hours)

Solving for the decay time yields:

$0.6ppm = 2.0\ ppm * e^{(-0.012*t)}$ ➔ t = 100.33 hours

The result of the above equation is that a dead-end water main must replace all of the water within the pipe at least once every 100 hours to meet the Collier County residual chlorine level of 0.6 ppm.

At this time there are no proposed flows demanded from the development. To ensure proper turn over occurs within the line a calculation to determine minimum flow within the automatic flushing device will be calculated. The minimum flow will be provided in order to maintain the chlorine residuals within the line per the 100.33-hour limitation.

The 12-inch water main stores 5.087 gallons/linear foot and the pipe length is 2802 linear feet (entire length of main within utility easement). Thus, the total volume of storage in the water main is 14,254 gallons. The required gpm to be turned over is calculated as:

100.33 hours ➔ $\left(\frac{14{,}254\ gal}{x\ gpm}\right)\left(\frac{1\ hour}{60\ min}\right)$ ➔ 2.36 gpm

Therefore, in order to meet or exceed the Collier County utility standards of required chlorine levels the water mainline must flush a minimum of 3,398 gallons per day.

Fire Protection:

Water for fire protection will also be provided by Collier County via the aforementioned 12-inch water main. Three (3) hydrants have been proposed along the access route at a maximum 500-foot separation. To ensure appropriate flow is available, the proposed water main was modeled using WaterCAD® Software. A flow of 750 gpm for the proposed hydrants has been modeled per the Collier County Code of Ordinances. From the WaterCAD® Modeling located in Appendix A, there will be adequate flow within the water main to guarantee acceptable flows within each hydrant.

Sanitary Sewer

General:

Sanitary service will be provided by Collier County Utilities. The proposed system consists of an 8-inch gravity main with proposed 6-inch stub-outs to future developments. The proposed 8-inch gravity main flow east-west and ties into a proposed 6-foot diameter lift station located within the cleared land at the most eastern edge. To ensure the lift station is sized appropriately for the proposed development and future development, all proposed uses with the cleared ±82.76 acres have been included in the lift station sizing calculations; please refer to Appendix B.

Gravity Hydraulic Analysis:

Pipe Diameter	=	8-inches
Average Flow	=	16,595 GPD = 0.026 cfs
Peak Flow	=	74,678 GPD = 0.116 cfs
Slope	=	0.0040
Manning n-value	=	0.013
Average Depth	=	0.084-feet = 1.008-inches
Average Velocity	=	1.017 fps
Peak Depth	=	0.175-feet = 2.10-inches
Peak Velocity	=	1.580 fps

These calculations confirm the eight (8) inch gravity sewer pipes are more than adequate in size for the proposed flow.

Storm Water Management

General:

The proposed ±344-acre site surface water management system was originally permitted through ERP No. 11-0285328-002 with FDEP. Based on the previously permitted and constructed system design, Davidson Engineering will update the land use tables and modeling results to include additional basin acreage, the existing approved permit and also provide a phased construction storm water management system. The following stormwater management system and land use breakdown provided in Table 1.3 and will be analyzed within this report.

The phased ±82.76-acre drainage basin will use on-site dry detention/retention areas for water quality volumes, nutrient removal, and attenuation storage prior to discharging. The surface water management system consists of a series of interconnected grate inlets, storm water pipes (HDPE and pre-cast), detention/retention areas, and outfall to the Golden Gate Canal via a hardened control structure and culvert. The discharge rate and volumes will meet the state and local requirements for quality and quantity.

Methodology:

The overall concept of the water management design is dictated by the assumed impervious calculations for the site and dedicated preserve areas. The proposed development is permitted with a control elevation of 8.23 ft-NAVD (9.50 ft-NGVD) per previously approved FDEP ERP No. 11-0285328-002. The approved permits for the Resource Recovery Business Park requires acquisition of 0.50-inch dry detention pre-treatment water quality volume. During this phase of construction ±82.76 acres will be cleared and prepared for future development. The phased storm water management system will provide a total of 1.5-inch of water quality volume prior to ultimate outfall into the Golden Gate Canal. Additionally, required nutrient removals will be incorporated into the phased storm water management system in order to substantiate the proposed system will have no harmful effects on surrounding vegetation/developments.

The dry retention/detention areas are interconnected per storm pipes and outfall via one control structure. Control Structure #1 (DS#129), provides 0.65-inch of water quality volume over the delineated basin described in the Harper Analysis Report (74.73 ac-ft x 0.65-inch x 1ft/12inchs = 4.04 ac-ft) in retention per the nutrient loading analysis requirements; please refer to Appendix F. Two rectangular notches at elevation 9.95 ft-NAVD ensures the required treatment volume will occur within the on-site dry retention system. From elevation 9.95 ft-NAVD to 10.55 ft-NAVD the remaining water quality volume will be accumulated on site within the dry detention ponds and discharge via two (2) additional rectangular notches.

Within the proposed water management system, the dry retention ponds are required to recover within 72 hours; this is illustrated using Modret Mounding Analysis and HydroCAD® Modeling, please refer to Appendix E and D, respectively. From elevation 9.95 ft-NAVD to storm water management retention/detention bottom elevation of 9.23 ft-NAVD Modret Mounding Analysis verifies through infiltration testing the site does recover within the 72 hour criteria. Additionally, to ensure the initial

bleeder has been sized appropriately the required drawdown calculation is not to exceed an allowable 24-hour discharge volume of 3.45 Acre-ft (0.5-inch over the site) based on the full water quality volume (10.55 ac-ft at 10.55 ft-NAVD) discharging the system. Please refer to the HydroCAD® Drawdown Modeling and SFWMD Worksheet for detailed calculations and modeling within Appendix D and C, respectively.

Water quality volume required was calculated as 1.0-inch of runoff of the entire site with an additional 50% per Collier county requirements, which was greater than 2.5 times percent impervious. The storm water system will not exceed the maximum discharge of 0.15 cfs/acre requirement or 0.5-inch in 24 hours. Additionally, it should be noted, tail water for the site has been manufactured at a lower elevation, due to a SFWMD regulated weir system within the Golden Gate Canal, than the existing control elevation for het site, therefore will not be a factor on the site.

Modeling Results:

Based on the SFWMD rainfall for the 10-year 1-day, 25-year 3-day, and 100-year 3-day events, the project was modeled using HydroCAD ® software to ensure the minimum water quality/quantity requirements were met and post development conditions have been improved for the site. Table 2 is a summary of the criteria used to model the project's water quality/quantity; please refer to Appendix C for further analysis.

Table 2: SFWMD Criteria

Control Elevation (ft-NAVD)	8.23 ft-NAVD 9.50 ft-NGVD
10-year, 1-day Rainfall Event (inches)	7.00
25-year, 3-day Rainfall Event (inches)	11.70
100-year, 3-day Rainfall Event (inches)	14.80
Required Water Quality Volume (ac-ft)	10.35
Required 0.5-inch Pretreatment Volume (ac-ft)	3.45
Required 0.65-inch Retention Volume (ac-ft)*	4.04
Peak Allowable Discharge (cfs)	12.41

*Per Harper Analysis Report Calculations

HydroCAD® Results:

Table 3, below summarizes the project's HydroCAD® results and outfall structure details. The full HydroCAD® report can be found in Appendix D.

Table 3: ±82.76 Drainage Basin Storm Water Management Report

Dry Retention Water Quality Volume Provided (ac-ft)	4.17
Dry Detention Water Quality Volume Provided (ac-ft)	6.38
Total Water Quality Volume Provided (ac-ft)	10.55
Provided Dry Retention Water Quality Elevation (ft-NAVD)	9.23 - 9.95
Provided Dry Detention Water Quality Elevation (ft-NAVD)	9.95 – 10.55
Peak Modeled Discharge (cfs)	12.36
10 Year 1 Day Storm Stage (ft-NAVD)	11.23
25 Year 3 Day Storm Stage (ft-NAVD)	11.84
Minimum Road Elevation (ft-NAVD)*	12.05
100 Year 3 Day Storm Stage (ft-NAVD)	12.51
Minimum Finished Floor Elevation (ft-NAVD)*	12.53
Control Structure DS#129 Bleeder Invert (ft-NAVD) Two (2) – 0.7' W x 0.6' H Rectangular Notch	9.95
Control Structure DS#129 Rectangular Notch Invert (ft-NAVD) Two (2) – 1.25' W X 0.4' H Rectangular Notch	10.55
Control Structure DS#129 Overflow Grate Elevation (ft-NAVD)	12.00

*Per previously approved FDEP ERP No. 11-0285328-002

StormCAD® Results:

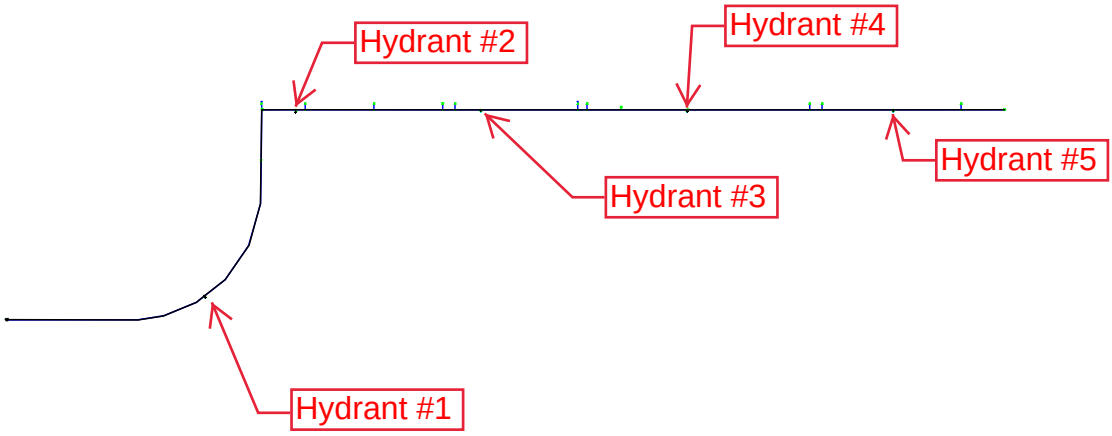
To ensure the interconnected pipes are of the appropriate size, StormCAD® was utilized. The StormCAD® program analyzes the storm sewer systems using the Rational Method and recommends pipe sizes. Each catchment basin was assigned a "C"-value based on the type of land usage. The design storm used is the 10 year-10 minute recurrence interval that provides a rainfall intensity of 6.9 inches per hour.

Based on the storm events modeled above, the size and slope of the storm drainage pipes were designed to produce velocities that will minimize sedimentation and provide flushing of the culverts. The results from the program indicate that the minimum pipe size is 18 inch and the maximum pipe size is 36 inch throughout the property with ultimate outfall into the lake. The full results of the StormCAD® Storm Sewer model are in Appendix G.

APPENDIX A

WaterCAD® Modeling Results

Scenario: Base



Scenario: Base
Current Time Step: 0.000Hr
Fire Flow Node FlexTable: Fire Flow Report

Label	Is Active?	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Satisfies Fire Flow Constraints?
H-1	True	750	4,180	True
H-2	True	750	3,072	True
H-3	True	750	2,724	True
H-8	True	750	4,000	True
H-9	True	750	3,525	True
J-1	True	750	2,649	True
J-2	True	750	4,443	True
J-3	True	750	3,154	True
J-4	True	750	2,800	True
J-6	True	750	4,000	True
J-7	True	750	3,678	True

Z:\Active Projects\Collier County\CC RRBP DIW\SDP\2nd Review\ENG & REPORTS\WATERCAD\2017-02-22-ccdiw watercad.wtg

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C
P-2	4	5.9	PVC	150.0
P-3	6	5.9	PVC	150.0
P-4	5	5.9	PVC	150.0
P-6	499	11.2	PVC	150.0
P-7	272	11.2	PVC	150.0
P-10	492	11.2	PVC	150.0
P-11	580	11.2	PVC	150.0
P-12	5	5.9	PVC	150.0
P-13	449	11.2	PVC	150.0
P-14	501	11.2	PVC	150.0
P-15	5	5.9	PVC	150.0

Z:\Active Projects\Collier County\CC RRBP DIW\SDP\2nd Review\ENG & REPORTS\WATERCAD\2017-02-22-ccdiw watercad.wtg

Scenario: Base
Current Time Step: 0.000Hr
FlexTable: Reservoir Table

Label	Elevation (ft)	Hydraulic Grade (ft)	Is Active?
R-1	92.40	92.40	True

Z:\Active Projects\Collier County\CC RRBP DIW\SDP\2nd Review\ENG & REPORTS\WATERCAD\2017-02-22-ccdiw watercad.wtg

APPENDIX B

Lift Station Sizing Specifications

Collier County Resource Recovery Business Park LOS

Proposed Usage

Sewage/Potable Water Demand									
Description		Unit Type		GPD/Unit		# Units		Average Daily Demand, GPD	Peak Daily Demand, GPD*
CC RRBP	73,800sf Office/221 Employees	100 sf	Employee	15	25	738	221	16595	74677.5
Total (GPD):								**16,595 gpd**	**74,678 gpd**

Based on FAC; 64E-6.008 System Size Determinations

***Factor of 4.5 was used to determmine Peak Daily Demand**

Assumed building coverage based on approved ERP with 6.78 acre building coverage with 25% office and remainder factory/warehouse at 1employye/1,000 sf

Type of Establishment	Demand (GPD)
COMMERCIAL:	
Factories	
gallons per employee per 8 hour shift	
No shower provided	15
Showers provided	25
Office Building	
per employee per 8 hour shift	15
per 100 square feet of floor space	15
whichever is greater	

Sanitary Sewer Pump Station Design

Project: Collier County Resource Recovery Business Park
Station: 1

Purpose: Design proposed lift station.

Pump Station Design Flows

CCRRBP - Assumed building coverage based on approved ERP with 6.78 acre building coverage with 25% office and remainder factory/warehouse at 1 employee/1,000 sf

Average Daily Flow (ADF)	16,595	GPD
Average Daily Operating Hours (hrs)	24	hrs
Average Flow*	11.52	GPM
Peak Factor	4.50	
Peak Flow, Q = Average Flow x Peak Factor	51.8	GPM

NOTE: Peak Flow = Design Capacity

Pump Information

Pump Type	HOMA GRP26/3
Impeller Type	Enclosed Single channel Impeller
Pump Horsepower	2.4 HP
Pump Voltage	230 Volts
Pump Phase	3 Phase
	3450 RPM

Forcemain Information

Force Main Length					2850	feet
Equivalent Force Main Length		7- 45deg elbows =	22 feet		2872	feet
Force Main Diameter			4 inch diameter = inside diameter =		3.90	inches
Hazen-Williams C					120	
Wetwell top	12.53 Ft-NAVD					
Efluent Invert	9.53 Ft-NAVD	Tie-in pressure	0.00 feet	Total	14.03	NAVD
Influent Invert	-4.50 Ft-NAVD		0 psi			

Pump Curve

Flow	90	80	70	50	30	10	1
Head	11.5	40	55	67.5	80	97.5	110

System Head Curve

Friction	23.4	18.8	14.7	7.9	3.1	0.4	0.0
Static	17.5	17.5	17.5	17.5	17.5	17.5	17.5
Velocity	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Total Head	41.0	36.4	32.3	25.4	20.6	17.9	17.5

Operating Point, Flow	81	GPM
Operating Point, Head	36.9	feet
Line Velocity	2.2	fps
Pump flow is GREATER than inflow, OK		

Tavg = (Vww/(Qdp-Qai) + (Vww/Qai) = 15 min

Tpeak = Vww/Qdp + Vww/Qpi = 4.6 min 60min/Tpeak = 12.9 cycles/hour (max)

Wetwell Design

Minimum Required Wetwell Storage		
Volume (V1)*	130	gallons
Starts/Pump	3	per hour
Number of Pumps in Wetwell	2	

Sanitary Sewer Pump Station Design

Wetwell Storage (V1)*	17.3	cubic ft
Inside Wetwell Diameter	5	feet
Outside Wetwell Diameter	5.3334	feet
Wetwell Interior Cross-Sectional Area	19.6	square ft
Storage Depth (1 ft min)*	1.0	feet
Actual Storage Provided*	147	gallons
Storage Time Provided*	13	minutes
Lead On-Lag On	12	inches
Finished Grade (use actual slab elevation)	12.53	NAVD
Influent Elevation	-4.50	NAVD
High Water Alarm*	-4.00	NAVD
Lag On*	-3.50	NAVD
Lead On*	-2.50	NAVD
Pump Off*	-3.50	NAVD
Bottom Elevation* (top of grout)	-4.75	NAVD
Base Diameter	6.00	feet
Base Thickness	0.50	feet

Flotation Calculations (fresh water volume displaced)

V storage =	146.9	gallons
V wetwell =	386.0	cubic ft
V base =	14.1	cubic ft
V wall =	46.8	cubic ft
V earth =	102.53193	cubic ft

Force Up on Cylinder: V wetwell x 62.4 lbs/ft^2	24,089	lb up
Force Up on Slab	882	lb up
Total Buoyancy Force	24,972	lb up
Cylinder Weight (basin and all internal equipment assumed 0 lb)	-	lb down
Anti-Float Collar (assumed saturated, based on 37.6 net lb/ft3)	23,614	lb down
Minimum Volume of Concrete	10.0	cu. Yd
Total Downward Force	27,469	lb down
Net Force	2,497	lb down
Net force is DOWN, wetwell size OK		

PUMP STATION DESIGN
HAND CALCULATIONS

Pump Station Design Flows

1. Average Flow ADF / operation hours/day / 60 minutes/hour
   = 12 GPM

Wetwell Design

1. Volume (V1)
   = Peak Flow x 15 / # starts/pump / # pumps in wetwell
   = 130 gallons
2. Wetwell Storage
   = Volume (V1) / 7.48 gal/cubic ft
   = 17.3 cubic feet
3. Wetwell Interior Cross-Sectional Area
   = pi x (inside diameter/2)^2
   = 19.6 square feet
4. Storage Depth
   = Wetwell Storage / Wetwell Interior Cross-Sectional Area
   (If quotient is less than 1, still require 1 ft. minimum storage as noted.)
   = 1.0 ft
5. Actual Storage Provided
   = Wetwell Interior Cross-Sectional Area x Storage Depth
   x 7.48 gal/cf
   = 147 gallons

6. Storage Time Provided
   = Actual Storage Provided / Average Flow
   = 13 minutes
7. High Water Alarm
   = Influent Elevation - .5 ft
   = -4 NAVD
8. Lag On
   = High Water Alarm - .5 ft
   = -3.5 NAVD
9. Lead On
   = Lag On - (Lead On-Lag On)/12 inches/ft
   = -2.5 NAVD
10. Pump Off
   = Lead On - Storage Depth
   = -3.5 NAVD
11. Bottom Elevation
   = Pump Off - 1.5 ft
   = -4.75 NAVD

Floatation Calculations (fresh water volume displaced)

1. Force Up on Cylinder
   = Total Wetwell Cross-Sectional Area x (Finished Grade - Bottom Elevation) x 62.4 lb/cubic ft
   [where Total Wetwell Cross-Sectional Area = pi x 1/2(inside wetwell diameter + 2 x wall thickness/12 in/ft)^2]
   = 24,089 lb up
2. Force Up on Slab
   = pi/4 x (Slab Diameter^2) x Slab Thickness x 62.4 lb/cubic ft
   = 882 lb up
3. Total Buoyancy Force
   = Force Up on Cylinder + Force Up on Slab
   = 24,972 lb up
4. Cylinder Weight and all internal equipment
   = 0
5. Anti-Float Collar & Concrete
   = (F up x 1.1) - (V earth x 37.6)
   = 23,614 lb down
6. Soil Overburden (does not consider top slab thickness)
   = (Area of Bottom Slab - Total Cross-Sectional Wetwell Area) x (Finished Grade - Bottom Elevation - Top Slab Thickness)
   x 37.6 lb/cubic foot (assume soil weight = 100 lb/cf)
   = 3,855 lb down
7. Total Downward Force
   = Cylinder Weight + Anti-Float Collar & Concrete + Soil Overburden
   = 27,469 lb down
8. Net Force
   = Total Downward Force - Total Buoyancy Force
   = 2,497 lb down

Performance Curve

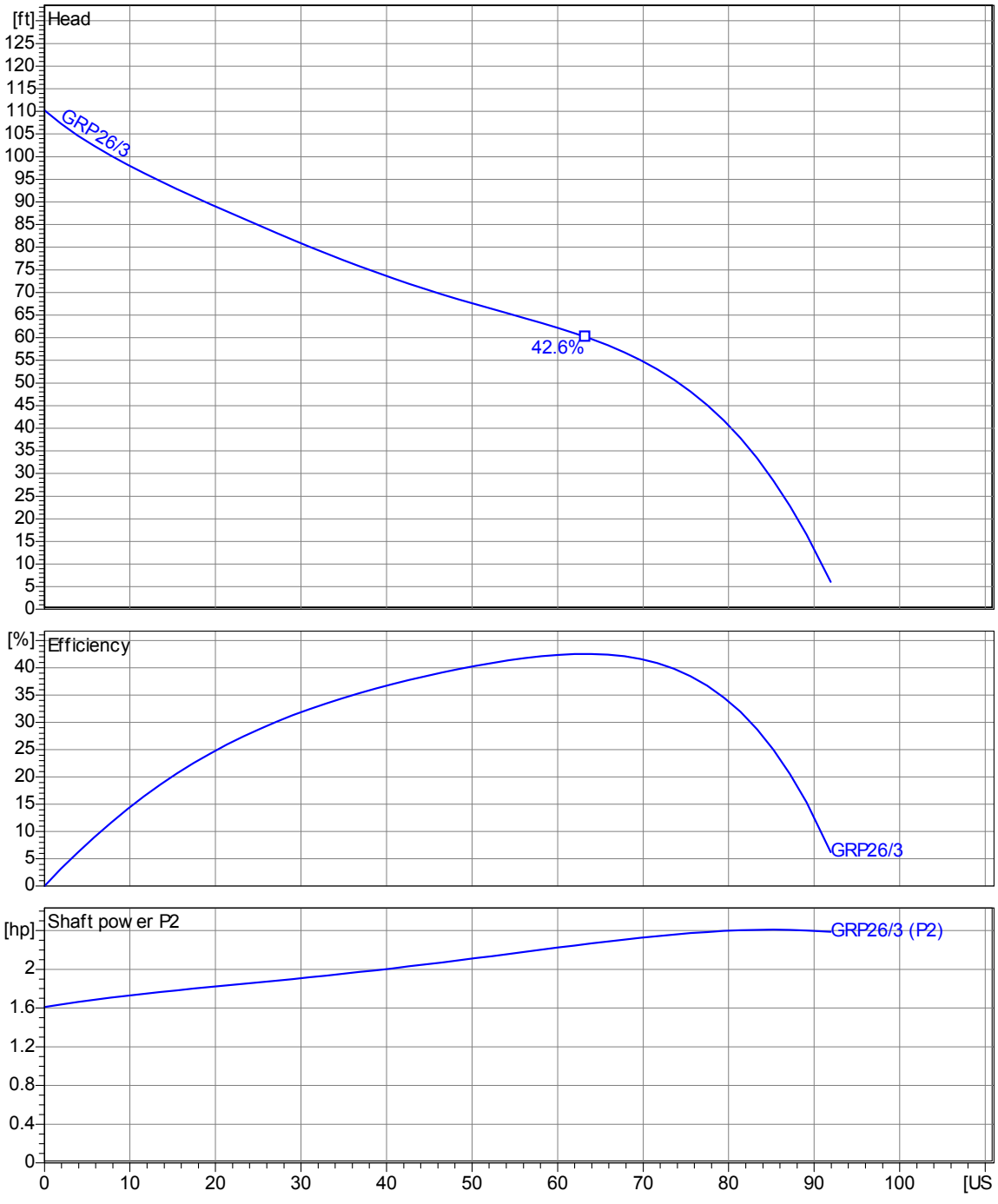
GRP26/3

Impeller				
Impeller type: Vane impeller with cutter sys.	Solid size Ø:	Max. Ø: 6 inch	Min. Ø: 5.9055 inch	Sel. Ø: 5.4331 inch

Operating data				
Speed: **3450 rpm**	Frequency: **60 Hz**	Duty point: **Q = 80 US g.p.m.** **H = 40 ft**	Shaft power P2: **2.4 hp**	Discharge port: **2" M**

Power data referred to:
Water [100%] ; 68°F; 62.322lb/ft³; 1.0818E-5ft²/s

Testnorm: **HI Standard Sect. 1**



2.3.7 - 14/03/2012 (Build 345)

Project	Project no.:	Created by:	Page:	Date:
			2	**23/09/2016**

APPENDIX C

SFWMD Worksheet

Davidson Engineering, Inc.

Project: **82.76 DRAINAGE BASIN**
Proj. #: _____ Task # _____
Calculated By: _____ Date: _____
Checked By: _____ Date: _____

Water Management Design Calculations

82.76 DRAINAGE BASIN

A) LAND USE SUMMARY - CONTRIBUTORY BASIN ONLY

Land Use	Total Area	Water Surface	Future Imp.	Pavement	Impervious Area	Pervious Area
	Acres	Acres	Acres	Acres	Acres	Acres
Lake	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0.00	0.00	0.00	0.00	0.00	0.00
Pavement/Driveway	31.28	0.00	0.00	31.28	31.28	0.00
N/A	0.00	0.00	0.00	0.00	0.00	0.00
Building	3.48	0.00	3.48	0.00	3.48	0.00
Open Space	39.97	0.00	0.00	0.00	0.00	39.97
Retention/Detention Areas	8.03	0.00	0.00	0.00	0.00	8.03
Totals:	**82.76**	**0.00**	**3.48**	**31.28**	**34.76**	**48.00**

B) DESIGN PARAMETERS

Control Elevation =	8.23	NAVD
3-day rainfall(100yr) =	14.80	Inches
3-day rainfall(25yr) =	11.70	Inches
1-day rainfall(10yr) =	7.00	Inches
Q(Allow) =	0.15	CFS/ac
Soil compaction factor (i.e. 25%)	25%	

Pervious Area= Project Area - Impervious Area
Pervious Area= 82.76 - 34.76
Pervious Area= **48.00** Acres

B) PEAK ALLOWABLE DISCHARGE

Excludes Wetland and Upland Preserve

Q(Allowable)= 0.15 x 82.76 ac
Q(Allowable)= **12.41** CFS

See HydroCAD® HydroGRAPH 25 YEAR - 3 DAY 25yr/72hr (12.36 CFS @ 65.31 HRS - OUTFLOW)

C) WATER QUALITY STORAGE VOLUME

1. First Inch of Runoff Criteria:

Water Quality Vol.= Project Area * 1 in.*(1ft/12in.)
Water Quality Vol.= 82.76 * 1 in.*(1ft/12in.)
Water Quality Vol.= **6.90** Ac-ft.
Allowable 24-HR Discharge Volume **3.45** Ac-ft. 1/2"

The Bleeder was sized to minimum 3.45 Ac-ft Discharge
Refer to Modeling Results within Drawdown Report

2. 2.5 % Impervious Criteria:

a) Site Area= Project Area - (Lake + Conservation) - Roof
Site Area= 82.76 - - - 3.48
Site Area= 79.28 Acres
b) Imp. Area= Site Area - Pervious Area
Imp. Area= 79.28 - 48.00
Imp. Area= 31.28 Acres
c) Vol. Stor. Req'd= 2.5 in.*(1ft/12in.) * (Imp. Area/Site Area) * (Project Area - Lake - Conserv.)
Vol. Stor. Req'd= 2.5 in.*(1ft/12in.) * 0.39 * 82.76
Vol. Stor. Req'd= **6.80** Ac-ft.

Therefore, calculation # 1 controls and a water quality volume of
6.90 Ac-ft must be detained on-site prior to discharge.

3. Maximum Daily Discharge:

Criteria: 1/2" per day
Q(Bleed-Down)= {(0.5in./24hrs.) * (1ft/12in.) * (43560sf/acre) * (1hr/3600s)} * (Project Area - Lake-Wetland-Preserve)
Q(Bleed-Down)= 0.021 * 82.76 - 0.00
Q(Bleed-Down)= **1.74** CFS

4. Type of Water Quaility Area (1st stage or pre-treatment) **Dry Retention**
Type of Water Quaility Area (2nd stage if needed) **Dry Detention**

5. Water Quaility calculations

Water quaility pre-treatment for Commerical and Industrial sites (1/2" min. no reduction) =	1/2" =	**3.45**	Ac-Ft.
Water Quality Required By SFWMD per B.O.R. (Greater of 1" or 2.5" x % Imp.)	1" =	**6.90**	Ac-Ft.
Water Quality Required by Collier County [per CC LDC 3.07.02 150% of BOR 5.2.1(a)	150% of B.O.R. =	**5.17**	Ac-Ft. of Dry Retention
25% reduction for Dry Detention or 50% reduction for Dry Retention or 1 1/2" min.]	1 1/2" =	**10.35**	Ac-Ft.
Total Water Quaility Required =		**10.35**	Ac-Ft.
Water quaility provided (1st stage or pre-treatment) =		**4.17**	Ac-Ft. of Dry Retention
Water quaility provided equvilent to Wet Detention per B.O.R. (1st stage or pre-treatment)		**8.34**	Ac-Ft.
Water quaility provided (2nd stage, i.e. Lake or Dry Detention)		**6.38**	
Water quaility provided equvilent to Wet Detention per B.O.R. (2nd stage, i.e. Lake or Dry Detention)		**8.51**	
Total Provided Water Quality Volume =		**10.55**	Ac-Ft.

Water quality volume will start at Control Elevation: **8.23** NAVD (ft.)

D) SOIL STORAGE

Depth to Water Table = 3.3 ft.
Interpolated Soil Storage for pervious areas = Sd = 4.95 Inches
From SFWMD; Basis for Review, Volume IV

S= Site-Wide Soil Storage
S= Sd * (Pervious Area/Project Area)
S= 4.95 * 48.00 / 82.76
S= **2.87** Inches

E) MINIMUM FINISHED FLOOR ELEVATION

1. Peak Stage from HydroCAD routings (100-year, 3-day, zero discharge):

Peak Stage= **12.51** NAVD (ft.)

2. FEMA Flood Zone: **AE 7**

The flood hazard elevation is: **12.53*** (worst case if more than one elevation zone)

3. 100-year, 3-day, zero discharge calculations (SCS method)

3-day rainfall= 14.80 Inches

Inches of Runoff= (P-0.2S)^2/(P+0.8S)

Inches of Runoff= 11.84 Inches

Volume of Runoff= (1ft/12in.) * (Inches of Runoff) * (Project Area)

Volume of Runoff= 1ft/12in. * 11.84 * 82.76

Volume of Runoff= **81.64** Ac-ft.

Therefore, using the stage storage curve a minimum finished floor elevation will be equal to or greater than **12.53*** NAVD

*Per Approved FDEP ERP No. 11-0285328-002

F) MINIMUM ROADS ELEVATION

1. Peak Stage from HydroCAD routings (25-year, 3-day):

Peak Stage= **11.84** NAVD (ft.)

2. 25-year, 3-day, zero discharge calculations (SCS method)

3-day rainfall= 11.70 Inches

Inches of Runoff= (P-0.2S)^2/(P+0.8S)

Inches of Runoff= 8.84 Inches

Volume of Runoff= (1ft/12in.) * (Inches of Runoff) * (Project Area) - (Bleed-down 3-Day Volume Allowed in Ac-Ft)

Volume of Runoff= 8.84 * 1'/12" * 82.76 - 10.35

Volume of Runoff= **50.65** Ac-ft.

Therefore, using the stage storage curve a minimum road elevation will be approximately: **12.05*** NAVD (ft.) Minimum 2' above C.E. Controls

*Per Approved FDEP ERP No. 11-0285328-002

G) MINIMUM PARKING ELEVATION

1. Peak Stage from HydroCAD routings (10-year, 1-day):

Peak Stage= **11.21** NAVD (ft.)

2. 10-year, 1-day, zero discharge calculations (SCS method)

1-day rainfall= 7.00 Inches

Inches of Runoff= (P-0.2S)^2/(P+0.8S)

Inches of Runoff= 4.44 Inches

Volume of Runoff= (1ft/12in.) * (Inches of Runoff) * (Project Area) - (Bleed-down 3-Day Volume Allowed in Ac-Ft)

Volume of Runoff= 4.44 * 1'/12" * 82.76 - 10.35

Volume of Runoff= **20.29** Ac-ft.

Therefore, using the stage storage curve a minimum parking elevation will be approximately: **11.30** NAVD (ft.) (Minimum 2' above C.E. Controls)

H) PERCENT DIRECTLY CONNECTED IMPERVIOUS AREA (DCIA)

%DCIA= Impervious Area / Project Area

%DCIA= 34.76 / 82.76

%DCIA= **42.0%**

I) CURVE NUMBER FOR PERVIOUS AREA

CN= 1000 / (10 + Sd)

CN= 1000 / 10.00 + 4.95

CN= **67**

J) DISCHARGE STRUCTURE

See Storm Water or HydroCAD® Draw Down Routings for calculations and results.

K) STORMWATER FLOOD ROUTING

1. Flood routing for the system is accomplished through the use of Santa Barbara Urban Hydrograph method to generate the runoff hydrographs and through the HydroCAD for multiple pond routing. The following pages are the input and output for this drainage area.

DEPTH TO WTR TABLE	NATURAL AVAILABLE STORAGE	DEV. AVAIL. STORAGE
0	0.00	0.00
1	0.60	0.45
1.5	1.50	1.10
2	2.50	1.88
2.5	4.50	3.40
3	6.60	4.95
3.5	8.90	6.80
4	10.90	8.18

APPENDIX D

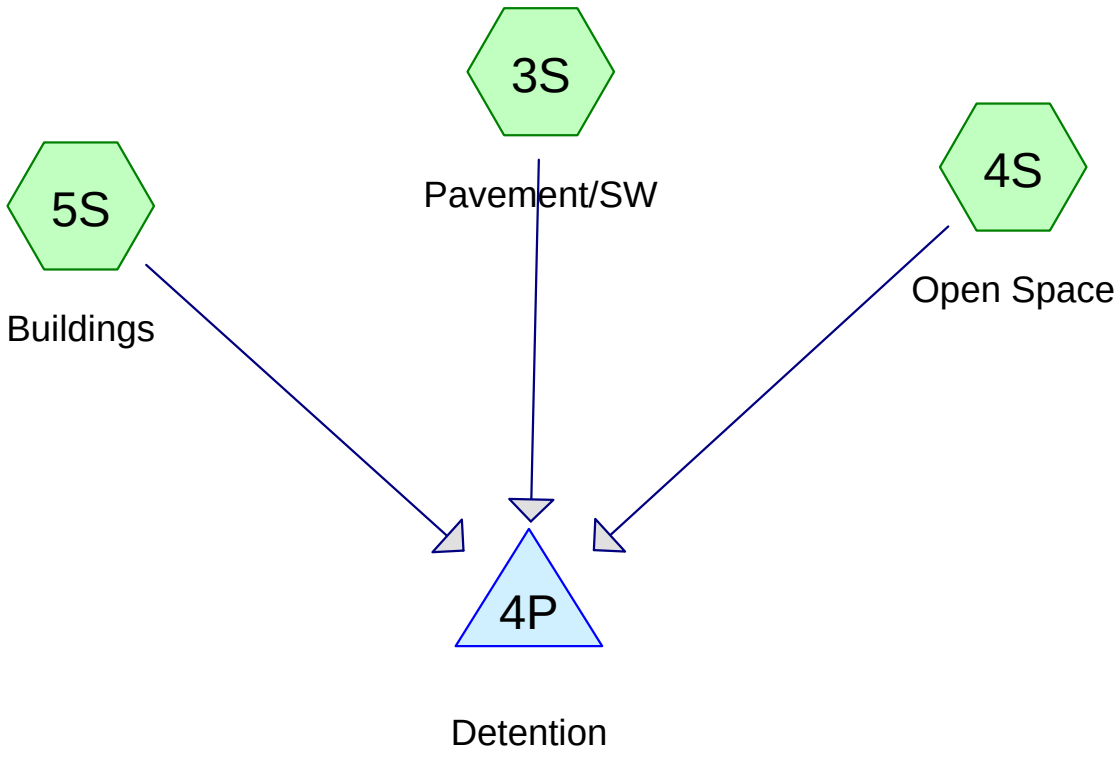
HydroCAD® Results

10- Year 1-Day

25-Year 3-Day

100-Year 3-Day

Drawdown



Subcat Reach Pond Link

Routing Diagram for 2016-08-25-25yr-72 hr (82.76 AC BASIN)
Prepared by Microsoft, Printed 9/8/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.870	85	Detention (305) (4S)
7.160	85	Detention (RRBP) (4S)
39.970	60	Open Space (RRBP) (4S)
3.480	98	bldg (5S)
31.280	98	pvmt (3S)
82.760	**78**	**TOTAL AREA**

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SBUH method, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 3S: Pavement/SW Runoff Area=31.280 ac 100.00% Impervious Runoff Depth=6.86"
Tc=30.0 min CN=98 Runoff=101.37 cfs 17.884 af

Subcatchment 4S: Open Space Runoff Area=48.000 ac 0.00% Impervious Runoff Depth=3.08"
Tc=30.0 min CN=64 Runoff=76.13 cfs 12.311 af

Subcatchment 5S: Buildings Runoff Area=3.480 ac 100.00% Impervious Runoff Depth=6.86"
Tc=15.0 min CN=98 Runoff=15.19 cfs 1.990 af

Pond 4P: Detention Peak Elev=11.21' Storage=24.454 af Inflow=192.03 cfs 32.184 af
Outflow=8.68 cfs 27.930 af

Total Runoff Area = 82.760 ac Runoff Volume = 32.184 af Average Runoff Depth = 4.67"
58.00% Pervious = 48.000 ac 42.00% Impervious = 34.760 ac

Summary for Subcatchment 3S: Pavement/SW

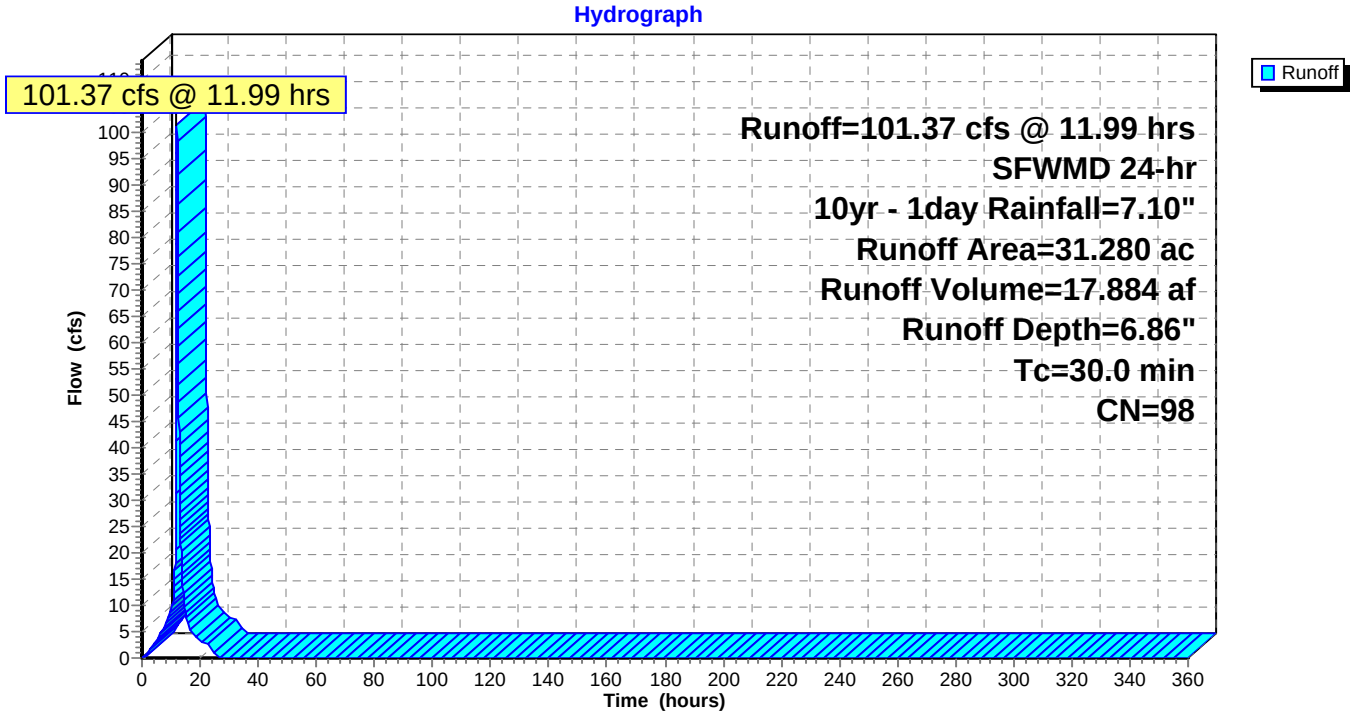
Runoff = 101.37 cfs @ 11.99 hrs, Volume= 17.884 af, Depth= 6.86"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 24-hr 10yr - 1day Rainfall=7.10"

	Area (ac)	CN	Description
*	31.280	98	pvmt
	31.280		100.00% Impervious Area

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

Subcatchment 3S: Pavement/SW



Hydrograph for Subcatchment 3S: Pavement/SW

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.44	0.27	3.30
10.00	1.51	1.29	**8.93**
15.00	6.05	5.81	**8.36**
20.00	**6.76**	**6.52**	3.92
25.00	**7.10**	**6.86**	0.38
30.00	7.10	6.86	0.00
35.00	7.10	6.86	0.00
40.00	7.10	6.86	0.00
45.00	7.10	6.86	0.00
50.00	7.10	6.86	0.00
55.00	7.10	6.86	0.00
60.00	7.10	6.86	0.00
65.00	7.10	6.86	0.00
70.00	7.10	6.86	0.00
75.00	7.10	6.86	0.00
80.00	7.10	6.86	0.00
85.00	7.10	6.86	0.00
90.00	7.10	6.86	0.00
95.00	7.10	6.86	0.00
100.00	7.10	6.86	0.00
105.00	7.10	6.86	0.00
110.00	7.10	6.86	0.00
115.00	7.10	6.86	0.00
120.00	7.10	6.86	0.00
125.00	7.10	6.86	0.00
130.00	7.10	6.86	0.00
135.00	7.10	6.86	0.00
140.00	7.10	6.86	0.00
145.00	7.10	6.86	0.00
150.00	7.10	6.86	0.00
155.00	7.10	6.86	0.00
160.00	7.10	6.86	0.00
165.00	7.10	6.86	0.00
170.00	7.10	6.86	0.00
175.00	7.10	6.86	0.00
180.00	7.10	6.86	0.00
185.00	7.10	6.86	0.00
190.00	7.10	6.86	0.00
195.00	7.10	6.86	0.00
200.00	7.10	6.86	0.00
205.00	7.10	6.86	0.00
210.00	7.10	6.86	0.00
215.00	7.10	6.86	0.00
220.00	7.10	6.86	0.00
225.00	7.10	6.86	0.00
230.00	7.10	6.86	0.00
235.00	7.10	6.86	0.00
240.00	7.10	6.86	0.00
245.00	7.10	6.86	0.00
250.00	7.10	6.86	0.00
255.00	7.10	6.86	0.00
260.00	7.10	6.86	0.00
265.00	7.10	6.86	0.00
270.00	7.10	6.86	0.00
275.00	7.10	6.86	0.00
280.00	7.10	6.86	0.00
285.00	7.10	6.86	0.00
290.00	7.10	6.86	0.00
295.00	7.10	6.86	0.00
300.00	7.10	6.86	0.00
305.00	7.10	6.86	0.00
310.00	7.10	6.86	0.00
315.00	7.10	6.86	0.00
320.00	7.10	6.86	0.00
325.00	7.10	6.86	0.00
330.00	7.10	6.86	0.00
335.00	7.10	6.86	0.00
340.00	7.10	6.86	0.00
345.00	7.10	6.86	0.00
350.00	7.10	6.86	0.00
355.00	7.10	6.86	0.00
360.00	7.10	6.86	0.00

Summary for Subcatchment 4S: Open Space

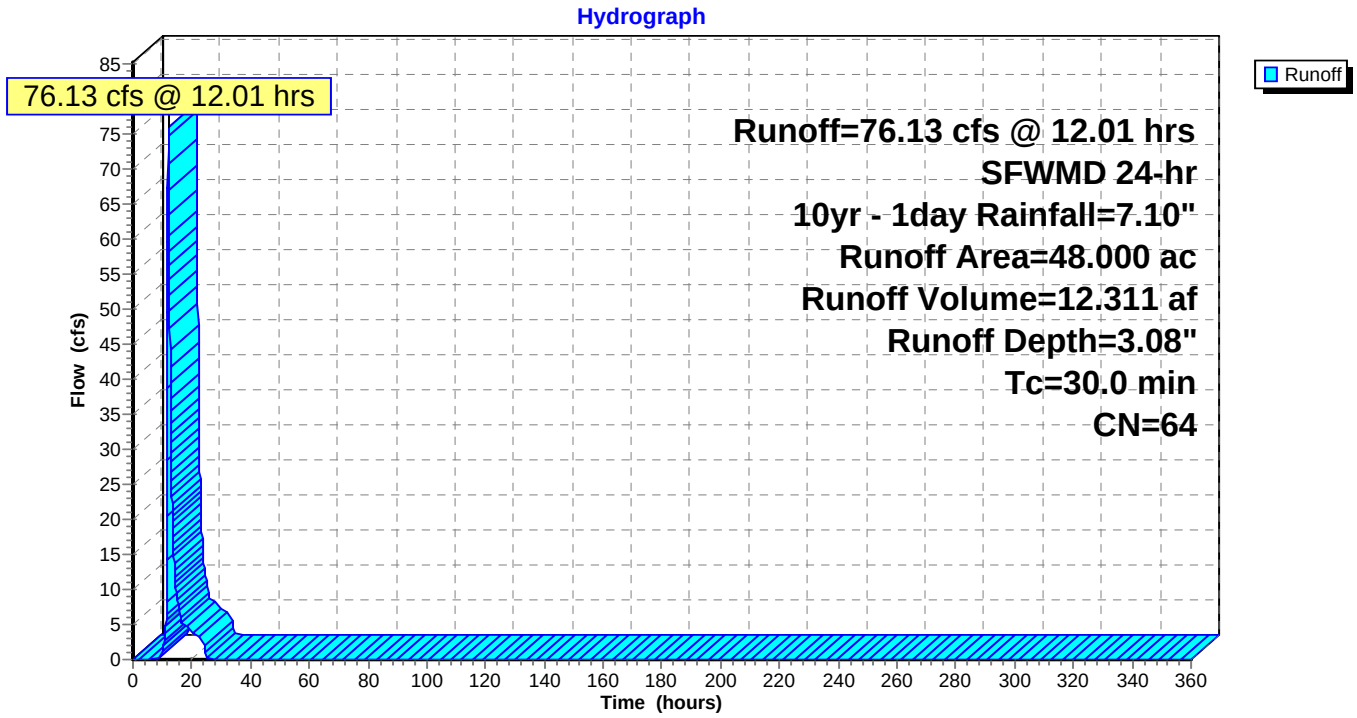
Runoff = 76.13 cfs @ 12.01 hrs, Volume= 12.311 af, Depth= 3.08"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 24-hr 10yr - 1day Rainfall=7.10"

	Area (ac)	CN	Description
*	7.160	85	Detention (RRBP)
*	0.870	85	Detention (305)
*	39.970	60	Open Space (RRBP)
	48.000	64	Weighted Average
	48.000		100.00% Pervious Area

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

Subcatchment 4S: Open Space



Hydrograph for Subcatchment 4S: Open Space

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.44	0.00	0.00
10.00	1.51	0.02	**1.15**
15.00	6.05	2.30	**8.99**
20.00	**6.76**	**2.82**	4.50
25.00	**7.10**	**3.08**	0.45
30.00	7.10	3.08	0.00
35.00	7.10	3.08	0.00
40.00	7.10	3.08	0.00
45.00	7.10	3.08	0.00
50.00	7.10	3.08	0.00
55.00	7.10	3.08	0.00
60.00	7.10	3.08	0.00
65.00	7.10	3.08	0.00
70.00	7.10	3.08	0.00
75.00	7.10	3.08	0.00
80.00	7.10	3.08	0.00
85.00	7.10	3.08	0.00
90.00	7.10	3.08	0.00
95.00	7.10	3.08	0.00
100.00	7.10	3.08	0.00
105.00	7.10	3.08	0.00
110.00	7.10	3.08	0.00
115.00	7.10	3.08	0.00
120.00	7.10	3.08	0.00
125.00	7.10	3.08	0.00
130.00	7.10	3.08	0.00
135.00	7.10	3.08	0.00
140.00	7.10	3.08	0.00
145.00	7.10	3.08	0.00
150.00	7.10	3.08	0.00
155.00	7.10	3.08	0.00
160.00	7.10	3.08	0.00
165.00	7.10	3.08	0.00
170.00	7.10	3.08	0.00
175.00	7.10	3.08	0.00
180.00	7.10	3.08	0.00
185.00	7.10	3.08	0.00
190.00	7.10	3.08	0.00
195.00	7.10	3.08	0.00
200.00	7.10	3.08	0.00
205.00	7.10	3.08	0.00
210.00	7.10	3.08	0.00
215.00	7.10	3.08	0.00
220.00	7.10	3.08	0.00
225.00	7.10	3.08	0.00
230.00	7.10	3.08	0.00
235.00	7.10	3.08	0.00
240.00	7.10	3.08	0.00
245.00	7.10	3.08	0.00
250.00	7.10	3.08	0.00
255.00	7.10	3.08	0.00
260.00	7.10	3.08	0.00
265.00	7.10	3.08	0.00
270.00	7.10	3.08	0.00
275.00	7.10	3.08	0.00
280.00	7.10	3.08	0.00
285.00	7.10	3.08	0.00
290.00	7.10	3.08	0.00
295.00	7.10	3.08	0.00
300.00	7.10	3.08	0.00
305.00	7.10	3.08	0.00
310.00	7.10	3.08	0.00
315.00	7.10	3.08	0.00
320.00	7.10	3.08	0.00
325.00	7.10	3.08	0.00
330.00	7.10	3.08	0.00
335.00	7.10	3.08	0.00
340.00	7.10	3.08	0.00
345.00	7.10	3.08	0.00
350.00	7.10	3.08	0.00
355.00	7.10	3.08	0.00
360.00	7.10	3.08	0.00

Summary for Subcatchment 5S: Buildings

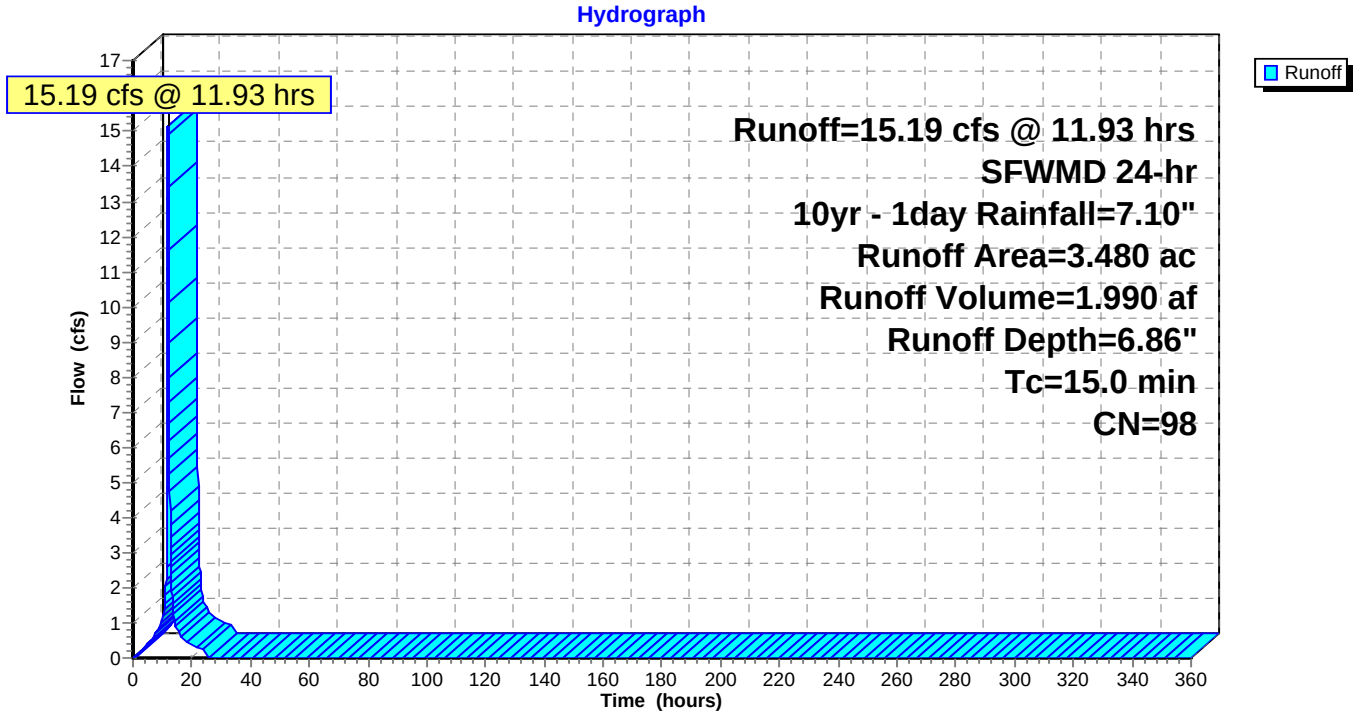
Runoff = 15.19 cfs @ 11.93 hrs, Volume= 1.990 af, Depth= 6.86"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 24-hr 10yr - 1day Rainfall=7.10"

	Area (ac)	CN	Description
*	3.480	98	bldg
	3.480		100.00% Impervious Area

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

Subcatchment 5S: Buildings



Hydrograph for Subcatchment 5S: Buildings

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.44	0.27	0.39
10.00	1.51	1.29	**1.03**
15.00	6.05	5.81	**0.82**
20.00	**6.76**	**6.52**	0.42
25.00	**7.10**	**6.86**	0.01
30.00	7.10	6.86	0.00
35.00	7.10	6.86	0.00
40.00	7.10	6.86	0.00
45.00	7.10	6.86	0.00
50.00	7.10	6.86	0.00
55.00	7.10	6.86	0.00
60.00	7.10	6.86	0.00
65.00	7.10	6.86	0.00
70.00	7.10	6.86	0.00
75.00	7.10	6.86	0.00
80.00	7.10	6.86	0.00
85.00	7.10	6.86	0.00
90.00	7.10	6.86	0.00
95.00	7.10	6.86	0.00
100.00	7.10	6.86	0.00
105.00	7.10	6.86	0.00
110.00	7.10	6.86	0.00
115.00	7.10	6.86	0.00
120.00	7.10	6.86	0.00
125.00	7.10	6.86	0.00
130.00	7.10	6.86	0.00
135.00	7.10	6.86	0.00
140.00	7.10	6.86	0.00
145.00	7.10	6.86	0.00
150.00	7.10	6.86	0.00
155.00	7.10	6.86	0.00
160.00	7.10	6.86	0.00
165.00	7.10	6.86	0.00
170.00	7.10	6.86	0.00
175.00	7.10	6.86	0.00
180.00	7.10	6.86	0.00
185.00	7.10	6.86	0.00
190.00	7.10	6.86	0.00
195.00	7.10	6.86	0.00
200.00	7.10	6.86	0.00
205.00	7.10	6.86	0.00
210.00	7.10	6.86	0.00
215.00	7.10	6.86	0.00
220.00	7.10	6.86	0.00
225.00	7.10	6.86	0.00
230.00	7.10	6.86	0.00
235.00	7.10	6.86	0.00
240.00	7.10	6.86	0.00
245.00	7.10	6.86	0.00
250.00	7.10	6.86	0.00
255.00	7.10	6.86	0.00
260.00	7.10	6.86	0.00
265.00	7.10	6.86	0.00
270.00	7.10	6.86	0.00
275.00	7.10	6.86	0.00
280.00	7.10	6.86	0.00
285.00	7.10	6.86	0.00
290.00	7.10	6.86	0.00
295.00	7.10	6.86	0.00
300.00	7.10	6.86	0.00
305.00	7.10	6.86	0.00
310.00	7.10	6.86	0.00
315.00	7.10	6.86	0.00
320.00	7.10	6.86	0.00
325.00	7.10	6.86	0.00
330.00	7.10	6.86	0.00
335.00	7.10	6.86	0.00
340.00	7.10	6.86	0.00
345.00	7.10	6.86	0.00
350.00	7.10	6.86	0.00
355.00	7.10	6.86	0.00
360.00	7.10	6.86	0.00

Summary for Pond 4P: Detention

Inflow Area = 82.760 ac, 42.00% Impervious, Inflow Depth = 4.67" for 10yr - 1day event
Inflow = 192.03 cfs @ 12.00 hrs, Volume= 32.184 af
Outflow = 8.68 cfs @ 20.04 hrs, Volume= 27.930 af, Atten= 95%, Lag= 482.9 min
Primary = 8.68 cfs @ 20.04 hrs, Volume= 27.930 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 11.21' @ 20.04 hrs Surf.Area= 6.731 ac Storage= 24.454 af

Plug-Flow detention time= 2,031.6 min calculated for 27.930 af (87% of inflow)
Center-of-Mass det. time= 1,964.0 min (2,762.1 - 798.1)

Volume	Invert	Avail.Storage	Storage Description
#1	9.23'	62.484 af	**Detention #1 (Irregular)**Listed below (Recalc)
#2	10.50'	3.653 af	**Detention #2 (Irregular)**Listed below (Recalc)
#3	9.23'	1.103 af	**Detention #3 (Irregular)**Listed below (Recalc)
#4	9.23'	8.802 af	**Detention #4 (Irregular)**Listed below (Recalc)
#5	10.00'	120.000 af	**Open Space Storage**Listed below
#6	11.50'	51.980 af	**Pavement Storage**Listed below
		248.022 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	5.010	4,352.0	0.000	0.000	5.010
9.95	5.306	4,373.0	3.713	3.713	5.352
12.00	5.910	4,409.0	11.491	15.204	5.966
20.00	5.910	4,409.0	47.280	62.484	6.776

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
10.50	0.075	3,273.0	0.000	0.000	0.075
12.00	0.415	3,302.0	0.333	0.333	0.441
20.00	0.415	3,302.0	3.320	3.653	1.048

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.054	228.0	0.000	0.000	0.054
12.00	0.110	285.0	0.223	0.223	0.110
20.00	0.110	285.0	0.880	1.103	0.162

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.540	1,526.0	0.000	0.000	0.540
12.00	0.860	1,582.0	1.922	1.922	0.873
20.00	0.860	1,582.0	6.880	8.802	1.164

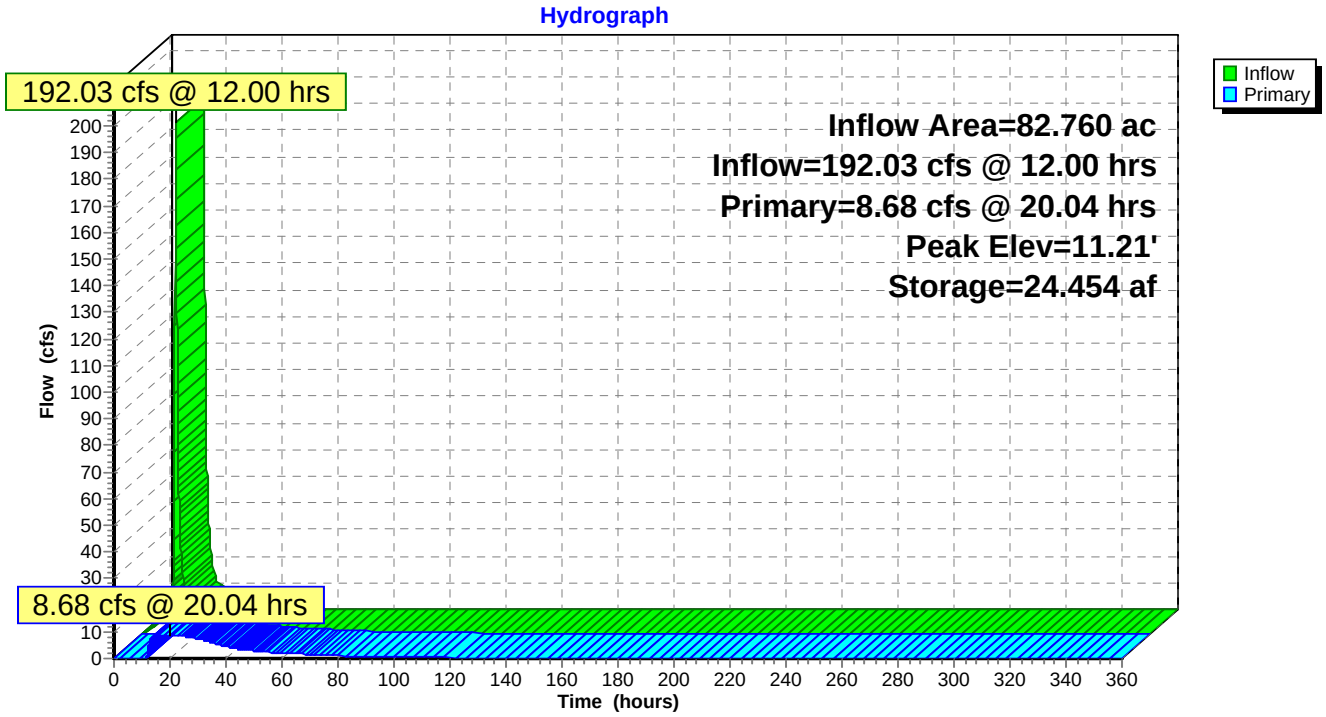
Elevation (feet)	Cum.Store (acre-feet)
10.00	0.000
10.50	2.000
11.00	8.000
11.50	18.000
12.00	32.000
12.50	50.000
13.00	72.000
13.50	96.000
14.00	120.000

Elevation (feet)	Cum.Store (acre-feet)
11.50	0.000
12.00	2.300
12.50	9.200
13.00	20.700
13.50	36.240
14.00	51.980

Device	Routing	Invert	Outlet Devices
#1	Primary	12.00'	**48.0" x 36.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	9.95'	**Custom Weir/Orifice X 2.00, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.60 0.60 1.00 Width (feet) 0.70 0.70 1.75 1.75

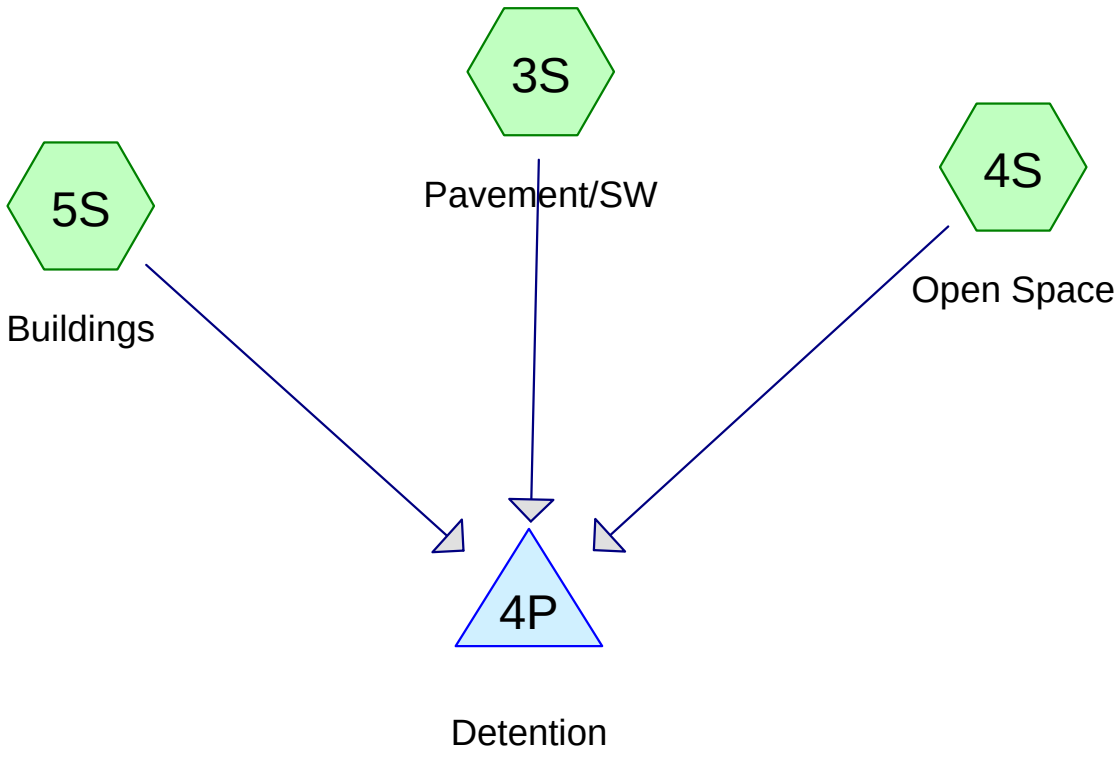
Primary OutFlow Max=8.68 cfs @ 20.04 hrs HW=11.21' (Free Discharge)
└**1=Grate** (Controls 0.00 cfs)
└**2=Custom Weir/Orifice** (Orifice Controls 8.68 cfs @ 3.88 fps)

Pond 4P: Detention



Hydrograph for Pond 4P: Detention

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	9.23	0.00
10.00	**11.11**	3.380	9.82	0.00
20.00	**8.85**	**24.454**	**11.21**	**8.68**
30.00	0.00	**20.062**	**11.05**	**7.35**
40.00	0.00	15.139	10.81	4.51
50.00	0.00	12.177	10.64	2.85
60.00	0.00	10.194	10.54	2.06
70.00	0.00	8.717	10.42	1.48
80.00	0.00	7.695	10.32	1.03
90.00	0.00	6.969	10.25	0.75
100.00	0.00	6.435	10.20	0.56
110.00	0.00	6.032	10.16	0.43
120.00	0.00	5.720	10.12	0.33
130.00	0.00	5.474	10.10	0.27
140.00	0.00	5.276	10.08	0.22
150.00	0.00	5.115	10.06	0.18
160.00	0.00	4.981	10.05	0.15
170.00	0.00	4.870	10.04	0.12
180.00	0.00	4.776	10.03	0.10
190.00	0.00	4.697	10.02	0.09
200.00	0.00	4.628	10.02	0.08
210.00	0.00	4.569	10.01	0.07
220.00	0.00	4.517	10.00	0.06
230.00	0.00	4.472	10.00	0.05
240.00	0.00	4.434	9.99	0.04
250.00	0.00	4.403	9.99	0.03
260.00	0.00	4.376	9.98	0.03
270.00	0.00	4.355	9.98	0.02
280.00	0.00	4.336	9.98	0.02
290.00	0.00	4.320	9.97	0.02
300.00	0.00	4.307	9.97	0.02
310.00	0.00	4.295	9.97	0.01
320.00	0.00	4.284	9.97	0.01
330.00	0.00	4.275	9.97	0.01
340.00	0.00	4.267	9.97	0.01
350.00	0.00	4.260	9.96	0.01
360.00	0.00	4.254	9.96	0.01



Subcat Reach Pond Link

Routing Diagram for 2016-08-25-25yr-72 hr (82.76 AC BASIN)
Prepared by Microsoft, Printed 9/8/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.870	85	Detention (305) (4S)
7.160	85	Detention (RRBP) (4S)
39.970	60	Open Space (RRBP) (4S)
3.480	98	bldg (5S)
31.280	98	pvmt (3S)
82.760	**78**	**TOTAL AREA**

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SBUH method, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 3S: Pavement/SW Runoff Area=31.280 ac 100.00% Impervious Runoff Depth=11.46"
Tc=30.0 min CN=98 Runoff=123.28 cfs 29.869 af

Subcatchment 4S: Open Space Runoff Area=48.000 ac 0.00% Impervious Runoff Depth=6.90"
Tc=30.0 min CN=64 Runoff=145.35 cfs 27.613 af

Subcatchment 5S: Buildings Runoff Area=3.480 ac 100.00% Impervious Runoff Depth=11.46"
Tc=15.0 min CN=98 Runoff=18.47 cfs 3.323 af

Pond 4P: Detention Peak Elev=11.84' Storage=45.538 af Inflow=286.65 cfs 60.804 af
Outflow=12.36 cfs 56.482 af

Total Runoff Area = 82.760 ac Runoff Volume = 60.804 af Average Runoff Depth = 8.82"
58.00% Pervious = 48.000 ac 42.00% Impervious = 34.760 ac

Summary for Subcatchment 3S: Pavement/SW

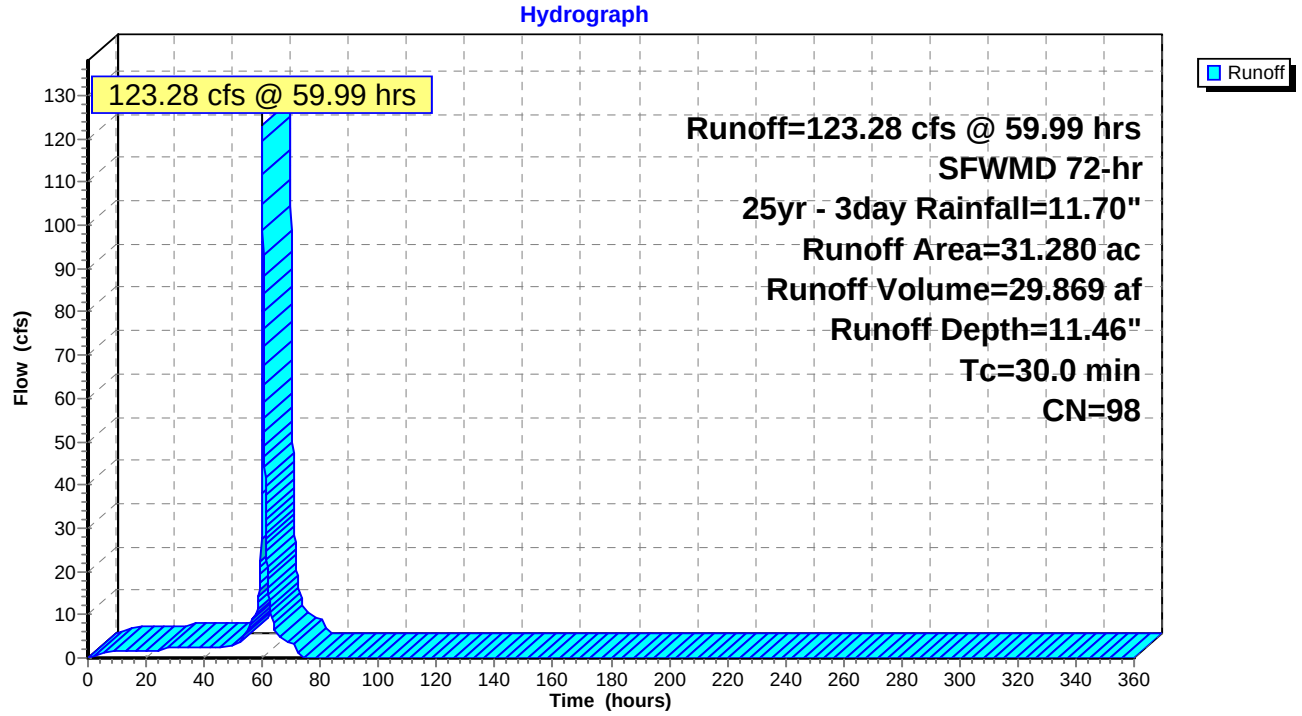
Runoff = 123.28 cfs @ 59.99 hrs, Volume= 29.869 af, Depth=11.46"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 72-hr 25yr - 3day Rainfall=11.70"

	Area (ac)	CN	Description
*	31.280	98	pvmt
	31.280		100.00% Impervious Area

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

Subcatchment 3S: Pavement/SW



Hydrograph for Subcatchment 3S: Pavement/SW

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.26	0.12	1.22
10.00	0.53	0.34	1.50
15.00	0.79	0.59	1.58
20.00	1.05	0.84	1.61
25.00	1.32	1.11	1.99
30.00	1.71	1.48	2.55
35.00	2.09	1.87	2.38
40.00	2.47	2.24	2.38
45.00	2.85	2.62	2.39
50.00	3.26	3.03	2.74
55.00	4.02	3.79	6.74
60.00	8.74	8.50	**123.18**
65.00	10.82	10.58	5.26
70.00	**11.49**	**11.25**	3.27
75.00	**11.70**	**11.46**	0.01
80.00	11.70	11.46	0.00
85.00	11.70	11.46	0.00
90.00	11.70	11.46	0.00
95.00	11.70	11.46	0.00
100.00	11.70	11.46	0.00
105.00	11.70	11.46	0.00
110.00	11.70	11.46	0.00
115.00	11.70	11.46	0.00
120.00	11.70	11.46	0.00
125.00	11.70	11.46	0.00
130.00	11.70	11.46	0.00
135.00	11.70	11.46	0.00
140.00	11.70	11.46	0.00
145.00	11.70	11.46	0.00
150.00	11.70	11.46	0.00
155.00	11.70	11.46	0.00
160.00	11.70	11.46	0.00
165.00	11.70	11.46	0.00
170.00	11.70	11.46	0.00
175.00	11.70	11.46	0.00
180.00	11.70	11.46	0.00
185.00	11.70	11.46	0.00
190.00	11.70	11.46	0.00
195.00	11.70	11.46	0.00
200.00	11.70	11.46	0.00
205.00	11.70	11.46	0.00
210.00	11.70	11.46	0.00
215.00	11.70	11.46	0.00
220.00	11.70	11.46	0.00
225.00	11.70	11.46	0.00
230.00	11.70	11.46	0.00
235.00	11.70	11.46	0.00
240.00	11.70	11.46	0.00
245.00	11.70	11.46	0.00
250.00	11.70	11.46	0.00
255.00	11.70	11.46	0.00
260.00	11.70	11.46	0.00
265.00	11.70	11.46	0.00
270.00	11.70	11.46	0.00
275.00	11.70	11.46	0.00
280.00	11.70	11.46	0.00
285.00	11.70	11.46	0.00
290.00	11.70	11.46	0.00
295.00	11.70	11.46	0.00
300.00	11.70	11.46	0.00
305.00	11.70	11.46	0.00
310.00	11.70	11.46	0.00
315.00	11.70	11.46	0.00
320.00	11.70	11.46	0.00
325.00	11.70	11.46	0.00
330.00	11.70	11.46	0.00
335.00	11.70	11.46	0.00
340.00	11.70	11.46	0.00
345.00	11.70	11.46	0.00
350.00	11.70	11.46	0.00
355.00	11.70	11.46	0.00
360.00	11.70	11.46	0.00

Summary for Subcatchment 4S: Open Space

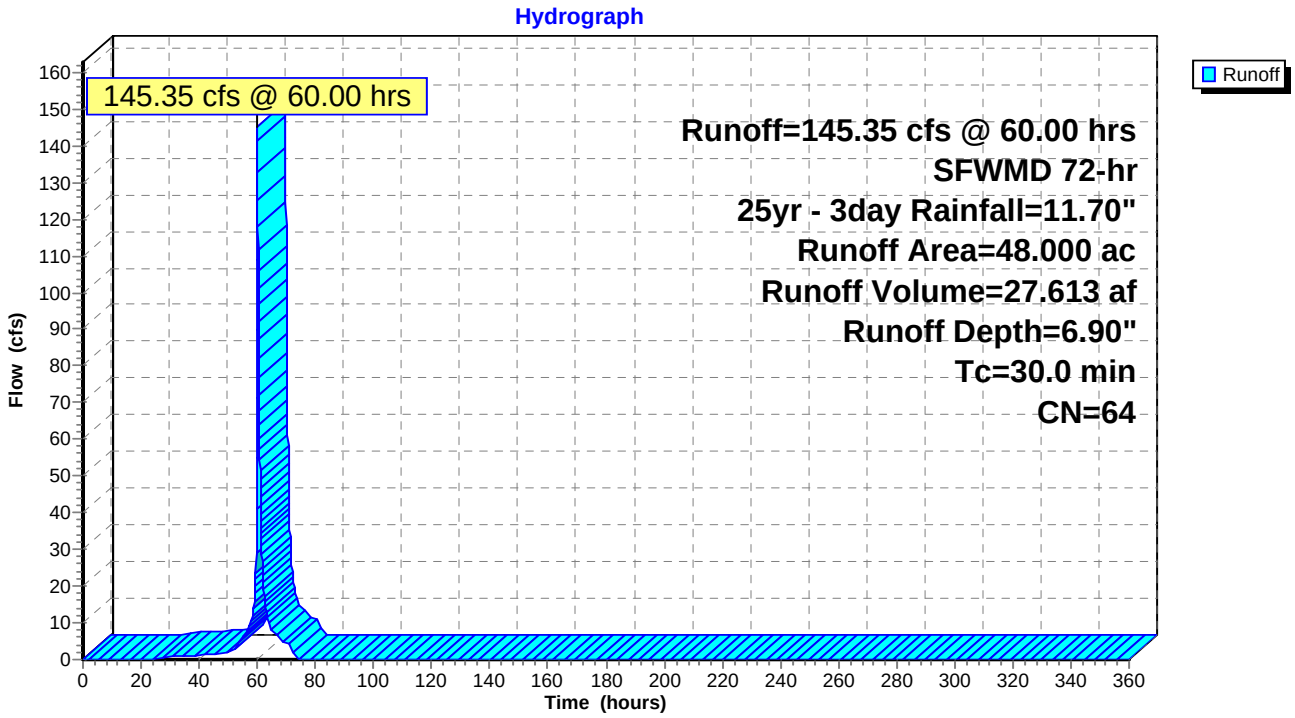
Runoff = 145.35 cfs @ 60.00 hrs, Volume= 27.613 af, Depth= 6.90"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 72-hr 25yr - 3day Rainfall=11.70"

	Area (ac)	CN	Description
*	7.160	85	Detention (RRBP)
*	0.870	85	Detention (305)
*	39.970	60	Open Space (RRBP)
	48.000	64	Weighted Average
	48.000		100.00% Pervious Area

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

Subcatchment 4S: Open Space



Hydrograph for Subcatchment 4S: Open Space

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.26	0.00	0.00
10.00	0.53	0.00	0.00
15.00	0.79	0.00	0.00
20.00	1.05	0.00	0.00
25.00	1.32	0.01	0.18
30.00	1.71	0.05	0.66
35.00	2.09	0.14	0.97
40.00	2.47	0.26	1.26
45.00	2.85	0.41	1.50
50.00	3.26	0.59	1.97
55.00	4.02	0.98	5.74
60.00	8.74	4.38	**145.34**
65.00	10.82	6.14	6.97
70.00	**11.49**	**6.72**	4.40
75.00	**11.70**	**6.90**	0.01
80.00	11.70	6.90	0.00
85.00	11.70	6.90	0.00
90.00	11.70	6.90	0.00
95.00	11.70	6.90	0.00
100.00	11.70	6.90	0.00
105.00	11.70	6.90	0.00
110.00	11.70	6.90	0.00
115.00	11.70	6.90	0.00
120.00	11.70	6.90	0.00
125.00	11.70	6.90	0.00
130.00	11.70	6.90	0.00
135.00	11.70	6.90	0.00
140.00	11.70	6.90	0.00
145.00	11.70	6.90	0.00
150.00	11.70	6.90	0.00
155.00	11.70	6.90	0.00
160.00	11.70	6.90	0.00
165.00	11.70	6.90	0.00
170.00	11.70	6.90	0.00
175.00	11.70	6.90	0.00
180.00	11.70	6.90	0.00
185.00	11.70	6.90	0.00
190.00	11.70	6.90	0.00
195.00	11.70	6.90	0.00
200.00	11.70	6.90	0.00
205.00	11.70	6.90	0.00
210.00	11.70	6.90	0.00
215.00	11.70	6.90	0.00
220.00	11.70	6.90	0.00
225.00	11.70	6.90	0.00
230.00	11.70	6.90	0.00
235.00	11.70	6.90	0.00
240.00	11.70	6.90	0.00
245.00	11.70	6.90	0.00
250.00	11.70	6.90	0.00
255.00	11.70	6.90	0.00
260.00	11.70	6.90	0.00
265.00	11.70	6.90	0.00
270.00	11.70	6.90	0.00
275.00	11.70	6.90	0.00
280.00	11.70	6.90	0.00
285.00	11.70	6.90	0.00
290.00	11.70	6.90	0.00
295.00	11.70	6.90	0.00
300.00	11.70	6.90	0.00
305.00	11.70	6.90	0.00
310.00	11.70	6.90	0.00
315.00	11.70	6.90	0.00
320.00	11.70	6.90	0.00
325.00	11.70	6.90	0.00
330.00	11.70	6.90	0.00
335.00	11.70	6.90	0.00
340.00	11.70	6.90	0.00
345.00	11.70	6.90	0.00
350.00	11.70	6.90	0.00
355.00	11.70	6.90	0.00
360.00	11.70	6.90	0.00

Summary for Subcatchment 5S: Buildings

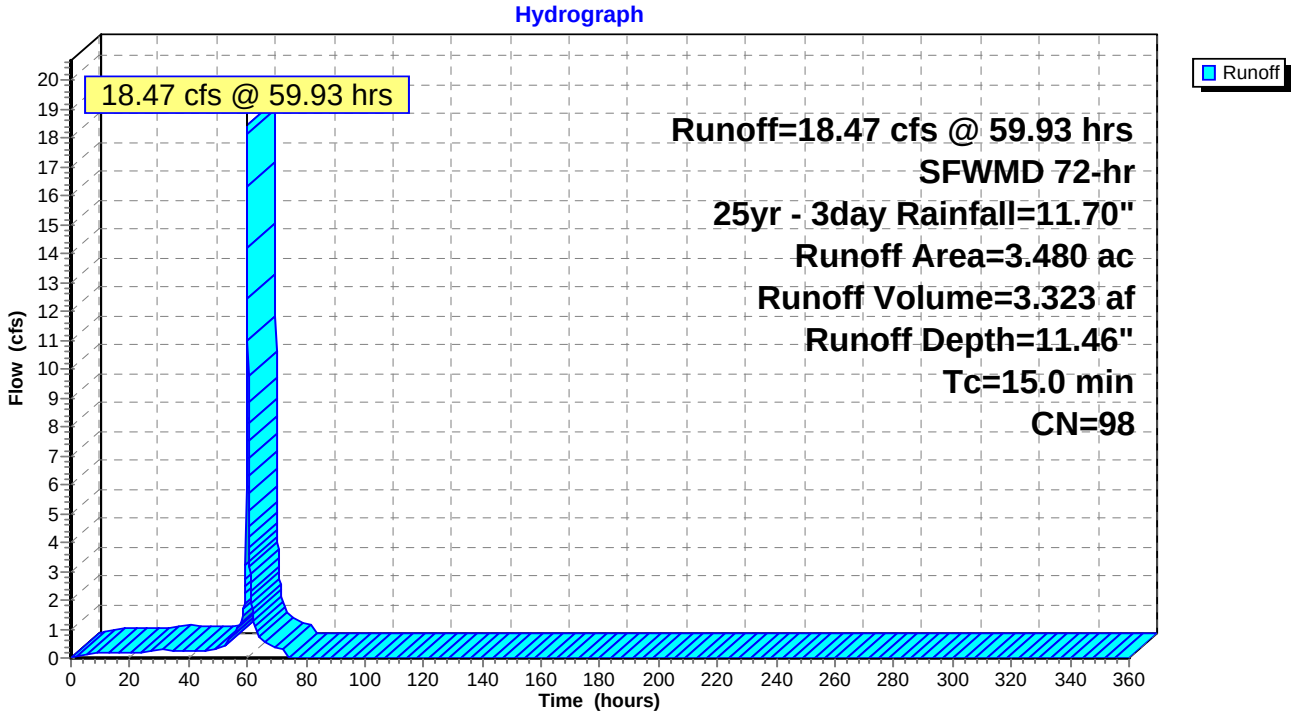
Runoff = 18.47 cfs @ 59.93 hrs, Volume= 3.323 af, Depth=11.46"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 72-hr 25yr - 3day Rainfall=11.70"

	Area (ac)	CN	Description
*	3.480	98	bldg
	3.480		100.00% Impervious Area

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

Subcatchment 5S: Buildings



Hydrograph for Subcatchment 5S: Buildings

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.26	0.12	0.14
10.00	0.53	0.34	0.17
15.00	0.79	0.59	0.18
20.00	1.05	0.84	0.18
25.00	1.32	1.11	0.24
30.00	1.71	1.48	0.29
35.00	2.09	1.87	0.26
40.00	2.47	2.24	0.27
45.00	2.85	2.62	0.27
50.00	3.26	3.03	0.31
55.00	4.02	3.79	**0.78**
60.00	8.74	8.50	**17.90**
65.00	10.82	10.58	0.55
70.00	**11.49**	**11.25**	0.36
75.00	**11.70**	**11.46**	0.00
80.00	11.70	11.46	0.00
85.00	11.70	11.46	0.00
90.00	11.70	11.46	0.00
95.00	11.70	11.46	0.00
100.00	11.70	11.46	0.00
105.00	11.70	11.46	0.00
110.00	11.70	11.46	0.00
115.00	11.70	11.46	0.00
120.00	11.70	11.46	0.00
125.00	11.70	11.46	0.00
130.00	11.70	11.46	0.00
135.00	11.70	11.46	0.00
140.00	11.70	11.46	0.00
145.00	11.70	11.46	0.00
150.00	11.70	11.46	0.00
155.00	11.70	11.46	0.00
160.00	11.70	11.46	0.00
165.00	11.70	11.46	0.00
170.00	11.70	11.46	0.00
175.00	11.70	11.46	0.00
180.00	11.70	11.46	0.00
185.00	11.70	11.46	0.00
190.00	11.70	11.46	0.00
195.00	11.70	11.46	0.00
200.00	11.70	11.46	0.00
205.00	11.70	11.46	0.00
210.00	11.70	11.46	0.00
215.00	11.70	11.46	0.00
220.00	11.70	11.46	0.00
225.00	11.70	11.46	0.00
230.00	11.70	11.46	0.00
235.00	11.70	11.46	0.00
240.00	11.70	11.46	0.00
245.00	11.70	11.46	0.00
250.00	11.70	11.46	0.00
255.00	11.70	11.46	0.00
260.00	11.70	11.46	0.00
265.00	11.70	11.46	0.00
270.00	11.70	11.46	0.00
275.00	11.70	11.46	0.00
280.00	11.70	11.46	0.00
285.00	11.70	11.46	0.00
290.00	11.70	11.46	0.00
295.00	11.70	11.46	0.00
300.00	11.70	11.46	0.00
305.00	11.70	11.46	0.00
310.00	11.70	11.46	0.00
315.00	11.70	11.46	0.00
320.00	11.70	11.46	0.00
325.00	11.70	11.46	0.00
330.00	11.70	11.46	0.00
335.00	11.70	11.46	0.00
340.00	11.70	11.46	0.00
345.00	11.70	11.46	0.00
350.00	11.70	11.46	0.00
355.00	11.70	11.46	0.00
360.00	11.70	11.46	0.00

Summary for Pond 4P: Detention

Inflow Area = 82.760 ac, 42.00% Impervious, Inflow Depth = 8.82" for 25yr - 3day event
Inflow = 286.65 cfs @ 59.99 hrs, Volume= 60.804 af
Outflow = 12.36 cfs @ 65.31 hrs, Volume= 56.482 af, Atten= 96%, Lag= 319.4 min
Primary = 12.36 cfs @ 65.31 hrs, Volume= 56.482 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 11.84' @ 65.31 hrs Surf.Area= 7.172 ac Storage= 45.538 af

Plug-Flow detention time= 2,304.5 min calculated for 56.482 af (93% of inflow)
Center-of-Mass det. time= 2,240.6 min (5,571.1 - 3,330.4)

Volume	Invert	Avail.Storage	Storage Description
#1	9.23'	62.484 af	**Detention #1 (Irregular)** Listed below (Recalc)
#2	10.50'	3.653 af	**Detention #2 (Irregular)** Listed below (Recalc)
#3	9.23'	1.103 af	**Detention #3 (Irregular)** Listed below (Recalc)
#4	9.23'	8.802 af	**Detention #4 (Irregular)** Listed below (Recalc)
#5	10.00'	120.000 af	**Open Space Storage** Listed below
#6	11.50'	51.980 af	**Pavement Storage** Listed below
		248.022 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	5.010	4,352.0	0.000	0.000	5.010
9.95	5.306	4,373.0	3.713	3.713	5.352
12.00	5.910	4,409.0	11.491	15.204	5.966
20.00	5.910	4,409.0	47.280	62.484	6.776

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
10.50	0.075	3,273.0	0.000	0.000	0.075
12.00	0.415	3,302.0	0.333	0.333	0.441
20.00	0.415	3,302.0	3.320	3.653	1.048

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.054	228.0	0.000	0.000	0.054
12.00	0.110	285.0	0.223	0.223	0.110
20.00	0.110	285.0	0.880	1.103	0.162

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.540	1,526.0	0.000	0.000	0.540
12.00	0.860	1,582.0	1.922	1.922	0.873
20.00	0.860	1,582.0	6.880	8.802	1.164

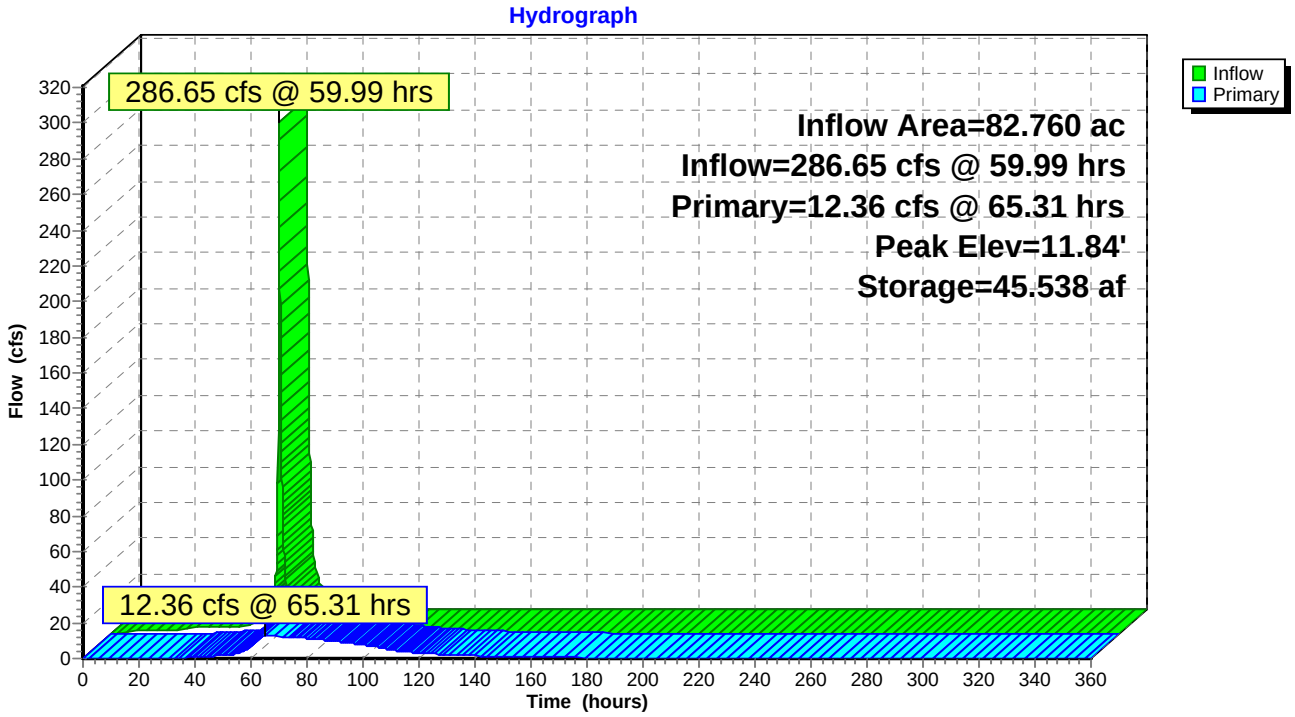
Elevation (feet)	Cum.Store (acre-feet)
10.00	0.000
10.50	2.000
11.00	8.000
11.50	18.000
12.00	32.000
12.50	50.000
13.00	72.000
13.50	96.000
14.00	120.000

Elevation (feet)	Cum.Store (acre-feet)
11.50	0.000
12.00	2.300
12.50	9.200
13.00	20.700
13.50	36.240
14.00	51.980

Device	Routing	Invert	Outlet Devices
#1	Primary	12.00'	**48.0" x 36.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	9.95'	**Custom Weir/Orifice X 2.00, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.60 0.60 1.00 Width (feet) 0.70 0.70 1.75 1.75

Primary OutFlow Max=12.36 cfs @ 65.31 hrs HW=11.84' (Free Discharge)
└**1=Grate** (Controls 0.00 cfs)
└**2=Custom Weir/Orifice** (Orifice Controls 12.36 cfs @ 5.52 fps)

Pond 4P: Detention

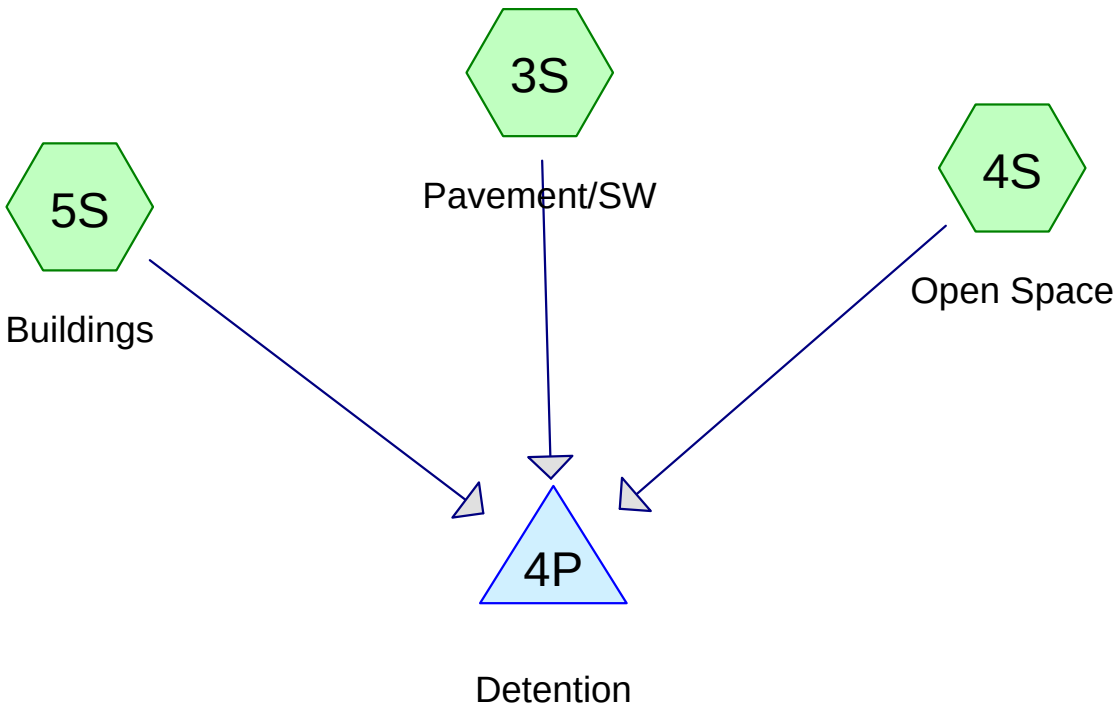


Hydrograph for Pond 4P: Detention

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	9.23	0.00
10.00	1.67	0.922	9.39	0.00
20.00	1.79	2.366	9.64	0.00
30.00	3.49	4.372	9.98	0.03
40.00	3.91	7.077	10.26	0.79
50.00	5.02	9.530	10.50	1.87
60.00	**286.41**	**25.838**	**11.27**	**9.05**
70.00	8.04	**44.918**	**11.82**	**12.28**
80.00	0.00	36.814	11.62	11.21
90.00	0.00	28.138	11.35	9.63
100.00	0.00	20.988	11.08	7.66
110.00	0.00	15.718	10.84	4.88
120.00	0.00	12.540	10.66	3.03
130.00	0.00	10.453	10.55	2.13
140.00	0.00	8.905	10.44	1.57
150.00	0.00	7.825	10.33	1.09
160.00	0.00	7.063	10.26	0.78
170.00	0.00	6.505	10.20	0.58
180.00	0.00	6.086	10.16	0.44
190.00	0.00	5.762	10.13	0.35
200.00	0.00	5.507	10.10	0.27
210.00	0.00	5.303	10.08	0.22
220.00	0.00	5.137	10.07	0.18
230.00	0.00	5.000	10.05	0.15
240.00	0.00	4.886	10.04	0.13
250.00	0.00	4.790	10.03	0.11
260.00	0.00	4.708	10.02	0.09
270.00	0.00	4.638	10.02	0.08
280.00	0.00	4.577	10.01	0.07
290.00	0.00	4.525	10.01	0.06
300.00	0.00	4.478	10.00	0.05
310.00	0.00	4.439	9.99	0.04
320.00	0.00	4.407	9.99	0.04
330.00	0.00	4.380	9.98	0.03
340.00	0.00	4.358	9.98	0.02
350.00	0.00	4.339	9.98	0.02
360.00	0.00	4.322	9.98	0.02

Stage-Area-Storage for Pond 4P: Detention

Elevation (feet)	Storage (acre-feet)
9.23	0.000
9.38	0.847
9.53	1.705
9.68	2.575
9.83	3.458
9.98	4.352
10.13	5.777
10.28	7.291
10.43	8.815
10.58	10.995
10.73	13.752
10.88	16.523
11.03	19.548
11.18	23.547
11.33	27.561
11.48	31.590
11.63	37.272
11.78	43.223
11.93	49.191
12.08	56.549
12.23	65.114
12.38	73.678
12.53	82.758
12.68	93.902
12.83	105.047
12.98	116.191
13.13	128.906
13.28	141.862
13.43	154.818
13.58	167.806
13.73	180.823
13.88	193.839
14.03	204.471
14.18	205.565
14.33	206.659
14.48	207.753
14.63	208.848
14.78	209.942
14.93	211.036
15.08	212.130
15.23	213.225
15.38	214.319
15.53	215.413
15.68	216.507
15.83	217.602
15.98	218.696
16.13	219.790
16.28	220.884
16.43	221.979
16.58	223.073
16.73	224.167
16.88	225.261
17.03	226.356
17.18	227.450
17.33	228.544
17.48	229.638
17.63	230.733
17.78	231.827
17.93	232.921
18.08	234.015
18.23	235.110
18.38	236.204
18.53	237.298
18.68	238.392
18.83	239.487
18.98	240.581
19.13	241.675
19.28	242.769
19.43	243.864
19.58	244.958
19.73	246.052
19.88	**247.146**



Subcat Reach Pond Link

Routing Diagram for 2016-05-05-100yr-72 hr (82.76 AC BASIN)
Prepared by Microsoft, Printed 9/1/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.870	85	Detention (305) (4S)
7.160	85	Detention (RRBP) (4S)
39.970	60	Open Space (RRBP) (4S)
3.480	98	bldg (5S)
31.280	98	pvmt (3S)
82.760	**78**	**TOTAL AREA**

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SBUH method, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 3S: Pavement/SW Runoff Area=31.280 ac 100.00% Impervious Runoff Depth=14.56"
Tc=30.0 min CN=98 Runoff=155.99 cfs 37.948 af

Subcatchment 4S: Open Space Runoff Area=48.000 ac 0.00% Impervious Runoff Depth=9.69"
Tc=30.0 min CN=64 Runoff=198.25 cfs 38.758 af

Subcatchment 5S: Buildings Runoff Area=3.480 ac 100.00% Impervious Runoff Depth=14.56"
Tc=30.0 min CN=98 Runoff=17.35 cfs 4.222 af

Pond 4P: Detention Peak Elev=12.51' Storage=80.927 af Inflow=371.57 cfs 80.927 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 82.760 ac Runoff Volume = 80.927 af Average Runoff Depth = 11.73"
58.00% Pervious = 48.000 ac 42.00% Impervious = 34.760 ac

Summary for Subcatchment 3S: Pavement/SW

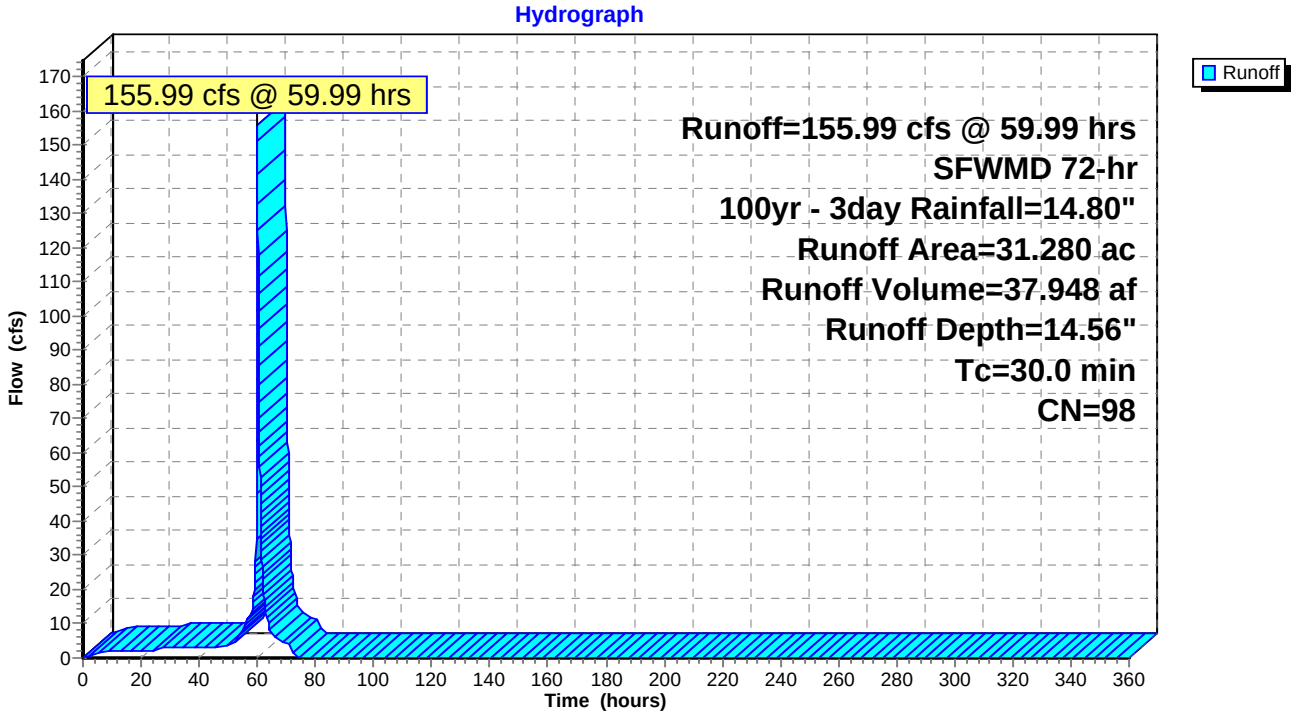
Runoff = 155.99 cfs @ 59.99 hrs, Volume= 37.948 af, Depth=14.56"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 72-hr 100yr - 3day Rainfall=14.80"

	Area (ac)	CN	Description
*	31.280	98	pvmt
	31.280		100.00% Impervious Area

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

Subcatchment 3S: Pavement/SW



Hydrograph for Subcatchment 3S: Pavement/SW

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.33	0.17	1.68
10.00	0.67	0.47	1.96
15.00	1.00	0.79	2.03
20.00	1.33	1.11	2.06
25.00	1.67	1.45	2.53
30.00	2.16	1.93	3.23
35.00	2.65	2.42	3.02
40.00	3.13	2.90	3.02
45.00	3.61	3.38	3.03
50.00	4.12	3.89	3.47
55.00	5.09	4.85	8.54
60.00	11.05	10.81	**155.86**
65.00	13.69	13.45	6.65
70.00	**14.54**	**14.30**	4.14
75.00	**14.80**	**14.56**	0.01
80.00	14.80	14.56	0.00
85.00	14.80	14.56	0.00
90.00	14.80	14.56	0.00
95.00	14.80	14.56	0.00
100.00	14.80	14.56	0.00
105.00	14.80	14.56	0.00
110.00	14.80	14.56	0.00
115.00	14.80	14.56	0.00
120.00	14.80	14.56	0.00
125.00	14.80	14.56	0.00
130.00	14.80	14.56	0.00
135.00	14.80	14.56	0.00
140.00	14.80	14.56	0.00
145.00	14.80	14.56	0.00
150.00	14.80	14.56	0.00
155.00	14.80	14.56	0.00
160.00	14.80	14.56	0.00
165.00	14.80	14.56	0.00
170.00	14.80	14.56	0.00
175.00	14.80	14.56	0.00
180.00	14.80	14.56	0.00
185.00	14.80	14.56	0.00
190.00	14.80	14.56	0.00
195.00	14.80	14.56	0.00
200.00	14.80	14.56	0.00
205.00	14.80	14.56	0.00
210.00	14.80	14.56	0.00
215.00	14.80	14.56	0.00
220.00	14.80	14.56	0.00
225.00	14.80	14.56	0.00
230.00	14.80	14.56	0.00
235.00	14.80	14.56	0.00
240.00	14.80	14.56	0.00
245.00	14.80	14.56	0.00
250.00	14.80	14.56	0.00
255.00	14.80	14.56	0.00
260.00	14.80	14.56	0.00
265.00	14.80	14.56	0.00
270.00	14.80	14.56	0.00
275.00	14.80	14.56	0.00
280.00	14.80	14.56	0.00
285.00	14.80	14.56	0.00
290.00	14.80	14.56	0.00
295.00	14.80	14.56	0.00
300.00	14.80	14.56	0.00
305.00	14.80	14.56	0.00
310.00	14.80	14.56	0.00
315.00	14.80	14.56	0.00
320.00	14.80	14.56	0.00
325.00	14.80	14.56	0.00
330.00	14.80	14.56	0.00
335.00	14.80	14.56	0.00
340.00	14.80	14.56	0.00
345.00	14.80	14.56	0.00
350.00	14.80	14.56	0.00
355.00	14.80	14.56	0.00
360.00	14.80	14.56	0.00

Summary for Subcatchment 4S: Open Space

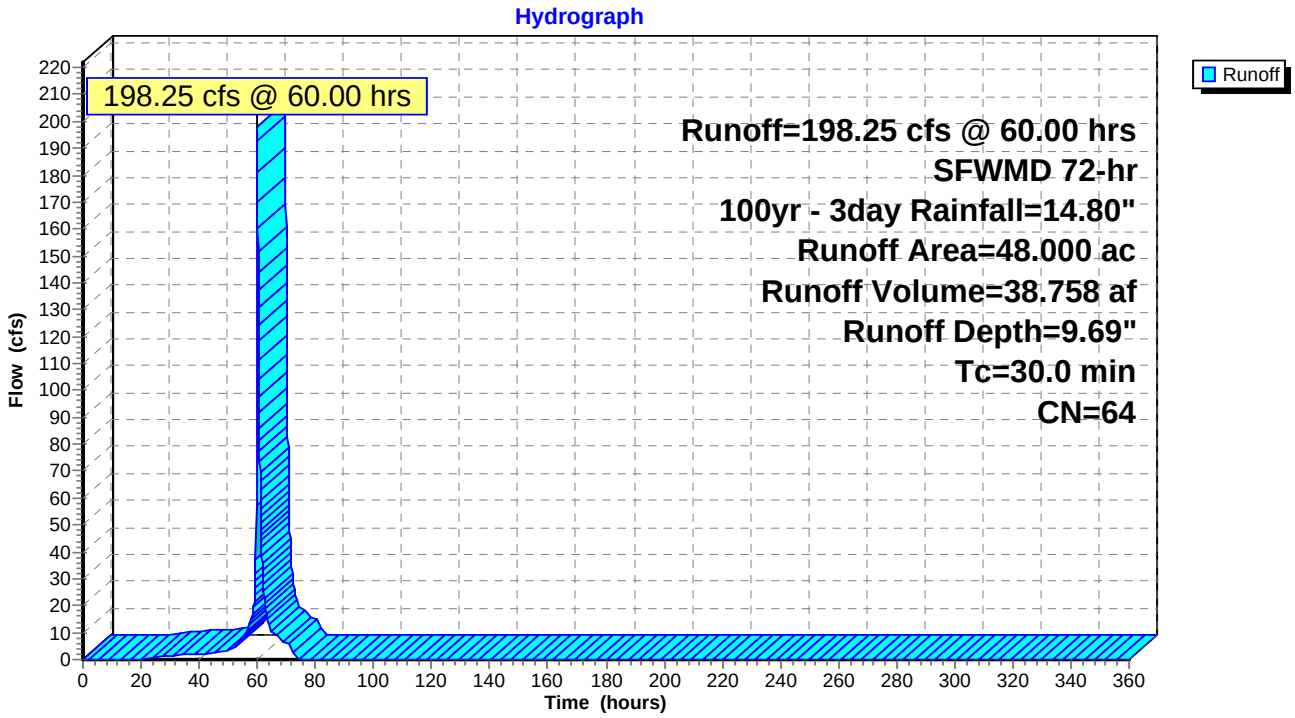
Runoff = 198.25 cfs @ 60.00 hrs, Volume= 38.758 af, Depth= 9.69"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 72-hr 100yr - 3day Rainfall=14.80"

	Area (ac)	CN	Description
*	7.160	85	Detention (RRBP)
*	0.870	85	Detention (305)
*	39.970	60	Open Space (RRBP)
	48.000	64	Weighted Average
	48.000		100.00% Pervious Area

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

Subcatchment 4S: Open Space



Hydrograph for Subcatchment 4S: Open Space

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.33	0.00	0.00
10.00	0.67	0.00	0.00
15.00	1.00	0.00	0.00
20.00	1.33	0.01	0.19
25.00	1.67	0.05	0.63
30.00	2.16	0.16	1.37
35.00	2.65	0.32	1.73
40.00	3.13	0.53	2.09
45.00	3.61	0.76	2.39
50.00	4.12	1.04	3.03
55.00	5.09	1.64	8.48
60.00	11.05	6.34	**198.21**
65.00	13.69	8.68	9.22
70.00	**14.54**	**9.45**	5.80
75.00	**14.80**	**9.69**	0.02
80.00	14.80	9.69	0.00
85.00	14.80	9.69	0.00
90.00	14.80	9.69	0.00
95.00	14.80	9.69	0.00
100.00	14.80	9.69	0.00
105.00	14.80	9.69	0.00
110.00	14.80	9.69	0.00
115.00	14.80	9.69	0.00
120.00	14.80	9.69	0.00
125.00	14.80	9.69	0.00
130.00	14.80	9.69	0.00
135.00	14.80	9.69	0.00
140.00	14.80	9.69	0.00
145.00	14.80	9.69	0.00
150.00	14.80	9.69	0.00
155.00	14.80	9.69	0.00
160.00	14.80	9.69	0.00
165.00	14.80	9.69	0.00
170.00	14.80	9.69	0.00
175.00	14.80	9.69	0.00
180.00	14.80	9.69	0.00
185.00	14.80	9.69	0.00
190.00	14.80	9.69	0.00
195.00	14.80	9.69	0.00
200.00	14.80	9.69	0.00
205.00	14.80	9.69	0.00
210.00	14.80	9.69	0.00
215.00	14.80	9.69	0.00
220.00	14.80	9.69	0.00
225.00	14.80	9.69	0.00
230.00	14.80	9.69	0.00
235.00	14.80	9.69	0.00
240.00	14.80	9.69	0.00
245.00	14.80	9.69	0.00
250.00	14.80	9.69	0.00
255.00	14.80	9.69	0.00
260.00	14.80	9.69	0.00
265.00	14.80	9.69	0.00
270.00	14.80	9.69	0.00
275.00	14.80	9.69	0.00
280.00	14.80	9.69	0.00
285.00	14.80	9.69	0.00
290.00	14.80	9.69	0.00
295.00	14.80	9.69	0.00
300.00	14.80	9.69	0.00
305.00	14.80	9.69	0.00
310.00	14.80	9.69	0.00
315.00	14.80	9.69	0.00
320.00	14.80	9.69	0.00
325.00	14.80	9.69	0.00
330.00	14.80	9.69	0.00
335.00	14.80	9.69	0.00
340.00	14.80	9.69	0.00
345.00	14.80	9.69	0.00
350.00	14.80	9.69	0.00
355.00	14.80	9.69	0.00
360.00	14.80	9.69	0.00

Summary for Subcatchment 5S: Buildings

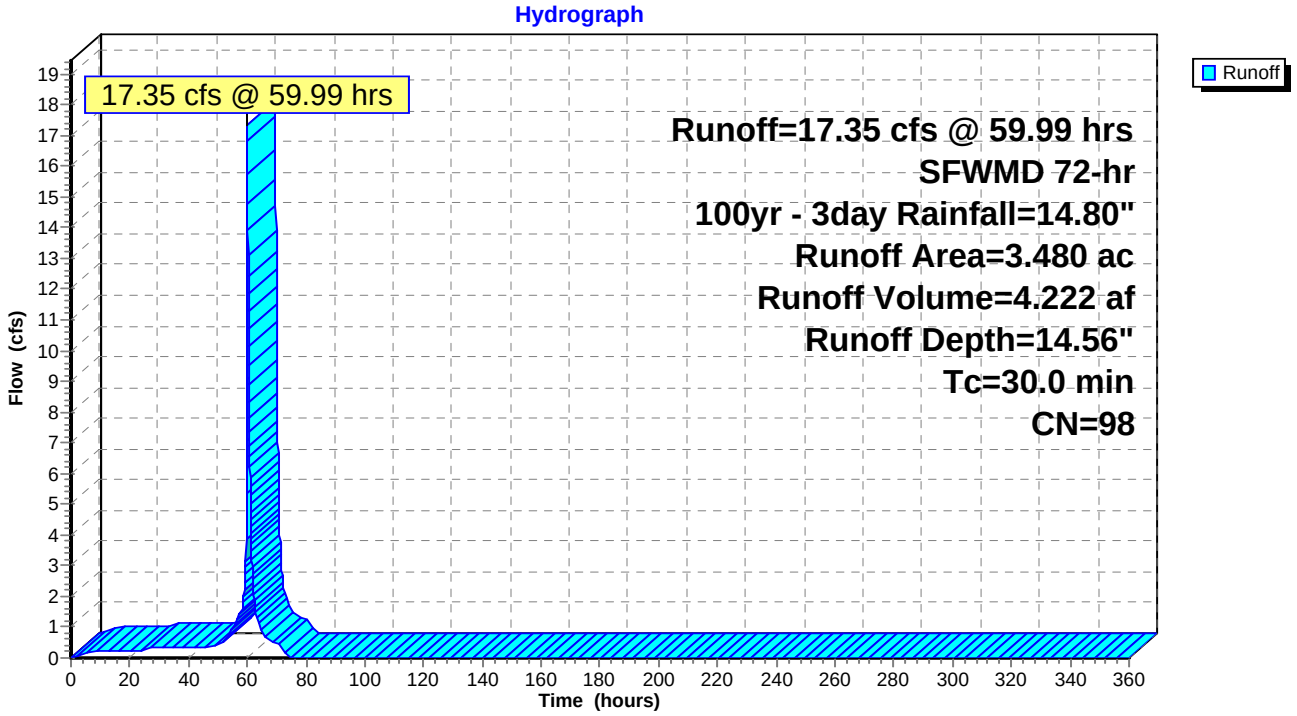
Runoff = 17.35 cfs @ 59.99 hrs, Volume= 4.222 af, Depth=14.56"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
SFWMD 72-hr 100yr - 3day Rainfall=14.80"

	Area (ac)	CN	Description
*	3.480	98	bldg
	3.480		100.00% Impervious Area

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

Subcatchment 5S: Buildings



Hydrograph for Subcatchment 5S: Buildings

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
5.00	0.33	0.17	0.19
10.00	0.67	0.47	0.22
15.00	1.00	0.79	0.23
20.00	1.33	1.11	0.23
25.00	1.67	1.45	0.28
30.00	2.16	1.93	0.36
35.00	2.65	2.42	0.34
40.00	3.13	2.90	0.34
45.00	3.61	3.38	0.34
50.00	4.12	3.89	0.39
55.00	5.09	4.85	0.95
60.00	11.05	10.81	**17.34**
65.00	13.69	13.45	0.74
70.00	**14.54**	**14.30**	0.46
75.00	**14.80**	**14.56**	0.00
80.00	14.80	14.56	0.00
85.00	14.80	14.56	0.00
90.00	14.80	14.56	0.00
95.00	14.80	14.56	0.00
100.00	14.80	14.56	0.00
105.00	14.80	14.56	0.00
110.00	14.80	14.56	0.00
115.00	14.80	14.56	0.00
120.00	14.80	14.56	0.00
125.00	14.80	14.56	0.00
130.00	14.80	14.56	0.00
135.00	14.80	14.56	0.00
140.00	14.80	14.56	0.00
145.00	14.80	14.56	0.00
150.00	14.80	14.56	0.00
155.00	14.80	14.56	0.00
160.00	14.80	14.56	0.00
165.00	14.80	14.56	0.00
170.00	14.80	14.56	0.00
175.00	14.80	14.56	0.00
180.00	14.80	14.56	0.00
185.00	14.80	14.56	0.00
190.00	14.80	14.56	0.00
195.00	14.80	14.56	0.00
200.00	14.80	14.56	0.00
205.00	14.80	14.56	0.00
210.00	14.80	14.56	0.00
215.00	14.80	14.56	0.00
220.00	14.80	14.56	0.00
225.00	14.80	14.56	0.00
230.00	14.80	14.56	0.00
235.00	14.80	14.56	0.00
240.00	14.80	14.56	0.00
245.00	14.80	14.56	0.00
250.00	14.80	14.56	0.00
255.00	14.80	14.56	0.00
260.00	14.80	14.56	0.00
265.00	14.80	14.56	0.00
270.00	14.80	14.56	0.00
275.00	14.80	14.56	0.00
280.00	14.80	14.56	0.00
285.00	14.80	14.56	0.00
290.00	14.80	14.56	0.00
295.00	14.80	14.56	0.00
300.00	14.80	14.56	0.00
305.00	14.80	14.56	0.00
310.00	14.80	14.56	0.00
315.00	14.80	14.56	0.00
320.00	14.80	14.56	0.00
325.00	14.80	14.56	0.00
330.00	14.80	14.56	0.00
335.00	14.80	14.56	0.00
340.00	14.80	14.56	0.00
345.00	14.80	14.56	0.00
350.00	14.80	14.56	0.00
355.00	14.80	14.56	0.00
360.00	14.80	14.56	0.00

Summary for Pond 4P: Detention

Inflow Area = 82.760 ac, 42.00% Impervious, Inflow Depth = 11.73" for 100yr - 3day event
Inflow = 371.57 cfs @ 59.99 hrs, Volume= 80.927 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 12.51' @ 86.75 hrs Surf.Area= 7.295 ac Storage= 80.927 af

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	9.23'	62.387 af	**Detention #1 (Irregular)** Listed below (Recalc)
#2	10.50'	3.653 af	**Detention #2 (Irregular)** Listed below (Recalc)
#3	9.23'	1.103 af	**Detention #3 (Irregular)** Listed below (Recalc)
#4	9.23'	8.802 af	**Detention #4 (Irregular)** Listed below (Recalc)
#5	10.00'	120.000 af	**Open Space Storage** Listed below
#6	11.50'	51.980 af	**Pavement Storage** Listed below
		247.925 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	5.010	4,352.0	0.000	0.000	5.010
12.00	5.910	4,409.0	15.107	15.107	5.964
20.00	5.910	4,409.0	47.280	62.387	6.774

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
10.50	0.075	3,273.0	0.000	0.000	0.075
12.00	0.415	3,302.0	0.333	0.333	0.441
20.00	0.415	3,302.0	3.320	3.653	1.048

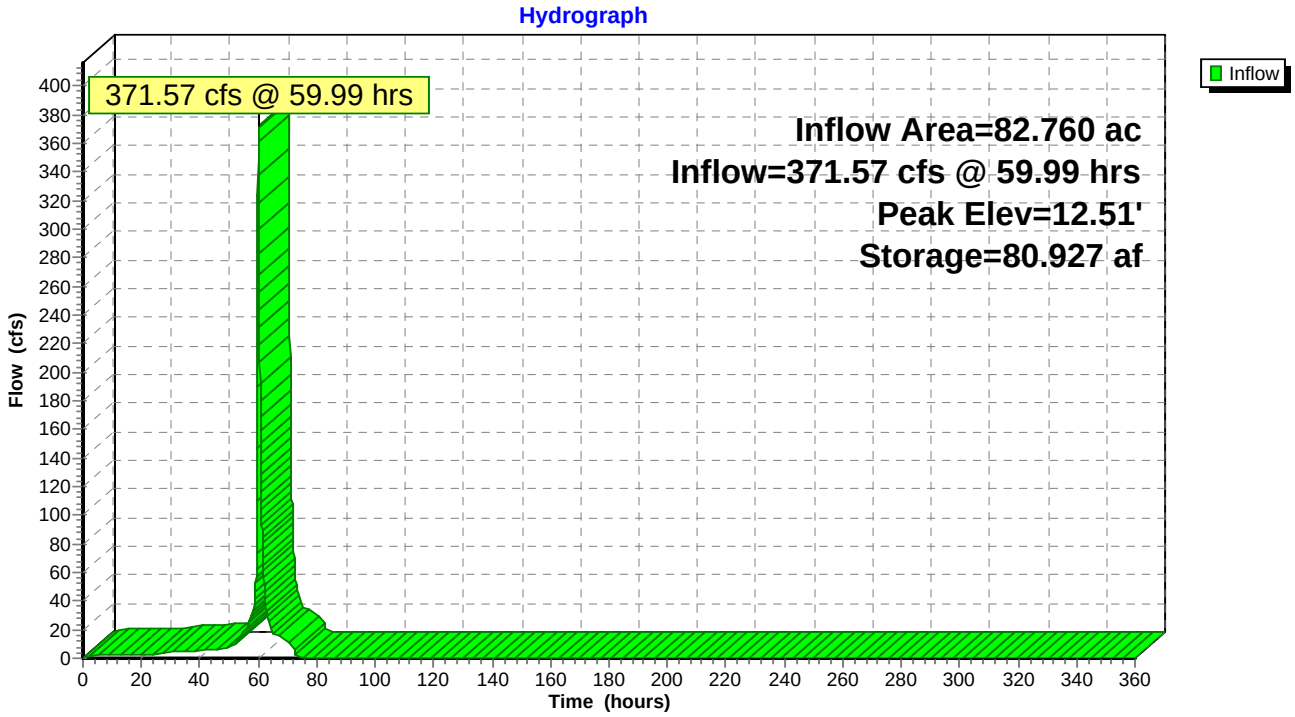
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.054	228.0	0.000	0.000	0.054
12.00	0.110	285.0	0.223	0.223	0.110
20.00	0.110	285.0	0.880	1.103	0.162

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.540	1,526.0	0.000	0.000	0.540
12.00	0.860	1,582.0	1.922	1.922	0.873
20.00	0.860	1,582.0	6.880	8.802	1.164

Elevation (feet)	Cum.Store (acre-feet)
10.00	0.000
10.50	2.000
11.00	8.000
11.50	18.000
12.00	32.000
12.50	50.000
13.00	72.000
13.50	96.000
14.00	120.000

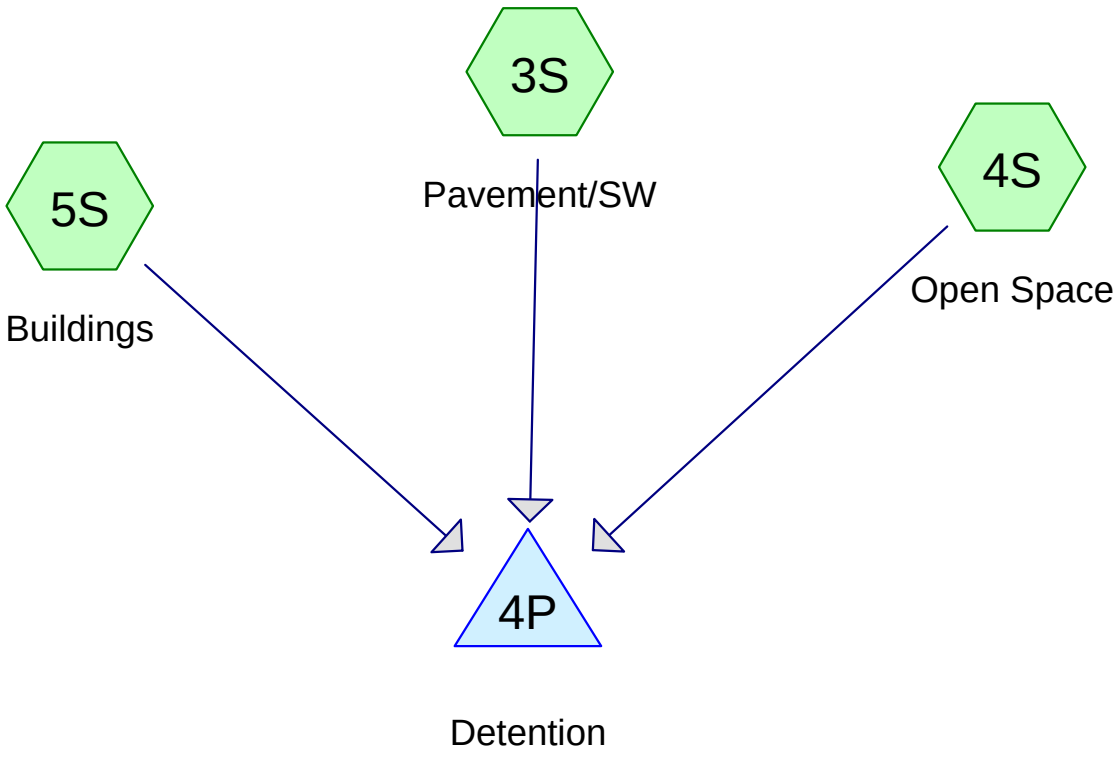
Elevation (feet)	Cum.Store (acre-feet)
11.50	0.000
12.00	2.300
12.50	9.200
13.00	20.700
13.50	36.240
14.00	51.980

Pond 4P: Detention



Hydrograph for Pond 4P: Detention

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)
0.00	0.00	0.000	9.23
5.00	1.87	0.417	9.30
10.00	2.18	1.271	9.45
15.00	2.26	2.190	9.62
20.00	2.48	3.152	9.78
25.00	3.44	4.253	9.97
30.00	4.97	6.024	10.16
35.00	5.08	8.080	10.36
40.00	5.45	10.259	10.54
45.00	5.75	12.574	10.67
50.00	6.89	15.141	10.81
55.00	17.96	19.818	11.04
60.00	**371.41**	40.526	11.71
65.00	16.61	72.945	12.37
70.00	10.40	78.759	12.47
75.00	0.03	80.926	12.51
80.00	0.00	80.927	12.51
85.00	0.00	**80.927**	**12.51**
90.00	0.00	**80.927**	**12.51**
95.00	0.00	80.927	12.51
100.00	0.00	80.927	12.51
105.00	0.00	80.927	12.51
110.00	0.00	80.927	12.51
115.00	0.00	80.927	12.51
120.00	0.00	80.927	12.51
125.00	0.00	80.927	12.51
130.00	0.00	80.927	12.51
135.00	0.00	80.927	12.51
140.00	0.00	80.927	12.51
145.00	0.00	80.927	12.51
150.00	0.00	80.927	12.51
155.00	0.00	80.927	12.51
160.00	0.00	80.927	12.51
165.00	0.00	80.927	12.51
170.00	0.00	80.927	12.51
175.00	0.00	80.927	12.51
180.00	0.00	80.927	12.51
185.00	0.00	80.927	12.51
190.00	0.00	80.927	12.51
195.00	0.00	80.927	12.51
200.00	0.00	80.927	12.51
205.00	0.00	80.927	12.51
210.00	0.00	80.927	12.51
215.00	0.00	80.927	12.51
220.00	0.00	80.927	12.51
225.00	0.00	80.927	12.51
230.00	0.00	80.927	12.51
235.00	0.00	80.927	12.51
240.00	0.00	80.927	12.51
245.00	0.00	80.927	12.51
250.00	0.00	80.927	12.51
255.00	0.00	80.927	12.51
260.00	0.00	80.927	12.51
265.00	0.00	80.927	12.51
270.00	0.00	80.927	12.51
275.00	0.00	80.927	12.51
280.00	0.00	80.927	12.51
285.00	0.00	80.927	12.51
290.00	0.00	80.927	12.51
295.00	0.00	80.927	12.51
300.00	0.00	80.927	12.51
305.00	0.00	80.927	12.51
310.00	0.00	80.927	12.51
315.00	0.00	80.927	12.51
320.00	0.00	80.927	12.51
325.00	0.00	80.927	12.51
330.00	0.00	80.927	12.51
335.00	0.00	80.927	12.51
340.00	0.00	80.927	12.51
345.00	0.00	80.927	12.51
350.00	0.00	80.927	12.51
355.00	0.00	80.927	12.51
360.00	0.00	80.927	12.51



Subcat Reach Pond Link

Routing Diagram for 2016-08-24-DD (82.76 AC BASIN)
Prepared by Microsoft, Printed 9/8/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.870	85	Detention (305) (4S)
7.160	85	Detention (RRBP) (4S)
39.970	60	Open Space (RRBP) (4S)
3.480	98	bldg (5S)
31.280	98	pvmt (3S)
82.760	**78**	**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 3S: Pavement/SW Runoff Area=31.280 ac 100.00% Impervious Runoff Depth=0.00"
Tc=30.0 min CN=98 Runoff=0.00 cfs 0.000 af

Subcatchment 4S: Open Space Runoff Area=48.000 ac 0.00% Impervious Runoff Depth=0.00"
Tc=30.0 min CN=64 Runoff=0.00 cfs 0.000 af

Subcatchment 5S: Buildings Runoff Area=3.480 ac 100.00% Impervious Runoff Depth=0.00"
Tc=15.0 min CN=98 Runoff=0.00 cfs 0.000 af

Pond 4P: Detention Peak Elev=10.55' Storage=10.445 af Inflow=0.00 cfs 0.000 af
Outflow=2.13 cfs 3.391 af

Total Runoff Area = 82.760 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
58.00% Pervious = 48.000 ac 42.00% Impervious = 34.760 ac

Summary for Subcatchment 3S: Pavement/SW

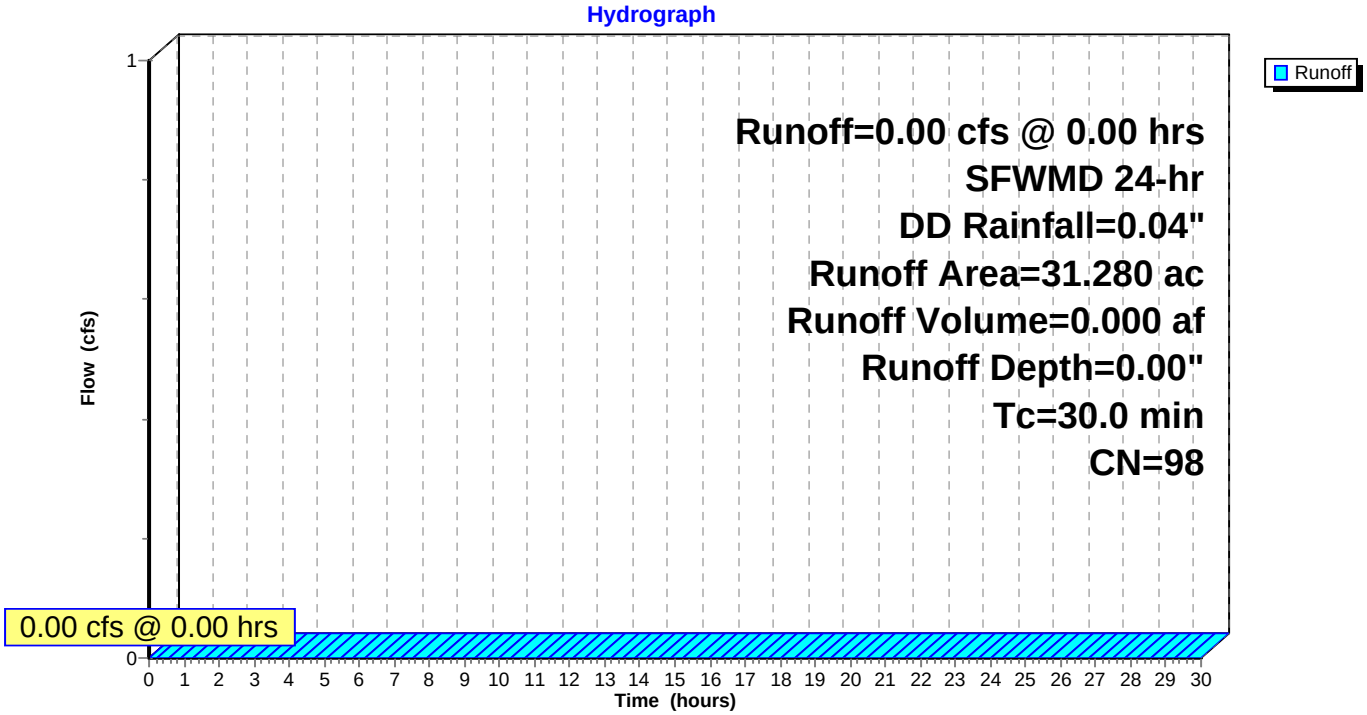
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
SFWMD 24-hr DD Rainfall=0.04"

	Area (ac)	CN	Description
*	31.280	98	pvmt
	31.280		100.00% Impervious Area

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

Subcatchment 3S: Pavement/SW



Hydrograph for Subcatchment 3S: Pavement/SW

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	**0.00**	**0.00**
0.50	0.00	0.00	0.00
1.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00
2.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00
4.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00
5.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00
6.00	0.00	0.00	0.00
6.50	0.00	0.00	0.00
7.00	0.00	0.00	0.00
7.50	0.00	0.00	0.00
8.00	0.01	0.00	0.00
8.50	0.01	0.00	0.00
9.00	0.01	0.00	0.00
9.50	0.01	0.00	0.00
10.00	0.01	0.00	0.00
10.50	0.01	0.00	0.00
11.00	0.01	0.00	0.00
11.50	0.01	0.00	0.00
12.00	0.03	0.00	0.00
12.50	0.03	0.00	0.00
13.00	0.03	0.00	0.00
13.50	0.03	0.00	0.00
14.00	0.03	0.00	0.00
14.50	0.03	0.00	0.00
15.00	0.03	0.00	0.00
15.50	0.03	0.00	0.00
16.00	0.04	0.00	0.00
16.50	0.04	0.00	0.00
17.00	0.04	0.00	0.00
17.50	0.04	0.00	0.00
18.00	0.04	0.00	0.00
18.50	0.04	0.00	0.00
19.00	0.04	0.00	0.00
19.50	0.04	0.00	0.00
20.00	0.04	0.00	0.00
20.50	0.04	0.00	0.00
21.00	0.04	0.00	0.00
21.50	0.04	0.00	0.00
22.00	0.04	0.00	0.00
22.50	0.04	0.00	0.00
23.00	0.04	0.00	0.00
23.50	0.04	0.00	0.00
24.00	**0.04**	0.00	0.00
24.50	0.04	0.00	0.00
25.00	0.04	0.00	0.00
25.50	0.04	0.00	0.00
26.00	0.04	0.00	0.00
26.50	0.04	0.00	0.00
27.00	0.04	0.00	0.00
27.50	0.04	0.00	0.00
28.00	0.04	0.00	0.00
28.50	0.04	0.00	0.00
29.00	0.04	0.00	0.00
29.50	0.04	0.00	0.00
30.00	0.04	0.00	0.00

Summary for Subcatchment 4S: Open Space

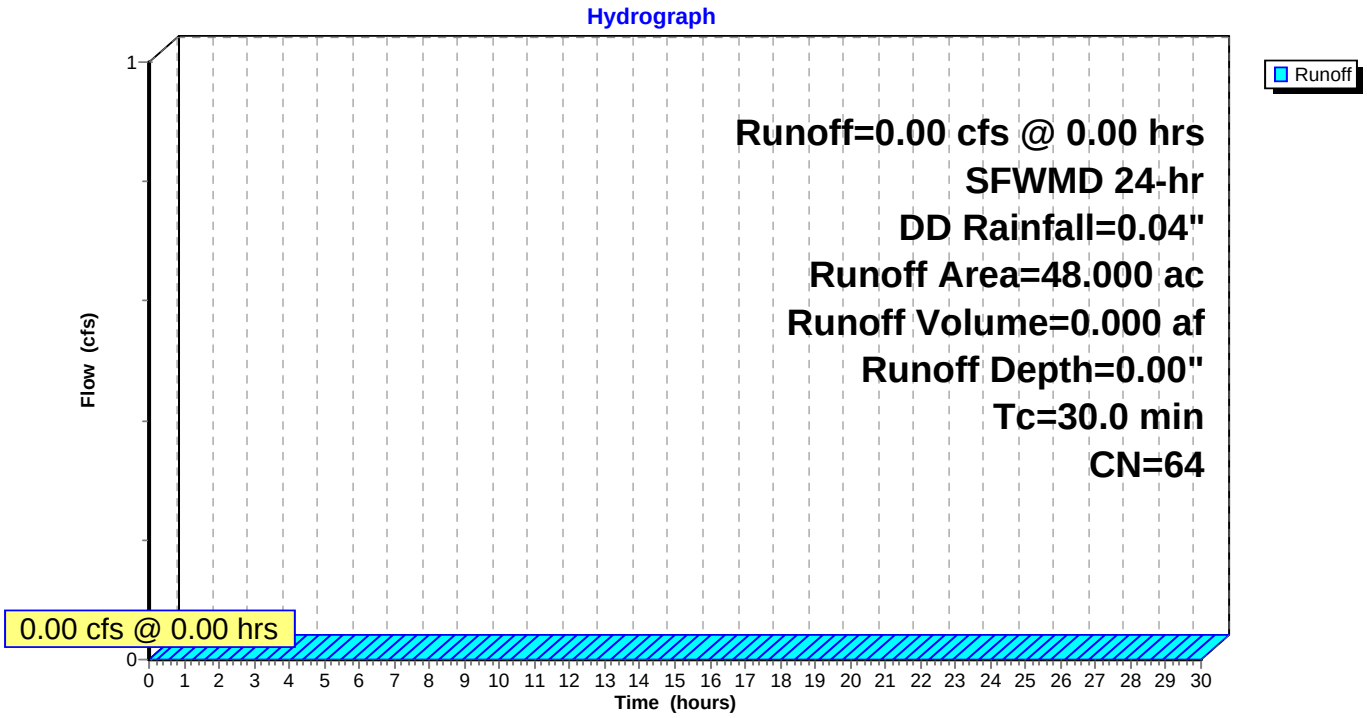
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
SFWMD 24-hr DD Rainfall=0.04"

	Area (ac)	CN	Description
*	7.160	85	Detention (RRBP)
*	0.870	85	Detention (305)
*	39.970	60	Open Space (RRBP)
	48.000	64	Weighted Average
	48.000		100.00% Pervious Area

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

Subcatchment 4S: Open Space



Hydrograph for Subcatchment 4S: Open Space

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	**0.00**	**0.00**
0.50	0.00	0.00	0.00
1.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00
2.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00
4.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00
5.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00
6.00	0.00	0.00	0.00
6.50	0.00	0.00	0.00
7.00	0.00	0.00	0.00
7.50	0.00	0.00	0.00
8.00	0.01	0.00	0.00
8.50	0.01	0.00	0.00
9.00	0.01	0.00	0.00
9.50	0.01	0.00	0.00
10.00	0.01	0.00	0.00
10.50	0.01	0.00	0.00
11.00	0.01	0.00	0.00
11.50	0.01	0.00	0.00
12.00	0.03	0.00	0.00
12.50	0.03	0.00	0.00
13.00	0.03	0.00	0.00
13.50	0.03	0.00	0.00
14.00	0.03	0.00	0.00
14.50	0.03	0.00	0.00
15.00	0.03	0.00	0.00
15.50	0.03	0.00	0.00
16.00	0.04	0.00	0.00
16.50	0.04	0.00	0.00
17.00	0.04	0.00	0.00
17.50	0.04	0.00	0.00
18.00	0.04	0.00	0.00
18.50	0.04	0.00	0.00
19.00	0.04	0.00	0.00
19.50	0.04	0.00	0.00
20.00	0.04	0.00	0.00
20.50	0.04	0.00	0.00
21.00	0.04	0.00	0.00
21.50	0.04	0.00	0.00
22.00	0.04	0.00	0.00
22.50	0.04	0.00	0.00
23.00	0.04	0.00	0.00
23.50	0.04	0.00	0.00
24.00	**0.04**	0.00	0.00
24.50	0.04	0.00	0.00
25.00	0.04	0.00	0.00
25.50	0.04	0.00	0.00
26.00	0.04	0.00	0.00
26.50	0.04	0.00	0.00
27.00	0.04	0.00	0.00
27.50	0.04	0.00	0.00
28.00	0.04	0.00	0.00
28.50	0.04	0.00	0.00
29.00	0.04	0.00	0.00
29.50	0.04	0.00	0.00
30.00	0.04	0.00	0.00

Summary for Subcatchment 5S: Buildings

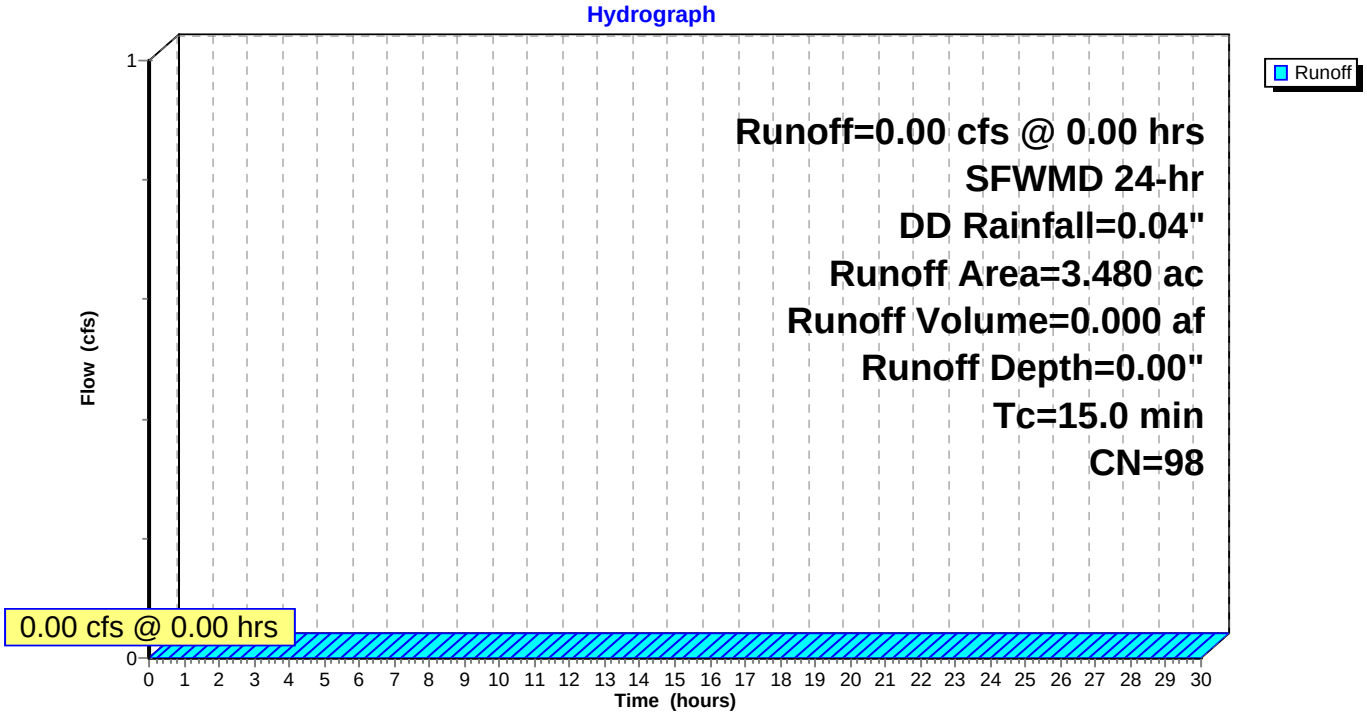
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
SFWMD 24-hr DD Rainfall=0.04"

	Area (ac)	CN	Description
*	3.480	98	bldg
	3.480		100.00% Impervious Area

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

Subcatchment 5S: Buildings



Hydrograph for Subcatchment 5S: Buildings

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	**0.00**	**0.00**
0.50	0.00	0.00	0.00
1.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00
2.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00
4.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00
5.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00
6.00	0.00	0.00	0.00
6.50	0.00	0.00	0.00
7.00	0.00	0.00	0.00
7.50	0.00	0.00	0.00
8.00	0.01	0.00	0.00
8.50	0.01	0.00	0.00
9.00	0.01	0.00	0.00
9.50	0.01	0.00	0.00
10.00	0.01	0.00	0.00
10.50	0.01	0.00	0.00
11.00	0.01	0.00	0.00
11.50	0.01	0.00	0.00
12.00	0.03	0.00	0.00
12.50	0.03	0.00	0.00
13.00	0.03	0.00	0.00
13.50	0.03	0.00	0.00
14.00	0.03	0.00	0.00
14.50	0.03	0.00	0.00
15.00	0.03	0.00	0.00
15.50	0.03	0.00	0.00
16.00	0.04	0.00	0.00
16.50	0.04	0.00	0.00
17.00	0.04	0.00	0.00
17.50	0.04	0.00	0.00
18.00	0.04	0.00	0.00
18.50	0.04	0.00	0.00
19.00	0.04	0.00	0.00
19.50	0.04	0.00	0.00
20.00	0.04	0.00	0.00
20.50	0.04	0.00	0.00
21.00	0.04	0.00	0.00
21.50	0.04	0.00	0.00
22.00	0.04	0.00	0.00
22.50	0.04	0.00	0.00
23.00	0.04	0.00	0.00
23.50	0.04	0.00	0.00
24.00	**0.04**	0.00	0.00
24.50	0.04	0.00	0.00
25.00	0.04	0.00	0.00
25.50	0.04	0.00	0.00
26.00	0.04	0.00	0.00
26.50	0.04	0.00	0.00
27.00	0.04	0.00	0.00
27.50	0.04	0.00	0.00
28.00	0.04	0.00	0.00
28.50	0.04	0.00	0.00
29.00	0.04	0.00	0.00
29.50	0.04	0.00	0.00
30.00	0.04	0.00	0.00

Summary for Pond 4P: Detention

Inflow Area = 82.760 ac, 42.00% Impervious, Inflow Depth = 0.00" for DD event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 2.13 cfs @ 0.00 hrs, Volume= 3.391 af, Atten= 0%, Lag= 0.0 min
Primary = 2.13 cfs @ 0.00 hrs, Volume= 3.391 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Starting Elev= 10.55' Surf.Area= 6.323 ac Storage= 10.445 af
Peak Elev= 10.55' @ 0.00 hrs Surf.Area= 6.323 ac Storage= 10.445 af

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

Volume	Invert	Avail.Storage	Storage Description
#1	9.23'	62.484 af	**Detention #1 (Irregular)**Listed below (Recalc)
#2	10.50'	3.653 af	**Detention #2 (Irregular)**Listed below (Recalc)
#3	9.23'	1.103 af	**Detention #3 (Irregular)**Listed below (Recalc)
#4	9.23'	8.802 af	**Detention #4 (Irregular)**Listed below (Recalc)
#5	10.00'	120.000 af	**Open Space Storage**Listed below
#6	11.50'	51.980 af	**Pavement Storage**Listed below
		248.022 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	5.010	4,352.0	0.000	0.000	5.010
9.95	5.306	4,373.0	3.713	3.713	5.352
12.00	5.910	4,409.0	11.491	15.204	5.966
20.00	5.910	4,409.0	47.280	62.484	6.776

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
10.50	0.075	3,273.0	0.000	0.000	0.075
12.00	0.415	3,302.0	0.333	0.333	0.441
20.00	0.415	3,302.0	3.320	3.653	1.048

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.054	228.0	0.000	0.000	0.054
12.00	0.110	285.0	0.223	0.223	0.110
20.00	0.110	285.0	0.880	1.103	0.162

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
9.23	0.540	1,526.0	0.000	0.000	0.540
12.00	0.860	1,582.0	1.922	1.922	0.873
20.00	0.860	1,582.0	6.880	8.802	1.164

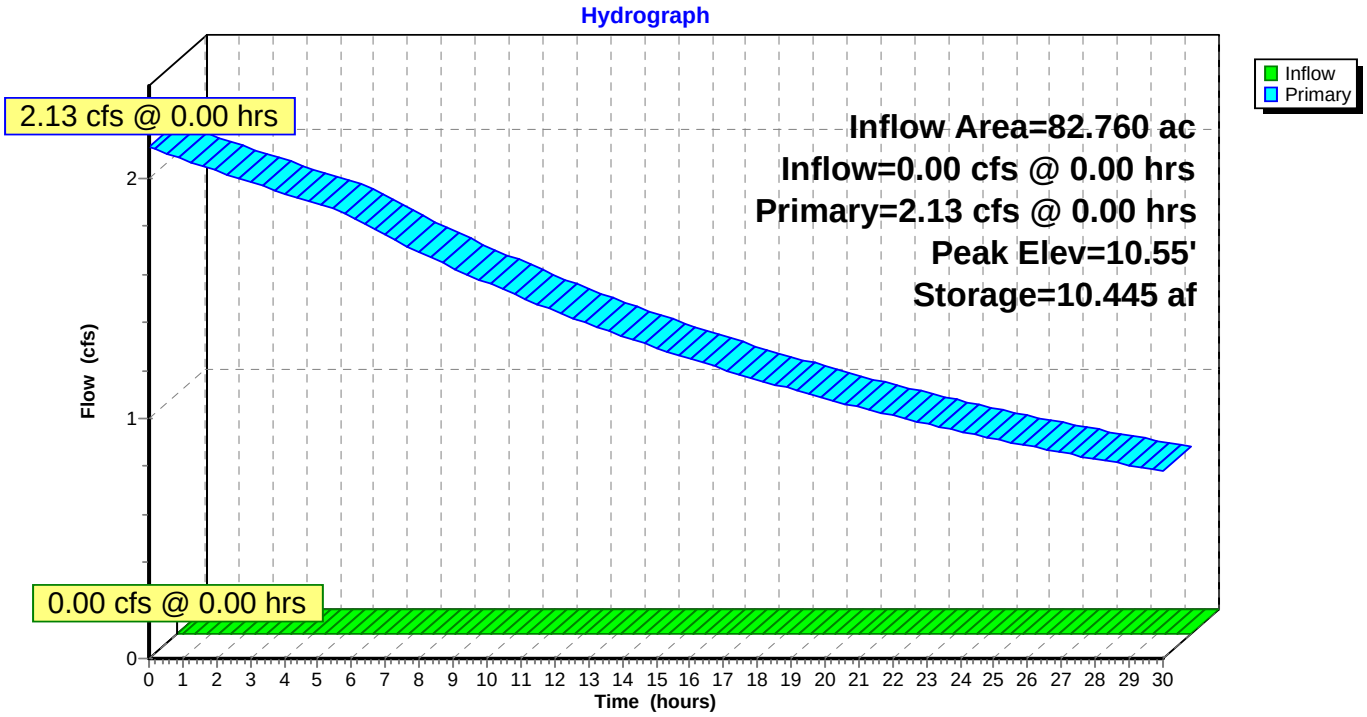
Elevation (feet)	Cum.Store (acre-feet)
10.00	0.000
10.50	2.000
11.00	8.000
11.50	18.000
12.00	32.000
12.50	50.000
13.00	72.000
13.50	96.000
14.00	120.000

Elevation (feet)	Cum.Store (acre-feet)
11.50	0.000
12.00	2.300
12.50	9.200
13.00	20.700
13.50	36.240
14.00	51.980

Device	Routing	Invert	Outlet Devices
#1	Primary	12.00'	**48.0" x 36.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	9.95'	**Custom Weir/Orifice X 2.00, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.60 0.60 1.00 Width (feet) 0.70 0.70 1.75 1.75

Primary OutFlow Max=2.13 cfs @ 0.00 hrs HW=10.55' (Free Discharge)
└**1=Grate** (Controls 0.00 cfs)
└**2=Custom Weir/Orifice** (Weir Controls 2.13 cfs @ 2.54 fps)

Pond 4P: Detention



Hydrograph for Pond 4P: Detention

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	**0.00**	**10.445**	**10.55**	**2.13**
1.00	0.00	10.271	10.54	2.08
2.00	0.00	10.101	10.53	2.03
3.00	0.00	9.935	10.52	1.98
4.00	0.00	9.773	10.51	1.94
5.00	0.00	9.615	10.50	1.89
6.00	0.00	9.460	10.49	1.84
7.00	0.00	9.312	10.48	1.76
8.00	0.00	9.169	10.46	1.69
9.00	0.00	9.032	10.45	1.63
10.00	0.00	8.900	10.44	1.56
11.00	0.00	8.773	10.43	1.51
12.00	0.00	8.651	10.41	1.45
13.00	0.00	8.533	10.40	1.39
14.00	0.00	8.420	10.39	1.34
15.00	0.00	8.311	10.38	1.30
16.00	0.00	8.206	10.37	1.25
17.00	0.00	8.105	10.36	1.20
18.00	0.00	8.007	10.35	1.16
19.00	0.00	7.913	10.34	1.12
20.00	0.00	7.821	10.33	1.08
21.00	0.00	7.733	10.32	1.05
22.00	0.00	7.648	10.32	1.01
23.00	0.00	7.566	10.31	0.98
24.00	0.00	7.487	10.30	0.95
25.00	0.00	7.410	10.29	0.92
26.00	0.00	7.335	10.28	0.89
27.00	0.00	7.263	10.28	0.86
28.00	0.00	7.193	10.27	0.83
29.00	0.00	7.126	10.26	0.81
30.00	0.00	7.060	10.26	0.78

APPENDIX E

Modret Modeling Analysis

MODRET

SUMMARY OF UNSATURATED & SATURATED INPUT PARAMETERS

PROJECT NAME :
POLLUTION VOLUME RUNOFF DATA USED
UNSATURATED ANALYSIS INCLUDED

Pond Bottom Area	218,073.00 ft²
Pond Volume between Bottom & DHWL	161,608.00 ft³
Pond Length to Width Ratio (L/W)	31.00
Elevation of Effective Aquifer Base	-12.00 ft
Elevation of Seasonal High Groundwater Table	8.23 ft
Elevation of Starting Water Level	9.23 ft
Elevation of Pond Bottom	9.23 ft
Design High Water Level Elevation	9.95 ft
Avg. Effective Storage Coefficient of Soil for Unsaturated Analysis	0.10
Unsaturated Vertical Hydraulic Conductivity	9.60 ft/d
Factor of Safety	2.00
Saturated Horizontal Hydraulic Conductivity	16.40 ft/d
Avg. Effective Storage Coefficient of Soil for Saturated Analysis	0.10
Avg. Effective Storage Coefficient of Pond/Exfiltration Trench	1.00

Hydraulic Control Features:

	Top	Bottom	Left	Right
Groundwater Control Features - Y/N	Y	Y	Y	Y
Distance to Edge of Pond	33.00	33.00	235.00	33.00
Elevation of Water Level	8.23	8.23	6.23	8.23
Impervious Barrier - Y/N	N	N	N	N
Elevation of Barrier Bottom	0.00	0.00	0.00	0.00

Analysis Date: 6/15/2016

MODRET

TIME - RUNOFF INPUT DATA

PROJECT NAME:

STRESS PERIOD NUMBER	INCREMENT OF TIME (hrs)	VOLUME OF RUNOFF (ft^3)
Unsat	0.50	21,807.30
1	1.00	139,800.70
2	1.81	0.00
3	1.81	0.00
4	1.81	0.00
5	1.81	0.00
6	1.81	0.00
7	1.81	0.00
8	1.81	0.00
9	1.81	0.00
10	1.81	0.00
11	1.81	0.00
12	1.81	0.00
13	1.81	0.00
14	1.81	0.00
15	1.81	0.00
16	1.81	0.00
17	1.81	0.00
18	1.81	0.00
19	1.81	0.00
20	1.81	0.00
21	1.81	0.00
22	1.81	0.00
23	1.81	0.00
24	1.81	0.00
25	1.81	0.00
26	1.81	0.00
27	1.81	0.00
28	1.81	0.00
29	1.81	0.00
30	1.81	0.00

MODRET

SUMMARY OF RESULTS

PROJECT NAME :

CUMULATIVE TIME (hrs)	WATER ELEVATION (feet)	INSTANTANEOUS INFILTRATION RATE (cfs)	AVERAGE INFILTRATION RATE (cfs)	CUMULATIVE OVERFLOW (ft^3)
00.00 - 0.00	8.230	0.000 *		
			0.00000	
0.00	8.230	6.96122		
			5.11225	
1.50	9.827	3.26328		0.00
			1.03504	
3.31	9.797	0.94909		0.00
			0.86315	
5.12	9.772	0.82948		0.00
			0.79581	
6.92	9.749	0.77751		0.00
			0.75920	
8.73	9.727	0.74628		0.00
			0.73335	
10.54	9.706	0.72243		0.00
			0.71151	
12.35	9.685	0.70182		0.00
			0.69213	
14.15	9.665	0.68317		0.00
			0.67421	
15.96	9.645	0.66587		0.00
			0.65753	
17.77	9.626	0.64969		0.00
			0.64184	
19.58	9.608	0.63451		0.00
			0.62717	
21.38	9.590	0.62028		0.00
			0.61339	
23.19	9.572	0.60684		0.00

Analysis Date: 6/15/2016

MODRET

SUMMARY OF RESULTS

PROJECT NAME :

CUMULATIVE TIME (hrs)	WATER ELEVATION (feet)	INSTANTANEOUS INFILTRATION RATE (cfs)	AVERAGE INFILTRATION RATE (cfs)	CUMULATIVE OVERFLOW (ft^3)
			0.60030	
25.00	9.554	0.59418		0.00
			0.58806	
26.81	9.537	0.58217		0.00
			0.57629	
28.62	9.521	0.57076		0.00
			0.56523	
30.42	9.504	0.56004		0.00
			0.55484	
32.23	9.488	0.54979		0.00
			0.54474	
34.04	9.472	0.54004		0.00
			0.53533	
35.85	9.457	0.53078		0.00
			0.52622	
37.65	9.442	0.52190		0.00
			0.51757	
39.46	9.427	0.51344		0.00
			0.50932	
41.27	9.412	0.50535		0.00
			0.50139	
43.08	9.397	0.49757		0.00
			0.49376	
44.88	9.383	0.49007		0.00
			0.48639	
46.69	9.369	0.48287		0.00
			0.47935	
48.50	9.355	0.47595		0.00

Analysis Date: 6/15/2016

MODRET

SUMMARY OF RESULTS

PROJECT NAME :

CUMULATIVE TIME (hrs)	WATER ELEVATION (feet)	INSTANTANEOUS INFILTRATION RATE (cfs)	AVERAGE INFILTRATION RATE (cfs)	CUMULATIVE OVERFLOW (ft^3)
			0.47254	
50.31	9.341	0.46925		0.00
			0.46596	
52.12	9.328	0.46280		0.00
			0.45965	
53.92	9.314	0.45655		0.00
			0.45346	
55.73	9.301	0.45049		0.00
			0.44751	
57.54	9.288	0.44457		0.00
			0.44162	
59.35	9.275	0.43886		0.00
			0.43610	
61.15	9.263	0.43333		0.00
			0.43057	
62.96	9.250	0.42797		0.00
			0.42537	
64.77	9.238	0.42267		0.00
			0.41998	
65.95	9.230	0.41749		0.00
			0.41501	
68.38	9.214	0.41254		0.00
			0.41008	
70.19	9.202	0.40764		0.00
			0.40521	
72.00	9.190			0.00

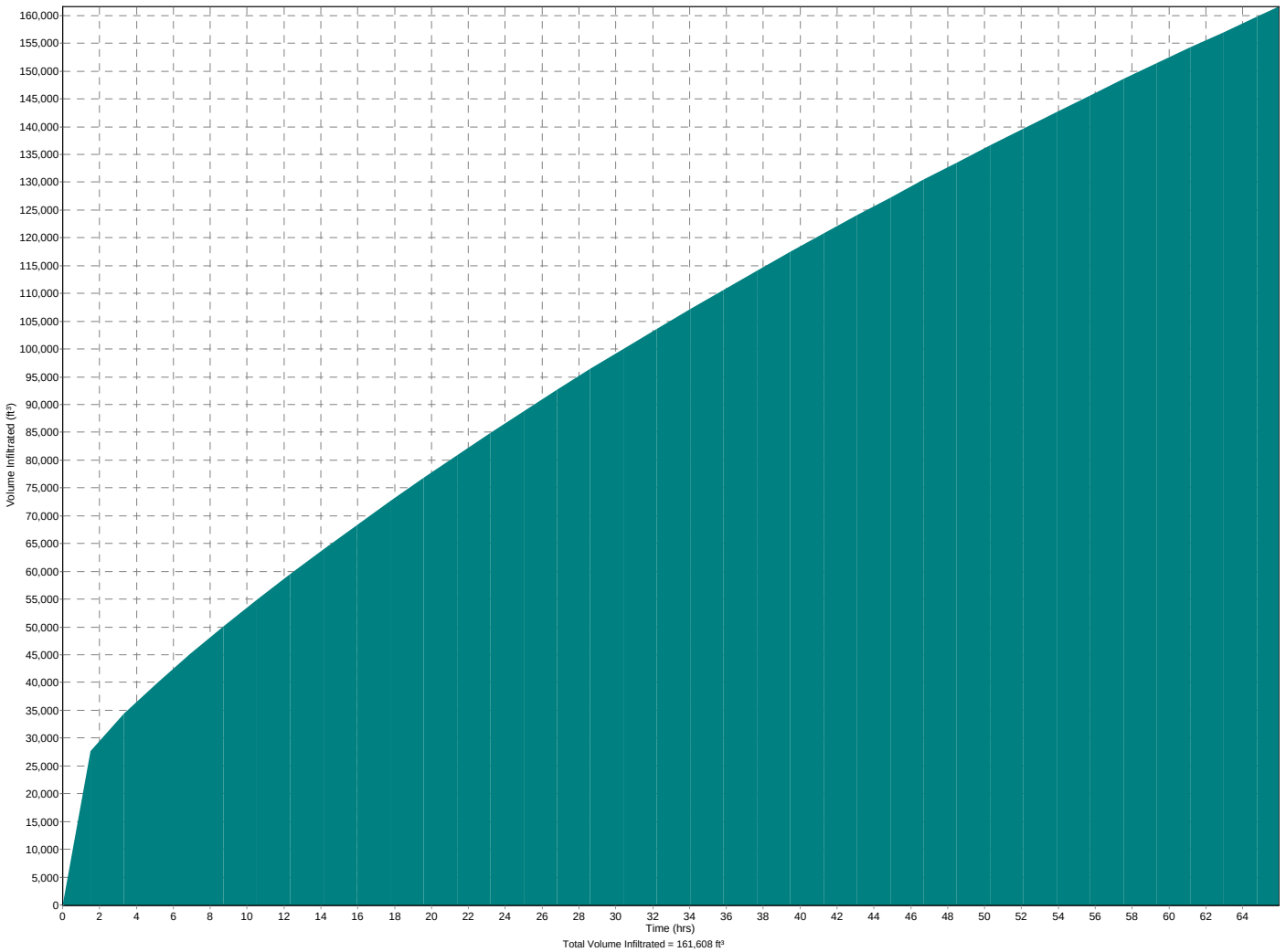
Maximum Water Elevation: 9.827 feet @ 1.50 hours Recovery @ 65.955 hours

* Time increment when there is no runoff

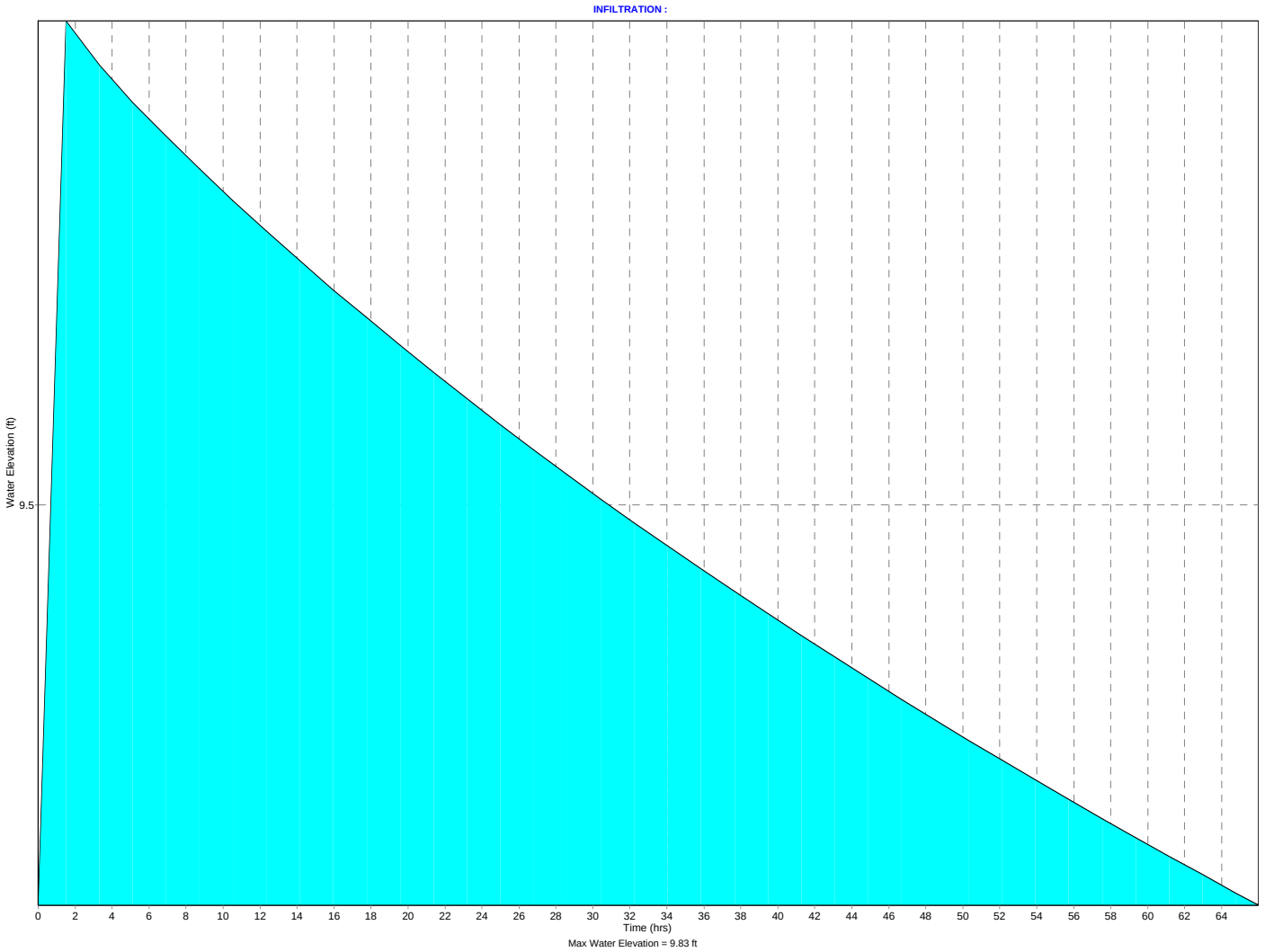
Maximum Infiltration Rate: 1.968 ft/day

Analysis Date: 6/15/2016

INFILTRATION :



Total Volume Infiltrated = 161,608 ft³


INFILTRATION :
Water Elevation (ft)
9.5
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Time (hrs)
Max Water Elevation = 9.83 ft

APPENDIX F

Harper Analysis Report

1.1 – General

For purposes of the "Evaluation of Alternative Stormwater Regulations: for Haldeman's Landing, both pre- and post-development loadings were calculated using the concentration-based method or 2007 Harper Method (Harper Analysis). The pre- and post-development loadings were calculated by estimating the runoff volumes and characteristics of rainfall for the site's conditions. All calculations and assumptions are based on the current stormwater design criteria provided by Florida Department of Environmental Protection in June 2007, as referenced at the end of the report.

The Resource Recovery Business Park is a proposed facility that will offer additional services to the landfill and provide other associated industrial uses within a ±360 acre parcel. Because of the size of the parcel the development will be broken down into a number of different phases. During this phase, ±86 acres will be modeled at 70% impervious to permit for future buildouts within the associated land. The project is located in Section 25 and 36, Township 49 South, Range 26 East, Collier County, Florida. The surface water management system consists of a series of interconnected grate inlets, stormwater pipes, and dry retention areas which will then discharge into the Golden Gate Canal.

1.2 – Existing Conditions – Pre-Development

The project site sits vacant and undisturbed. A land use breakdown for the existing conditions is located in Table 1.2 Pre-development Land Use Breakdown and is based on the environmental characteristics identified within the FLUCCS Report.

1.2 Pre-development Land Use Breakdown

Land Use	Acreage	Run-off Value
Woods	86.02	0% DCIA
Total:	86.02 Acres	

*DCIA = Directly Connected Impervious Area

Conditions of Site:

Soil Types

Hydrologic Soil Group (HSG)

Collier County = HSG-A – Sand (USDA, A-9)

1.3 – Methodology and Analysis for Pre-development Conditions

In the following methodology and analysis, one will see the evaluation of alternative stormwater loadings for pre-development conditions for the phased construction of the Resource Recovery Business Park. Since this method considers site-specific hydrologic characteristics in estimating pollutant loadings, the accuracy of this method is considerably greater than traditional methods. Pre-development loadings are calculated using estimates of runoff volumes and runoff characteristics. As previously stated, all calculations and assumptions are based on the current stormwater design criteria provided by Florida Department of Environmental Protection in June 2007, as referenced at the end of the report.

The runoff volumes for the Fort Myers area (Southwest Coastal) were obtained from the National Climatic Data Center (NCDC) from 1960 – 2003 ("Evaluation of the Current…", 3-5). The aforementioned runoff characteristics take into consideration all land uses categories in Southwest Florida and thus, result in a series of annual runoff coefficients used in this analysis. For further explanation of this methodology, please see the "Evaluation of Alternative Stormwater Regulations for Southwest Florida – Final Report," by Harper and Baker or "Evaluation of Current Stormwater Design Criteria within the State of Florida – Final Report," by Harper and Baker.

1.3 a – Estimate curve number / runoff coefficient:

The nDCIA curve numbers were calculated based on the average depth to wet season water table (WSWT) and contingent on the land being developed or undeveloped based on the existing conditions. These variables determined available soil storage (S) which in turn calculates the Curve Number (CN) for each land use category, see Equation 1.3a. A validated calculation of each land use curve number is available in Table 1.3a – Curve Number Calculations.

Equation 1.3a $$CN = \frac{1{,}000}{(10+S)}$$

Table 1.3a Curve Number Calculations

Land Use	WSWT (ft-NAVD)	Depth to WSWT (ft-NAVD)	Undeveloped Available Soil Storage (S - inches)	Developed Available Soil Storage (S - inches)	CN
Woods	8.23	2.0	2.5	-	80

1.3b – Runoff Coefficients, Zone-4 (Baker and Harper, Appendix C)

From Appendix C of "Evaluation of Alternative…," Harper and Baker developed an interpolation table to determine a runoff coefficient based on nDCIA CN and %DCIA. The determined coefficients are listed in Table 1.3b - Zone 4 Runoff Coefficients.

Table 1.3b – Zone 4 Runoff Coefficients

Land Use	%DCIA	nDCIA CN	C
Woods	0	80	0.130

1.3c – Calculate Annual Runoff Volumes (Ai)

The annual runoff volume is calculated based on the previously calculated run-off coefficient (C), area of interest and mean annual rainfall (MAR) event. The mean annual rainfall event was established by location, aforementioned, the NCDC has deemed 53.13-inches the mean annual rainfall event for this location. Equation 1.3c calculates the Annual Runoff Volume (Ai).

Equation 1.3c $$Ai = (Area) * (MAR) * \left(\frac{1\,ft}{12\,in}\right)$$

Table 1.3c summarizes the Annual Runoff Volumes for each land use category.

Table 1.3c – Annual Runoff Volumes (Ai)

Land Use	Area (Ac)	C	Ai (Ac-ft)
Woods	86.02	0.130	49.51

1.3d – Estimate Runoff Characteristics for Land Uses

Based on the particular land use, nutrient concentrations for phosphorus and nitrogen have been assumed according to the "Evaluation of Current…," by Harper and Baker and can be found in Table 4-17 of these readings; additional information is also available with Harper PowerPoint. These values are available in Table 1.3d – Estimate Runoff Characteristics of Nitrogen (N) and Phosphorus (P).

1.3d – Estimate Runoff Characteristics of Nitrogen (N) and Phosphorus (P)

Land Use	TC, N (mg/l)	TC, P (mg/l)
Woods	1.17	0.187

1.3e Calculate Pre-Development Loadings

To calculate the Pre-development loadings the following equation was utilized:

Equation 1.3e $$N\ or\ P, Load = (Ai) * \left(\frac{43{,}560\ ft^2}{acre}\right) * \left(\frac{7.48\ gal}{ft^3}\right) * \left(\frac{3.785\ l}{gal}\right) * (TC) * \left(\frac{1\ kg}{10^6}\right)$$

1.3e – Pre-development Nitrogen and Phosphorus Loadings

Land Use	Ai (Ac-ft)	TC, N (mg/l)	TC, P (mg/l)	N, Load (TN/yr)	P, Load (TN/yr)
Woods	49.51	1.17	0.187	71.44	11.42

1.3f Total Pre-Development Loadings:

The total Pre-development loadings are the summation of the previously calculated values.

Total N, Loadings: 71.44 kg TN/yr
Total P, Loadings: 11.42 kg TP/yr

Per South Florida Water Management District requirements sites that require a Harper Analysis must ensure Post Development Loadings do not exceed Pre-Development Loadings; no other treatment requirements are obligatory.

2.1 Proposed Conditions – Post Development

Proposed build-out conditions for Haldeman's Landing will contain the following site specific conditions:

Table 2.1 Post-Development Land Use Breakdown

Land Use	Acres	Run-Off Value
Light Industrial	74.73	42% DCIA
Dry Retention	8.03	0% DCIA
Total:	82.76 Acres	

*DCIA = Directly Connected Impervious Area

Conditions of Site:
Soil Types
Hydrologic Soil Group (HSG)
Collier County = HSG-A – Sand (USDA, A-9)
Impervious Areas (Proposed Conditions):
31.28 Acres connected impervious/74.73 total acres = 0.4185 = 41.85%

2.2 Methodology and Analysis for Post-development Conditions:

In the following methodology and analysis, one will see the evaluation of alternative storm water loadings for post-development with proposed/existing build-out conditions. The Harper Analysis considers site specific hydrologic characteristics in estimating pollutant loadings, therefore calculating a far more accurate depiction of runoff conditions than traditional methods. Post-development loadings required by South Florida Water Management District require a clear reduction in post development routing versus pre-development routings by using site specific runoff volumes and characteristics presented by Harper and Baker in "Evaluation of Current Stormwater…".

The runoff volumes for the Fort Myers area (Southwest Coastal) were obtained from the National Climatic Data Center (NCDC) from 1960 – 2003 ("Evaluation of the Current…", 3-5). The aforementioned runoff characteristics take into consideration all land uses categories in Southwest Florida and thus, result in a series of annual runoff coefficients used in this analysis. For further explanation of this methodology, please see the "Evaluation of Alternative Stormwater Regulations for Southwest Florida – Final Report," by Harper and Baker or "Evaluation of Current Stormwater Design Criteria within the State of Florida – Final Report," by Harper and Baker.

2.2a Estimate Curve Number/Runoff Coefficient:

The nDCIA curve numbers were calculated based on the average depth to wet season water table (WSWT) and contingent on the land being developed or undeveloped based on the existing conditions, see Davidson Engineering Plan Set for detailed layout. These variables determined available soil storage (S) which in turn calculates the Curve Number (CN) for each land use category, see Equation 1.3a. A validated calculation of each land use curve number is available in Table 2.2a – Curve Number Calculations.

Table 2.2a – Curve Number Calculations

Land Use	WSWT (ft-NGVD)	Depth to WSWT (ft-NGVD)	Undeveloped Available Soil Storage (S)	Developed Available Soil Storage (S)	CN
Light Industrial	8.23	3.00	N/A	N/A	67
Dry Retention	8.23	1.00	1.90	-	55

2.2b – Runoff Coefficients, Zone-4 (Baker and Harper, Appendix C)

From Appendix C of "Evaluation of Alternative…," Harper and Baker developed an interpolation table to determine a runoff coefficient based on nDCIA CN and %DCIA. The determined coefficients are listed in Table 2.2b - Zone 4 Runoff Coefficients.

Table 2.2b – Zone 4 Runoff Coefficients

Land Use	%DCIA	nDCIA CN	C
Light Industrial	42	67	0.381
Dry Retention	0	55	0.030

2.2c – Calculate Annual Runoff Volumes (Ai)

The annual runoff volume is calculated based on the previously calculated run-off coefficient (C), area of interest and mean annual rainfall (MAR) event. The mean annual rainfall event was established by location, aforementioned, the NCDC has deemed 53.13-inches the mean annual rainfall event for this location. Equation 1.3c calculates the Annual Runoff Volume (Ai).

Table 2.2c summarizes the Annual Runoff Volumes for each land use category.

Table 2.2c – Annual Runoff Volumes (Ai)

Land Use	Acres	C	Ai (Ac-ft)
Light Industrial	74.73	0.381	118.45
Dry Retention*	8.03	0.030	1.07

*Note: Stormwater management systems have incidental mass inputs of pollutants and therefore are not included in the post development loading calculations, only in the pollutant removal process, as outlined in Harper's evaluation; see also "Evaluation of Current…".

2.2d – Estimate Runoff Characteristics for Land Uses

Based on the particular land use, nutrient concentrations for phosphorus and nitrogen have been assumed according to the "Evaluation of Current…" by Harper and Baker and can be found in Table 4-17 of these readings; additional information is also available with Harper PowerPoint. These values are available in Table 1.3d – Estimate Runoff Characteristics of Nitrogen (N) and Phosphorus (P).

2.2d – Estimate Runoff Characteristics of Nitrogen (N) and Phosphorus (P)

Land Use	TC, N (mg/l)	TC, P (mg/l)
Light Industrial	1.20	0.260

2.2e – Calculate Post-development Loadings:

Refer to Equation 1.3e for specification on how post-development loadings were calculated.

Land Use	Ai (Ac-ft)	TC, N (mg/l)	TC, P (mg/l)	N, Load (TN/yr)	P, Load (TN/yr)
Light Industrial	118.45	1.20	0.260	175.30	37.98

2.2f Total Post-development Loadings:

The total Post-development loadings are the summation of the previously calculated values.

Total N, Loadings: 175.30 kg TN/yr
Total P, Loadings: 37.98 kg TP/yr

3.1 - Methodology and Analysis for Post-development – Dry Retention System:

Aforementioned, Haldeman's Landing has a proposed site surface water management system that will consist of a series of grate inlets, curb inlets, junction boxes, and dry retention areas used to collect the surface water runoff from the proposed build-out. Within this system the required water volume will be pretreated within the dry retention areas prior to outfall to Naples Bay.

The goal of the site is to reduce post development loading beyond pre-development loadings. Based on the calculated Pre and Post-development loadings, Table 3.1- Pre- vs. Post-Development Loadings Prior to Treatment, the post-development loadings will need removal efficiency of 60.1%.

3.1a – Pre- vs. Post-Development Loadings Prior to Treatment

	Total Nitrogen (kg-TN/yr)	Total Phosphorus (kg-TP/yr)
Pre-Development	71.44	11.42
Post-Development	175.30	37.98

A minimum of 70.0% removal efficiency will deduce the Post-Development Loadings to the following:

$$(RTN), Remaining\ TN = \left(175.30\ \frac{kg\ TN}{year}\right) * (1 - 0.700) = 52.59\ \frac{kg\ TN}{year}$$

$$(RTP), Remaining\ TP = \left(37.98\ \frac{kg\ TP}{year}\right) * (1 - 0.700) = 11.39 \frac{kg\ TP}{year}$$

3.1a - Methodology and Analysis for Removal Efficiency within Dry Retention:

To determine an efficiency rate of 70.0% removal in Zone 4 the weighted average for DCIA % and non-DCIA values must be determined. These values are based on the proposed site characteristics located in Table 2.2b – Zone 4 Runoff Coefficients. The weighted averages for this project are:

DCIA Percentage: **42.0%**
Non-DCIA CN: **67.0**

Using these values and referencing Appendix D (Zone 4) from "Evaluation of Current…" (Harper & Baker, 2007), the necessary dry-retention depth to achieve 70.0% efficiency is 0.61-inches. To ensure a factor of safety the site will be designed to 0.65-inch dry-retention depth with a removal efficiency of 76.392%.

3.1b – Mass Load of Total Nitrogen & Total Phosphorus Removed by the Dry Retention Area:

$$TNremoved = (76.39\%) * \left(175.30\ \frac{kg\ TN}{yr}\right) = 133.91 \frac{kg\ TN}{yr}$$

$$TPremoved = (76.39\%) * \left(37.98\ \frac{kg\ TN}{yr}\right) = 29.01 \frac{kg\ TP}{yr}$$

3.1c - Remaining Mass Load of Total Nitrogen & Total Phosphorus after Dry Retention Treatment:

$$(RTN), Remaining\ TN = \left(175.30\ \frac{kg\ TN}{year}\right) * (1 - 0.7639) = 41.38 \frac{kg\ TN}{year}$$

$$(RTP), Remaining\ TP = \left(37.98\ \frac{kg\ TP}{year}\right) * (1 - 0.7639) = 8.97 \frac{kg\ TP}{year}$$

4.1 Conclusion

As stated in the "Evaluation of Alternative …" and in the "Evaluation of Current Stormwater Design Criteria within the State of Florida," the pre-development loadings must be less than the post-development loadings in order for the proposed site conditions are deemed acceptable.

	Pre-development Loadings	Post Development Loadings
Nitrogen	71.44 kg-TN/yr	41.38 kg-TN/yr
Phosphorus	11.42 kg-TP/yr	8.97 kg-TP/yr

Works Cited

Harper, H. H. (2008). *Stormwater Characteristics of Natural Vegetation Communities in Florida.* Orlando: Environmental Research & Design, Inc.

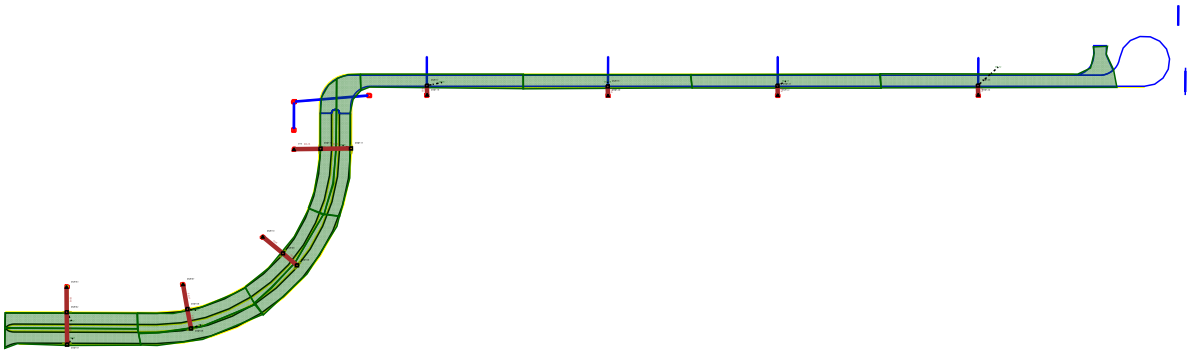
Harper, H. H., & Baker, D. M. (2003). *Evaluation of Alternative Stormwater REgulations for Southwest Florida.* Orlando: Environmental Research & Design, Inc.

Harper, H. H., & Baker, D. M. (2007). *Evaluation of Current Stormwater Design Criteria within the State of Florida.* Orlando: Environmental Research and Design, Inc.

APPENDIX G

StormCAD® Results

Scenario: Base



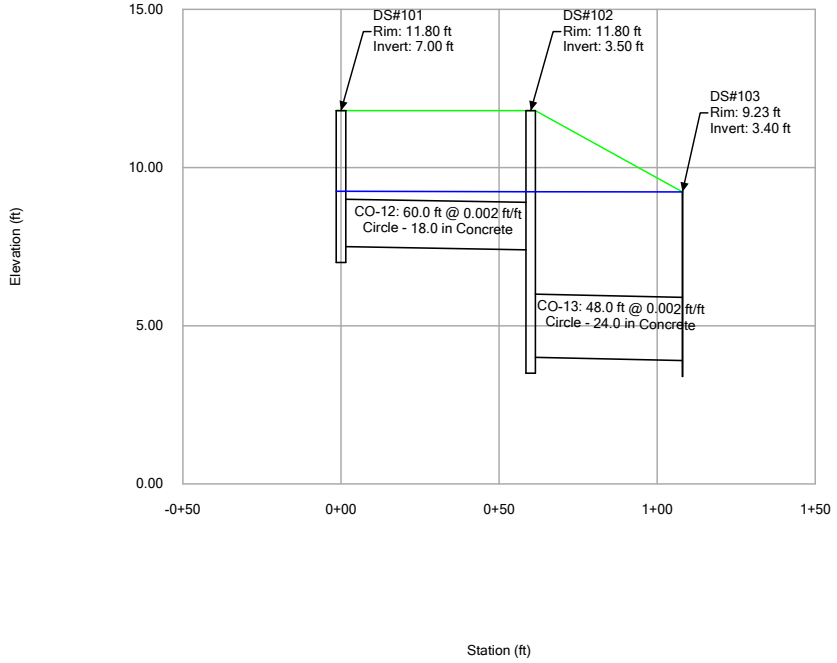
Scenario: Base
Current Time Step: 0.000Hr
Conduit FlexTable: DOT Report

-Node- Upstream Downstream	Diameter (in)	Length (User Defined) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Upstream Inlet Area (acres)	Upstream Inlet C	System CA (acres)	-EGL- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	Section Discharge Capacity (cfs)	Velocity (ft/s)
DS#123	18.0	17.0	3.90	3.90	0.000	0.341	0.900	0.307	10.54	10.51	2.43	1.38
DS#124	-	-	-	-	-	-	-	-	(N/A)	10.50	0.00	-
DS#121	18.0	17.0	3.90	3.90	0.000	0.238	0.900	0.215	10.52	10.50	1.70	0.96
DS#122	-	-	-	-	-	-	-	-	(N/A)	10.50	0.00	-
DS#119	18.0	17.0	3.90	3.90	0.000	0.212	0.900	0.191	10.51	10.50	1.51	0.86
DS#120	-	-	-	-	-	-	-	-	(N/A)	10.50	0.00	-
DS#117	18.0	17.0	3.90	3.90	0.000	0.204	0.900	0.184	10.51	10.50	1.46	0.82
DS#118	-	-	-	-	-	-	-	-	(N/A)	10.50	0.00	-
DS#111	18.0	61.0	7.50	7.40	0.002	0.206	0.900	0.185	9.26	9.25	1.47	0.83
DS#112	-	-	-	-	-	-	-	-	9.25	9.24	4.25	-
DS#109	24.0	48.0	4.00	3.90	0.002	0.156	0.900	0.298	9.24	9.24	2.32	0.74
DS#110	-	-	-	-	-	-	-	-	(N/A)	9.23	10.33	-
DS#108	18.0	38.0	7.50	7.40	0.003	0.175	0.900	0.158	9.25	9.24	1.25	0.71
DS#109	-	-	-	-	-	-	-	-	9.24	9.24	5.39	-
DS#105	18.0	38.0	7.50	7.40	0.003	0.139	0.900	0.125	9.24	9.24	0.99	0.56
DS#106	-	-	-	-	-	-	-	-	9.24	9.24	5.39	-
DS#106	24.0	48.0	4.00	3.90	0.002	0.196	0.900	0.302	9.24	9.24	2.33	0.74
DS#107	-	-	-	-	-	-	-	-	(N/A)	9.23	10.33	-
DS#101	18.0	60.0	7.50	7.40	0.002	0.208	0.900	0.187	9.26	9.25	1.48	0.84
DS#102	-	-	-	-	-	-	-	-	9.25	9.24	4.29	-
DS#102	24.0	48.0	4.00	3.90	0.002	0.189	0.900	0.357	9.25	9.24	2.75	0.88
DS#103	-	-	-	-	-	-	-	-	(N/A)	9.23	10.33	-
DS#112	24.0	48.0	4.00	3.90	0.002	0.182	0.900	0.349	9.25	9.24	2.69	0.86
DS#113	-	-	-	-	-	-	-	-	(N/A)	9.23	10.33	-

Z:\Active Projects\Collier County\CC RRBP DIW\SDP\3rd Review\ENG & REPORTS\STORMCAD\2017-03-23-stormcad.stsw

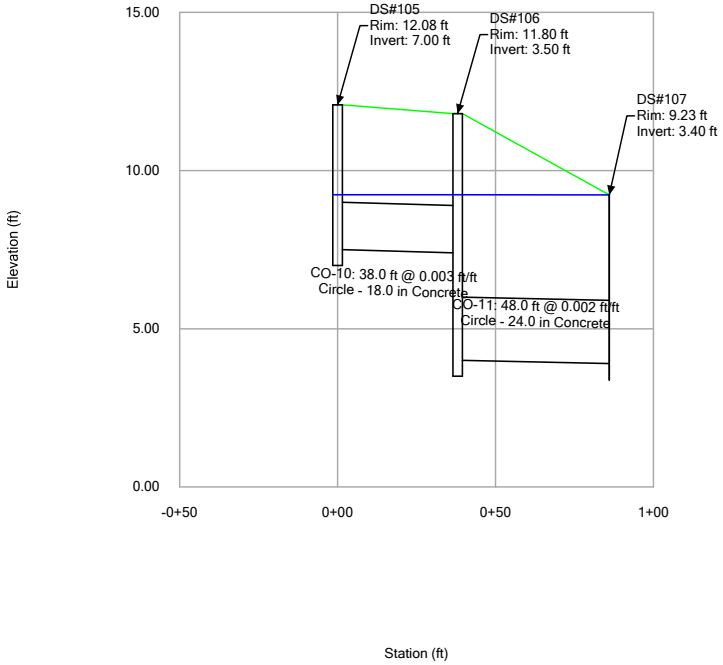
Profile Report

Engineering Profile - DS#101 to DS#103 (2017-03-23-stormcad.stsw)



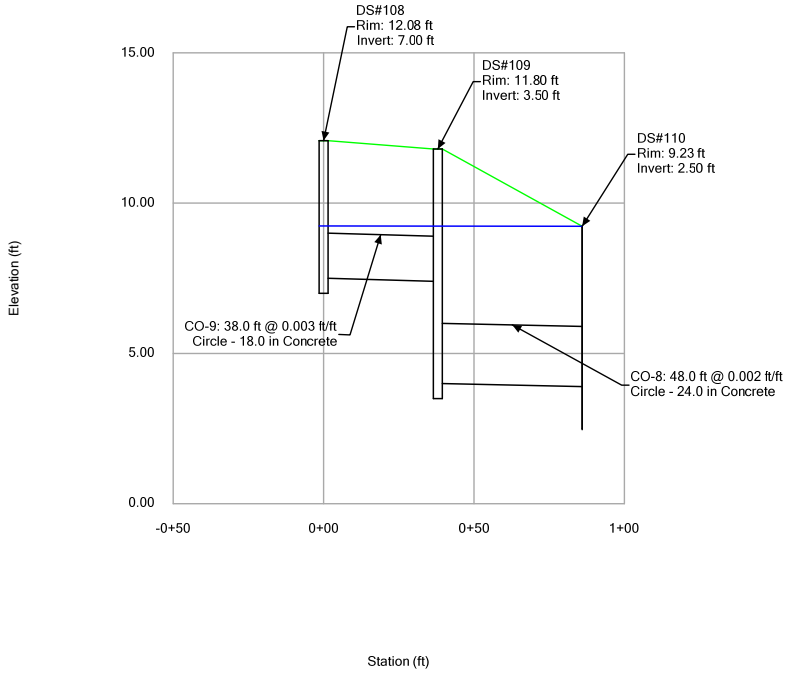
Profile Report

Engineering Profile - DS#105 to DS#107 (2017-03-23-stormcad.stsw)



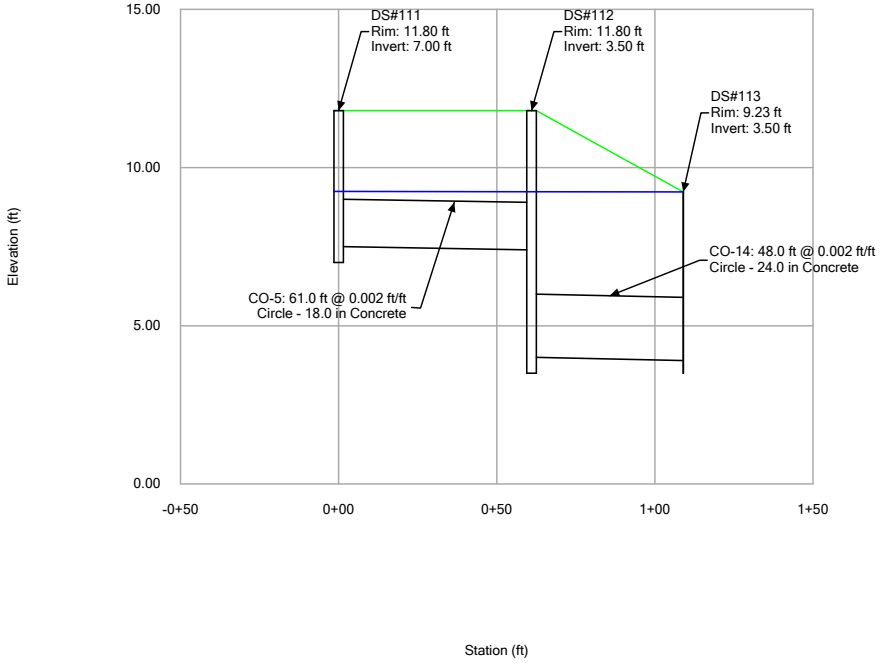
Profile Report

Engineering Profile - DS#108 to DS#110 (2017-03-23-stormcad.stsw)



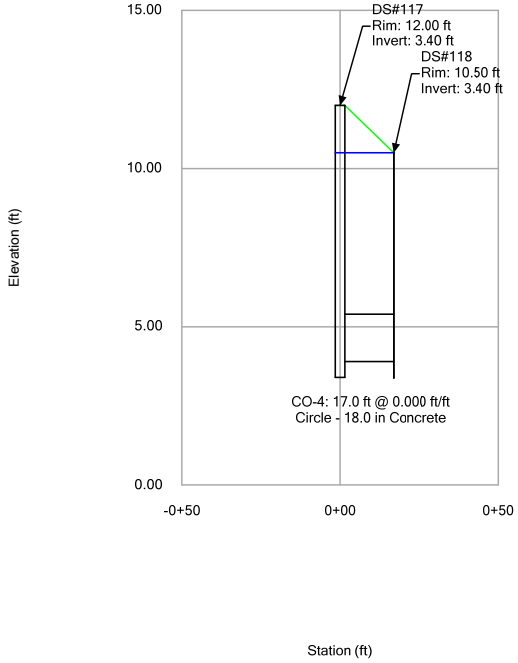
Profile Report

Engineering Profile - DS#111 to DS#113 (2017-03-23-stormcad.stsw)



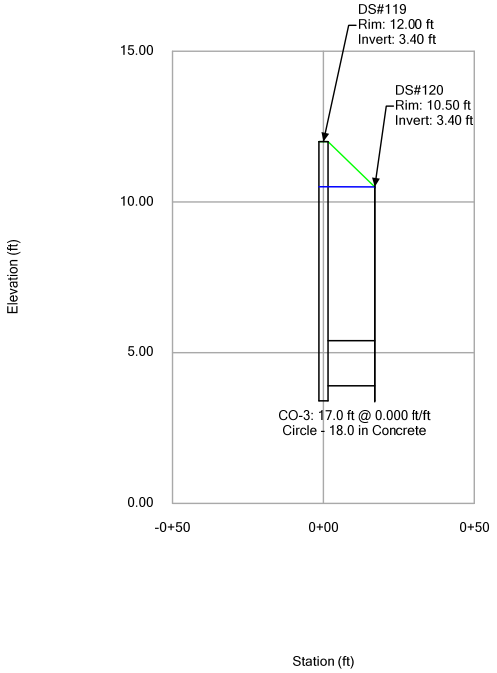
Profile Report

Engineering Profile - DS#117 to DS#118 (2017-03-23-stormcad.stsw)



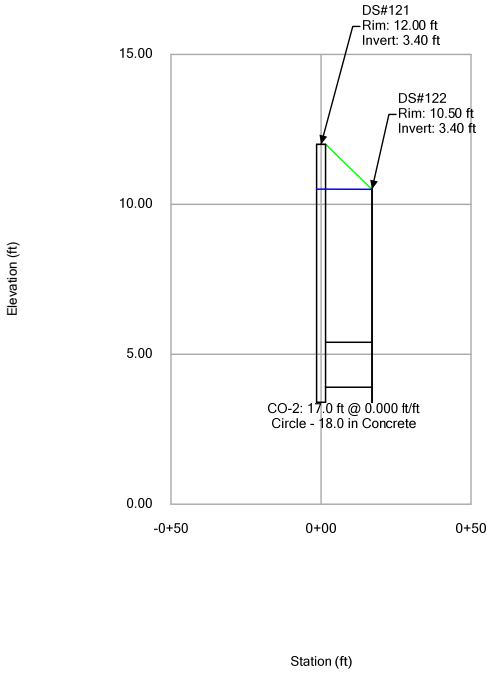
Profile Report

Engineering Profile - DS#119 to DS#120 (2017-03-23-stormcad.stsw)



Profile Report

Engineering Profile - DS#121 to DS#122 (2017-03-23-stormcad.stsw)



Profile Report

Engineering Profile - DS#123 to DS#124 (2017-03-23-stormcad.stsw)