

Stormwater Narrative

22 Depot Street

Richmond, Vermont

Project Description

Jameson Partners LLC is proposing an addition to the existing structure at 22 Depot Street. The existing building is currently occupied by the Giffords Mortuary on the first floor and two residential units on the upper level. The project will expand the west side of the building to include two commercial or retail spaces on the lowest level and 4 new residential dwellings on the second and third floors. The project will add 12 new parking spaces at the back of the building to displace the existing parking and provide a space for each unit.

The project will include 0.07 acres of expanded impervious and 0.10 acres of redevelopment impervious.

Stormwater Strategy

The project is below the State of Vermont stormwater jurisdiction for an operational permit. Therefore, the stormwater management design focused on compliance with the Town of Richmond Zoning Regulations Section 6.1.6(c) Drainage. The project is required to maintain the post development peak discharge rates of the 25-year, 24 hour storm below the pre-development peak discharge rates for the same storm event.

The site is mapped by the USDA Natural Resources Conservation Service to include infiltrative soils so we performed a test hole and permeability test. The soil investigation proved the mapping to be correct as shown in the testing results provided on plan sheet WS-Post. The stormwater system has been designed to rely on the deep layer of well drain coarse sand. An underground stormwater infiltration chamber system has been designed to capture and infiltrate the 10 year, 24 hour storm event for the drainage area on the parcel. Plan sheet WS-Post shows the drainage area for watershed WS-P2 that is collected by the practice. This includes the new parking lot behind the building, the re-directed roof runoff from the existing building, and the northeastern half of the new building. By infiltrating the 10 year storm the project will reduce the post development peak runoff for the 25 year storm from 1.57 cfs to 1.22 cfs. The hydrologic modeling for the 25-year storm event, calculations, and plans are attached for review.

Section 6.1.6(c) of the Richmond Zoning Regulations also states that “Unless stormwater flows are contained on the lot where such parking areas and roadways are located, there must also be adequate off-site drainage areas to accommodate such flows.” The site has been designed with an overflow to address this standard. Storms larger than the 10-year event will flow out of the catch basin, over a flush curb and then conveyed through a swale that follows the west side of the building. The runoff then discharges off site at the southwest corner of the lot. It flows across Depot Street in a similar manner to the existing drainage pattern except the post development peak discharge rate for the 25-year storm will be less than the current condition. The overflow path is shown on plan Sheet WS-Post.

Infiltration (4.3.3)

Practice Drainage Area		For Permit Coverage	Not for Permit Coverage	Total to Practice
1	Total Area (acres)	0.112	0.000	0.112
2	New Impervious (acres)	0.060	0.000	0.060
3	Redeveloped Impervious	0.093	0.000	0.093
		WQ _V for credit	WQ _V not for credit	Total WQ _V
4	WQ _V to practice	0.0087	0.0000	0.0087

Modified CN for WQ (1.0") storm: 99

5 Design Volume for Infiltration (T_V) 0.0000 ← T_V value to enter on the Standards Compliance Workbook for this practice

6 Practice Type

- ☐ Infiltration Basin
- ☐ Infiltration Trench
- ☒ Infiltration Chambers
- ☐ Drywell(s)

Note: If the practice is designed to infiltrate the WQ_V, then T_V = WQ_V. Designers may use the Practice Drainage Area Runoff Calculator (second tab) for calculation of practice-specific runoff volumes for other treatment standards. Sizing of the filter bed area/swale bottom need to consider the desired treatment volume (see treatment section). Some design requirements will change based on the size of storm the practice is designed to treat.

* Questions preceded by an asterisk (*) may change based on previously entered values

Feasibility (4.3.3.1)		Response	Attachment location
7	Has the infiltration rate (fc) of the underlying soil been confirmed to be at least 0.2 inches per hour by the soil testing requirements in Section 4.3.3.2?	<input type="radio"/> Yes <input type="radio"/> No	
8*	Is the seasonal high groundwater table (SHGWT) separated at least three (3) feet vertically from the bottom of the practice?	<input type="radio"/> Yes <input type="radio"/> No	
9	Has a groundwater mounding analysis been performed if the practice is designed to infiltrate >1 year storm and the SHGWT <4 feet?	<input type="radio"/> Yes <input type="radio"/> No	
10	Have the proper setback requirements for groundwater source protection been observed? (Section 4.3.3.1)	<input type="radio"/> Yes <input type="radio"/> No	
11	Has the practice been placed so that it will not cause intrusion problems for down-gradient structures? (Section 4.3.3.1)	<input type="radio"/> Yes <input type="radio"/> No	
12	Is the site free from subsurface contamination or prior approval obtained from the Agency? (If approval is required based on prior contamination, include	<input type="radio"/> Yes <input type="radio"/> No	
13*		<input type="radio"/> Yes <input type="radio"/> No	

Conveyance (4.3.3.2)

Response	Attachment location
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14	Have the outfalls and the conveyance to the discharge point been designed/protected to avoid erosive velocities?	<input type="radio"/> Yes <input type="radio"/> No	
15	Is the practice designed to completely dewater the treatment volume (T_V) within 48 hours after the storm event?	<input type="radio"/> Yes <input type="radio"/> No	
16	If the practice is designed to infiltrate <1 year storm and runoff is delivered by the main conveyance system, has it been designed as an off-line practice?	<input type="radio"/> Yes <input type="radio"/> No	

Pre-Treatment (4.3.3.3)		Response	Attachment location
17	Has pretreatment been provided for non-rooftop runoff?	<input type="radio"/> Yes <input type="radio"/> No	
18	What type of pretreatment is being used? <div> <input type="checkbox"/> Swale <input checked="" type="checkbox"/> Forebay <input type="checkbox"/> Proprietary <input type="checkbox"/> Filter Strip <input type="checkbox"/> Deep Sump Catch Basins </div>		
19*	Is the infiltration rate (f_c) greater than or less than 2 inches per hour?	<input type="radio"/> ≤ 2 in/hr <input type="radio"/> > 2 in/hr	
20*	Is the forebay sized to hold at least 50% of the WQv?	<input type="radio"/> Yes <input type="radio"/> No	
21*	Is the forebay separated at least three (3) feet from the SHGWT or located over impermeable soils?	<input type="radio"/> Yes <input type="radio"/> No	

Treatment (4.3.2.4)		Response	Attachment location
22	Has direct access been provided to the practice for maintenance and rehabilitation?	<input type="radio"/> Yes <input type="radio"/> No	
23*	Has an observation well been installed in every trench, drywell, or subsurface system?	<input type="radio"/> Yes <input type="radio"/> No	
24	What is the physical storage volume up to the overflow? (ac-ft)		Enter this on the eNOI
25	What is the treatment volume provided by the STP? T_V (ac-ft)		

Treatment Volume (T_V) for infiltration practices may be calculated using the equations provided as design guidance in Section 4.3.3.5 OR by demonstrating infiltration of the T_V using TR-20 or an approved equivalent.

Landscaping (4.3.2.5)		Response	Attachment location
26	Does the site plan specify a landscaping plan that ensures dense and vigorous vegetation over the contributing pervious drainage areas and the practice?	<input type="radio"/> Yes <input type="radio"/> No	

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

Practice Drainage Area Runoff Calculator

Project Name: 22 Depot Street Total WS

Discharge Point: 1

Infiltration Practice # 1

This tool may be used to calculate the required treatment volumes for the area draining to an individual practice where the practices drainage area is only a portion of of the area draining to a discharge point. Where the practice receives runoff from the entire area to a discharge point, this calculator will give the same information as the Standards Compliance Workbook.

Precipitation Data* Precipitation values shall be obtained from [NOAA Atlas 14](#)

Storm	WQ Storm	1 yr, 24 hr	10 yr, 24 hr	100 yr, 24 hr
Precipitation (inches)	1.00	1.98	3.49	5.28

Drainage Area Information

Pre Development Land Use (acres)

Landuse	Hydrologic Soil Group				Total (acres)
	A	B	C	D	
Grass	0.107	0.000	0.000	0.000	0.107
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.000	0.000	0.000
Pavement, roofs, and other impervious	0.166	0.000	0.000	0.000	0.166
Total	0.273	0.000	0.000	0.000	0.273

Post Development Land Use (acres)

Landuse	Hydrologic Soil Group				Total (acres)
	A	B	C	D	
Grass	0.056	0.000	0.000	0.000	0.056
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.000	0.000	0.000
Pavement, roofs, and other impervious	0.217	0.000	0.000	0.000	0.217
Total	0.273	0.000	0.000	0.000	0.273

 T_v of upstream practices: 0.000 ac-ft T_v credit of this practice: 0.000 ac-ft

Treatment Standard	Required Treatment Volume	Post Development Runoff Volume	Pre-development Runoff Volume	Post Composite CN (to practice)	CN _{Adj} (with T_v practice credit)	Pre Composite CN
Channel Protection (Hydrologic Condition Method)	0.0075	0.0317	0.0243	94	94	90
Overbank Flood	0.0138	0.0589	0.0451	92	92	85
Extreme Flood	0.0203	0.0924	0.0721	89	89	80

Information for Calculating T_c by the Watershed Lag Method

Average Catchment

Hydraulic

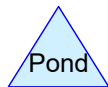
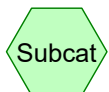
Time of Concentration, T_c (min)

	Slope, Y (%)	Length, l (ft)	1 yr	10 yr	100 yr
Pre Development	5.50%	181.00	2.4	3.0	3.4
Post Development, upstream of practice	5.50%	94.00	1.2	1.3	1.5
Post Development, with T _v credit from practice	0.00%	0.00	0.0	0.0	0.0

22 Depot Street, Richmond

25YR Storm Post

25YR Storm Pre



Routing Diagram for 22 Depot Storm

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22 Depot Storm

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Page 3

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.208	95	Worksheet (27S)
0.338	90	Worksheet (31S, 32S)
0.546	92	TOTAL AREA

22 Depot Storm

Type II 24-hr 25 Year Rainfall=4.19"

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Page 4

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment27S: WS 2

Runoff Area=0.208 ac 0.00% Impervious Runoff Depth=3.62"
Tc=1.1 min CN=95 Runoff=1.39 cfs 0.063 af

Subcatchment31S: WS-Untreated

Runoff Area=0.065 ac 0.00% Impervious Runoff Depth=3.10"
Tc=1.5 min CN=90 Runoff=0.39 cfs 0.017 af

Subcatchment32S: WS-Untreated

Runoff Area=0.273 ac 0.00% Impervious Runoff Depth=3.10"
Tc=3.1 min CN=90 Runoff=1.57 cfs 0.071 af

Pond 28P: Infiltration TrenchA

Peak Elev=329.56' Storage=926 cf Inflow=1.39 cfs 0.063 af
Discarded=0.07 cfs 0.058 af Primary=0.95 cfs 0.005 af Outflow=1.02 cfs 0.063 af

Link 29L: Off Site

Inflow=1.22 cfs 0.022 af
Primary=1.22 cfs 0.022 af

Link 33L: Off Site

Inflow=1.57 cfs 0.071 af
Primary=1.57 cfs 0.071 af

Total Runoff Area = 0.546 ac Runoff Volume = 0.150 af Average Runoff Depth = 3.30"
100.00% Pervious = 0.546 ac 0.00% Impervious = 0.000 ac

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Type II 24-hr 25 Year Rainfall=4.19"

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Page 5

Summary for Subcatchment 27S: **WS 2**

Runoff = 1.39 cfs @ 11.91 hrs, Volume= 0.063 af, Depth= 3.62"

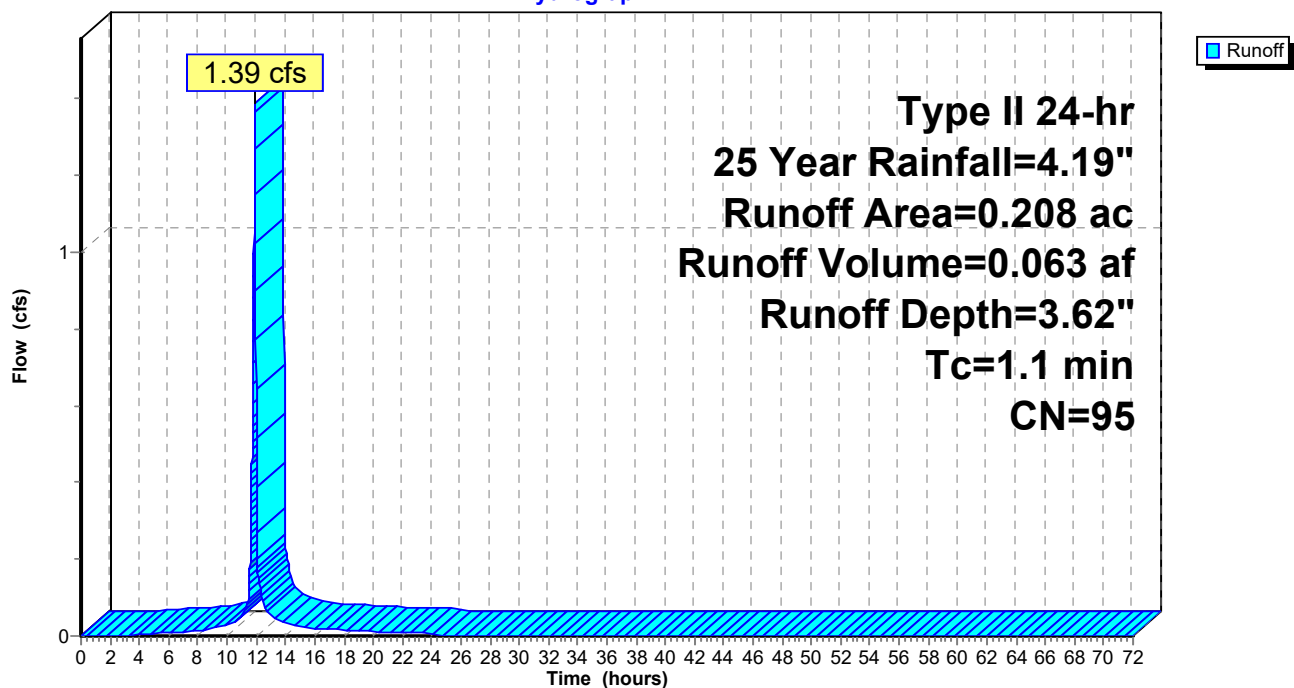
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Rainfall=4.19"

Area (ac)	CN	Description
* 0.208	95	Worksheet
0.208		100.00% Pervious Area

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

Subcatchment 27S: WS 2

Hydrograph



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Type II 24-hr 25 Year Rainfall=4.19"

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Page 6

Summary for Subcatchment 31S: WS-Untreated

Runoff = 0.39 cfs @ 11.92 hrs, Volume= 0.017 af, Depth= 3.10"

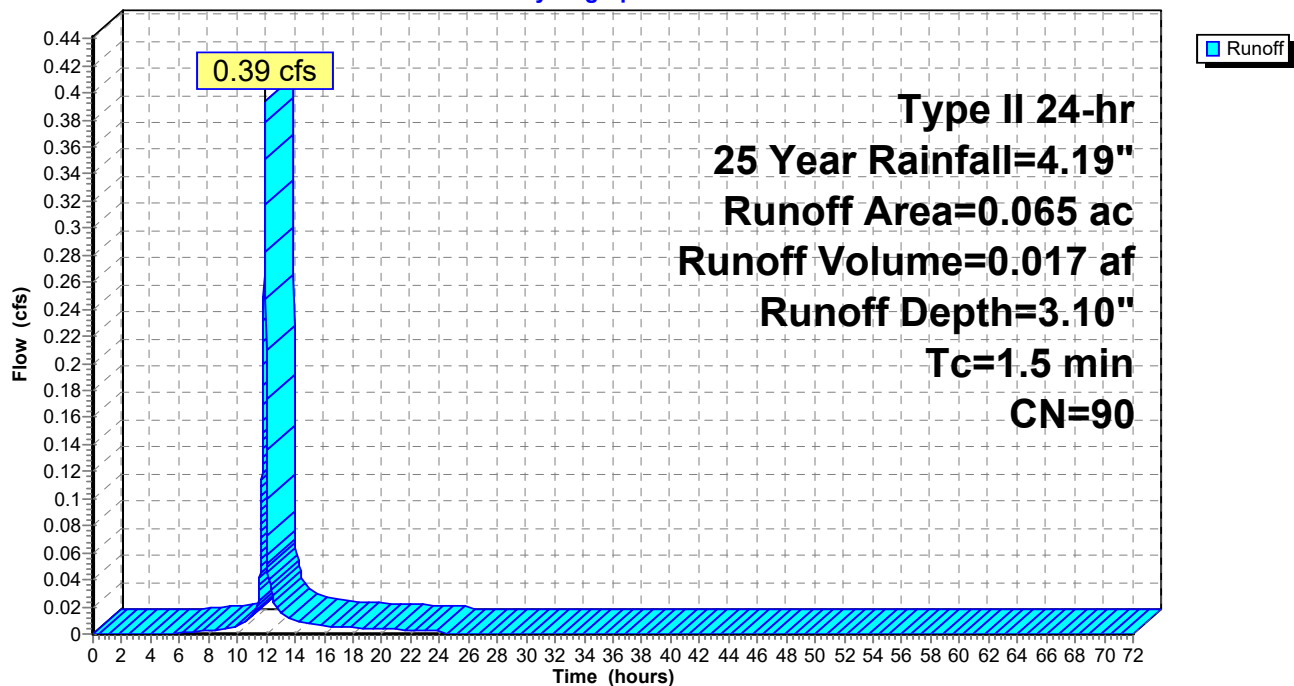
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Rainfall=4.19"

Area (ac)	CN	Description
* 0.065	90	Worksheet
0.065		100.00% Pervious Area

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

Subcatchment 31S: WS-Untreated

Hydrograph



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Type II 24-hr 25 Year Rainfall=4.19"

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Page 7

Summary for Subcatchment 32S: WS-Untreated

Runoff = 1.57 cfs @ 11.94 hrs, Volume= 0.071 af, Depth= 3.10"

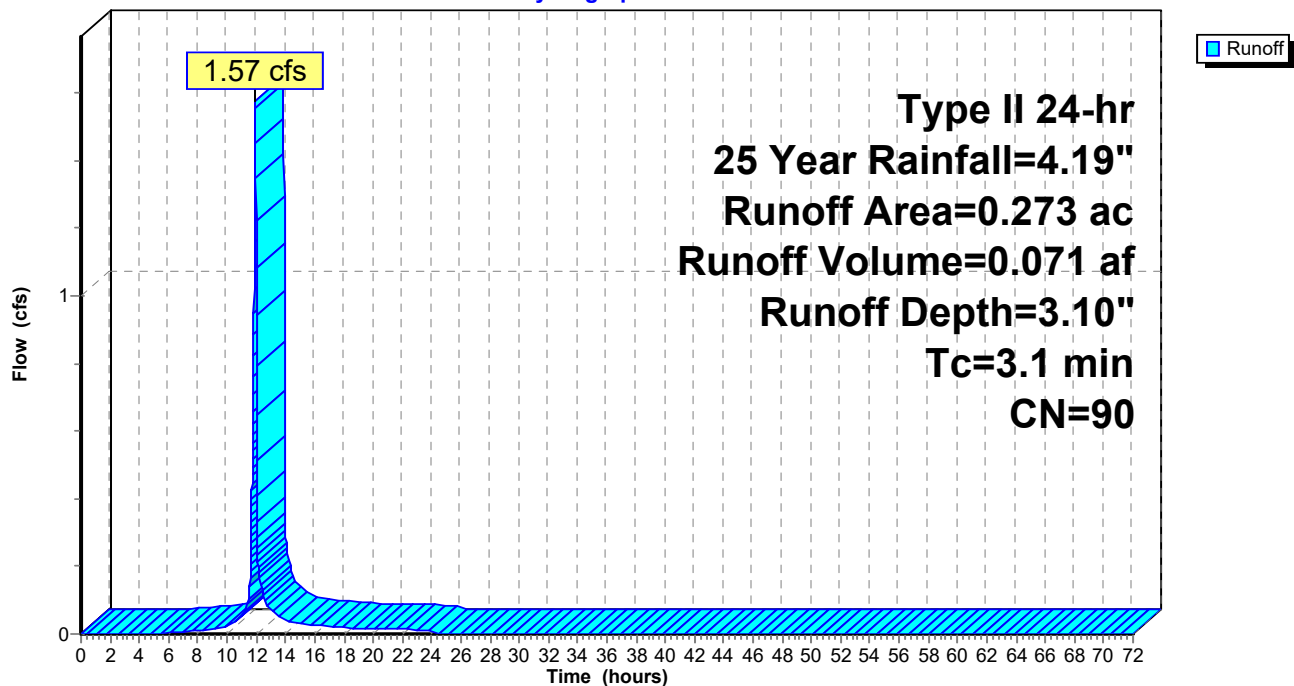
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Rainfall=4.19"

Area (ac)	CN	Description
* 0.273	90	Worksheet
0.273		100.00% Pervious Area

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

Subcatchment 32S: WS-Untreated

Hydrograph



22 Depot Storm

Type II 24-hr 25 Year Rainfall=4.19"

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Page 8

Summary for Pond 28P: Infiltration TrenchA

Inflow Area = 0.208 ac, 0.00% Impervious, Inflow Depth = 3.62" for 25 Year event
Inflow = 1.39 cfs @ 11.91 hrs, Volume= 0.063 af
Outflow = 1.02 cfs @ 11.96 hrs, Volume= 0.063 af, Atten= 27%, Lag= 3.1 min
Discarded = 0.07 cfs @ 11.25 hrs, Volume= 0.058 af
Primary = 0.95 cfs @ 11.96 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 329.56' @ 11.96 hrs Surf.Area= 377 sf Storage= 926 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 86.3 min (851.3 - 765.0)

5 chambers
Provided

Volume	Invert	Avail.Storage	Storage Description
#1	329.45'	8 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
#2A	323.95'	340 cf	7.42'W x 40.62'L x 4.75'H Field A 1,431 cf Overall - 581 cf Embedded = 850 cf x 40.0% Voids
#3A	324.45'	581 cf	ADS_StormTech MC-3500 c +Cap x 5 Inside #2 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= +15.6 cf x 2 x 1 rows = 31.2 cf
929 cf			Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
329.45	10	0	0
329.60	100	8	8

Device	Routing	Invert	Outlet Devices
#1	Discarded	323.95'	10.000 in/hr Exfiltration over Surface area below 323.96'
#2	Primary	329.45'	10.0' long x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.07 cfs @ 11.25 hrs HW=324.01' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.82 cfs @ 11.96 hrs HW=329.56' (Free Discharge)

↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.82 cfs @ 0.77 fps)

22 Depot Storm

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Type II 24-hr 25 Year Rainfall=4.19"

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Page 9

Pond 28P: Infiltration TrenchA - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 c +Cap (ADS StormTech® MC-3500 c rev 05/12 with Cap storage)

Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf

Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap

Cap Storage= +15.6 cf x 2 x 1 rows = 31.2 cf

5 Chambers/Row x 7.17' Long +1.88' Cap Length x 2 = 39.62' Row Length +6.0" End Stone x 2 = 40.62' Base Length

1 Rows x 77.0" Wide + 6.0" Side Stone x 2 = 7.42' Base Width

6.0" Base + 45.0" Chamber Height + 6.0" Cover = 4.75' Field Height

5 Chambers x 110.0 cf + 15.6 cf Cap Volume x 2 x 1 Rows = 581.0 cf Chamber Storage

1,430.9 cf Field - 581.0 cf Chambers = 849.9 cf Stone x 40.0% Voids = 340.0 cf Stone Storage

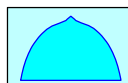
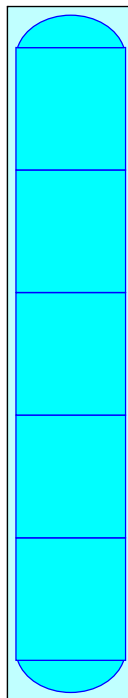
Chamber Storage + Stone Storage = 920.9 cf = 0.021 af

Overall Storage Efficiency = 64.4%

5 Chambers

53.0 cy Field

31.5 cy Stone



22 Depot Storm

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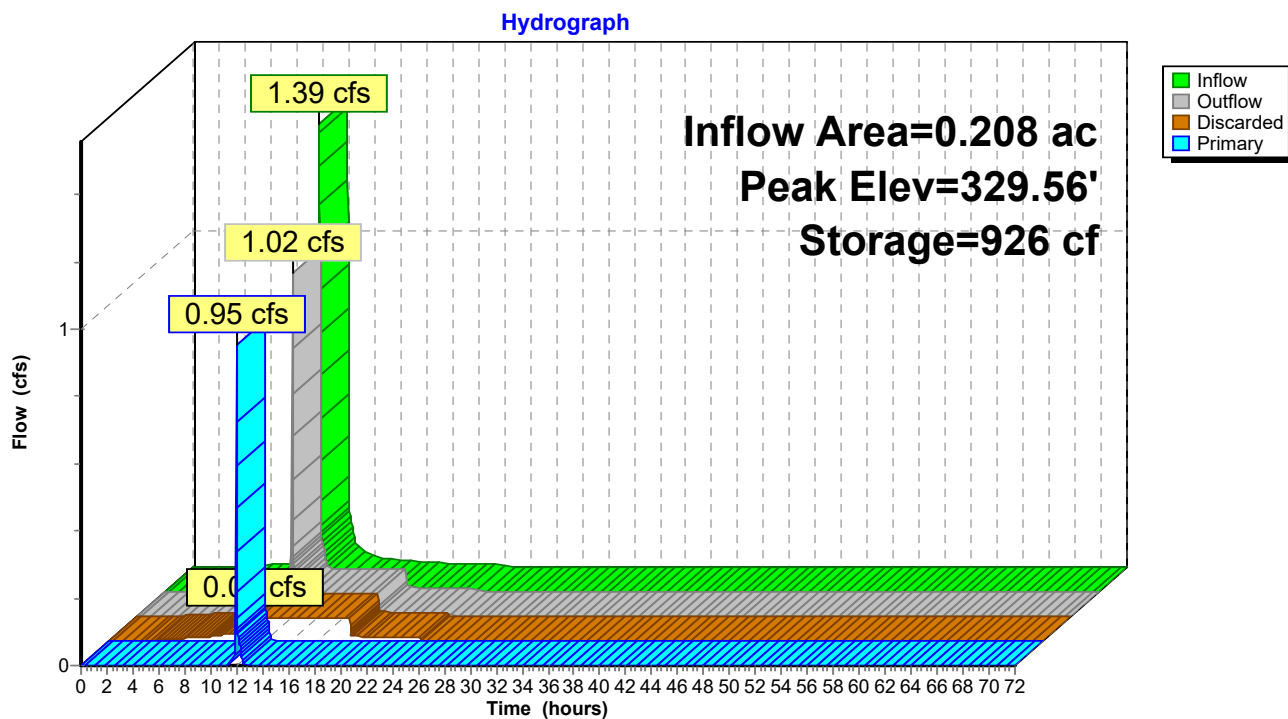
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Page 10

Pond 28P: Infiltration TrenchA



22 Depot Storm

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Page 11

Post development peak
discharge rate for 25 year
storm = 1.22 cfs. Less than
pre development peak

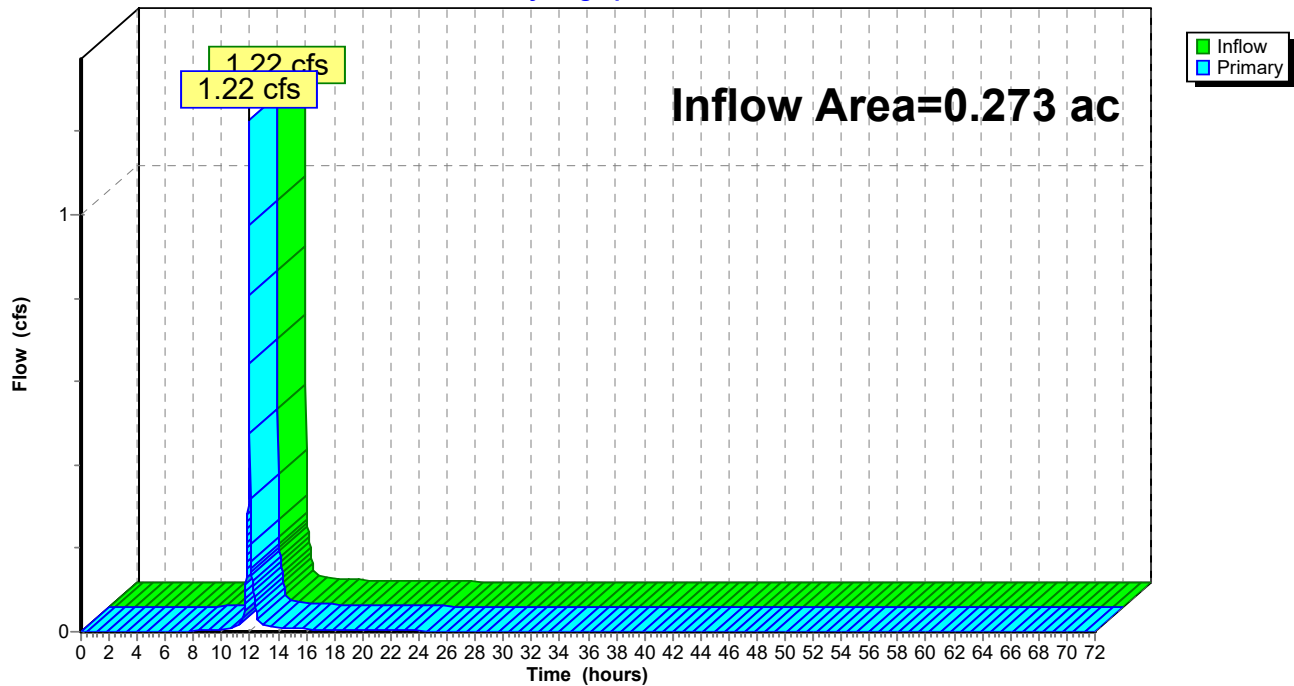
Summary for Link 29L: Off Site

Inflow Area = 0.273 ac, 0.00% Impervious, Inflow Depth = 0.96" for 25 Year event
Inflow = 1.22 cfs @ 11.96 hrs, Volume= 0.022 af
Primary = 1.22 cfs @ 11.96 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 29L: Off Site

Hydrograph



Pre development peak
discharge rate for 25 year
storm = 1.57 cfs.

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Page 12

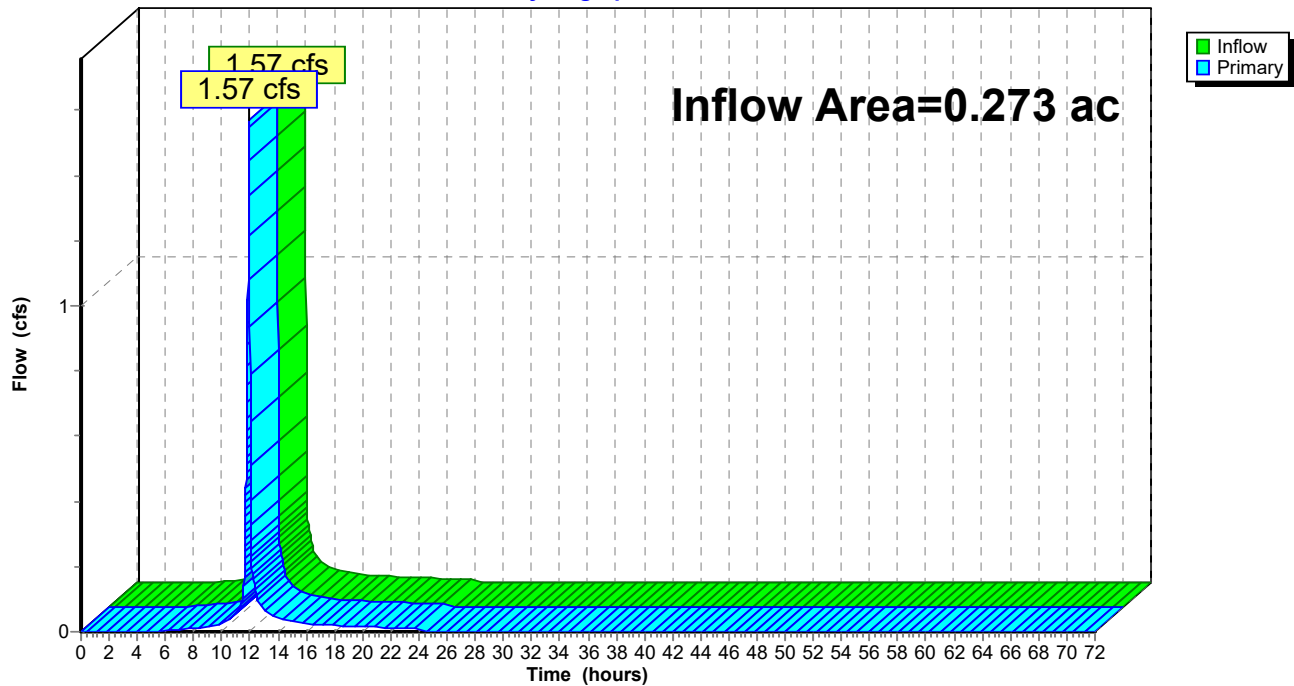
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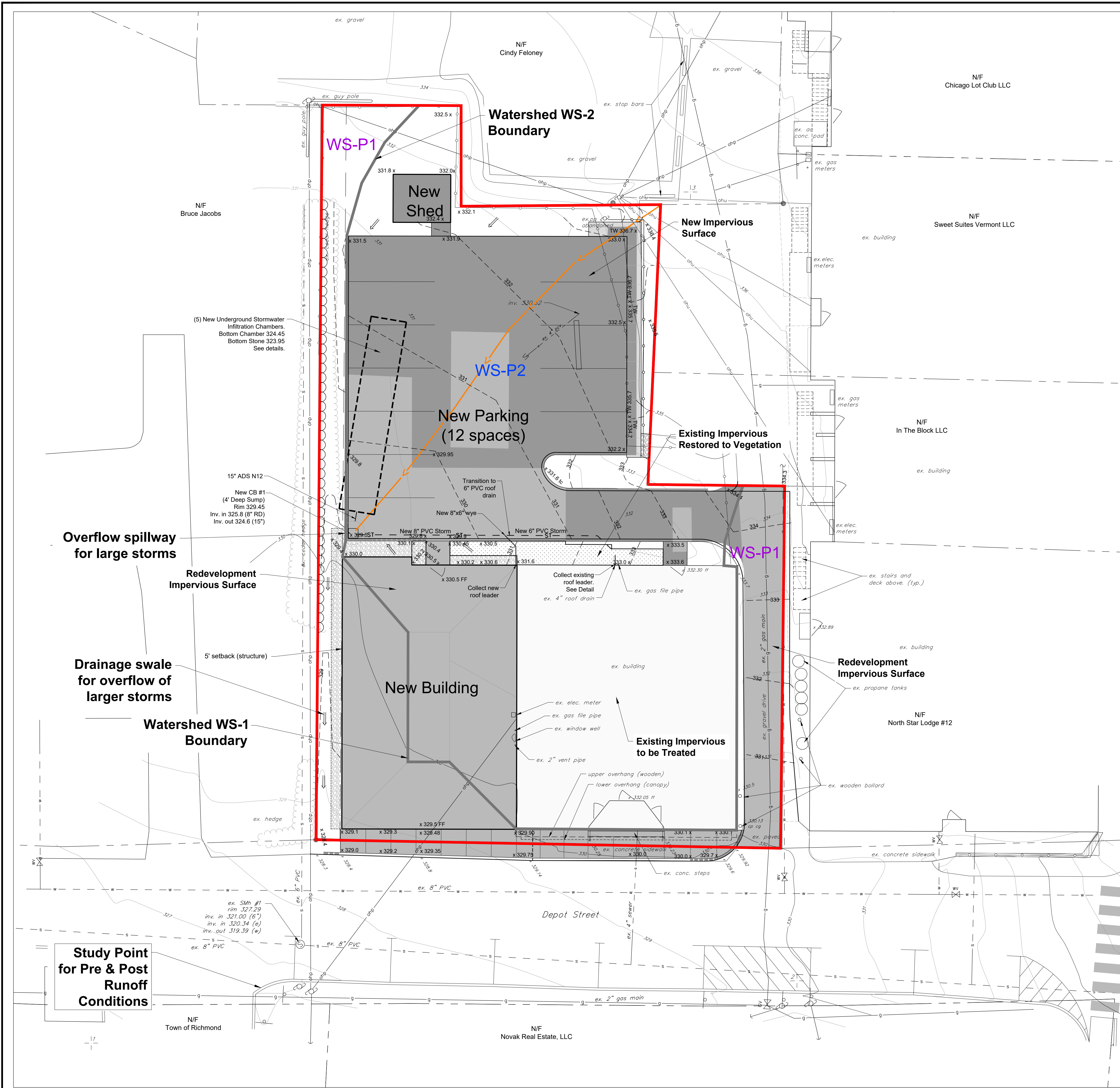
Inflow Area = 0.273 ac, 0.00% Impervious, Inflow Depth = 3.10" for 25 Year event
Inflow = 1.57 cfs @ 11.94 hrs, Volume= 0.071 af
Primary = 1.57 cfs @ 11.94 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 33L: Off Site

Hydrograph





Soil Test Pit Log
22 Depot Street
22 Depot St, Richmond Vermont

Date: March 16, 2023
Weather: 38° F, clouds
Present: Cameron Goodrich, Krebs & Lansing Consulting Engineers, Inc.

NLTD = no ledge to depth
NWTD = no water to depth
HSWT = high seasonal water table

TP-1 0" - 12" 10YR 3/3 Dark Brown, gravelly loamy sand, 25% gravels, loose single grain, structureless, some decaying cobbles, roots, worms
12" - 28" 10YR 5/6 Yellowish Brown, fine loamy sand, single grain, loose, structureless, few roots, few decaying cobbles
28" - 43" 2.5Y 5/4 Light Olive Brown, fine loamy sand, single grain, loose, few roots
43" - 48" 2.5YR 5/3 Light Olive Brown, fine sand, structureless, single grain, loose, prominent redox band at @48" interface
48" - 64" 2.5YR 5/3 Light Olive Brown, fine sand, structureless, single grain, loose, evidence of redox throughout layer, pockets of damp fine loamy sand
64" - 97" 2.5Y 4/4 Olive Brown, very coarse sandy, single grain, loose, structureless, salt and pepper sand, clean. No evidence of redox to depth suggests a perched water table above
NLTD, NWTD
HSWT Not Observed

INFILTRATION TESTING

Project Name: 22 Depot Street
Testing By: CPG
Date: 3/16/2023
Depth of Test: 36 inches

Infiltration Testing using Borehole Infiltration Test per 2017 VSWMM Section 4.3.2.5
* Alternative pre-soaking procedure per "Oregon State publication" was used

** The lowest rate of the 4 infiltration tests performed at each Test Site
*** Using Factor of Safety of 2, Design Rate = Lowest Rate/2

Test #	Lowest Rate** (in/hr)	Design Rate*** (in/hr)
IT-1	20	10

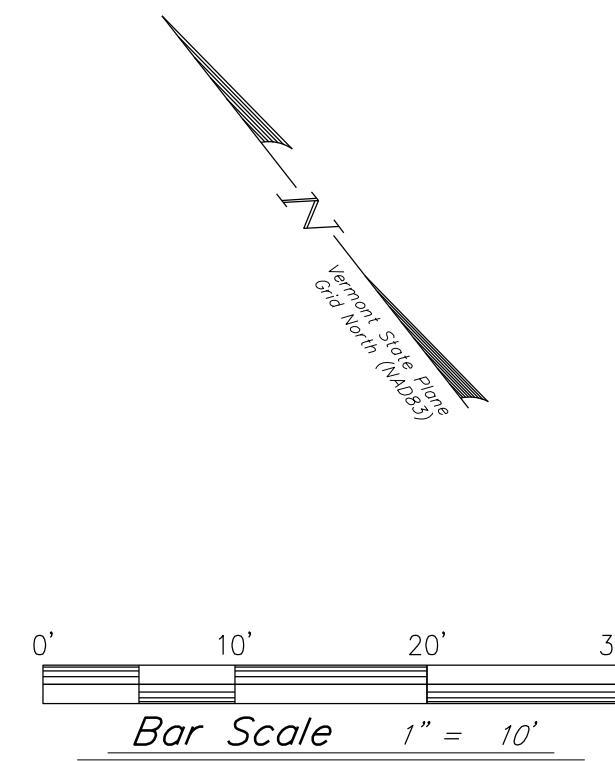
Impervious Area Legend

- NEW Impervious Areas
- Redevelopment Impervious
- EXISTING to be Treated
- Existing Impervious RESTORED to vegetation
- Watershed Limit
- Site Area Limits
- Post Development TC



164 Main Street, Suite 201
Colchester, Vermont 05446
P: (802) 878-0375
www.krebsandlansing.com

STAMP:



Project:
22 Depot Street
Mixed Use Addition

Richmond, Vermont

Project No. 22280
Scale 1" = 10'
Drawn by CPG
Checked by
Date 04/27/2023

No.	Date	Description
1	06/23/2023	stormwater discharge notes

Drawing Title
Post Development
Watershed Plan

Drawing No.
WS-POST

