

**POST CONSTRUCTION STORMWATER MANAGEMENT REPORT**  
**120 VERANDA STREET**  
**PORTLAND, MAINE**  
**February 22, 2012 (Revised April 11th, 2014)**

## **INTRODUCTION**

The subject property (the Site) is located at 120 Veranda Street in Portland, Maine. The stormwater runoff from this project discharges via overland sheet flow to the northwest of the property where it drains along the abutting property line, eventually draining to the enclosed drainage system with Hodgins Street.

The original site was approximately 18,094 ± square feet with a two-story, single family structure featuring associated driveway and walks. The owner has subdivided the property into three separate, single-family lots; one with the existing single-family home and the remaining two will have single-family structures constructed with associated driveways and site features. This report discusses the Site's hydrological conditions and compares stormwater runoff between existing and proposed conditions.

## **DATA COLLECTION AND ASSUMPTIONS**

Site Data was gathered from an on Site survey performed by Nadeau Land Surveys in March, 2011, as well as utility information on record at the City of Portland. Additionally, site visits to confirm existing conditions were performed in February and December, 2013. This data was used to create a HydroCAD stormwater model, which is based on the United States Department of Agriculture's (USDA) Technical Release 20 (TR-20) and Technical Release 55 (TR-55) hydraulic programs.

Curve numbers (CN's) assigned to differing land cover and soil types were taken from tables within the HydroCAD software, which are from the SCS TR-55 manual, revised 1986. Twenty-four-hour rainfall depths were taken from *Stormwater Management for Maine: Volume III BMP's Technical Design Manual, January 2006*. Time of concentrations were calculated with the HydroCAD software using the TR-55 methodologies including direct entry.

The existing and proposed watershed subcatchments for this analysis are shown on attached Drawing, D-100, entitled "Pre and Post Development Drainage". The attached HydroCAD output summarizes modeling assumptions for both the pre-development and post-development conditions.

### **EXISTING SITE CONDITIONS**

Land cover at the Site has been modeled as grass/open space and impervious. We have classified the existing structures and driveways as impervious area. For existing conditions, the total Site impervious area is 2,385 ± square feet.

Site topography generally slopes towards the northwest corner of the property. Slopes are generally mild to moderate. Stormwater runoff from the Site travels via overland flow from southeast to northwest.

According to the United States Department of Agriculture and Soil Conservation Service Soil Survey for Cumberland County, on Site soils are reported as "Elmwood", which has a "C" Hydrological Soil Grouping (HSG) classification. "Elmwood" soils are moderately to poorly draining, with a moderate to high rate of stormwater run-off.

### **PROPOSED SITE CONDITIONS**

The proposed improvements include the creation of two new single family lots with construction of two residences with associated driveway and two small grass underdrained soil filters to mitigate stormwater impacts. Land cover changes include converting grass areas to impervious areas. The proposed improvements will result in 6,495 ± square feet of impervious area, an increase of 4,110 ± square feet from pre-development conditions. Refer to the aforementioned Drawing and HydroCAD model for details of proposed Site improvements.

Two underdrained soil filter beds are proposed, one for each new lot, to mitigate stormwater quality. These ponds have the storage capacity to retain and treat a combination of 4,120 square feet of new impervious area (see calculations and Drawing D-1). The filter beds have been designed per the guidelines as issued by the Maine Department of Environmental Protection in the most recently updated BMP manual (update as of December, 2012).

**WATER QUALITY**

The two small underdrained soil filter beds have been designed to attenuate stormwater flows from the proposed increase in impervious areas for the two added single-family lots. They have been sized to detain and treat the “first flush”, or 1” of stormwater runoff. For general hydrologic modeling purposes, we have included an analysis for the 1” and 2-year storm events. The grading and design for the filter basins has been indicated on the attached Drawing D-100.

**WATER QUANTITY**

We have provided the hydrologic modeling for the 2, 10 and 25 year storm events. The points of analysis from pre-development to post-development have been altered due to the collection of treated stormwater near Veranda Street (Lot A). In the pre-development conditions, All on-site stormwater runoff drains to POA#1 in Hodgins Street. For the post-development conditions, POA#10 sees a very slight increase in the 2-year peak flow, but decreased flows for the 10- and 25-year storms. POA#11 represents the flows from Lot A which drain via stormdrain to Veranda street. Due to the creation of the new analysis point in the post-development conditions, a waiver for an increase in peak flow stormwater runoff into the City of Portland Stormdrain System will be required. Considering the flow increases are small, and that the stormdrain is separated from the sewer, there will be no significant downstream effects. See Sheet D-100 for graphic representation.

A summary of peak flow analysis is below:

**Table 1: Summary of Peak Flows**

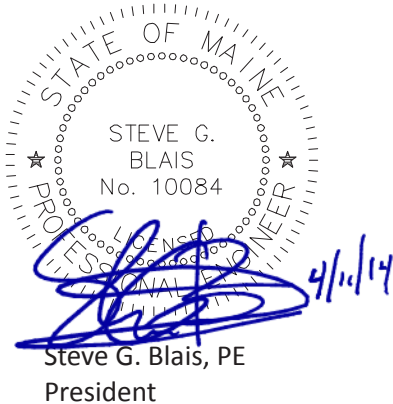
Point of Analysis	Pre-Development			Post-Development		
	2-Year (cfs)	10-Year (cfs)	25-Year (cfs)	2-Year (cfs)	10-Year (cfs)	25-Year (cfs)
POA1/10	0.45	0.97	1.23	0.46	0.86	1.06
POA11	n/a	n/a	n/a	0.04	0.20	0.35

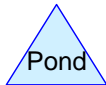
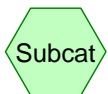
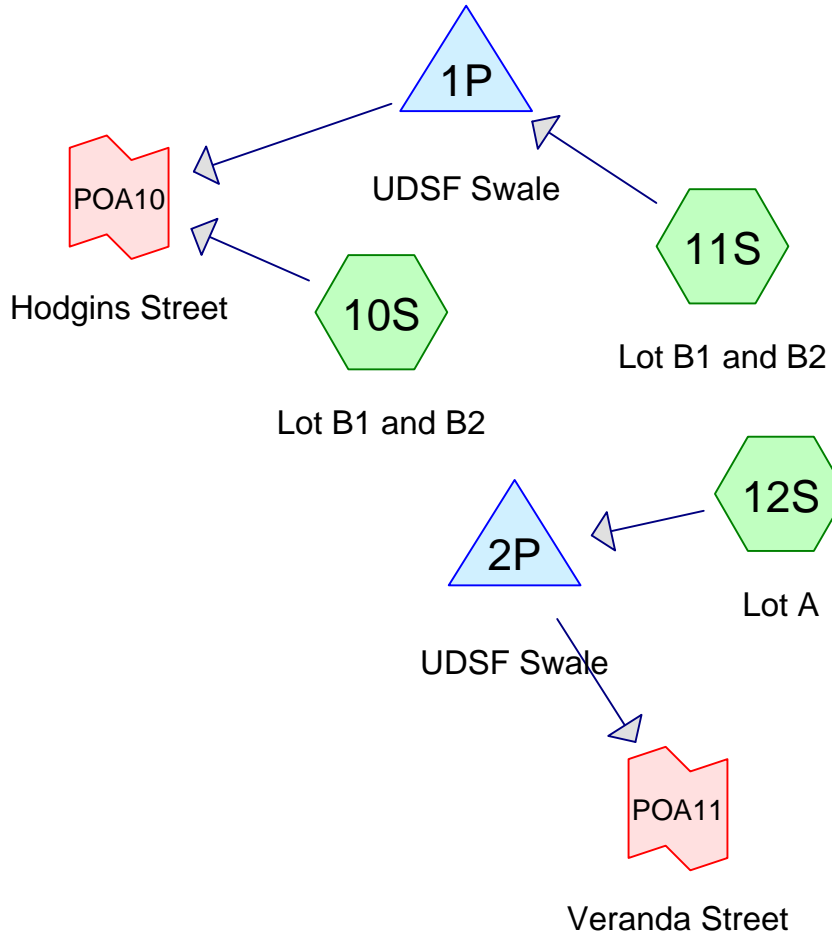
CONCLUSIONS

The proposed stormwater design will use low impact development features, or Stormwater Best Management Practices (BMPs) such as the underdrained soil filters to receive and treat the initial 1", or "first flush", of stormwater runoff. These filter beds, as well as long-term and short-term erosion control measures, will mitigate stormwater runoff to the maximum extent practicable.

Stormwater related calculations and computer modeling are also included with this report.

BLAIS CIVIL ENGINEERS, PA





**Routing Diagram for 140320,13136, Pre and Post**  
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13136, 120 Veranda Street  
Type III 24-hr 2-Yr Rainfall=3.00"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points  
Runoff by SCS TR-20 method, UH=SCS  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S:** Runoff Area=14,090 sf 22.96% Impervious Runoff Depth=1.25"  
Flow Length=115' Slope=0.0200 '/ Tc=6.3 min CN=80 Runoff=0.45 cfs 0.034 af

**Subcatchment 10S: Lot B1 and B2** Runoff Area=2,078 sf 45.72% Impervious Runoff Depth=1.59"  
Tc=5.0 min CN=85 Runoff=0.09 cfs 0.006 af

**Subcatchment 11S: Lot B1 and B2** Runoff Area=8,410 sf 48.81% Impervious Runoff Depth=1.66"  
Tc=5.0 min CN=86 Runoff=0.38 cfs 0.027 af

**Subcatchment 12S: Lot A** Runoff Area=2,830 sf 69.26% Impervious Runoff Depth=2.07"  
Tc=5.0 min CN=91 Runoff=0.16 cfs 0.011 af

**Pond 1P: UDSF Swale** Peak Elev=16.56' Storage=211 cf Inflow=0.38 cfs 0.027 af  
Outflow=0.37 cfs 0.025 af

**Pond 2P: UDSF Swale** Peak Elev=18.36' Storage=132 cf Inflow=0.16 cfs 0.011 af  
Outflow=0.04 cfs 0.011 af

**Link POA1: Hodgins Street** Inflow=0.45 cfs 0.034 af  
Primary=0.45 cfs 0.034 af

**Link POA10: Hodgins Street** Inflow=0.46 cfs 0.031 af  
Primary=0.46 cfs 0.031 af

**Link POA11: Veranda Street** Inflow=0.04 cfs 0.011 af  
Primary=0.04 cfs 0.011 af

**Total Runoff Area = 0.629 ac Runoff Volume = 0.078 af Average Runoff Depth = 1.49"**  
**62.60% Pervious = 0.394 ac 37.40% Impervious = 0.235 ac**

**140320,13136, Pre and Post**

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13136, 120 Veranda Street  
Type III 24-hr 2-Yr Rainfall=3.00"

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**Summary for Subcatchment 1S:**

Runoff = 0.45 cfs @ 12.10 hrs, Volume= 0.034 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Yr Rainfall=3.00"

Area (sf)	CN	Description
10,855	74	>75% Grass cover, Good, HSG C
* 2,835	98	Roof and Driveway
* 400	98	Off-Site Impervious
14,090	80	Weighted Average
10,855		77.04% Pervious Area
3,235		22.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.0200	0.14		<b>Sheet Flow, A to B</b> Grass: Short n= 0.150 P2= 3.00"
0.5	65	0.0200	2.12		<b>Shallow Concentrated Flow, B to C</b> Grassed Waterway Kv= 15.0 fps
6.3	115	Total			

**Summary for Subcatchment 10S: Lot B1 and B2**

Runoff = 0.09 cfs @ 12.08 hrs, Volume= 0.006 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Yr Rainfall=3.00"

Area (sf)	CN	Description
1,128	74	>75% Grass cover, Good, HSG C
* 950	98	Walkway and Drive
2,078	85	Weighted Average
1,128		54.28% Pervious Area
950		45.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Subcatchment 11S: Lot B1 and B2**

Runoff = 0.38 cfs @ 12.08 hrs, Volume= 0.027 af, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Yr Rainfall=3.00"

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Type III 24-hr 2-Yr Rainfall=3.00"

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Area (sf)	CN	Description
4,305	74	>75% Grass cover, Good, HSG C
* 1,830	98	Rooftop
* 1,875	98	Drive and Walkway
* 400	98	Off-Site Roof
8,410	86	Weighted Average
4,305		51.19% Pervious Area
4,105		48.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Subcatchment 12S: Lot A**

Runoff = 0.16 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 2.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Yr Rainfall=3.00"

Area (sf)	CN	Description
870	74	>75% Grass cover, Good, HSG C
* 1,960	98	Roof & drive
2,830	91	Weighted Average
870		30.74% Pervious Area
1,960		69.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Pond 1P: UDSF Swale**

Inflow Area = 0.193 ac, 48.81% Impervious, Inflow Depth = 1.66" for 2-Yr event  
 Inflow = 0.38 cfs @ 12.08 hrs, Volume= 0.027 af  
 Outflow = 0.37 cfs @ 12.11 hrs, Volume= 0.025 af, Atten= 1%, Lag= 2.2 min  
 Primary = 0.37 cfs @ 12.11 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2  
 Peak Elev= 16.56' @ 12.12 hrs Surf.Area= 445 sf Storage= 211 cf

Plug-Flow detention time= 62.8 min calculated for 0.025 af (94% of inflow)  
 Center-of-Mass det. time= 29.8 min ( 854.2 - 824.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	13.99'	478 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)



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Type III 24-hr 2-Yr Rainfall=3.00"

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Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.99	185	0.0	0	0
14.00	185	40.0	1	1
14.49	185	40.0	36	37
14.50	185	0.0	0	37
15.99	185	0.0	0	37
16.00	185	100.0	2	39
16.50	395	100.0	145	184
17.00	780	100.0	294	478

Device	Routing	Invert	Outlet Devices
#1	Primary	14.00'	<b>6.0" Round Culvert</b> L= 45.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.00' / 13.50' S= 0.0111 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	15.00'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	16.50'	<b>24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.34 cfs @ 12.11 hrs HW=16.56' (Free Discharge)

- 1=Culvert (Passes 0.34 cfs of 1.08 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.03 cfs @ 5.93 fps)
- 3=Orifice/Grate (Weir Controls 0.30 cfs @ 0.80 fps)

**Summary for Pond 2P: UDSF Swale**

Inflow Area = 0.065 ac, 69.26% Impervious, Inflow Depth = 2.07" for 2-Yr event  
 Inflow = 0.16 cfs @ 12.07 hrs, Volume= 0.011 af  
 Outflow = 0.04 cfs @ 12.44 hrs, Volume= 0.011 af, Atten= 74%, Lag= 22.0 min  
 Primary = 0.04 cfs @ 12.44 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2  
 Peak Elev= 18.36' @ 12.44 hrs Surf.Area= 239 sf Storage= 132 cf

Plug-Flow detention time= 29.0 min calculated for 0.011 af (100% of inflow)  
 Center-of-Mass det. time= 28.5 min ( 832.5 - 804.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	15.89'	207 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.89	170	0.0	0	0
15.90	170	40.0	1	1
16.49	170	40.0	40	41
16.50	170	0.0	0	41
17.90	170	0.0	0	41
18.00	170	100.0	17	58
18.50	265	100.0	109	167
18.65	275	100.0	40	207

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Type III 24-hr 2-Yr Rainfall=3.00"

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Device	Routing	Invert	Outlet Devices
#1	Primary	15.90'	<b>6.0" Round Culvert</b> L= 25.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.90' / 15.70' S= 0.0080 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	15.80'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	18.60'	<b>24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.04 cfs @ 12.44 hrs HW=18.36' (Free Discharge)

1=Culvert (Passes 0.04 cfs of 1.11 cfs potential flow)  
2=Orifice/Grate (Orifice Controls 0.04 cfs @ 7.56 fps)  
3=Orifice/Grate ( Controls 0.00 cfs)

## Summary for Link POA1: Hodgins Street

Inflow Area = 0.323 ac, 22.96% Impervious, Inflow Depth = 1.25" for 2-Yr event  
Inflow = 0.45 cfs @ 12.10 hrs, Volume= 0.034 af  
Primary = 0.45 cfs @ 12.10 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

## Summary for Link POA10: Hodgins Street

Inflow Area = 0.241 ac, 48.20% Impervious, Inflow Depth = 1.56" for 2-Yr event  
Inflow = 0.46 cfs @ 12.11 hrs, Volume= 0.031 af  
Primary = 0.46 cfs @ 12.11 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

## Summary for Link POA11: Veranda Street

Inflow Area = 0.065 ac, 69.26% Impervious, Inflow Depth = 2.07" for 2-Yr event  
Inflow = 0.04 cfs @ 12.44 hrs, Volume= 0.011 af  
Primary = 0.04 cfs @ 12.44 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points  
Runoff by SCS TR-20 method, UH=SCS  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment 1S:</b>	Runoff Area=14,090 sf 22.96% Impervious Runoff Depth=2.63" Flow Length=115' Slope=0.0200 '/ Tc=6.3 min CN=80 Runoff=0.97 cfs 0.071 af
<b>Subcatchment 10S: Lot B1 and B2</b>	Runoff Area=2,078 sf 45.72% Impervious Runoff Depth=3.09" Tc=5.0 min CN=85 Runoff=0.17 cfs 0.012 af
<b>Subcatchment 11S: Lot B1 and B2</b>	Runoff Area=8,410 sf 48.81% Impervious Runoff Depth=3.19" Tc=5.0 min CN=86 Runoff=0.72 cfs 0.051 af
<b>Subcatchment 12S: Lot A</b>	Runoff Area=2,830 sf 69.26% Impervious Runoff Depth=3.69" Tc=5.0 min CN=91 Runoff=0.27 cfs 0.020 af
<b>Pond 1P: UDSF Swale</b>	Peak Elev=16.60' Storage=228 cf Inflow=0.72 cfs 0.051 af Outflow=0.69 cfs 0.048 af
<b>Pond 2P: UDSF Swale</b>	Peak Elev=18.64' Storage=203 cf Inflow=0.27 cfs 0.020 af Outflow=0.20 cfs 0.020 af
<b>Link POA1: Hodgins Street</b>	Inflow=0.97 cfs 0.071 af Primary=0.97 cfs 0.071 af
<b>Link POA10: Hodgins Street</b>	Inflow=0.86 cfs 0.060 af Primary=0.86 cfs 0.060 af
<b>Link POA11: Veranda Street</b>	Inflow=0.20 cfs 0.020 af Primary=0.20 cfs 0.020 af

**Total Runoff Area = 0.629 ac Runoff Volume = 0.155 af Average Runoff Depth = 2.95"**  
**62.60% Pervious = 0.394 ac 37.40% Impervious = 0.235 ac**

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Type III 24-hr 10-Yr Rainfall=4.70"

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**Summary for Subcatchment 1S:**

Runoff = 0.97 cfs @ 12.10 hrs, Volume= 0.071 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Yr Rainfall=4.70"

Area (sf)	CN	Description
10,855	74	>75% Grass cover, Good, HSG C
* 2,835	98	Roof and Driveway
* 400	98	Off-Site Impervious
14,090	80	Weighted Average
10,855		77.04% Pervious Area
3,235		22.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.0200	0.14		<b>Sheet Flow, A to B</b> Grass: Short n= 0.150 P2= 3.00"
0.5	65	0.0200	2.12		<b>Shallow Concentrated Flow, B to C</b> Grassed Waterway Kv= 15.0 fps
6.3	115	Total			

**Summary for Subcatchment 10S: Lot B1 and B2**

Runoff = 0.17 cfs @ 12.07 hrs, Volume= 0.012 af, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Yr Rainfall=4.70"

Area (sf)	CN	Description
1,128	74	>75% Grass cover, Good, HSG C
* 950	98	Walkway and Drive
2,078	85	Weighted Average
1,128		54.28% Pervious Area
950		45.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Subcatchment 11S: Lot B1 and B2**

Runoff = 0.72 cfs @ 12.07 hrs, Volume= 0.051 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Yr Rainfall=4.70"

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Type III 24-hr 10-Yr Rainfall=4.70"

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	Area (sf)	CN	Description
	4,305	74	>75% Grass cover, Good, HSG C
*	1,830	98	Rooftop
*	1,875	98	Drive and Walkway
*	400	98	Off-Site Roof
	8,410	86	Weighted Average
	4,305		51.19% Pervious Area
	4,105		48.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Subcatchment 12S: Lot A**

Runoff = 0.27 cfs @ 12.07 hrs, Volume= 0.020 af, Depth= 3.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Yr Rainfall=4.70"

	Area (sf)	CN	Description
	870	74	>75% Grass cover, Good, HSG C
*	1,960	98	Roof & drive
	2,830	91	Weighted Average
	870		30.74% Pervious Area
	1,960		69.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Pond 1P: UDSF Swale**

Inflow Area = 0.193 ac, 48.81% Impervious, Inflow Depth = 3.19" for 10-Yr event

Inflow = 0.72 cfs @ 12.07 hrs, Volume= 0.051 af

Outflow = 0.69 cfs @ 12.09 hrs, Volume= 0.048 af, Atten= 3%, Lag= 0.9 min

Primary = 0.69 cfs @ 12.09 hrs, Volume= 0.048 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2  
Peak Elev= 16.60' @ 12.09 hrs Surf.Area= 473 sf Storage= 228 cf

Plug-Flow detention time= 54.3 min calculated for 0.048 af (93% of inflow)

Center-of-Mass det. time= 17.7 min ( 823.5 - 805.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	13.99'	478 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

**140320,13136, Pre and Post**

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13136, 120 Veranda Street  
Type III 24-hr 10-Yr Rainfall=4.70"

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Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.99	185	0.0	0	0
14.00	185	40.0	1	1
14.49	185	40.0	36	37
14.50	185	0.0	0	37
15.99	185	0.0	0	37
16.00	185	100.0	2	39
16.50	395	100.0	145	184
17.00	780	100.0	294	478

Device	Routing	Invert	Outlet Devices
#1	Primary	14.00'	<b>6.0" Round Culvert</b> L= 45.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.00' / 13.50' S= 0.0111 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	15.00'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	16.50'	<b>24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.67 cfs @ 12.09 hrs HW=16.60' (Free Discharge)

- 1=Culvert (Passes 0.67 cfs of 1.09 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.03 cfs @ 6.01 fps)
- 3=Orifice/Grate (Weir Controls 0.64 cfs @ 1.03 fps)

**Summary for Pond 2P: UDSF Swale**

Inflow Area = 0.065 ac, 69.26% Impervious, Inflow Depth = 3.69" for 10-Yr event  
 Inflow = 0.27 cfs @ 12.07 hrs, Volume= 0.020 af  
 Outflow = 0.20 cfs @ 12.17 hrs, Volume= 0.020 af, Atten= 27%, Lag= 5.6 min  
 Primary = 0.20 cfs @ 12.17 hrs, Volume= 0.020 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2  
 Peak Elev= 18.64' @ 12.15 hrs Surf.Area= 274 sf Storage= 203 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 33.1 min ( 821.0 - 788.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	15.89'	207 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.89	170	0.0	0	0
15.90	170	40.0	1	1
16.49	170	40.0	40	41
16.50	170	0.0	0	41
17.90	170	0.0	0	41
18.00	170	100.0	17	58
18.50	265	100.0	109	167
18.65	275	100.0	40	207

**140320,13136, Pre and Post**

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13136, 120 Veranda Street

Type III 24-hr 10-Yr Rainfall=4.70"

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Device	Routing	Invert	Outlet Devices
#1	Primary	15.90'	<b>6.0" Round Culvert</b> L= 25.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.90' / 15.70' S= 0.0080 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	15.80'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	18.60'	<b>24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.17 cfs @ 12.17 hrs HW=18.63' (Free Discharge)

1=Culvert (Passes 0.17 cfs of 1.18 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 0.04 cfs @ 7.96 fps)  
 3=Orifice/Grate (Weir Controls 0.13 cfs @ 0.60 fps)

**Summary for Link POA1: Hodgins Street**

Inflow Area = 0.323 ac, 22.96% Impervious, Inflow Depth = 2.63" for 10-Yr event  
 Inflow = 0.97 cfs @ 12.10 hrs, Volume= 0.071 af  
 Primary = 0.97 cfs @ 12.10 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

**Summary for Link POA10: Hodgins Street**

Inflow Area = 0.241 ac, 48.20% Impervious, Inflow Depth = 2.99" for 10-Yr event  
 Inflow = 0.86 cfs @ 12.09 hrs, Volume= 0.060 af  
 Primary = 0.86 cfs @ 12.09 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

**Summary for Link POA11: Veranda Street**

Inflow Area = 0.065 ac, 69.26% Impervious, Inflow Depth = 3.71" for 10-Yr event  
 Inflow = 0.20 cfs @ 12.17 hrs, Volume= 0.020 af  
 Primary = 0.20 cfs @ 12.17 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

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Type III 24-hr 25-Yr Rainfall=5.50"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points  
Runoff by SCS TR-20 method, UH=SCS  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S:** Runoff Area=14,090 sf 22.96% Impervious Runoff Depth=3.33"  
Flow Length=115' Slope=0.0200 '/ Tc=6.3 min CN=80 Runoff=1.23 cfs 0.090 af

**Subcatchment 10S: Lot B1 and B2** Runoff Area=2,078 sf 45.72% Impervious Runoff Depth=3.83"  
Tc=5.0 min CN=85 Runoff=0.21 cfs 0.015 af

**Subcatchment 11S: Lot B1 and B2** Runoff Area=8,410 sf 48.81% Impervious Runoff Depth=3.94"  
Tc=5.0 min CN=86 Runoff=0.88 cfs 0.063 af

**Subcatchment 12S: Lot A** Runoff Area=2,830 sf 69.26% Impervious Runoff Depth=4.47"  
Tc=5.0 min CN=91 Runoff=0.33 cfs 0.024 af

**Pond 1P: UDSF Swale** Peak Elev=16.62' Storage=235 cf Inflow=0.88 cfs 0.063 af  
Outflow=0.85 cfs 0.066 af

**Pond 2P: UDSF Swale** Peak Elev=18.67' Storage=207 cf Inflow=0.33 cfs 0.024 af  
Outflow=0.35 cfs 0.024 af

**Link POA1: Hodgins Street** Inflow=1.23 cfs 0.090 af  
Primary=1.23 cfs 0.090 af

**Link POA10: Hodgins Street** Inflow=1.06 cfs 0.081 af  
Primary=1.06 cfs 0.081 af

**Link POA11: Veranda Street** Inflow=0.35 cfs 0.024 af  
Primary=0.35 cfs 0.024 af

**Total Runoff Area = 0.629 ac Runoff Volume = 0.193 af Average Runoff Depth = 3.67"**  
**62.60% Pervious = 0.394 ac 37.40% Impervious = 0.235 ac**



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Type III 24-hr 25-Yr Rainfall=5.50"

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**Summary for Subcatchment 1S:**

Runoff = 1.23 cfs @ 12.10 hrs, Volume= 0.090 af, Depth= 3.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Yr Rainfall=5.50"

Area (sf)	CN	Description
10,855	74	>75% Grass cover, Good, HSG C
* 2,835	98	Roof and Driveway
* 400	98	Off-Site Impervious
14,090	80	Weighted Average
10,855		77.04% Pervious Area
3,235		22.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.0200	0.14		<b>Sheet Flow, A to B</b> Grass: Short n= 0.150 P2= 3.00"
0.5	65	0.0200	2.12		<b>Shallow Concentrated Flow, B to C</b> Grassed Waterway Kv= 15.0 fps
6.3	115	Total			

**Summary for Subcatchment 10S: Lot B1 and B2**

Runoff = 0.21 cfs @ 12.07 hrs, Volume= 0.015 af, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Yr Rainfall=5.50"

Area (sf)	CN	Description
1,128	74	>75% Grass cover, Good, HSG C
* 950	98	Walkway and Drive
2,078	85	Weighted Average
1,128		54.28% Pervious Area
950		45.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Subcatchment 11S: Lot B1 and B2**

Runoff = 0.88 cfs @ 12.07 hrs, Volume= 0.063 af, Depth= 3.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Yr Rainfall=5.50"

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Type III 24-hr 25-Yr Rainfall=5.50"

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	Area (sf)	CN	Description
	4,305	74	>75% Grass cover, Good, HSG C
*	1,830	98	Rooftop
*	1,875	98	Drive and Walkway
*	400	98	Off-Site Roof
	8,410	86	Weighted Average
	4,305		51.19% Pervious Area
	4,105		48.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Subcatchment 12S: Lot A**

Runoff = 0.33 cfs @ 12.07 hrs, Volume= 0.024 af, Depth= 4.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Yr Rainfall=5.50"

	Area (sf)	CN	Description
	870	74	>75% Grass cover, Good, HSG C
*	1,960	98	Roof & drive
	2,830	91	Weighted Average
	870		30.74% Pervious Area
	1,960		69.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					<b>Direct Entry, Minimum</b>

**Summary for Pond 1P: UDSF Swale**

Inflow Area = 0.193 ac, 48.81% Impervious, Inflow Depth = 3.94" for 25-Yr event

Inflow = 0.88 cfs @ 12.07 hrs, Volume= 0.063 af

Outflow = 0.85 cfs @ 12.09 hrs, Volume= 0.066 af, Atten= 3%, Lag= 0.9 min

Primary = 0.85 cfs @ 12.09 hrs, Volume= 0.066 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2  
Peak Elev= 16.62' @ 12.09 hrs Surf.Area= 485 sf Storage= 235 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= 57.5 min ( 857.4 - 799.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	13.99'	478 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.99	185	0.0	0	0
14.00	185	40.0	1	1
14.49	185	40.0	36	37
14.50	185	0.0	0	37
15.99	185	0.0	0	37
16.00	185	100.0	2	39
16.50	395	100.0	145	184
17.00	780	100.0	294	478

Device	Routing	Invert	Outlet Devices
#1	Primary	14.00'	<b>6.0" Round Culvert</b> L= 45.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.00' / 13.50' S= 0.0111 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	15.00'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	16.50'	<b>24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.83 cfs @ 12.09 hrs HW=16.61' (Free Discharge)

- 1=Culvert (Passes 0.83 cfs of 1.09 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.03 cfs @ 6.04 fps)
- 3=Orifice/Grate (Weir Controls 0.79 cfs @ 1.11 fps)

### Summary for Pond 2P: UDSF Swale

Inflow Area = 0.065 ac, 69.26% Impervious, Inflow Depth = 4.47" for 25-Yr event  
 Inflow = 0.33 cfs @ 12.07 hrs, Volume= 0.024 af  
 Outflow = 0.35 cfs @ 12.11 hrs, Volume= 0.024 af, Atten= 0%, Lag= 2.5 min  
 Primary = 0.35 cfs @ 12.11 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2  
 Peak Elev= 18.67' @ 12.12 hrs Surf.Area= 275 sf Storage= 207 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 30.7 min ( 813.5 - 782.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	15.89'	207 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.89	170	0.0	0	0
15.90	170	40.0	1	1
16.49	170	40.0	40	41
16.50	170	0.0	0	41
17.90	170	0.0	0	41
18.00	170	100.0	17	58
18.50	265	100.0	109	167
18.65	275	100.0	40	207

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13136, 120 Veranda Street

Type III 24-hr 25-Yr Rainfall=5.50"

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Device	Routing	Invert	Outlet Devices
#1	Primary	15.90'	<b>6.0" Round Culvert</b> L= 25.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.90' / 15.70' S= 0.0080 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	15.80'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	18.60'	<b>24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.31 cfs @ 12.11 hrs HW=18.66' (Free Discharge)

- 1=Culvert (Passes 0.31 cfs of 1.18 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.04 cfs @ 7.99 fps)
- 3=Orifice/Grate (Weir Controls 0.27 cfs @ 0.77 fps)

**Summary for Link POA1: Hodgins Street**

Inflow Area = 0.323 ac, 22.96% Impervious, Inflow Depth = 3.33" for 25-Yr event  
 Inflow = 1.23 cfs @ 12.10 hrs, Volume= 0.090 af  
 Primary = 1.23 cfs @ 12.10 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

**Summary for Link POA10: Hodgins Street**

Inflow Area = 0.241 ac, 48.20% Impervious, Inflow Depth = 4.04" for 25-Yr event  
 Inflow = 1.06 cfs @ 12.09 hrs, Volume= 0.081 af  
 Primary = 1.06 cfs @ 12.09 hrs, Volume= 0.081 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

**Summary for Link POA11: Veranda Street**

Inflow Area = 0.065 ac, 69.26% Impervious, Inflow Depth = 4.52" for 25-Yr event  
 Inflow = 0.35 cfs @ 12.11 hrs, Volume= 0.024 af  
 Primary = 0.35 cfs @ 12.11 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs