Att. L

FIRE DEPARTMENT CHECKLIST

1. Name, address, telephone number of applicant

   Avesta 72 Bishop Street, LP
   307 Cumberland Avenue
   Portland, Maine 04101
   Contact: Brooks More
   Phone: 207.553.7777

2. Name, address, telephone number of architect

   CWS Architects
   434 Cumberland Avenue
   Portland, Maine 04101
   Contact: Ben Walter
   Phone: 207.774.4441

3. Proposed uses of any structures [NFPA and IBC classification]

   IBC: R-2 Apartments

   NFPA: Residential – New Apartment Building

4. Square footage of all structures [total and per story]

First Floor:	7,804 SF
Second Floor:	7,035 SF
Third Floor:	6,535 SF
Total:	21,374 SF

5. Elevation of all structures

   Building Height is 36.0 feet as measured by IBC definitions

6. Proposed fire protection of all structures
   NFPA 13R system throughout.

7. Hydrant locations:

   There is a hydrant adjacent to the proposed driveway on Bishop Street.

8. A 12 inch water main is located within Bishop Street. Two water services are proposed for the building, one 6 inch service for fire and one 2 inch service for domestic.

9. Access to all structures [min. 2 sides]

   The proposed structure is accessible from Bishop Street and a driveway along the east side of the building.

10. A code summary shall be included referencing NFPA 1 and all fire department Technical standards.

    Preliminary Code Summary provided to PFD under separate cover (CWS to review details with Portland Fire Department).

11. The elevator shall be sized to fit an 80" x 24" stretcher and two personnel

    Elevator Cab Size to meet PFD Requirements (CWS to review details with Portland Fire Department).

12. Some structures may require Fire flows using annex H of NFPA 1

    Fire Flows to meet PFD Requirements (CWS to review details with Portland Fire Department).

GORRILL PALMER

PO Box 1237, 15 Shaker Road
Gray, Maine 04039
207.657.6910

April 7, 2015

Robert B. Metcalf, Principal
Maine Licensed Landscape Architect
Mitchell & Associates
70 Center Street
Portland, Maine 04101

Subject: Trip Generation, Crash History and Access Review
Avesta Housing Project on Bishop St.

Dear Bob:

Gorrill Palmer (GP) has completed a trip generation forecast, crash history review, access review and on-site parking forecast per your request for the proposed Avesta Housing project at 72 Bishop Street in Portland. The project will be similar to the Logan Place at Frederick Street in Portland which has 30 units. The Bishop Street project will be a first housing project for the homeless and will consist of 30 units and twelve parking spaces. It is our understanding that the housing is to be targeted for low-income, formerly-homeless individuals, some with medical disability. We understand they will tend to be an older population than Logan Place and less likely to own a car.

Background Data

GP based the study on the following information:

- A layout and lighting plan, L2, prepared by Mitchell & Associates dated April 10, 2015.
- Crash data for 2011-2013 provided by the Maine Department of Transportation (MaineDOT).
- Memo to the City Planning Board from Mark Swann dated August 1, 2014.

Sight Distance Evaluation

The Maine Department of Transportation has guidelines for sight distances at driveways within urban compacts. The sight line standards for driveways in an urban compact are as follows:

Maine DOT Standards for Sight Distance

Posted Speed (mph)	Sight Distance
25	200
30	250
35	305
40	360

GP has evaluated the available sight lines at the proposed 72 Bishop Street driveway in accordance with Maine DOT standards.

The Maine DOT standards are as follows:

Driveway observation point:	10 feet off major street travelway
Height of eye at driveway:	3 ½ feet above ground
Height of approaching vehicle:	4 ¼ feet above road surface

The posted speed on Bishop Street in the vicinity of the site driveway is 25 mph. The results of this sight line analysis exiting the site drive is summarized in the following table:

72 Bishop Street Apartments Driveway Sight Line Evaluation

Direction	Posted Speed (mph)	Recommended Sight Line (ft)	Actual Sight Line (ft)
Exiting onto Bishop Street Looking			
Left	25	200	+300
Right	25	200	+300

As shown, the sight lines for the driveway exceeds MaineDOT requirements. GP recommends that all plantings, which will be located within the right of way, not exceed 3 feet in height and be maintained at or below that height. Signage should not interfere with sight lines. In addition, we recommend that during construction, when heavy equipment is entering and exiting into the site, that appropriate measures, such as signage and flag persons, be utilized in accordance with the Manual on Uniform Traffic Control Devices.

Crash Data

In order to evaluate whether a location has a crash problem, Maine DOT uses two criteria to define High Crash Locations (HCL). Both criteria must be met in order to be classified as an HCL.

1. A critical rate factor of 1.00 or more for a three-year period. (A Critical Rate Factor {CRF} compares the actual accident rate to the rate for similar intersections in the State. A CRF of less than 1.00 indicates a rate less than average) and:
2. A minimum of 8 crashes over a three-year period.

Our office reviewed the 2011-2013 crash data in this area and found there were no high crash locations in the immediate area of the project site on Bishop Street. A copy of the collision history is included in the Appendix.

Trip Generation

Forecast based on ITE. Traffic engineers traditionally use the Institute of Transportation Engineers (ITE) publication *Trip Generation*, 9th Edition to estimate the potential trip generation for the proposed project. Based on Land Use Code (LUC) 220, Apartment, with 30 units, the proposed site would be forecast to generate the following trips during the peak hour of the adjacent street traffic:

AM Peak Hour 15 trip ends
PM Peak Hour 19 trip ends

A trip end is either an entering or exiting vehicle, thus a round trip equals two trip ends. ITE trip rates are based on surveys of predominantly suburban locations rather than urban and does not reflect the type of tenant proposed for this project and therefore is not appropriate for use in this project.

Data based in Preble Street Memo: Given these results, the fact that the project is in an urban area, and that the housing is to be targeted for low-income, formerly-homeless individuals with some disability, most of the traffic for the project is anticipated to come from staff, outside medical providers and social workers. GP has utilized a memo dated August 1, 2014 to the Portland Planning board from Mark Swann of Preble Street concerning staffing at the proposed project. A copy of the memo has been included with this letter. The following peak hour trips are estimated based on that memo.

Project staff- a maximum of 4 staff members are anticipated to be on site at any one time between the hours of 8 AM and 8 PM along with a maximum of 3 management staff. Assuming these staff all arrive in the same hour which is very conservative yields 7 trips into the site. Assuming two overnight staff leaving within the same hour yields a combined total of 9 trip ends for staff during the AM peak hour. For the PM peak hour, we have assumed 2 staff arrive and 2 leave and that 3 management staff leave for a total of 7 trip ends.

Service and healthcare providers- up to 12 individuals visit the site to provide case management, assistance with daily activities or a follow-up to a medical appointment. The attached memo from Preble Street states that there were an average of 4 service workers visit clients each day at Logan Place with a typical appointment lasting 60 minutes with the maximum number on site at the same time of 2. GP has estimated 2 trip ends in both the morning and afternoon peak hours based on this information.

Non-service guest visits- The Preble Street memo estimates a total number of non-service guest visits of approximately 6 per day. GP has estimated 2 trip ends in both the morning and afternoon peak hours based on this information.

Based on the information presented in the memo from Preble Street, GP estimates the following peak hour trip ends:

AM Peak hour: 13 trip ends
PM Peak hour: 11 trip ends

Pedestrian Circulation

The Applicant is proposing to construct approximately 600 feet of 5 foot sidewalk along the southerly side of Bishop Street from the site easterly to match into the existing 300 foot sidewalk at the easterly end of Bishop Street. This will enable tenants to access Metro Route 3 which stops on Stevens Ave approximately 350 feet south of Bishop Street in front of Bogusha', or Metro Route 2 which stops on Forest Avenue approximately 375 feet southerly of Bishop Street near Meineke. Since some of the residents may have medical issues, case managers from several organizations including Maine Health, Catholic Charities, and Preble Street can transport tenants for shopping. These resources are also available to assist able individuals in learning how to use the Metro.

Parking Evaluation

The City ordinance suggests one parking space per housing unit which would result in the Applicant needing to provide a total of 30 spaces. Providing more parking than needed to meet the demand would result in loss of open space, increases stormwater impacts, and underutilization of valuable urban land. At the same time, providing too little parking would have adverse impacts on residents and the surrounding neighborhood. The applicant's goal through the parking demand analysis process is to find the appropriate ratio of parking spaces. It is the opinion of GP that the parking needs for this project will be far less than one space per unit based on the following information. First, Logan Place, the most similar project to the proposed project, has had only one tenant since they have been leasing that owned a car. Secondly, the parking needs for the project is most likely to come from staff, outside medical providers and social workers. The Preble Street memo referenced earlier in this letter in the trip generation discussion, states that for Logan Place (30 units), it is rare for there to be more than 5 cars on site at any one time. Based on the staffing and visitation information presented in the trip generation discussion, we anticipate the parking demand to be as follows:

Staff: 4 spaces
Supervisors: 3 spaces
Service and healthcare providers: 2 spaces
Visitors: 2 spaces
Total:11

There are 12 spaces planned as part of the project which should be adequate based on this forecast.

Closure

In summary, it is our opinion that the project should generate 11 and 13 trip ends during the AM and PM peak hours respectively and that the proposed 12 on site spaces should adequately serve the project.

Please contact us with any questions.

Sincerely,

Gorrill-Palmer Consulting Engineers, Inc.

Thomas L Gorrill, P.E., PTOE

STATE OF MAINE
THOMAS L. GORRILL
No. 4614
LICENSED
PROFESSIONAL ENGINEER

Enc.

TLG/tlg/JN2976 /Trip generation and parking study 4-7-15.doc

Preble Street

Turning Hunger and Homelessness into Opportunity and Hope

38 Preble Street
Portland, ME 04101
207.775.0026 Phone
info@preblestreet.org
www.preblestreet.org

Memo to: City of Portland Planning Board
From: Mark R. Swann
Date: August 1, 2014
Re: Zoning Changing for 72 Bishop Street

Thank you for your consideration of this important addition to the Portland community. We look forward to being a valuable and contributing neighbor on Bishop Street. We hope the information below will assist in your assessment.

We remain available to answer any questions you may have.

Staffing Requirements on site at any one time:
A minimum of two staff members will be on duty at all times, with as many as four on-site between the hours of 8 a.m. and 8 p.m. We expect to have 10 full time employees: one coordinator, one supervisor, and one team leader managing seven housing support workers. Full-time staff will be supplemented by as-needed staff to cover vacations and sick days. Management personnel will be onsite during daytime hours, and overnight shifts will have a team leader on site. Preble Street's Chief Program Officer will oversee the program, and Preble Street provides a 24-hour on-call system, staffed by a clinical manager, to address clinically challenging situations. Additional staffing will include social work, counseling, and occupational therapy interns, as well as trained volunteers.

Staff/service traffic volume:
The staff/service traffic volume at Logan Place, the first housing development of this kind in Portland, varies greatly from day to day. Service and healthcare providers make individual appointments with tenants, and there may be a dozen individuals coming to provide case management or assistance with activities of daily living or a follow up to a medical appointment in a given day. Over a two month period from May 1, 2014, through June 30, 2014, Logan Place had an average of four service workers visiting clients each day. This number is slightly inflated due to one tenant being seriously ill and requiring daily hospice visits. A typical service appointment usually lasts 60 minutes or less. These visits are spread throughout the day, sometimes into the evening. The volume at any one time of day is typically one or two, maximum. It is rare for there to be more than five cars in the Logan Place parking lot at any one time. Non-service guest visits total approximately six per day.

Potential number of outside medical providers that would visit residents, including frequency:
As noted above, the average number of outside medical visits at Logan Place, is one or two a day. At the Bishop Street facility, because the target population is individuals who are medically compromised, we anticipate this number will be slightly higher. However, we anticipate being able to mitigate this factor by engaging with a healthcare partner and having medically credentialed staff as part of the program. This will lead to increased efficiency due to coordination of visits.

Transportation options provided to residents:
Transportation is a critical part of service planning for each tenant. Case managers from several organizations including Maine Health, Catholic Charities, and Preble Street can transport individuals for shopping and assist individuals in learning to be comfortable

with available public transportation. All tenants can get bus passes. Preble Street has an account with Elite Taxi service for emergency use. Additionally, most clients in the Bishop Street building will qualify for Medicaid assistance for rides to appointments. Preble Street is working closely with Maine's new Mainecare ride contractor, Logisticare, to transport clients to scheduled medical, case management, mental health, substance abuse counseling or treatment appointments. Tenants and Preble Street staff make these arrangements, which include pick up and return after any appointment. Many tenants who are mobile will be able to walk to local convenience stores and grocers.

Services provided by Preble Street and other partners:
Preble Street provides case management services to all tenants to ensure that individuals succeed in making the transition from chronic homelessness to permanent housing. A key role of Preble Street staff is working alongside tenants to develop service plans for improving independent living skills such as cooking or budgeting, meeting vocational or school goals, or beginning treatment for mental illnesses. Preble Street staff collaborate with tenants to reach goals, and establish new ones over time, making referrals to other providers and organizations as needed to assist tenant in achieving those goals and maintaining health and stability. Outside agencies are welcome at any time to visit and work with tenants, at tenants' discretion. Many tenants routinely receive services ranging from behavioral health to personal care attendants to housekeeping assistance.

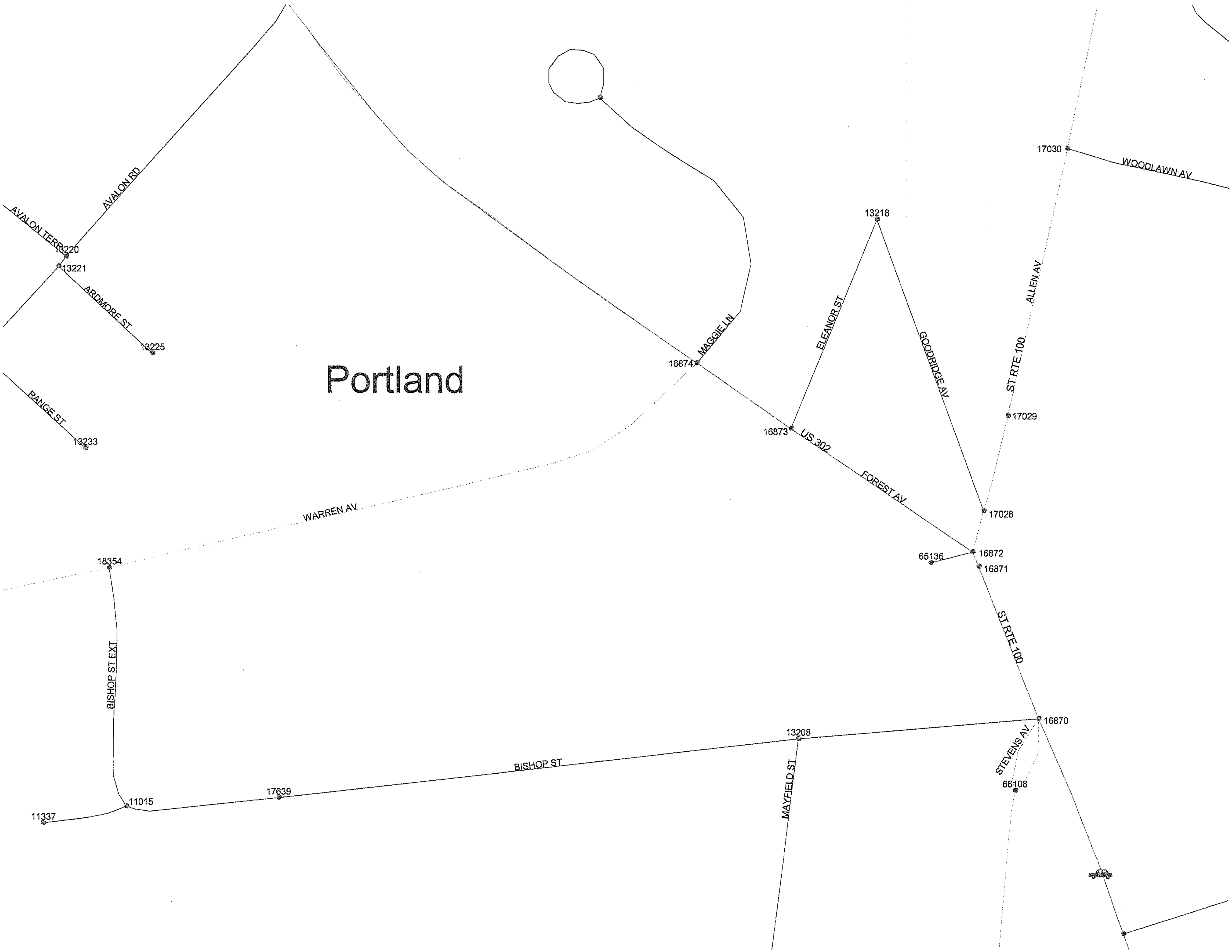
Because many long term homeless individuals need assistance with household responsibilities, such as cleaning and cooking, staff often focus on these issues, and for disabled tenants, will find resources from the community to assist with these tasks.

How the facility will be managed:
Avesta Housing provides building maintenance and is the landlord for all tenants. Preble Street staff work closely with the building manager, facilitating communication and supporting clients with maintaining stable housing.

Preble Street takes building management and security very seriously. Staff provide on-site monitoring and support to deal with any crisis that emerges and to ensure tenant safety. Each residential site has a front desk that is staffed 24 hours a day. The doors to each building are locked and visitors are required to check in at the front desk and produce identification which is copied and filed by staff. The staff member at the front desk monitors the building exterior through strategically placed cameras. The front desk is also the place where can tenants seek assistance if they have a question or concern. An intercom in each room allows tenants to contact the desk, and makes it easy for staff to check in with tenants regarding visitors.

Tenants are allowed a maximum of five overnight visits per month in accordance with public housing leases, and staff maintains a visitor log noting every guest entry and exit. Staff members do regular rounds, ensuring the security of the building and monitoring living spaces. Preble Street offers 24-hour clinical support through an on-call system staffed by managers, and staff are trained to call for medical or law enforcement support in the case of any disturbance.

Tenants at Logan Place have created a strong community, supported by staff and volunteers. Tenants at Logan Place prepare communal dinners, participate in regular house meetings to address their concerns and issues, and enjoy activities and outings such as hikes, cooking contests, and game tournaments.


Portland
AVALON RD
AVALON TERR
13220
13221
ARDMORE ST
13225
RANGE ST
13233
MAGGIE LN
16874
16873
US 302
FOREST AV
ELEANOR ST
13218
GOODRIDGE AV
ALLEN AV
ST RTE 100
17030
WOODLAWN AV
17029
17028
16872
16871
65136
ST RTE 100
16870
STEVENS AV
66108
WARREN AV
18354
BISHOP ST EXT
11015
11337
17639
BISHOP ST
13208
MAYFIELD ST

Maine Department Of Transportation - Traffic Engineering, Crash Records Section

Crash Summary Report

Report Selections and Input Parameters

REPORT SELECTIONS

☑ **Crash Summary I** ☐ **Section Detail** ☑ **Crash Summary II** ☐ **1320 Public** ☐ **1320 Private** ☐ **1320 Summary**

REPORT DESCRIPTION

Bishop St area

REPORT PARAMETERS

Year 2011, Start Month 1 through Year 2013 End Month: 12

Route: **0560062**	Start Node: **11015** End Node: **16870**	Start Offset: **0** End Offset: **0**	☐ **Exclude First Node** ☐ **Exclude Last Node**
Route: **0561237**	Start Node: **11015** End Node: **18354**	Start Offset: **0** End Offset: **0**	☑ **Exclude First Node** ☐ **Exclude Last Node**
Route: **0100X**	Start Node: **16870** End Node: **17030**	Start Offset: **0** End Offset: **0**	☑ **Exclude First Node** ☑ **Exclude Last Node**
Route: **0560767**	Start Node: **18354** End Node: **16874**	Start Offset: **0** End Offset: **0**	☑ **Exclude First Node** ☐ **Exclude Last Node**
Route: **0302X**	Start Node: **16872** End Node: **16874**	Start Offset: **0** End Offset: **0**	☑ **Exclude First Node** ☑ **Exclude Last Node**
Route: **0560249**	Start Node: **13218** End Node: **16873**	Start Offset: **0** End Offset: **0**	☐ **Exclude First Node** ☑ **Exclude Last Node**
Route: **0560320**	Start Node: **13218** End Node: **17028**	Start Offset: **0** End Offset: **0**	☑ **Exclude First Node** ☑ **Exclude Last Node**

Crash Summary I

Nodes

Node	Route - MP	Node Description	U/R	Total Crashes	Injury Crashes K	A	B	C	PD	Percent Injury	Annual M Ent-Veh	Crash Rate	Critical Rate	CRF
11015	0560062 - 0.03	0501427 POR,BISHOP ST,BISHOP ST EXT	2	1	0	0	0	0	1	0.0	0.404	0.83 Statewide Crash Rate:	0.60 0.14	1.37
17639	0560062 - 0.09	0508057 POR,BISHOP ST,.22W/O MAYFIELD	2	0	0	0	0	0	0	0.0	0.425	0.00 Statewide Crash Rate:	0.60 0.14	0.00
13208	0560062 - 0.31	0503622 POR,MAYFIELD,BISHOP ST.	2	0	0	0	0	0	0	0.0	0.601	0.00 Statewide Crash Rate:	0.58 0.14	0.00
16870	0560062 - 0.40	Int of BISHOP ST FOREST AV STEVENS AV	9	30	0	0	2	7	21	30.0	12.739	0.78 Statewide Crash Rate:	0.97 0.65	0.00
18354	0561237 - 0.10	Int of BISHOP ST EXT WARREN AV	2	2	0	0	0	1	1	50.0	5.153	0.13 Statewide Crash Rate:	0.35 0.14	0.00
16871	0100X - 2.80	Non Int FOREST AV	2	0	0	0	0	0	0	0.0	5.970	0.00 Statewide Crash Rate:	0.30 0.12	0.00
16872	0100X - 2.81	Int of ALLEN AV ENTRANCE TO MCDONALDS Z RD FORE	9	53	0	0	4	17	32	39.6	15.378	1.15 Statewide Crash Rate:	0.94 0.65	1.22
17028	0100X - 2.83	Int of ALLEN AV GOODRIDGE AV	2	3	0	0	0	1	2	33.3	6.998	0.14 Statewide Crash Rate:	0.33 0.14	0.00
17029	0100X - 2.87	Non-Int ALLEN AV	2	1	0	0	0	1	0	100.0	6.934	0.05 Statewide Crash Rate:	0.33 0.14	0.00
16874	0560767 - 1.89	Int of FOREST AV MAGGIE LN WARREN AV	9	29	0	0	0	8	21	27.6	11.834	0.82 Statewide Crash Rate:	0.98 0.65	0.00
16873	0302X - 2.40	Int of ELEANOR ST, FOREST AV	2	2	0	0	0	1	1	50.0	11.411	0.06 Statewide Crash Rate:	0.26 0.12	0.00
13218	0560249 - 0	0503632 POR,GOODRIDGE AVE,PW AHD.	2	0	0	0	0	0	0	0.0	0.024	0.00 Statewide Crash Rate:	-3.31 0.14	0.00
Study Years: 3.00		NODE TOTALS:		121	0	0	6	36	79	34.7	77.871	0.52	0.50	1.03

Maine Department Of Transportation - Traffic Engineering, Crash Records Section

Crash Summary I

Sections

Start Node	End Node	Element	Offset Begin - End	Route - MP	Section Length	U/R	Total Crashes	K	A	B	C	PD	Percent Injury	Annual HMVM	Crash Rate	Critical Rate	CRF
11015	17639	184811	0 - 0.06	0560062 - 0.03	0.06	2	0	0	0	0	0	0	0.0	0.00019	0.00	1478.63	0.00
0501427 POR,BISHOP ST,BISHOP ST EXT				RD INV 05 60062											Statewide Crash Rate: 346.93		
13208	17639	187890	0 - 0.22	0560062 - 0.09	0.22	2	2	0	0	0	0	2	0.0	0.00117	570.21	1014.53	0.00
0503622 POR,MAYFIELD,BISHOP ST.				RD INV 05 60062											Statewide Crash Rate: 346.93		
13208	16870	187889	0 - 0.09	0560062 - 0.31	0.09	2	1	0	0	0	0	1	0.0	0.00054	614.98	1229.30	0.00
0503622 POR,MAYFIELD,BISHOP ST.				RD INV 05 60062											Statewide Crash Rate: 346.93		
11015	18354	184812	0 - 0.10	0561237 - 0	0.10	2	0	0	0	0	0	0	0.0	0.00039	0.00	1319.62	0.00
0501427 POR,BISHOP ST,BISHOP ST EXT				RD INV 05 61237											Statewide Crash Rate: 346.93		
16870	16871	3106426	0 - 0.07	0100X - 2.73	0.07	2	10	0	0	0	4	6	40.0	0.00836	398.84	366.48	1.09
Int of BISHOP ST FOREST AV STEVENS AV				ST RTE 100											Statewide Crash Rate: 172.66		
16871	16872	3120028	0 - 0.01	0100X - 2.80	0.01	2	0	0	0	0	0	0	0.0	0.00119	0.00	598.64	0.00
Non Int FOREST AV				ST RTE 100											Statewide Crash Rate: 172.66		
16872	17028	3120112	0 - 0.02	0100X - 2.81	0.02	2	3	0	0	0	0	3	0.0	0.00140	715.22	610.28	1.17
Int of ALLEN AV ENTRANCE TO MCDONALDS Z RD FOREST AV				ST RTE 100											Statewide Crash Rate: 186.42		
17028	17029	3106523	0 - 0.04	0100X - 2.83	0.04	2	2	0	0	0	1	1	50.0	0.00278	239.55	511.45	0.00
Int of ALLEN AV GOODRIDGE AV				ST RTE 100											Statewide Crash Rate: 186.42		
17029	17030	3106524	0 - 0.11	0100X - 2.87	0.11	2	5	0	0	0	4	1	80.0	0.00760	219.24	397.39	0.00
Non-Int ALLEN AV				ST RTE 100											Statewide Crash Rate: 186.42		
16874	18354	3106429	0 - 0.26	0560767 - 1.63	0.26	2	8	0	1	1	2	4	50.0	0.01246	214.01	354.96	0.00
Int of FOREST AV MAGGIE LN WARREN AV				RD INV 05 60767											Statewide Crash Rate: 186.42		
16872	16873	3106427	0 - 0.09	0302X - 2.31	0.09	2	11	0	0	1	2	8	27.3	0.01023	358.44	349.59	1.03
Int of ALLEN AV ENTRANCE TO MCDONALDS Z RD FOREST AV				US 302											Statewide Crash Rate: 172.66		
16873	16874	3119258	0 - 0.05	0302X - 2.40	0.05	2	5	0	0	0	2	3	40.0	0.00570	292.16	402.19	0.00
Int of ELEANOR ST, FOREST AV				US 302											Statewide Crash Rate: 172.66		
13218	16873	187898	0 - 0.08	0560249 - 0	0.08	2	0	0	0	0	0	0	0.0	0.00004	0.00	435.87	0.00
0503632 POR,GOODRIDGE AVE,PW AHD.				RD INV 05 60249											Statewide Crash Rate: 346.93		
13218	17028	187899	0 - 0.10	0560320 - 0	0.10	2	1	0	0	0	0	1	0.0	0.00005	7079.40	844.29	8.39
0503632 POR,GOODRIDGE AVE,PW AHD.				RD INV 05 60320											Statewide Crash Rate: 346.93		
Study Years: 3.00				**Section Totals:**	1.30		48	0	1	2	15	30	37.5	0.05211	307.04	272.92	1.13
				Grand Totals:	1.30		169	0	1	8	51	109	35.5	0.05211	1081.04	391.52	2.76

Crash Summary

Section Details

Start Node	End Node	Element	Offset Begin - End	Route - MP	Total Crashes	K	A	B	C	PD	Crash Report	Crash Date	Crash Mile Point	Injury Degree
11015	17639	184811	0 - 0.06	0560062 - 0.03	0	0	0	0	0	0				
13208	17639	187890	0 - 0.22	0560062 - 0.09	2	0	0	0	0	2	2012-49919	11/18/2012	0.11	PD
											2011-952C	01/20/2011	0.13	PD
13208	16870	187889	0 - 0.09	0560062 - 0.31	1	0	0	0	0	1	2011-14828	11/06/2011	0.38	PD
11015	18354	184812	0 - 0.10	0561237 - 0	0	0	0	0	0	0				
16870	16871	3106426	0 - 0.07	0100X - 2.73	10	0	0	0	4	6	2012-36460	08/24/2012	2.76	C
											2013-25544	10/14/2013	2.76	C
											2012-36610	08/26/2012	2.76	PD
											2012-41209	10/16/2012	2.77	C
											2013-16294	07/05/2013	2.77	PD
											2011-8015	08/16/2011	2.77	PD
											2012-29274	05/29/2012	2.77	PD
											2011-7939C	04/30/2011	2.79	C
											2012-40747	10/10/2012	2.79	PD
											2012-47725	12/13/2012	2.79	PD
16871	16872	3120028	0 - 0.01	0100X - 2.80	0	0	0	0	0	0				
16872	17028	3120112	0 - 0.02	0100X - 2.81	3	0	0	0	0	3	2013-22613	09/11/2013	2.82	PD
											2013-3646	02/12/2013	2.82	PD
											2011-5719C	03/22/2011	2.82	PD
17028	17029	3106523	0 - 0.04	0100X - 2.83	2	0	0	0	1	1	2011-8543C	05/18/2011	2.85	PD
											2011-6139C	04/01/2011	2.86	C
17029	17030	3106524	0 - 0.11	0100X - 2.87	5	0	0	0	4	1	2011-5964	07/28/2011	2.90	C
											2013-33044	12/12/2013	2.92	C
											2013-33241	12/08/2013	2.94	C
											2011-12770	10/14/2011	2.95	C
											2011-8667C	06/09/2011	2.96	PD
16874	18354	3106429	0 - 0.26	0560767 - 1.63	8	0	1	1	2	4	2011-1710C	01/29/2011	1.64	PD
											2011-5315C	03/03/2011	1.75	PD
											2012-26093	04/11/2012	1.76	PD
											2013-14899	06/21/2013	1.79	PD
											2013-1666	01/20/2013	1.84	A
											2013-4581	02/19/2013	1.84	C
											2013-6821	03/12/2013	1.84	C
											2013-9426	04/13/2013	1.87	B

Crash Summary

Section Details

Start Node	End Node	Element	Offset Begin - End	Route - MP	Total Crashes	K	Injury Crashes A	B	C	PD	Crash Report	Crash Date	Crash Mile Point	Injury Degree
16872	16873	3106427	0 - 0.09	0302X - 2.31	11	0	0	1	2	8	2012-31797	06/26/2012	2.32	C
											2012-35127	08/09/2012	2.35	PD
											2013-13399	06/04/2013	2.35	PD
											2012-38683	09/14/2012	2.36	B
											2013-29142	11/19/2013	2.36	C
											2013-21392	08/27/2013	2.36	PD
											2013-31149	12/03/2013	2.37	PD
											2012-29378	05/30/2012	2.37	PD
											2013-2143	01/26/2013	2.37	PD
											2011-5215	07/19/2011	2.39	PD
											2013-26365	10/23/2013	2.39	PD
16873	16874	3119258	0 - 0.05	0302X - 2.40	5	0	0	0	2	3	2013-2937	02/04/2013	2.43	C
											2013-19733	08/12/2013	2.43	PD
											2011-39C	01/03/2011	2.44	C
											2013-29987	11/22/2013	2.44	PD
											2012-23666	03/08/2012	2.44	PD
13218	16873	187898	0 - 0.08	0560249 - 0	0	0	0	0	0	0				
13218	17028	187899	0 - 0.10	0560320 - 0	1	0	0	0	0	1	2012-34503	08/07/2012	0.09	PD
				Totals:	48	0	1	2	15	30				

Maine Department Of Transportation - Traffic Engineering, Crash Records Section

Crash Summary II - Characteristics

Crashes by Day and Hour

	AM												Hour of Day						PM							
Day Of Week	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Un**	**Tot**
SUNDAY	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	2	3	0	0	0	11
MONDAY	0	0	0	0	0	0	0	6	3	3	1	1	1	5	0	2	1	2	1	0	0	0	0	0	0	26
TUESDAY	0	0	0	0	0	1	0	1	2	2	1	2	2	3	2	3	3	3	1	2	0	0	1	0	0	29
WEDNESDAY	0	0	0	0	0	0	2	6	2	1	0	3	2	2	2	3	2	4	0	0	1	0	0	0	0	30
THURSDAY	0	0	0	0	0	0	0	1	3	5	4	2	0	2	1	0	6	2	1	0	1	0	1	0	0	29
FRIDAY	0	0	0	0	1	1	0	3	1	1	3	1	5	0	1	2	1	5	0	1	1	0	0	0	0	27
SATURDAY	0	0	0	0	0	0	0	2	1	1	2	2	3	0	2	0	1	0	0	1	0	1	1	0	0	17
Totals	0	1	0	0	1	2	2	19	13	14	11	11	14	13	8	10	15	16	3	4	5	4	3	0	0	**169**

Vehicle Counts by Type

Unit Type	Total	Unit Type	Total
1-Passenger Car	224	23-Bicyclist	3
2-(Sport) Utility Vehicle	55	24-Witness	17
3-Passenger Van	7	25-Other	7
4-Cargo Van (10K lbs or Less)	3	**Total**	**370**
5-Pickup	42		
6-Motor Home	1		
7-School Bus	0		
8-Transit Bus	0		
9-Motor Coach	0		
10-Other Bus	1		
11-Motorcycle	0		
12-Moped	1		
13-Low Speed Vehicle	0		
14-Autocycle	0		
15-Experimental	0		
16-Other Light Trucks (10,000 lbs or Less)	1		
17-Medium/Heavy Trucks (More than 10,000 lbs)	4		
18-ATV - (4 wheel)	0		
20-ATV - (2 wheel)	0		
21-Snowmobile	0		
22-Pedestrian	4		

Crash Summary II - Characteristics

Crashes by Driver Action at Time of Crash

Driver Action at Time of Crash	Dr 1	Dr 2	Dr 3	Dr 4	Dr 5	Other	Total
No Contributing Action	68	65	12	1	0	0	146
Ran Off Roadway	6	0	0	0	0	0	6
Failed to Yield Right-of-Way	25	11	0	0	0	0	36
Ran Red Light	0	1	1	0	0	0	2
Ran Stop Sign	0	0	0	0	0	0	0
Disregarded Other Traffic Sign	0	0	1	0	0	0	1
Disregarded Other Road Markings	1	0	0	0	0	0	1
Exceeded Posted Speed Limit	3	2	0	0	0	0	5
Drove Too Fast For Conditions	3	3	0	0	0	0	6
Improper Turn	2	2	0	0	0	0	4
Improper Backing	1	1	0	0	0	0	2
Improper Passing	0	4	0	0	0	0	4
Wrong Way	0	0	0	0	0	0	0
Followed Too Closely	21	29	6	0	0	0	56
Failed to Keep in Proper Lane	2	4	0	0	0	0	6
Operated Motor Vehicle in Erratic, Reckless, Careless, Negligent or Aggressive Manner	1	1	1	0	0	0	3
Swerved or Avoided Due to Wind, Slippery Surface, Motor Vehicle, Object, Non-Motorist in Roadway	1	0	0	0	0	0	1
Over-Correcting/Over-Steering	0	0	0	0	0	0	0
Other Contributing Action	4	3	1	0	0	0	8
Unknown	3	4	1	0	0	0	8
Total	**141**	**130**	**23**	**1**	**0**	**0**	**295**

Crashes by Apparent Physical Condition And Driver

Apparent Physical Condition	Dr 1	Dr 2	Dr 3	Dr 4	Dr 5	Other	Total
Apparently Normal	155	144	23	1	0	4	327
Physically Impaired or Handicapped	0	0	0	0	0	0	0
Emotional(Depressed, Angry, Disturbed, etc.)	0	0	0	0	0	0	0
Ill (Sick)	1	0	0	0	0	0	1
Asleep or Fatigued	0	0	0	0	0	0	0
Under the Influence of Medications/Drugs/Alcohol	4	0	0	0	0	2	6
Other	3	3	0	0	0	0	6
Total	**163**	**147**	**23**	**1**	**0**	**6**	**340**

Driver Age by Unit Type

Age	Driver	Bicycle	SnowMobile	Pedestrian	ATV	Total
09-Under	0	0	0	0	0	0
10-14	0	0	0	0	0	0
15-19	23	0	0	0	0	23
20-24	39	0	0	0	0	39
25-29	39	0	0	0	0	39
30-39	65	0	0	0	0	65
40-49	67	0	0	0	0	67
50-59	51	0	0	0	0	51
60-69	31	0	0	0	0	31
70-79	13	0	0	0	0	13
80-Over	5	0	0	0	0	5
Unknown	13	3	0	4	0	20
Total	**346**	**3**	**0**	**4**	**0**	**353**

Maine Department Of Transportation - Traffic Engineering, Crash Records Section

Crash Summary II - Characteristics

Most Harmful Event

Most Harmful Event	Total
1-Overturn / Rollover	3
2-Fire / Explosion	0
3-Immersion	0
4-Jackknife	0
5-Cargo / Equipment Loss Or Shift	0
6-Fell / Jumped from Motor Vehicle	0
7-Thrown or Falling Object	0
8-Other Non-Collision	2
9-Pedestrian	1
10-Pedalcycle	0
11-Railway Vehicle - Train, Engine	0
12-Animal	1
13-Motor Vehicle in Transport	249
14-Parked Motor Vehicle	4
15-Struck by Falling, Shifting Cargo or Anything Set in Motion by Motor Vehicle	0
16-Work Zone / Maintenance Equipment	0
17-Other Non-Fixed Object	2
18-Impact Attenuator / Crash Cushion	0
19-Bridge Overhead Structure	0
20-Bridge Pier or Support	0
21-Bridge Rail	0
22-Cable Barrier	0
23-Culvert	0
24-Curb	0
25-Ditch	0
26-Embankment	0
27-Guardrail Face	0
28-Guardrail End	0
29-Concrete Traffic Barrier	0
30-Other Traffic Barrier	0
31-Tree (Standing)	0
32-Utility Pole / Light Support	3
33-Traffic Sign Support	0
34-Traffic Signal Support	0
35-Fence	0
36-Mailbox	0
37-Other Post Pole or Support	0
38-Other Fixed Object (wall, building, tunnel, etc.)	0
39-Unknown	13
40-Gate or Cable	0
41-Pressure Ridge	0
Total	**278**

Traffic Control Devices

Traffic Control Device	Total
1-Traffic Signals (Stop & Go)	132
2-Traffic Signals (Flashing)	2
3-Advisory/Warning Sign	0
4-Stop Signs - All Approaches	0
5-Stop Signs - Other	5
6-Yield Sign	0
7-Curve Warning Sign	0
8-Officer, Flagman, School Patrol	0
9-School Bus Stop Arm	0
10-School Zone Sign	0
11-R.R. Crossing Device	1
12-No Passing Zone	0
13-None	28
14-Other	1
Total	**169**

Injury Data

Severity Code	Injury Crashes	Number Of Injuries
K	0	0
A	1	1
B	8	10
C	51	58
PD	109	0
Total	**169**	**69**

Road Character

Road Grade	Total
1-Level	158
2-On Grade	11
3-Top of Hill	0
4-Bottom of Hill	0
5-Other	0
Total	**169**

Light

Light Condition	Total
1-Daylight	132
2-Dawn	3
3-Dusk	2
4-Dark - Lighted	32
5-Dark - Not Lighted	0
6-Dark - Unknown Lighting	0
7-Unknown	0
Total	**169**

Crash Summary II - Characteristics

Crashes by Year and Month

Month	2011	2012	2013	Total
JANUARY	9	6	5	20
FEBRUARY	6	3	8	17
MARCH	7	2	3	12
APRIL	5	4	3	12
MAY	3	4	2	9
JUNE	3	5	6	14
JULY	6	3	3	12
AUGUST	5	6	4	15
SEPTEMBER	3	5	2	10
OCTOBER	2	6	7	15
NOVEMBER	2	3	5	10
DECEMBER	7	11	5	23
Total	**58**	**58**	**53**	**169**

Report is limited to the last 10 years of data.

Crash Summary II - Characteristics

Crashes by Crash Type and Type of Location

Crash Type	Straight Road	Curved Road	Three Leg Intersection	Four Leg Intersection	Five or More Leg Intersection	Driveways	Bridges	Interchanges	Other	Parking Lot	Private Way	Cross Over	Railroad Crossing	Total
Object in Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rear End / Sideswipe	27	0	1	86	1	7	0	0	0	0	0	0	1	123
Head-on / Sideswipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intersection Movement	0	0	5	13	0	10	0	0	0	0	0	0	0	28
Pedestrians	0	0	0	4	0	0	0	0	0	0	0	0	0	4
Train	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Went Off Road	4	1	1	4	0	0	0	0	0	0	0	0	0	10
All Other Animal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycle	0	0	0	2	0	1	0	0	0	0	0	0	0	3
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jackknife	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rollover	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fire	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Submersion	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thrown or Falling Object	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deer	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moose	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Total	**31**	**1**	**7**	**110**	**1**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**169**

Maine Department Of Transportation - Traffic Engineering, Crash Records Section

Crash Summary II - Characteristics

Crashes by Weather, Light Condition and Road Surface

Weather / Light	Dry	Ice/Frost	Mud, Dirt, Gravel	Oil	Other	Sand	Slush	Snow	Unknown	Water (Standing, Moving)	Wet	Total
Blowing Sand, Soil, Dirt												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Blowing Snow												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Clear												
Dark - Lighted	19	0	0	0	0	0	0	1	0	0	2	22
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	2	1	0	0	0	0	0	0	0	0	0	3
Daylight	89	2	0	0	0	0	1	1	0	0	3	96
Dusk	1	0	0	0	0	0	0	0	0	0	0	1
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Cloudy												
Dark - Lighted	3	0	0	0	0	0	0	0	0	0	0	3
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	10	0	0	0	0	0	0	0	0	0	4	14
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0

Maine Department Of Transportation - Traffic Engineering, Crash Records Section

Crash Summary II - Characteristics

Crashes by Weather, Light Condition and Road Surface

Weather / Light	Dry	Ice/Frost	Mud, Dirt, Gravel	Oil	Other	Sand	Slush	Snow	Unknown	Water (Standing, Moving)	Wet	Total
Fog, Smog, Smoke												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	1	1
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Other												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Rain												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	5	5
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	14	14
Dusk	0	0	0	0	0	0	0	0	0	0	1	1
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Severe Crosswinds												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0

Maine Department Of Transportation - Traffic Engineering, Crash Records Section

Crash Summary II - Characteristics

Crashes by Weather, Light Condition and Road Surface

Weather / Light	Dry	Ice/Frost	Mud, Dirt, Gravel	Oil	Other	Sand	Slush	Snow	Unknown	Water (Standing, Moving)	Wet	Total
Sleet, Hail (Freezing Rain or Drizzle)												
Dark - Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	0	0	0	0	0	0	0	0	0	0	0
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Snow												
Dark - Lighted	0	1	0	0	0	0	0	1	0	0	0	2
Dark - Not Lighted	0	0	0	0	0	0	0	0	0	0	0	0
Dark - Unknown Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Dawn	0	0	0	0	0	0	0	0	0	0	0	0
Daylight	0	2	0	0	0	0	0	4	0	0	1	7
Dusk	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**124**	**6**	**0**	**0**	**0**	**0**	**1**	**7**	**0**	**0**	**0**	**169**

RANSOM Consulting, Inc.

Consulting Engineers and Scientists

Bishop Street Stormwater Management Report

Date:	May 22, 2015
To:	City of Portland
From:	Stephen J. Bradstreet, P.E.
Peer Review:	Maureen P. McGlone, P.E.
Location:	72 Bishop Street, Portland, Maine

List of Appendices:

Appendix A: Post Construction Stormwater Compliance Requirements
Appendix B: Stormwater BMP Inspection and Maintenance Requirements
Appendix C: Stormwater Quality Calculations
Appendix D: Pre Development Hydro CAD Calculations
Appendix E: Post Development Hydro CAD Calculations

Existing Conditions:

The site is a 52,383 SF (1.203 acre) lot located on the south side of 72 Bishop Street, west of Mayfield Street and adjacent to the Masonic Lodge. The parcel is trapezoidal in shape and is primarily vegetated (wooded/scrub brush) on the southern 2/3 of the site and grass on the northern 1/3 of the site adjacent to Bishop Street. The northern portion appears to be a fill area and fairly flat though sloping in a south-southeasterly direction into a wetland area. The southern portion of the site is primarily wetlands with some upland area sloping steeply up to the adjacent Masonic Lodge site. The parcel is at the headwaters of the Capisic Brook which is an impaired stream. Stormwater runoff from the site flows into the on-site wetlands and then off-site and onto the abutting property of the University of New England.

Proposed Development:

The applicant, Avesta Housing proposes to construct a 3 story building and housing for the homeless. The site will have 12 spaces of parking, access aisle, sidewalk, outdoor sitting spaces and landscaped areas. The proposed building, pavement and sidewalk areas will increase the impervious area from 1,206 SF to 20,659 SF.

Stormwater Management – Basic Standards:

Erosion and sedimentation control measures are detailed within the design plans. Good housekeeping practices will be in accordance with Maine DEP Best Management Practices. A post construction stormwater management plan is provided in *Appendix A*. Stormwater BMP inspection and maintenance requirements are provided in *Appendix B*.

Stormwater Management – Quality (General Standards):

The existing site is currently a mix of grass and vegetated (wooded/scrub brush) upland areas and wetlands with a small area of impervious (1,206 SF). The site currently drains to the wetlands on site which is also the headwaters of the Capisic Brook, an impaired stream. The site's new impervious area is now 19,453 SF. For water quality treatment, the site design incorporates a paver drain system along the retaining wall and on the southeast side of the parking area and drive aisle. This will capture the sidewalk and parking area runoff, with only a small area exiting the site toward Bishop Street. The paver drain system is comprised of the pavers underlain by a layer of 3/8" stone, then a layer of 3/4" crushed stone and finally a layer of bio-filter media for filtration for the stormwater runoff. The paver drain system overlays an R-Tank system that will be used for detention during larger storm events. The roof will drain internal to the building and will be filtered through filter cartridges. The roof drains will then outlet into a separate set of R-Tanks for detention. Calculations have been included in Appendix C.

Stormwater Management – Quantity (Flooding Standards):

The use of the R-Tanks will detain the stormwater runoff to below pre-development conditions. The proposed detention system consists of a series of R-Tanks adjacent to the retaining wall and under the paver drains. These R-Tanks are then connected into a supplemental R-Tank system at the outlets of the roof leader and vegetated filter swale. The additional storage is required for site stormwater capacity reasons. The roof drains outlet at the south end of the building into a separate set of R-Tanks for detention. The parking lot R-Tanks and roof drain R-Tanks are connected with an equalizing pipe. Stormwater from the downstream roof drain R-Tanks will flow into an outlet control structure that will control the flow with orifices and a weir. The stormwater then discharges into the upland area at the southwest area of the developed site. During larger storm events there is a catch basin in the southern most area of the parking lot that will collect the additional stormwater and direct it into the R-Tank system for detention.

Hydraulic Analysis:

Stormwater runoff calculations for quantity were made using the HydroCAD 10.0 computer program, which is based on the Soil Conservation Service's TR-20 methodology. Runoff hydrographs are generated based on a standard Type III 24 hour storm.

Five storm events were modeled as follows:

1. 1" storm: The 1" storm event was analyzed to simulate a heavy weather event that would typically happen multiple times over a given year and may impact the CSO frequency and volume.

2. 2-year frequency flood event: 3" rainfall

3. 10-year frequency flood event: 4.7” rainfall

4. 25-year frequency flood event: 5.5” rainfall

5. 100-year frequency flood event: 6.7” rainfall

Runoff Curve numbers were determined based on land coverage and hydro-geological soil type D. Times of concentration were developed based on runoff flow paths for each subarea and shown on the Pre and Post-Development plans. A minimum Tc of 6 minutes was set in the HydroCAD model.

Peak runoff flow rates and runoff volumes are provided at the analysis point, which is identified on the Pre and Post-Development plans.

Storm Event	PRE-Development Peak Runoff RATES cubic feet per second (CFS)
	Analysis Point A Upland
1” Storm	0.25
2 Year Frequency Storm	1.99
10 Year Frequency Storm	3.65
25 Year Frequency Storm	4.44
100 Year Frequency Storm	5.61

Storm Event	POST-Development Peak Runoff RATES cubic feet per second (CFS)
	Analysis Point A Upland
1” Storm	0.38
2 Year Frequency Storm	1.98
10 Year Frequency Storm	3.37
25 Year Frequency Storm	4.01
100 Year Frequency Storm	4.98

Storm Event	PRE-Development Runoff VOLUMES acre feet (AF) volume of water 1' deep over one acre Analysis Point A Upland
1" Storm	0.02
2 Year Frequency Storm	0.17
10 Year Frequency Storm	0.32
25 Year Frequency Storm	0.39
100 Year Frequency Storm	0.50

Storm Event	POST-Development Runoff VOLUMES acre feet (AF) volume of water 1' deep over one acre Analysis Point A Upland
1" Storm	0.02
2 Year Frequency Storm	0.123
10 Year Frequency Storm	0.259
25 Year Frequency Storm	0.307
100 Year Frequency Storm	0.414

Urban Impaired Stream Standard:

The project is located within the Capisic Brook watershed. Section 5 of the City of Portland's Technical Manual requires that all development within the Capisic Brook watershed (except single and two family homes) comply with the urban impaired stream standards. As such, an in-lieu compensation and mitigation credits have been determined. A compensation fee has been determined to be $1,927. Those calculations are included in *Appendix C.*

APPENDIX A

Post Construction Stormwater Compliance Requirements

City of Portland
72 Bishop Street
Portland, Maine

Ransom Consulting, Inc.
Project 141.06146

Bishop Street Post-Construction Stormwater Compliance Requirements

The Applicant shall maintain the BMPs in accordance with the approved plan and shall demonstrate compliance with the plan as follows:

(a) *Inspections.* The owner or operator of a BMP shall hire a qualified post-construction stormwater inspector to at least annually, inspect the BMPs, including but not limited to any parking areas, catch basins, drainage swales, detention basins and ponds, pipes and related structures, in accordance with all municipal and state inspection, cleaning and maintenance requirements of the approved post-construction stormwater management plan.

(b) *Maintenance and repair.* If the BMP requires maintenance, repair or replacement to function as intended by the approved post-construction stormwater management plan, the owner or operator of the BMP shall take corrective action(s) to address the deficiency or deficiencies as soon as possible after the deficiency is discovered and shall provide a record of the deficiency and corrective action(s) to the department of public services ("DPS") in the annual report.

(c) *Annual report.* The owner or operator of a BMP or a qualified post-construction stormwater inspector hired by that person, shall, on or by June 30 of each year, provide a completed and signed certification to DPS in a form provided by DPS, certifying that the person has inspected the BMP(s) and that they are adequately maintained and functioning as intended by the approved post-construction stormwater management plan, or that they require maintenance or repair, including the record of the deficiency and corrective action(s) taken.

(d) *Filing fee.* Any persons required to file and annual certification under this section shall include with the annual certification a filing fee established by DPS to pay the administrative and technical costs of review of the annual certification.

(e) *Right of entry.* In order to determine compliance with this article and with the post-construction stormwater management plan, DPS may enter upon property at reasonable hours with the consent of the owner, occupant or agent to inspect the BMPs.

APPENDIX B

Stormwater BMP Inspection and Maintenance Log

City of Portland
72 Bishop Street
Portland, Maine

Ransom Consulting, Inc.
Project 141.06146

Bishop Street: Stormwater BMP Inspection Log

The City of Portland, ME requires ongoing annual inspections to ensure the proper maintenance and operation of stormwater management facilities. Inspections must be conducted by third parties qualified by the City.

A. General Information

Use only one Cover Sheet per site with as many specific structural BMP Inspection Report attachments as needed. Attach required color digital photos of site, structures and devices as applicable with captions.

Project Name:	**Bishop Street**	**Inspection Date:**	
Parcel Map, Block and Lot:		**Current Weather:**	
BMP Owner:	**Avesta Housing**	**Date / Amount Last Precip:**	
Owner Mailing Address:	**307 Cumberland Avenue** **Portland, Maine**		
		3PI Mailing Address:	
Owner Phone #:			
Owner Email:		**Inspector Name:**	
		Inspector Phone #:	
		Inspector Email:	

B. Inspection Report Attachments

Please document the number of each structural BMP type found at this site in the blank spaces provided below. Use additional Attachments if / as needed and submit all Attachments together with the Cover Sheet as a single report.

BMP Type	Number BMPs at site
Vegetated Areas	-
Stormdrain Outlets	1
Stormdrain Structures: Overflow Control and Catch Basin	2
R-Tank Subsurface Detention-Infiltration System	1

Other (describe	

C. Inspection Results

FAIL** ☐

** If any one item on an Inspection Report attachment is coded as "Work Needed" then entire BMP fails inspection.

** If a site has multiple BMPs and one fails inspection, mark as "Fail" until all BMPs pass inspection.

Note: Applicable BMP Inspection Reports and confirmatory color digital photos summarizing required repairs must be submitted to the City following completion of the preliminary inspection. A re-inspection and certification must be completed within 60 days of the failed preliminary report. It is recommended that the inspector be part of the repair / maintenance process to ensure that repairs are performed properly.

PASS ☐

Note: a qualified professional (as determined by the City) must sign below and include all applicable Inspection Report attachments and confirmatory digital color photos with captions.

D. Professional Certification (as qualified by City of Portland Stormwater Program Coordinator)

To be completed only when all BMPs at this site are functioning as designed with no outstanding maintenance issues.

I, ________________________________, as a duly qualified third party inspector attest that a thorough inspection has been completed for ALL applicable BMPs that are associated with this particular site. All inspected structural BMPs are performing as designed and intended and are in compliance with the provisions of the City Portland’s Standards

Signature: ________________________________

Date: ________________________________

Form Adapted from the City of South Portland’s Annual Structural BMP Inspection Report Cover Sheet

Owner: Avesta Housing	**Operator:**
Location & Parcel Id:	**Inspector:**
	Date:
General Information	**Observations**
Inspection duration (hours)	
Days since last precipitation	
Quantity of last precipitation (in)	
Type of inspection	
Storm event	
Current weather	
Photos taken	☐ Yes ☐ No ☐ NA
Nearby natural resources	☐ Yes ☐ No ☐ NA
Copy of ESC plan	☐ Yes ☐ No ☐ NA
MEDEP Permit # (*if applicable*)	
General info notes	
Vegetated Areas	**Observations**
Condition of slopes and embankment is good	☐ Yes ☐ No ☐ NA
No bare areas (< 90% covered) with sparse growth	☐ Yes ☐ No ☐ NA
Armored areas have no rill erosion or the flow diverted to onsite areas can withstand concentrated flows	☐ Yes ☐ No ☐ NA
Vegetated area notes	
Stormdrain outlets	**Observations**
Accumulated sediments and debris at the outlet and within the conduit have been removed.	☐ Yes ☐ No ☐ NA
Erosion damage at the outlet have been repaired	☐ Yes ☐ No ☐ NA
Outlet notes	

Stormdrain Structures (Require inspection TWICE per year)	**Observations**
Accumulated sediments from inflow channels, pipes and sumps between basins have been removed and legally disposed of.	☐ Yes ☐ No ☐ NA
Floating debris and floating oils have been removed.	☐ Yes ☐ No ☐ NA
Debris and Sediment Removed From Outlet Control Structure	☐ Yes ☐ No ☐ NA

Other Comments	**Observations**
Corrective action needed	☐ Yes ☐ No ☐ NA
If corrective action in needed, please explain detail	
Verbal notification provided to responsible party	☐ Yes ☐ No
Verbal notification contact	
Follow up required	☐ Yes ☐ No
Final comment notes	

Photos (*use additional pages as needed*)

Review Notes
Date Reviewed: Reviewed by: Date entered: Date edited: Edited by:

APPENDIX C

Stormwater Quality Calculations

City of Portland
72 Bishop Street
Portland, Maine

Ransom Consulting, Inc.
Project 141.06146

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Byfield, Massachusetts 978-465-1822
Providence, Rhode Island 401-433-2160
Portsmouth, New Hampshire 603-436-1490
Portland, Maine 207-772-2891
Hamilton, New Jersey 609-584-0090

PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 1 OF
CALCULATED BY MPM DATE 4/9/15
CHECKED BY ~~190~~ 5/22/15 DATE Rev. 5/20/15
SCALE N/A

Objective: Determine water quality requirements

Developed Area: 28,407 sf.

Paved: 9,364 sf. 9669 + 471 (wall) = 10140

Sidewalk: 1308 + 105 = ~~1413~~ 2745 sf — 12885

Building: ~~7811 sf~~ 7774 sf — Treated w/ drip edge: 1432; Treated w/ Roof drains: 6342; ~~treated w/ landscape:~~

Total impervious = ~~18588 sf~~ 20659

Landscaped = 9819 sf (assume 75%)

See Revised Begin. pg 5

* volume of Quality treatment = 1" over impervious / 0.4" over landscaped

18588 ft² x 1"/12" = 1549 cf

9819 sf x 0.4"/12" = 327.3 cf

1876.3 cf treatment volume

Hydrocad / Water Quantity calcs.

Existing conditions: assume Scantic 'C' soils

Lot size: 52,383 sf
Roof = 826 sf
Gravel drive: 380 sf] 1206 sf

Grass (assume 50-75%) 5852 - 826 380 14646 ft²

Vegetated (woodland) 36531 ft²

assumed CN of 92

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Hamilton, New Jersey 609-584-0090

PROJECT NO. 141 06146 SITE Bishop St
SHEET NO. 2 OF
CALCULATED BY MPM DATE 5/20/15
CHECKED BY DATE
SCALE N/A

Objective: Redefine areas of Development

- Roof impervious: 7774 sf ± (new Roof plan)

Roof area to drip edge: 1123 sf

Roof area by roof drains: 7774 - 1123 = 6651 sf

- Paved impervious:

4x4 conc. pad	: 16 sf
patio/walk	: 2729 sf
Parking/drive	: 9669 sf
Wall	: 471 sf
	12885 sf

Total impervious: 20659 sf

Developed Area: 28,098 sf

∴ Landscaped area = 28,098 sf - 20659 sf = 7439 sf

Existing impervious = 826 sf + 380 sf = 1206 sf

∴ new impervious = 19453 sf

Impervious Area left untreated:
(driveway to street/ 752 sf +
walkway to street) 30 sf 782 sf

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PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 3 OF
CALCULATED BY MPM DATE 5/20/15
CHECKED BY DATE
SCALE N/A

% new impervious area being treated:

19453 sf − 782 sf = 18671 / 19453

= 96% > 95%

Removing the Roof impervious (treated by other means) the amount of impervious for treatment by swale & pavers = 18671 − 7774 = 10897 sf

Untreated Landscaped area:

785
+ 113
792
15
82
1787

% treated developed area

Developed Area − untreated area =

28098 − 782 (paved) − 1787 (unpaved) = 25529 / 28098

= 91% > 80%

Treatment by filtration swale:

Total area: 2762

Impervious: 157 + 306 + 16 = 479

∴ Landscaped: 2283 sf

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PROJECT NO. 141.06146 SITE Bishop St
SHEET NO. 4 OF
CALCULATED BY MPM DATE 5/20/15
CHECKED BY DATE
SCALE N/A

Grassed underdrain filter treatment Volume:

1" over impervious and 0.4" over landscaped

$479 sf \times 1''/12'' = 39.9 cf$

$\frac{2283 (0.4)}{12} = 76.1 cf$

116 cf

Filter Area: 5% of imperv. + 2% of landscaped

$0.05(479) + 0.02(2223) = 68.4 sf$

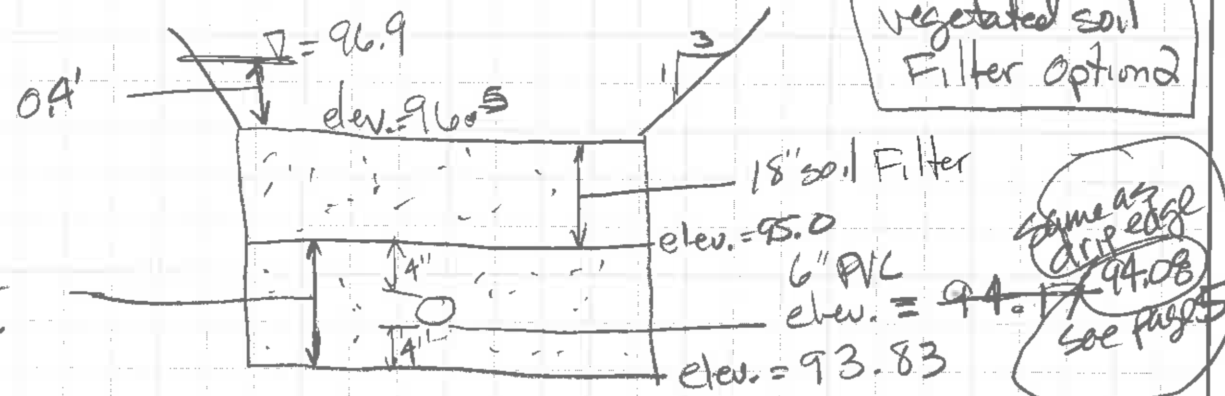
Filter @ elevation 96.5

Surface area (polylines in ACAD) =

41 + 252 = 293 sf × .4' water depth

= 118 cf Storage > 116 cf √ okay

Vegetated soil Filter Option 2



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PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 5 OF
CALCULATED BY MPM DATE 5/21/15
CHECKED BY DATE
SCALE N/A

- Roof Dripline BMP:

Roof being treated by dripedge = 1123 sf

Treatment volume = 1123 sf × 1"/12" = 93.58 cf

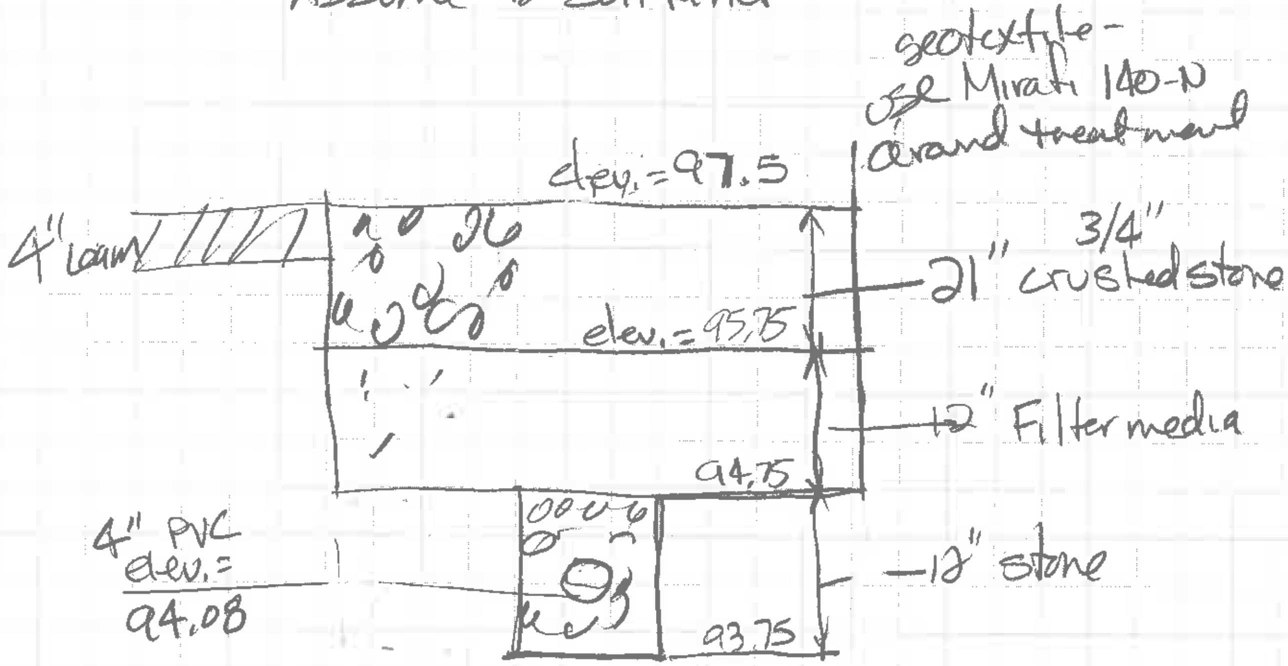
Assuming 40% voids required storage volume

= 93.58 / 0.4 = 234 cf

Surface area of Drip edge treatment = 139 sf

∴ 234 cf / 139 sf = 1.7' depth min. (21")

Assume 12" soil filter



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PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 6 OF
CALCULATED BY MPM DATE 5/21/15
CHECKED BY DATE
SCALE N/A

Vegetated underdrain soil filter @ building front

Landscaped area: 1324sf

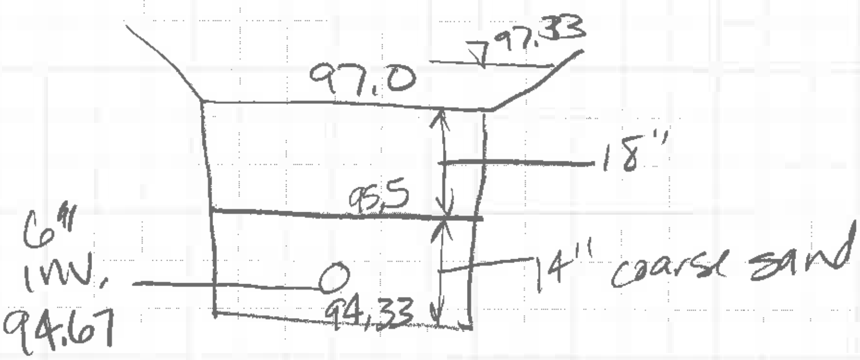
Treatment volume $= \frac{1324^{sf}(0.4')}{12''} = 44cf$

Filter area Req'd: 2% (1324sf) = 26.5sf

Filter area provided = 168sf

assume level of channel protection volume = 4inches = 0.33ft,

168sf x 0.33 = 56 cf > 44cf req'd



• Manmade Pervious Surfaces - based on April 2015 Revision to Section 7.7 (attached)

Impervious Area to be treated by Pavers

Total new impervious: 19453sf
- Imp. Untreated 7825sf
- treatment by Roof 7774sf = 10,418sf
- treatment by swale 479sf

Section 7.7
Manmade Pervious Surfaces

Revised April 2015

7.7.1 Description

A porous surface consists of the use of a permeable surface material and mineral base and subbase materials which allow penetration of runoff and into the underlying soils.
The efficiency of pavement alternative systems will depend on whether the surface is designed to store and infiltrate most runoff with the remainder discharged to a storm drainage system or over-land flow. The effectiveness of pervious alternatives will also depend on their long term maintenance and serviceability.

7.7.2 General Design Criteria

A typical permeable pavement alternative consists of a top porous structure that is providing structural strength and will allow the infiltration of runoff, a filter course, a reservoir course (with drainage if needed), a geotextile fabric and existing soil or subbase material. The following surface alternatives are example of pervious surfaces:
Porous Asphalt and Concrete: Porous asphalt is similar to conventional asphalt except that it contains very few particles smaller than coarse sand (less than # 30 sieve). Without these finer particles, water is able to infiltrate and into the subsurface.
Block pavers: Block paves are interlocking concrete blocks that leave void spaces between which water can infiltrate. The void spaces can be filled with gravel or soil and grass.
Plastic grid Pavers: These are often constructed from recycled material and come in a honeycomb pattern. The voids are filled with gravel or may be grassed.
Artificial ball fields (turf ballfields): These are also considered pervious surfaces that require similar design considerations. The synthetic nature of the turf may be a concern for the infiltration of chemical into the subsurface; however, no restriction will be applied until more data is available on this subject.

Any manmade pervious surface shall be subject to the General Standards of Chapter 500, Stormwater Management Rules and the DEP licensing staff must be consulted for permitting requirements. However, the use of this technology will provide needed level of treatment to meet the General Standards if designed as below.

7.7.3 Specific Design Criteria

Traffic Volumes: Pavement alternatives are limited to areas with light to moderate traffic. They are not recommended for most roadways, and cannot withstand heavy vehicles.
Grading: The site should slope with less than 5% and preferably closer to 1%.
Sediment loading: Pavement should not be used in areas expected to receive high levels of sediments as they are highly susceptible to clogging. Also alternative measures such as salt should be implemented over these areas in the winter.
Reservoir Course: The reservoir course should consist of clean washed 11/2-inch to 3-inch aggregate that is free of debris. The depth of the reservoir course shall be based on the desired storage volume and frost penetration.

7.7.3 Design Criteria for Infiltration

- All specifications from SW rules, Appendix D, Section 2 apply.
- At a minimum, one foot separation is needed below the road subbase and above the groundwater table. The depth of the water table elevation needs to be considered in designing the road for sufficient frost protection depth.
- A filter layer providing pretreatment before infiltration to groundwater needs to be included in the road design and can be part of the subbase and base. The media must be a mineral soil with between 4 and 7% fines (passing #200 sieve) and should be a minimum of 8 inches thick.
- To meet the General Standards requirements (1 inch infiltration), a minimum storage capacity within the filter layer or subbase and base is needed to allow the direct entry of one inch or more.
- To meet the Flooding Standards requirements, the road design needs to provide a minimum storage capacity for the direct entry of the rain precipitation from a 24-hour, 25-year storm (5 + inches).
- Infiltration rate should be confirmed with a double ring infiltrometer test to determine the soils ability to accept water. The test needs to be on native subgrade even if there is fill above it, and not on the fill itself. Recommended infiltration should be less than 2.41 inches per hour but great enough that the inch of stored precipitation infiltrates in 24 hours (i.e. >0.04 inches per hour).
- The stored volume needs to fully infiltrate within 24-48 hours
- Provide appropriate drainage and discharge of flows from larger storms where is needed.

7.7.4 Design Criteria for Storage and Filtration

- Appropriate specifications from SW rules, Appendix E and BMP design standards for an underdrained filter bed apply
- To meet the General Standards requirements (treatment of 1 inch of runoff), a minimum storage capacity within the filter layer or subbase and base is needed to allow the treatment of one inch or more.
- To meet the Flooding Standards requirements, the road design needs to provide a minimum storage capacity for the direct entry of the rain precipitation from a 24-hour, 25-year storm (5 + inches).
- The filter bed may be part of the road base and subbase horizon. The filter media must be a mineral soil with between 4 and 7% fines (passing #200 sieve) and must be a minimum of 4 inches thick.
- An underdrained bed consisting of a minimum of 12 inches of underdrain gravel meeting the MDOT Specification 703.22, Type B should be a minimum of 12 inches to provide sufficient coverage for the underdrain piping.
- An underdrain pipe network is needed to drain adequately the underdrain bed. Pipes should be placed perpendicular to the slope and should be spaced no further apart than 20 feet. An orifice may be needed to control the outflow.
- Stored volume needs to fully drain within 24-48 hours.
- Provide appropriate drainage and discharge of flows from larger storms where is needed.

7.7.5 Modular Pervious Pavement

In addition to the design guidelines from above, an area of modular pervious pavement structure may be used to provide the treatment of impervious pavement where the area of pervious pavement is 20% of the impervious area that drains to it, if the thickness of the filter sand layer is equivalently increased and meet the following sizing criteria:

- The flow path over the impervious area should not exceed 50 feet before reaching the pervious pavement section for treatment.
- The thickness of the filter layer should be increased exponentially from 4 inches for a full (100%) pervious pavement section with no run-on from other areas to 18 inches for a pervious section and treatment system that is no less than 20% of the impervious area draining into it.
- Long-term inspection and maintenance by a DEP approved stormwater maintenance inspector will be regularly provided under a five-year binding inspection and maintenance contract that is renewed before contract expiration.
- The replacement of the modular pervious system will be provided when more than 40% of the pervious system shows signs of clogging.

Pervious surfaces and pavement, whether asphalt, concrete or paving stones, have the potential to become impervious if not properly maintained. The following need to be planned for and be met:

- Design pervious pavement structures to prevent erosion from surrounding areas from reaching the pavement and sediment deposition.
- Restrain vehicles with muddy wheels from accessing pervious pavement areas.
- Limit salt use for deicing and do not use sand.
- Remove leaves and organic debris in the fall.
- Sweep, vacuum and/or pressure wash pavement **twice** annually at a minimum.

7.7.6 Maintenance Criteria

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PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 10 OF
CALCULATED BY MPM DATE 5/21/15
CHECKED BY DATE
SCALE N/A

Landscaped Area to be Treated by Pavers

Total = 7439 sf
- untreated: 1787 sf
- treated by swale: 2283
- treated by front filter: 1324

0.4"/1"

= 2045 sf Remaining x (0.4)

= 818 sf

Total area to be treated by pavers

10,418 + 818 = 11,236 sf x 0.2

= 2247 sf of pavers Req'd.

Pavers are 1' x 1' and will be placed over R-Tanks

R Tanks: 15.75" W x 28.15" L height varies
(1.31) x (2.35)

Paver Area provided = 2280 sf > 2247 sf

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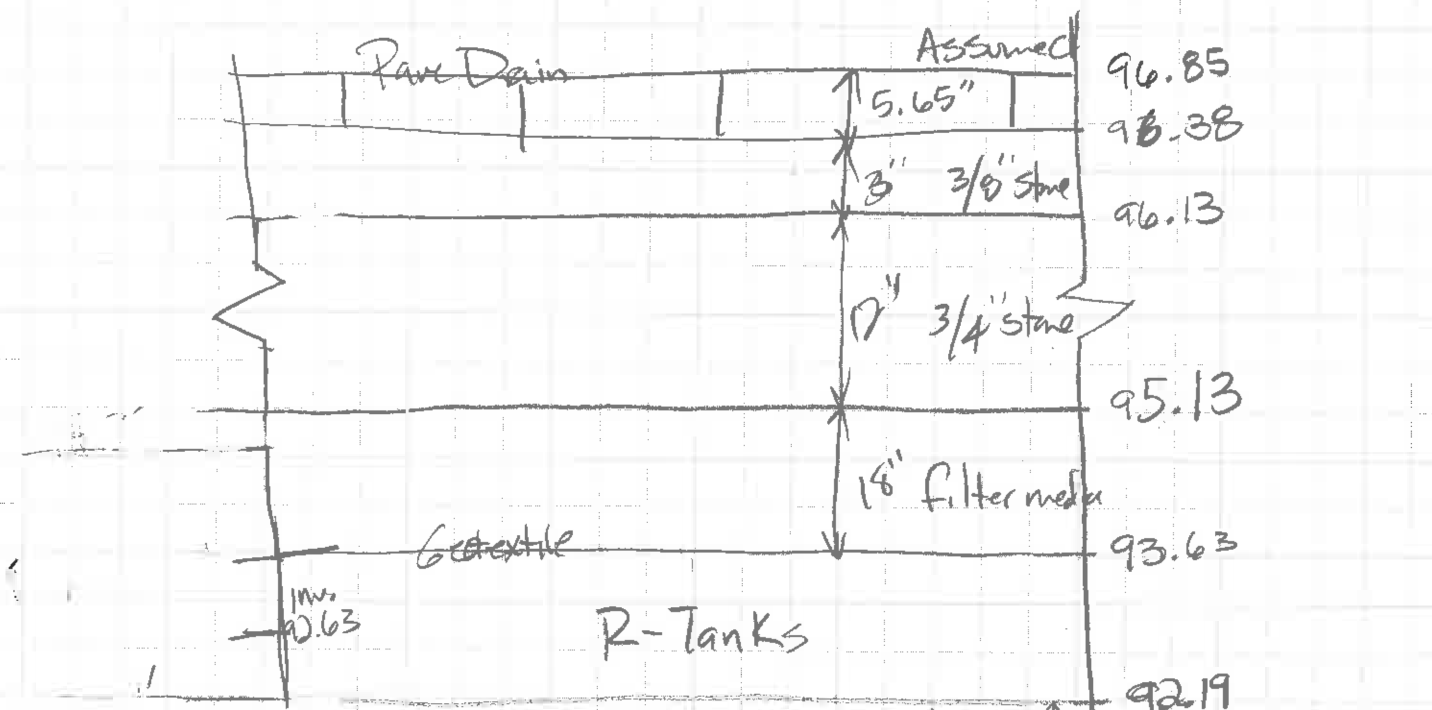
PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 11 OF
CALCULATED BY MPM DATE 4/10/15
CHECKED BY DATE
SCALE N/A



4 x 54 R-Tanks under media (singles)

weir = 94.3

4" = 93.8

4" = 93.3

(2) 4" = 92.8

R-Tanks - single (1)

4 x 106 = 424

+ 5 x 53 = 265

689

5.25 x 246.1

6.55 x 148

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PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 12 OF
CALCULATED BY MPM DATE 5/21/15
CHECKED BY DATE
SCALE N/A

HydroCAD Inputs

Subcatchment No. 1 - Areas Draining to Pervious Pavers

Total Area: 15022

Impervious (add in untreated) : 19453 - 7774 - 479 = 11,200

Landscaped (add in untreated) : 3822 + 1324 from front = 5146

Tc assumed 6 min.

Subcatchment No. 2 - Roof & swale

Roof impervious : 7774

Swale: Impervious = 479
Landscaped = 2283

Total impervious 8253
" Landscaped 2283
10536

Subcatchment No. 3:

52383 - 28092 = 24291 sf

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Hamilton, New Jersey 609-584-0090

PROJECT NO. 141.06146 SITE Bishop St.
SHEET NO. 13 OF
CALCULATED BY MPM DATE 5/14/15
CHECKED BY DATE
SCALE

Objective: Determine compensation fees or mitigation credits required

Non Impervious Roof Area: Assumes pre-existing area exempt.

Paved: 12885 sf − 380sf (existing Gravel)

= 12505 sf / 43560 sf/Ac = 0.29 AC

compensation: $5000 x 0.29 = $ 1435

Mitigation: 0.5 credits x 0.29 = 0.15 credits

Roof area: 7774 sf − 826 (existing roof) = 6948 sf

6948 sf / 43560 sf/Ac = 0.16 AC

Compensation: $2000 x 0.16 = $ 321

Mitigation: 0.2 credits x 0.16 = 0.03 credits

Landscaping: New developed area − 7439 sf / 43560 sf/Ac = 0.17 Ac

Compensation: $1000 x 0.17 = $ 171

Mitigation: 0.1 credits x 0.17 = 0.02 credits

Total compensation: $1927
Mitigation: 0.2 credits

APPENDIX D

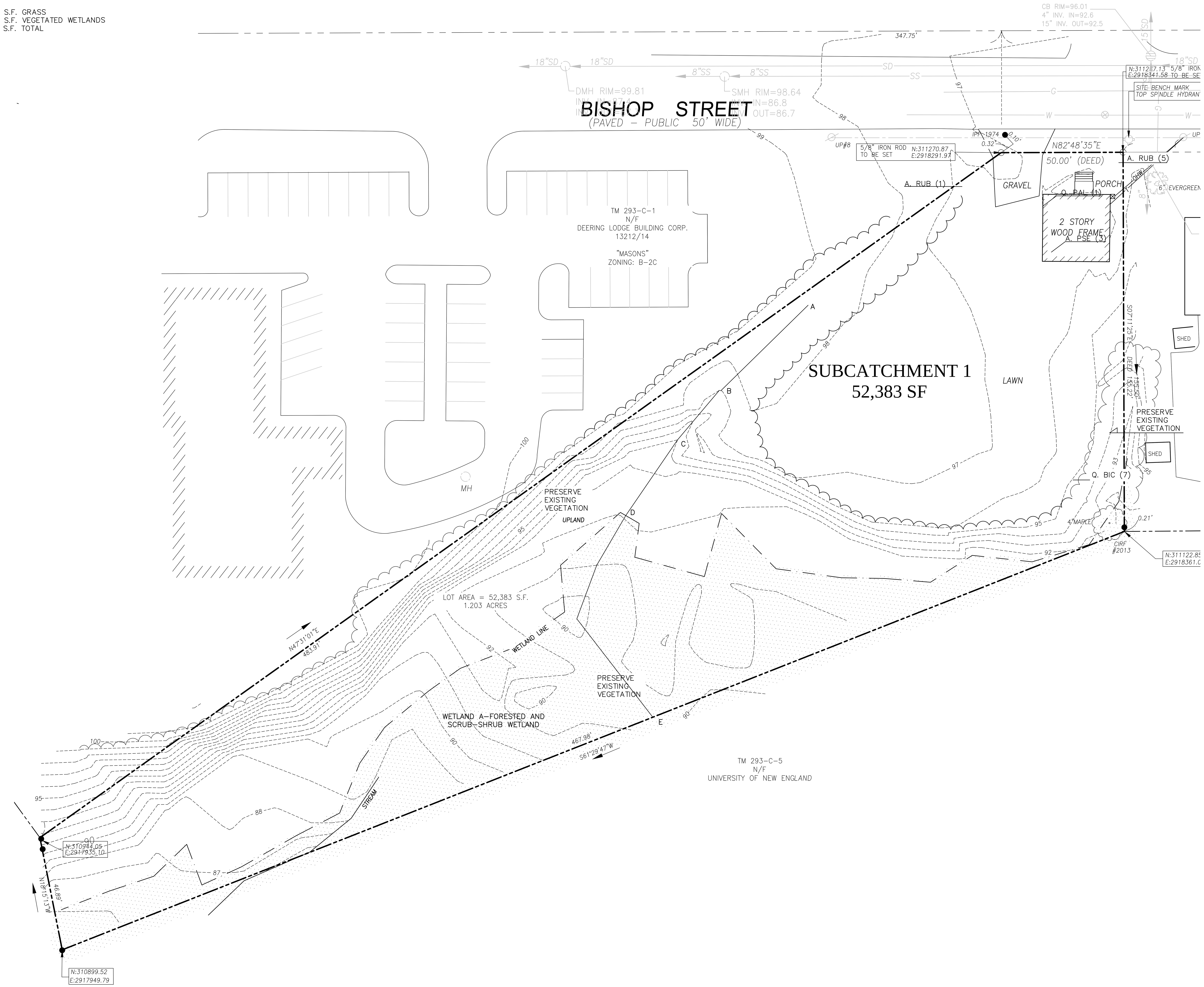
Pre-Development Stormwater Calculations

City of Portland
72 Bishop Street
Portland, Maine

Ransom Consulting, Inc.
Project 141.06146

GENERAL NOTES:

1. SITE AREA: 52,383 SF OR 1.20 ACRES
2. IMPERVIOUS AREA: 826 S.F. BUILDING
   380 S.F. GRAVEL DRIVE
   1,206 S.F. TOTAL
3. LANDSCAPED AREA: 14,646 S.F. GRASS
   36,531 S.F. VEGETATED WETLANDS
   51,177 S.F. TOTAL



STATE OF MAINE
STEPHEN J. BRADSTREET
#5740
LICENSED
PROFESSIONAL ENGINEER

RANSOM
Consulting Engineers and Scientists

Prepared For:

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Tel.: 207-553-7777

Prepared By:
MITCHELL & ASSOCIATES
Landscape Architects
The Staples School
70 Center Street
Portland, Maine 04101
Tel.: 207-774-4427

72 BISHOP STREET

Portland, Maine

Bishop Street

Date:
April 10, 2015

Issued For:
Site Plan and Subdivision Plan Review

Revisions:

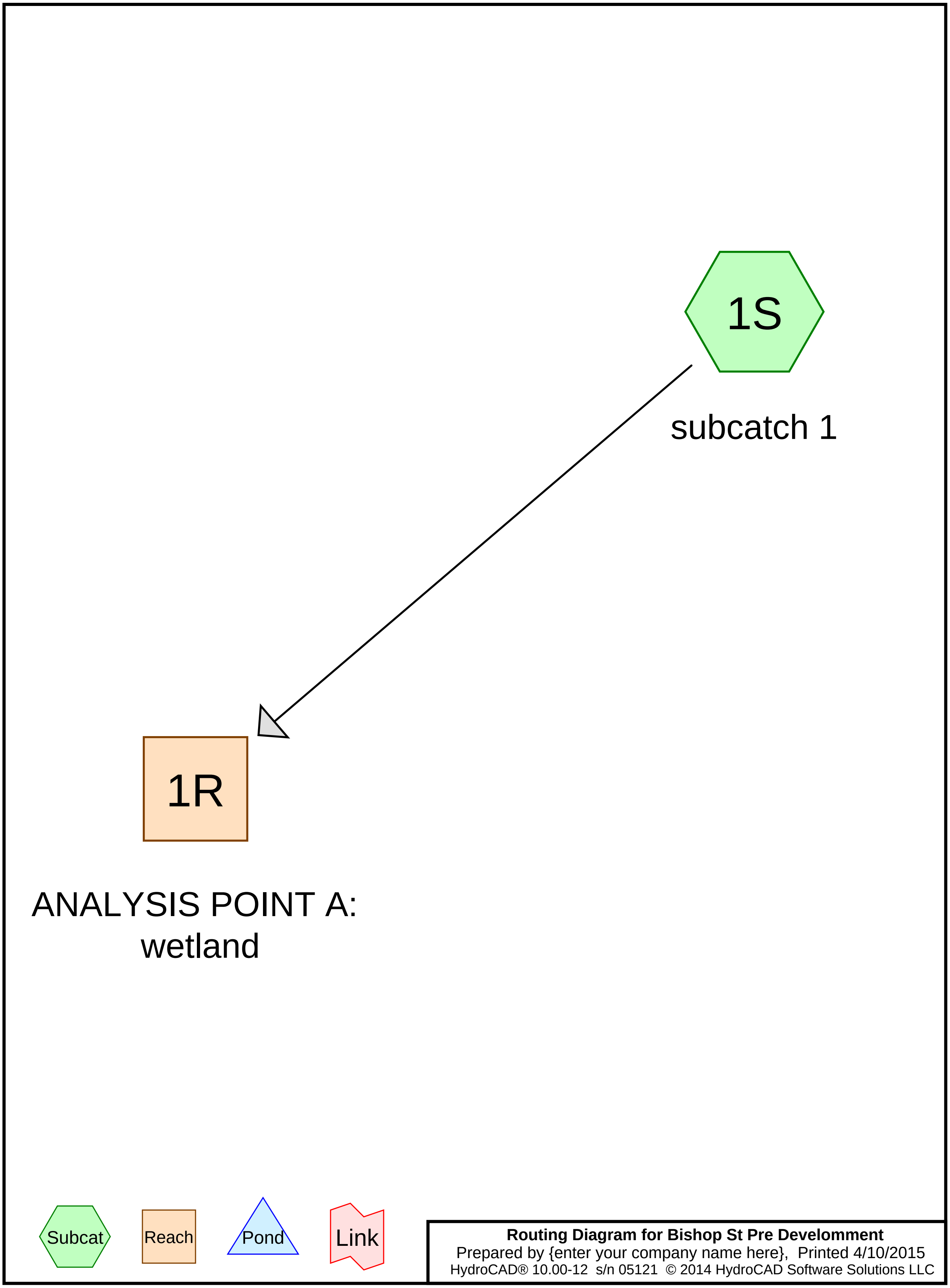
Title:
PRE-DEVELOPMENT STORMWATER PLAN

Scale: 1"= 20'

0 10 20 40 ft.

North:

Sheet No.:
SW 1



Routing Diagram for Bishop St Pre Develomment
Prepared by {enter your company name here}, Printed 4/10/2015

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.336	79	50-75% Grass cover, Fair, HSG C (1S)
0.009	96	Gravel surface, HSG C (1S)
0.019	98	Paved parking & roofs (1S)
0.839	92	wooded wetlands area (1S)
1.203	**88**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.345	HSG C	1S
0.000	HSG D	
0.858	Other	1S
1.203		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.336	0.000	0.000	0.336	50-75% Grass cover, Fair	1S
0.000	0.000	0.009	0.000	0.000	0.009	Gravel surface	1S
0.000	0.000	0.000	0.000	0.019	0.019	Paved parking & roofs	1S
0.000	0.000	0.000	0.000	0.839	0.839	wooded wetlands area	1S
0.000	**0.000**	**0.345**	**0.000**	**0.858**	**1.203**	**TOTAL AREA**	

Time span=2.00-20.00 hrs, dt=0.01 hrs, 1801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: subcatch1 Runoff Area=52,383 sf 1.58% Impervious Runoff Depth>0.23"
Flow Length=213' Tc=14.0 min CN=88 Runoff=0.24 cfs 0.023 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=0.24 cfs 0.023 af
Outflow=0.24 cfs 0.023 af

Total Runoff Area = 1.203 ac Runoff Volume = 0.023 af Average Runoff Depth = 0.23"
98.42% Pervious = 1.184 ac 1.58% Impervious = 0.019 ac

Summary for Subcatchment 1S: subcatch 1

Runoff = 0.24 cfs @ 12.21 hrs, Volume= 0.023 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-inch Rainfall=1.00"

	Area (sf)	CN	Description
	826	98	Paved parking & roofs
	380	96	Gravel surface, HSG C
	14,646	79	50-75% Grass cover, Fair, HSG C
*	36,531	92	wooded wetlands area
	52,383	88	Weighted Average
	51,557		98.42% Pervious Area
	826		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.00"
0.3	27	0.1110	1.67		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	38	0.0530	1.15		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.3	98	0.0200	0.71		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
14.0	213	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.203 ac, 1.58% Impervious, Inflow Depth > 0.23" for 1-inch event
Inflow = 0.24 cfs @ 12.21 hrs, Volume= 0.023 af
Outflow = 0.24 cfs @ 12.21 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs / 3

Time span=2.00-20.00 hrs, dt=0.01 hrs, 1801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: subcatch1 Runoff Area=52,383 sf 1.58% Impervious Runoff Depth>1.70"
Flow Length=213' Tc=14.0 min CN=88 Runoff=1.99 cfs 0.170 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=1.99 cfs 0.170 af
Outflow=1.99 cfs 0.170 af

Total Runoff Area = 1.203 ac Runoff Volume = 0.170 af Average Runoff Depth = 1.70"
98.42% Pervious = 1.184 ac 1.58% Impervious = 0.019 ac

Summary for Subcatchment 1S: subcatch 1

Runoff = 1.99 cfs @ 12.19 hrs, Volume= 0.170 af, Depth> 1.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
	826	98	Paved parking & roofs
	380	96	Gravel surface, HSG C
	14,646	79	50-75% Grass cover, Fair, HSG C
*	36,531	92	wooded wetlands area
	52,383	88	Weighted Average
	51,557		98.42% Pervious Area
	826		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.00"
0.3	27	0.1110	1.67		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	38	0.0530	1.15		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.3	98	0.0200	0.71		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
14.0	213	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.203 ac, 1.58% Impervious, Inflow Depth > 1.70" for 2-Year event
Inflow = 1.99 cfs @ 12.19 hrs, Volume= 0.170 af
Outflow = 1.99 cfs @ 12.19 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs / 3

Time span=2.00-20.00 hrs, dt=0.01 hrs, 1801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: subcatch1 Runoff Area=52,383 sf 1.58% Impervious Runoff Depth>3.18"
Flow Length=213' Tc=14.0 min CN=88 Runoff=3.65 cfs 0.319 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=3.65 cfs 0.319 af
Outflow=3.65 cfs 0.319 af

Total Runoff Area = 1.203 ac Runoff Volume = 0.319 af Average Runoff Depth = 3.18"
98.42% Pervious = 1.184 ac 1.58% Impervious = 0.019 ac

Summary for Subcatchment 1S: subcatch 1

Runoff = 3.65 cfs @ 12.18 hrs, Volume= 0.319 af, Depth> 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

	Area (sf)	CN	Description
	826	98	Paved parking & roofs
	380	96	Gravel surface, HSG C
	14,646	79	50-75% Grass cover, Fair, HSG C
*	36,531	92	wooded wetlands area
	52,383	88	Weighted Average
	51,557		98.42% Pervious Area
	826		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.00"
0.3	27	0.1110	1.67		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	38	0.0530	1.15		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.3	98	0.0200	0.71		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
14.0	213	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.203 ac, 1.58% Impervious, Inflow Depth > 3.18" for 10-Year event
Inflow = 3.65 cfs @ 12.18 hrs, Volume= 0.319 af
Outflow = 3.65 cfs @ 12.18 hrs, Volume= 0.319 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs / 3

Time span=2.00-20.00 hrs, dt=0.01 hrs, 1801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: subcatch1 Runoff Area=52,383 sf 1.58% Impervious Runoff Depth>3.91"
Flow Length=213' Tc=14.0 min CN=88 Runoff=4.44 cfs 0.391 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=4.44 cfs 0.391 af
Outflow=4.44 cfs 0.391 af

Total Runoff Area = 1.203 ac Runoff Volume = 0.391 af Average Runoff Depth = 3.91"
98.42% Pervious = 1.184 ac 1.58% Impervious = 0.019 ac

Summary for Subcatchment 1S: subcatch 1

Runoff = 4.44 cfs @ 12.18 hrs, Volume= 0.391 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
	826	98	Paved parking & roofs
	380	96	Gravel surface, HSG C
	14,646	79	50-75% Grass cover, Fair, HSG C
*	36,531	92	wooded wetlands area
	52,383	88	Weighted Average
	51,557		98.42% Pervious Area
	826		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.00"
0.3	27	0.1110	1.67		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	38	0.0530	1.15		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.3	98	0.0200	0.71		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
14.0	213	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.203 ac, 1.58% Impervious, Inflow Depth > 3.91" for 25-Year event
Inflow = 4.44 cfs @ 12.18 hrs, Volume= 0.391 af
Outflow = 4.44 cfs @ 12.18 hrs, Volume= 0.391 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs / 3

Time span=2.00-20.00 hrs, dt=0.01 hrs, 1801 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: subcatch1 Runoff Area=52,383 sf 1.58% Impervious Runoff Depth>5.01"
Flow Length=213' Tc=14.0 min CN=88 Runoff=5.61 cfs 0.502 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=5.61 cfs 0.502 af
Outflow=5.61 cfs 0.502 af

Total Runoff Area = 1.203 ac Runoff Volume = 0.502 af Average Runoff Depth = 5.01"
98.42% Pervious = 1.184 ac 1.58% Impervious = 0.019 ac

Summary for Subcatchment 1S: subcatch 1

Runoff = 5.61 cfs @ 12.18 hrs, Volume= 0.502 af, Depth> 5.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.70"

	Area (sf)	CN	Description
	826	98	Paved parking & roofs
	380	96	Gravel surface, HSG C
	14,646	79	50-75% Grass cover, Fair, HSG C
*	36,531	92	wooded wetlands area
	52,383	88	Weighted Average
	51,557		98.42% Pervious Area
	826		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.00"
0.3	27	0.1110	1.67		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	38	0.0530	1.15		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.3	98	0.0200	0.71		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
14.0	213	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.203 ac, 1.58% Impervious, Inflow Depth > 5.01" for 100-Year event
Inflow = 5.61 cfs @ 12.18 hrs, Volume= 0.502 af
Outflow = 5.61 cfs @ 12.18 hrs, Volume= 0.502 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 2.00-20.00 hrs, dt= 0.01 hrs / 3

APPENDIX E

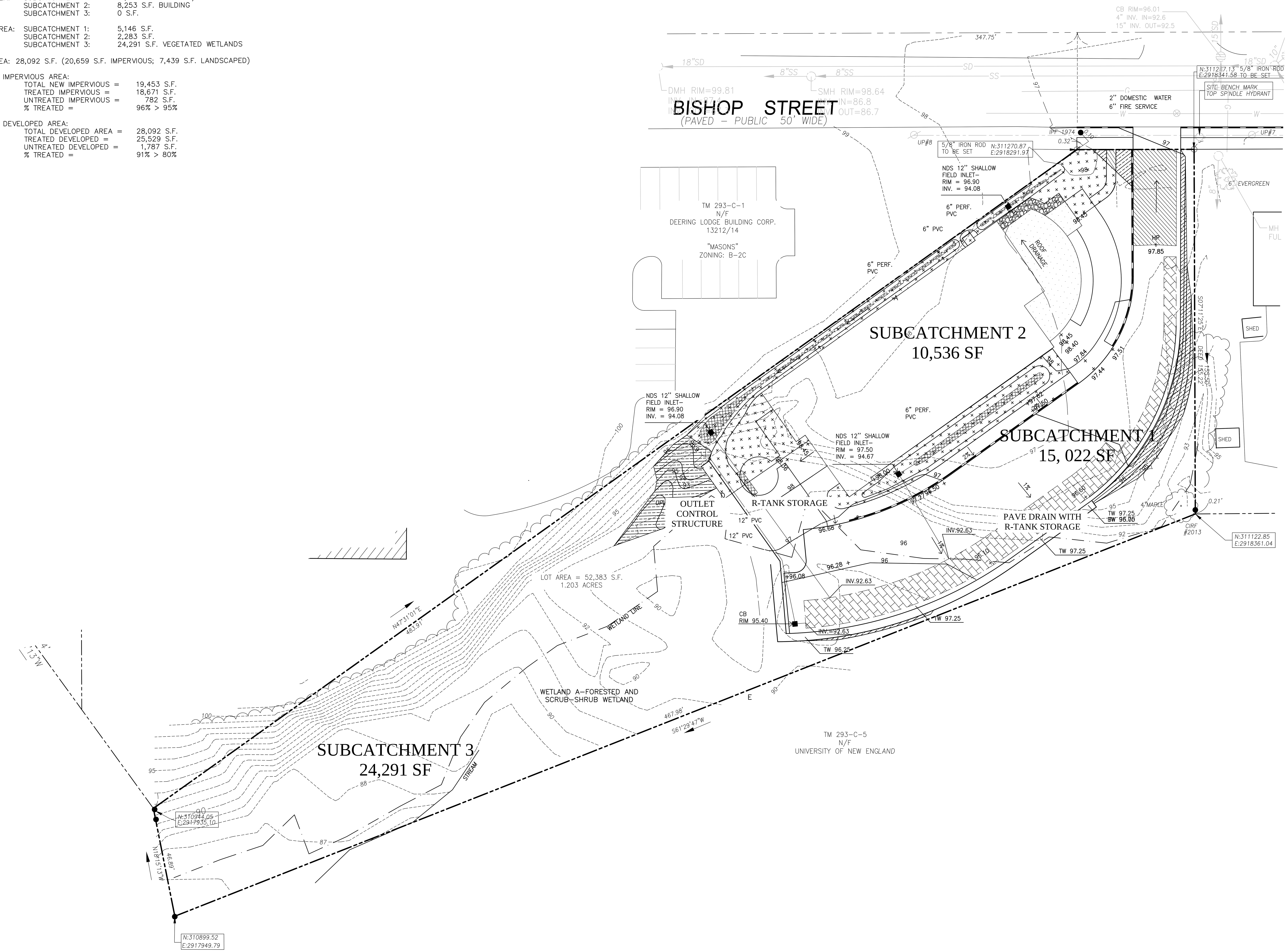
Post-Development Stormwater Calculations

City of Portland
72 Bishop Street
Portland, Maine

Ransom Consulting, Inc.
Project 141.06146

GENERAL NOTES:

1. SITE AREA: 52,383 SF OR 1.20 ACRES
2. IMPERVIOUS AREA:
   - SUBCATCHMENT 1: 11,200 S.F. PARKING/SIDEWALK
   - SUBCATCHMENT 2: 8,253 S.F. BUILDING
   - SUBCATCHMENT 3: 0 S.F.
3. LANDSCAPED AREA:
   - SUBCATCHMENT 1: 5,146 S.F.
   - SUBCATCHMENT 2: 2,283 S.F.
   - SUBCATCHMENT 3: 24,291 S.F. VEGETATED WETLANDS
4. DEVELOPED AREA: 28,092 S.F. (20,659 S.F. IMPERVIOUS; 7,439 S.F. LANDSCAPED)
5. TREATMENT OF IMPERVIOUS AREA:
   - TOTAL NEW IMPERVIOUS = 19,453 S.F.
   - TREATED IMPERVIOUS = 18,671 S.F.
   - UNTREATED IMPERVIOUS = 782 S.F.
   - % TREATED = 96% > 95%
6. TREATMENT OF DEVELOPED AREA:
   - TOTAL DEVELOPED AREA = 28,092 S.F.
   - TREATED DEVELOPED = 25,529 S.F.
   - UNTREATED DEVELOPED = 1,787 S.F.
   - % TREATED = 91% > 80%



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STATE OF MAINE — STEPHEN J. BRADSTREET #5740 — LICENSED — PROFESSIONAL ENGINEER

RANSOM Consulting Engineers and Scientists

72 BISHOP STREET

Portland, Maine

Bishop Street

Date: April 10, 2015

Issued For: Site Plan and Subdivision Plan Review

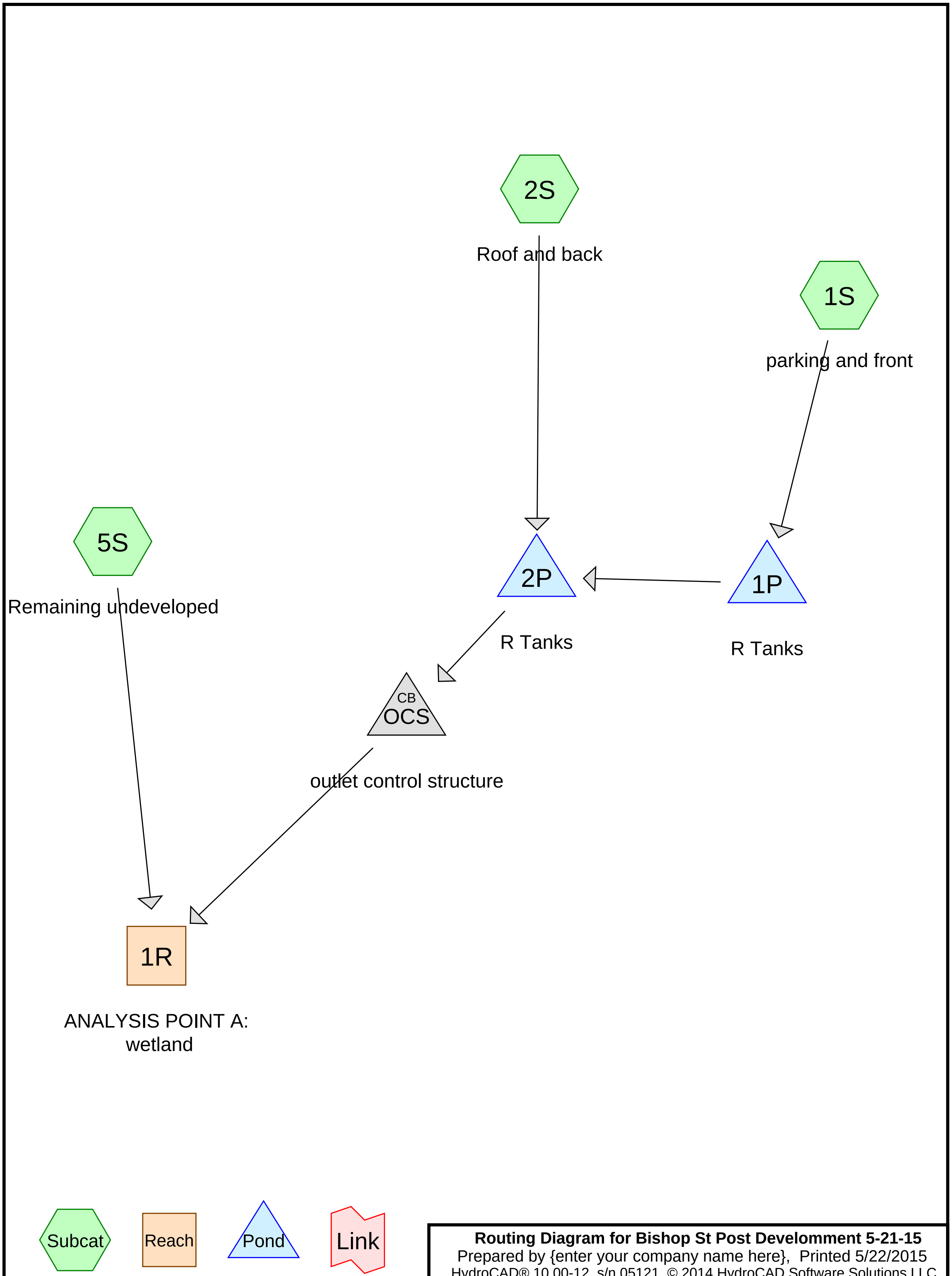
Revisions:

Title: POST DEVELOPMENT STORMWATER PLAN

Scale: 1"= 20'

North:

Sheet No.: SW 2



Routing Diagram for Bishop St Post Develomment 5-21-15
Prepared by {enter your company name here}, Printed 5/22/2015
HydroCAD® 10.00-12 s/n 05121 © 2014 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.171	74	>75% Grass cover, Good, HSG C (1S, 2S)
0.257	98	Paved parking & roofs (1S)
0.189	98	Unconnected roofs, HSG C (2S)
0.558	92	wooded wetland (5S)
1.175	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.360	HSG C	1S, 2S
0.000	HSG D	
0.815	Other	1S, 5S
1.175		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.171	0.000	0.000	0.171	>75% Grass cover, Good	1S, 2S
0.000	0.000	0.000	0.000	0.257	0.257	Paved parking & roofs	1S
0.000	0.000	0.189	0.000	0.000	0.189	Unconnected roofs	2S
0.000	0.000	0.000	0.000	0.558	0.558	wooded wetland	5S
0.000	**0.000**	**0.360**	**0.000**	**0.815**	**1.175**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	92.63	92.63	80.0	0.0000	0.013	12.0	0.0	0.0
2	2P	92.63	92.63	20.0	0.0000	0.013	12.0	0.0	0.0

Time span=3.00-15.00 hrs, dt=0.01 hrs, 1201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: parking and front Runoff Area=16,346 sf 68.52% Impervious Runoff Depth>0.23"
Tc=6.0 min CN=90 Runoff=0.13 cfs 0.007 af

Subcatchment2S: Roof and back Runoff Area=10,536 sf 78.33% Impervious Runoff Depth>0.34"
Tc=6.0 min CN=93 Runoff=0.13 cfs 0.007 af

Subcatchment5S: Remaining undeveloped Runoff Area=24,285 sf 0.00% Impervious Runoff Depth>0.30"
Flow Length=90' Slope=0.0300 '/' Tc=6.5 min CN=92 Runoff=0.25 cfs 0.014 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=0.38 cfs 0.020 af
Outflow=0.38 cfs 0.020 af

Pond 1P: R Tanks Peak Elev=92.21' Storage=309 cf Inflow=0.13 cfs 0.007 af
12.0" Round Culvert n=0.013 L=80.0' S=0.0000 '/' Outflow=0.00 cfs 0.000 af

Pond 2P: R Tanks Peak Elev=92.90' Storage=52 cf Inflow=0.13 cfs 0.007 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0000 '/' Outflow=0.12 cfs 0.006 af

Pond OCS: outlet control structure Peak Elev=92.97' Inflow=0.12 cfs 0.006 af
Outflow=0.12 cfs 0.006 af

Total Runoff Area = 1.175 ac Runoff Volume = 0.028 af Average Runoff Depth = 0.28"
61.98% Pervious = 0.728 ac 38.02% Impervious = 0.447 ac

Summary for Subcatchment 1S: parking and front

Runoff = 0.13 cfs @ 12.10 hrs, Volume= 0.007 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
11,200	98	Paved parking & roofs
5,146	74	>75% Grass cover, Good, HSG C
16,346	90	Weighted Average
5,146		31.48% Pervious Area
11,200		68.52% Impervious Area

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

Summary for Subcatchment 2S: Roof and back

Runoff = 0.13 cfs @ 12.09 hrs, Volume= 0.007 af, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
8,253	98	Unconnected roofs, HSG C
2,283	74	>75% Grass cover, Good, HSG C
10,536	93	Weighted Average
2,283		21.67% Pervious Area
8,253		78.33% Impervious Area
8,253		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 5S: Remaining undeveloped

Runoff = 0.25 cfs @ 12.10 hrs, Volume= 0.014 af, Depth> 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-inch Rainfall=1.00"

	Area (sf)	CN	Description
*	24,285	92	wooded wetland
	24,285		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	20	0.0300	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.3	70	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	90	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

Inflow Area = 1.175 ac, 38.02% Impervious, Inflow Depth > 0.20" for 1-inch event
Inflow = 0.38 cfs @ 12.10 hrs, Volume= 0.020 af
Outflow = 0.38 cfs @ 12.10 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: R Tanks

Inflow Area = 0.375 ac, 68.52% Impervious, Inflow Depth > 0.23" for 1-inch event
Inflow = 0.13 cfs @ 12.10 hrs, Volume= 0.007 af
Outflow = 0.00 cfs @ 3.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 3.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 92.21' @ 15.00 hrs Surf.Area= 2,703 sf Storage= 309 cf

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
#1A	91.94'	1,687 cf	**21.06'W x 128.33'L x 2.69'H Field A** 7,280 cf Overall - 3,062 cf Embedded = 4,218 cf x 40.0% Voids
#2A	92.19'	2,909 cf	**ACF R-Tank HD 1.0** x 689 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 13 Rows of 53 Chambers
		4,596 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 3.00 hrs HW=91.94' TW=91.94' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 2P: R Tanks

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 0.13" for 1-inch event
Inflow = 0.13 cfs @ 12.09 hrs, Volume= 0.007 af
Outflow = 0.12 cfs @ 12.11 hrs, Volume= 0.006 af, Atten= 2%, Lag= 1.0 min
Primary = 0.12 cfs @ 12.11 hrs, Volume= 0.006 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 92.90' @ 12.11 hrs Surf.Area= 104 sf Storage= 52 cf

Plug-Flow detention time= 31.2 min calculated for 0.006 af (84% of inflow)
Center-of-Mass det. time= 12.6 min (762.9 - 750.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	94 cf	**6.62'W x 15.73'L x 2.69'H Field A** 281 cf Overall - 44 cf Embedded = 236 cf x 40.0% Voids
#2A	92.19'	42 cf	**ACF R-Tank HD 1.0** x 10 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 2 Rows of 5 Chambers
		137 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=92.90' TW=92.97' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond OCS: outlet control structure

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 0.11" for 1-inch event
Inflow = 0.12 cfs @ 12.11 hrs, Volume= 0.006 af
Outflow = 0.12 cfs @ 12.11 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min
Primary = 0.12 cfs @ 12.11 hrs, Volume= 0.006 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 92.97' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	93.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	93.30'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	92.80'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=0.12 cfs @ 12.11 hrs HW=92.97' TW=0.00' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir**(Controls 0.00 cfs)
—**2=Orifice/Grate** (Controls 0.00 cfs)
└—**3=Orifice/Grate** (Orifice Controls 0.12 cfs @ 1.40 fps)

Time span=3.00-15.00 hrs, dt=0.01 hrs, 1201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: parking and front Runoff Area=16,346 sf 68.52% Impervious Runoff Depth>1.58"
Tc=6.0 min CN=90 Runoff=0.87 cfs 0.049 af

Subcatchment2S: Roof and back Runoff Area=10,536 sf 78.33% Impervious Runoff Depth>1.83"
Tc=6.0 min CN=93 Runoff=0.62 cfs 0.037 af

Subcatchment5S: Remaining undeveloped Runoff Area=24,285 sf 0.00% Impervious Runoff Depth>1.74"
Flow Length=90' Slope=0.0300 '/' Tc=6.5 min CN=92 Runoff=1.36 cfs 0.081 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=1.98 cfs 0.123 af
Outflow=1.98 cfs 0.123 af

Pond 1P: R Tanks Peak Elev=92.91' Storage=1,884 cf Inflow=0.87 cfs 0.049 af
12.0" Round Culvert n=0.013 L=80.0' S=0.0000 '/' Outflow=0.05 cfs 0.006 af

Pond 2P: R Tanks Peak Elev=93.41' Storage=82 cf Inflow=0.62 cfs 0.043 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0000 '/' Outflow=0.63 cfs 0.042 af

Pond OCS: outlet control structure Peak Elev=93.34' Inflow=0.63 cfs 0.042 af
Outflow=0.63 cfs 0.042 af

Total Runoff Area = 1.175 ac Runoff Volume = 0.167 af Average Runoff Depth = 1.71"
61.98% Pervious = 0.728 ac 38.02% Impervious = 0.447 ac

Summary for Subcatchment 1S: parking and front

Runoff = 0.87 cfs @ 12.09 hrs, Volume= 0.049 af, Depth> 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
	11,200	98	Paved parking & roofs
	5,146	74	>75% Grass cover, Good, HSG C
	16,346	90	Weighted Average
	5,146		31.48% Pervious Area
	11,200		68.52% Impervious Area

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

Summary for Subcatchment 2S: Roof and back

Runoff = 0.62 cfs @ 12.09 hrs, Volume= 0.037 af, Depth> 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
	8,253	98	Unconnected roofs, HSG C
	2,283	74	>75% Grass cover, Good, HSG C
	10,536	93	Weighted Average
	2,283		21.67% Pervious Area
	8,253		78.33% Impervious Area
	8,253		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 5S: Remaining undeveloped

Runoff = 1.36 cfs @ 12.09 hrs, Volume= 0.081 af, Depth> 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.00"

	Area (sf)	CN	Description
*	24,285	92	wooded wetland
	24,285		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	20	0.0300	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.3	70	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	90	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

Inflow Area = 1.175 ac, 38.02% Impervious, Inflow Depth > 1.26" for 2-Year event
Inflow = 1.98 cfs @ 12.09 hrs, Volume= 0.123 af
Outflow = 1.98 cfs @ 12.09 hrs, Volume= 0.123 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: R Tanks

Inflow Area = 0.375 ac, 68.52% Impervious, Inflow Depth > 1.58" for 2-Year event
Inflow = 0.87 cfs @ 12.09 hrs, Volume= 0.049 af
Outflow = 0.05 cfs @ 14.56 hrs, Volume= 0.006 af, Atten= 94%, Lag= 148.4 min
Primary = 0.05 cfs @ 14.56 hrs, Volume= 0.007 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 92.91' @ 14.22 hrs Surf.Area= 2,703 sf Storage= 1,884 cf

Plug-Flow detention time= 243.7 min calculated for 0.006 af (13% of inflow)
Center-of-Mass det. time= 118.6 min (850.6 - 732.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	1,687 cf	**21.06'W x 128.33'L x 2.69'H Field A** 7,280 cf Overall - 3,062 cf Embedded = 4,218 cf x 40.0% Voids
#2A	92.19'	2,909 cf	**ACF R-Tank HD 1.0** x 689 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 13 Rows of 53 Chambers
		4,596 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.08 cfs @ 14.56 hrs HW=92.91' TW=92.85' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.08 cfs @ 0.65 fps)

Summary for Pond 2P: R Tanks

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 0.84" for 2-Year event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.043 af
Outflow = 0.63 cfs @ 12.16 hrs, Volume= 0.042 af, Atten= 0%, Lag= 4.5 min
Primary = 0.63 cfs @ 12.16 hrs, Volume= 0.042 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.41' @ 12.09 hrs Surf.Area= 104 sf Storage= 82 cf

Plug-Flow detention time= 12.0 min calculated for 0.042 af (97% of inflow)
Center-of-Mass det. time= 8.0 min (748.9 - 741.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	94 cf	**6.62'W x 15.73'L x 2.69'H Field A** 281 cf Overall - 44 cf Embedded = 236 cf x 40.0% Voids
#2A	92.19'	42 cf	**ACF R-Tank HD 1.0** x 10 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 2 Rows of 5 Chambers
		137 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.16 hrs HW=93.27' TW=93.34' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond OCS: outlet control structure

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 0.82" for 2-Year event
Inflow = 0.63 cfs @ 12.16 hrs, Volume= 0.042 af
Outflow = 0.63 cfs @ 12.16 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min
Primary = 0.63 cfs @ 12.16 hrs, Volume= 0.042 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.34' @ 12.16 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	93.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	93.30'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	92.80'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=0.63 cfs @ 12.16 hrs HW=93.34' TW=0.00' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir**(Weir Controls 0.11 cfs @ 0.66 fps)
—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.69 fps)
—**3=Orifice/Grate** (Orifice Controls 0.51 cfs @ 2.95 fps)

Time span=3.00-15.00 hrs, dt=0.01 hrs, 1201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: parking and front Runoff Area=16,346 sf 68.52% Impervious Runoff Depth>2.92"
Tc=6.0 min CN=90 Runoff=1.53 cfs 0.091 af

Subcatchment2S: Roof and back Runoff Area=10,536 sf 78.33% Impervious Runoff Depth>3.22"
Tc=6.0 min CN=93 Runoff=1.04 cfs 0.065 af

Subcatchment5S: Remaining undeveloped Runoff Area=24,285 sf 0.00% Impervious Runoff Depth>3.12"
Flow Length=90' Slope=0.0300 '/' Tc=6.5 min CN=92 Runoff=2.32 cfs 0.145 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=3.37 cfs 0.259 af
Outflow=3.37 cfs 0.259 af

Pond 1P: R Tanks Peak Elev=93.38' Storage=2,951 cf Inflow=1.53 cfs 0.091 af
12.0" Round Culvert n=0.013 L=80.0' S=0.0000 '/' Outflow=0.60 cfs 0.034 af

Pond 2P: R Tanks Peak Elev=93.54' Storage=90 cf Inflow=1.04 cfs 0.116 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0000 '/' Outflow=1.04 cfs 0.114 af

Pond OCS: outlet control structure Peak Elev=93.41' Inflow=1.04 cfs 0.114 af
Outflow=1.04 cfs 0.114 af

Total Runoff Area = 1.175 ac Runoff Volume = 0.301 af Average Runoff Depth = 3.07"
61.98% Pervious = 0.728 ac 38.02% Impervious = 0.447 ac

Summary for Subcatchment 1S: parking and front

Runoff = 1.53 cfs @ 12.09 hrs, Volume= 0.091 af, Depth> 2.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
11,200	98	Paved parking & roofs
5,146	74	>75% Grass cover, Good, HSG C
16,346	90	Weighted Average
5,146		31.48% Pervious Area
11,200		68.52% Impervious Area

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

Summary for Subcatchment 2S: Roof and back

Runoff = 1.04 cfs @ 12.08 hrs, Volume= 0.065 af, Depth> 3.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
8,253	98	Unconnected roofs, HSG C
2,283	74	>75% Grass cover, Good, HSG C
10,536	93	Weighted Average
2,283		21.67% Pervious Area
8,253		78.33% Impervious Area
8,253		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 5S: Remaining undeveloped

Runoff = 2.32 cfs @ 12.09 hrs, Volume= 0.145 af, Depth> 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

	Area (sf)	CN	Description
*	24,285	92	wooded wetland
	24,285		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	20	0.0300	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.3	70	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	90	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

Inflow Area = 1.175 ac, 38.02% Impervious, Inflow Depth > 2.65" for 10-Year event
Inflow = 3.37 cfs @ 12.09 hrs, Volume= 0.259 af
Outflow = 3.37 cfs @ 12.09 hrs, Volume= 0.259 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: R Tanks

Inflow Area = 0.375 ac, 68.52% Impervious, Inflow Depth > 2.92" for 10-Year event
Inflow = 1.53 cfs @ 12.09 hrs, Volume= 0.091 af
Outflow = 0.60 cfs @ 12.50 hrs, Volume= 0.034 af, Atten= 61%, Lag= 24.9 min
Primary = 0.60 cfs @ 12.50 hrs, Volume= 0.051 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.38' @ 12.54 hrs Surf.Area= 2,703 sf Storage= 2,951 cf

Plug-Flow detention time= 154.0 min calculated for 0.034 af (37% of inflow)
Center-of-Mass det. time= 83.9 min (804.1 - 720.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	1,687 cf	**21.06'W x 128.33'L x 2.69'H Field A** 7,280 cf Overall - 3,062 cf Embedded = 4,218 cf x 40.0% Voids
#2A	92.19'	2,909 cf	**ACF R-Tank HD 1.0** x 689 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 13 Rows of 53 Chambers
		4,596 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.39 cfs @ 12.50 hrs HW=93.38' TW=93.33' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.39 cfs @ 0.85 fps)

Summary for Pond 2P: R Tanks

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 2.25" for 10-Year event
Inflow = 1.04 cfs @ 12.08 hrs, Volume= 0.116 af
Outflow = 1.04 cfs @ 12.09 hrs, Volume= 0.114 af, Atten= 0%, Lag= 0.3 min
Primary = 1.04 cfs @ 12.09 hrs, Volume= 0.114 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.54' @ 12.09 hrs Surf.Area= 104 sf Storage= 90 cf

Plug-Flow detention time= 6.4 min calculated for 0.114 af (98% of inflow)
Center-of-Mass det. time= 4.2 min (752.3 - 748.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	94 cf	**6.62'W x 15.73'L x 2.69'H Field A**
			281 cf Overall - 44 cf Embedded = 236 cf x 40.0% Voids
#2A	92.19'	42 cf	**ACF R-Tank HD 1.0** x 10 Inside #1
			Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf
			Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf
			2 Rows of 5 Chambers
		137 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert**
			L= 20.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.04 cfs @ 12.09 hrs HW=93.54' TW=93.41' (Dynamic Tailwater)
└—**1=Culvert** (Inlet Controls 1.04 cfs @ 1.39 fps)

Summary for Pond OCS: outlet control structure

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 2.23" for 10-Year event
Inflow = 1.04 cfs @ 12.09 hrs, Volume= 0.114 af
Outflow = 1.04 cfs @ 12.09 hrs, Volume= 0.114 af, Atten= 0%, Lag= 0.0 min
Primary = 1.04 cfs @ 12.09 hrs, Volume= 0.114 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.41' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	93.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	93.30'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	92.80'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=1.04 cfs @ 12.09 hrs HW=93.41' TW=0.00' (Dynamic Tailwater)
—**1=Sharp-Crested Rectangular Weir**(Weir Controls 0.46 cfs @ 1.07 fps)
—**2=Orifice/Grate** (Orifice Controls 0.03 cfs @ 1.12 fps)
—**3=Orifice/Grate** (Orifice Controls 0.56 cfs @ 3.20 fps)

Time span=3.00-15.00 hrs, dt=0.01 hrs, 1201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: parking and front Runoff Area=16,346 sf 68.52% Impervious Runoff Depth>3.57"
Tc=6.0 min CN=90 Runoff=1.84 cfs 0.112 af

Subcatchment2S: Roof and back Runoff Area=10,536 sf 78.33% Impervious Runoff Depth>3.88"
Tc=6.0 min CN=93 Runoff=1.24 cfs 0.078 af

Subcatchment5S: Remaining undeveloped Runoff Area=24,285 sf 0.00% Impervious Runoff Depth>3.78"
Flow Length=90' Slope=0.0300 '/' Tc=6.5 min CN=92 Runoff=2.77 cfs 0.175 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=4.01 cfs 0.307 af
Outflow=4.01 cfs 0.307 af

Pond 1P: R Tanks Peak Elev=93.54' Storage=3,299 cf Inflow=1.84 cfs 0.112 af
12.0" Round Culvert n=0.013 L=80.0' S=0.0000 '/' Outflow=0.56 cfs 0.054 af

Pond 2P: R Tanks Peak Elev=93.61' Storage=93 cf Inflow=1.24 cfs 0.133 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0000 '/' Outflow=1.24 cfs 0.131 af

Pond OCS: outlet control structure Peak Elev=93.43' Inflow=1.24 cfs 0.131 af
Outflow=1.24 cfs 0.131 af

Total Runoff Area = 1.175 ac Runoff Volume = 0.365 af Average Runoff Depth = 3.73"
61.98% Pervious = 0.728 ac 38.02% Impervious = 0.447 ac

Summary for Subcatchment 1S: parking and front

Runoff = 1.84 cfs @ 12.08 hrs, Volume= 0.112 af, Depth> 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
11,200	98	Paved parking & roofs
5,146	74	>75% Grass cover, Good, HSG C
16,346	90	Weighted Average
5,146		31.48% Pervious Area
11,200		68.52% Impervious Area

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

Summary for Subcatchment 2S: Roof and back

Runoff = 1.24 cfs @ 12.08 hrs, Volume= 0.078 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
8,253	98	Unconnected roofs, HSG C
2,283	74	>75% Grass cover, Good, HSG C
10,536	93	Weighted Average
2,283		21.67% Pervious Area
8,253		78.33% Impervious Area
8,253		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 5S: Remaining undeveloped

Runoff = 2.77 cfs @ 12.09 hrs, Volume= 0.175 af, Depth> 3.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.50"

	Area (sf)	CN	Description
*	24,285	92	wooded wetland
	24,285		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	20	0.0300	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.3	70	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	90	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

Inflow Area = 1.175 ac, 38.02% Impervious, Inflow Depth > 3.13" for 25-Year event
Inflow = 4.01 cfs @ 12.09 hrs, Volume= 0.307 af
Outflow = 4.01 cfs @ 12.09 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: R Tanks

Inflow Area = 0.375 ac, 68.52% Impervious, Inflow Depth > 3.57" for 25-Year event
Inflow = 1.84 cfs @ 12.08 hrs, Volume= 0.112 af
Outflow = 0.56 cfs @ 12.96 hrs, Volume= 0.054 af, Atten= 70%, Lag= 52.6 min
Primary = 0.56 cfs @ 12.96 hrs, Volume= 0.054 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.54' @ 12.42 hrs Surf.Area= 2,703 sf Storage= 3,299 cf

Plug-Flow detention time= 129.9 min calculated for 0.054 af (49% of inflow)
Center-of-Mass det. time= 73.6 min (789.8 - 716.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	1,687 cf	**21.06'W x 128.33'L x 2.69'H Field A** 7,280 cf Overall - 3,062 cf Embedded = 4,218 cf x 40.0% Voids
#2A	92.19'	2,909 cf	**ACF R-Tank HD 1.0** x 689 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 13 Rows of 53 Chambers
		4,596 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.70 cfs @ 12.96 hrs HW=93.37' TW=93.20' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.70 cfs @ 1.58 fps)

Summary for Pond 2P: R Tanks

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 2.58" for 25-Year event
Inflow = 1.24 cfs @ 12.08 hrs, Volume= 0.133 af
Outflow = 1.24 cfs @ 12.09 hrs, Volume= 0.131 af, Atten= 0%, Lag= 0.3 min
Primary = 1.24 cfs @ 12.09 hrs, Volume= 0.131 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.61' @ 12.09 hrs Surf.Area= 104 sf Storage= 93 cf

Plug-Flow detention time= 6.1 min calculated for 0.131 af (99% of inflow)
Center-of-Mass det. time= 4.0 min (744.4 - 740.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	94 cf	**6.62'W x 15.73'L x 2.69'H Field A** 281 cf Overall - 44 cf Embedded = 236 cf x 40.0% Voids
#2A	92.19'	42 cf	**ACF R-Tank HD 1.0** x 10 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 2 Rows of 5 Chambers
		137 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.24 cfs @ 12.09 hrs HW=93.61' TW=93.43' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.24 cfs @ 1.59 fps)

Summary for Pond OCS: outlet control structure

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 2.55" for 25-Year event
Inflow = 1.24 cfs @ 12.09 hrs, Volume= 0.131 af
Outflow = 1.24 cfs @ 12.09 hrs, Volume= 0.131 af, Atten= 0%, Lag= 0.0 min
Primary = 1.24 cfs @ 12.09 hrs, Volume= 0.131 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.43' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	93.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	93.30'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	92.80'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=1.24 cfs @ 12.09 hrs HW=93.43' TW=0.00' (Dynamic Tailwater)
—**1=Sharp-Crested Rectangular Weir**(Weir Controls 0.63 cfs @ 1.19 fps)
—**2=Orifice/Grate** (Orifice Controls 0.04 cfs @ 1.24 fps)
—**3=Orifice/Grate** (Orifice Controls 0.57 cfs @ 3.29 fps)

Time span=3.00-15.00 hrs, dt=0.01 hrs, 1201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: parking and front Runoff Area=16,346 sf 68.52% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=90 Runoff=2.30 cfs 0.142 af

Subcatchment2S: Roof and back Runoff Area=10,536 sf 78.33% Impervious Runoff Depth>4.88"
Tc=6.0 min CN=93 Runoff=1.54 cfs 0.098 af

Subcatchment5S: Remaining undeveloped Runoff Area=24,285 sf 0.00% Impervious Runoff Depth>4.77"
Flow Length=90' Slope=0.0300 '/' Tc=6.5 min CN=92 Runoff=3.44 cfs 0.222 af

Reach 1R: ANALYSISPOINT A: wetland Inflow=4.98 cfs 0.414 af
Outflow=4.98 cfs 0.414 af

Pond 1P: R Tanks Peak Elev=93.86' Storage=3,758 cf Inflow=2.30 cfs 0.142 af
12.0" Round Culvert n=0.013 L=80.0' S=0.0000 '/' Outflow=1.29 cfs 0.085 af

Pond 2P: R Tanks Peak Elev=93.90' Storage=106 cf Inflow=2.20 cfs 0.194 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0000 '/' Outflow=2.02 cfs 0.192 af

Pond OCS: outlet control structure Peak Elev=93.52' Inflow=2.02 cfs 0.192 af
Outflow=2.02 cfs 0.192 af

Total Runoff Area = 1.175 ac Runoff Volume = 0.463 af Average Runoff Depth = 4.73"
61.98% Pervious = 0.728 ac 38.02% Impervious = 0.447 ac

Summary for Subcatchment 1S: parking and front

Runoff = 2.30 cfs @ 12.08 hrs, Volume= 0.142 af, Depth> 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
11,200	98	Paved parking & roofs
5,146	74	>75% Grass cover, Good, HSG C
16,346	90	Weighted Average
5,146		31.48% Pervious Area
11,200		68.52% Impervious Area

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

Summary for Subcatchment 2S: Roof and back

Runoff = 1.54 cfs @ 12.08 hrs, Volume= 0.098 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
8,253	98	Unconnected roofs, HSG C
2,283	74	>75% Grass cover, Good, HSG C
10,536	93	Weighted Average
2,283		21.67% Pervious Area
8,253		78.33% Impervious Area
8,253		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 5S: Remaining undeveloped

Runoff = 3.44 cfs @ 12.09 hrs, Volume= 0.222 af, Depth> 4.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.70"

	Area (sf)	CN	Description
*	24,285	92	wooded wetland
	24,285		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	20	0.0300	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.3	70	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	90	Total			

Summary for Reach 1R: ANALYSIS POINT A: wetland

Inflow Area = 1.175 ac, 38.02% Impervious, Inflow Depth > 4.23" for 100-Year event
Inflow = 4.98 cfs @ 12.09 hrs, Volume= 0.414 af
Outflow = 4.98 cfs @ 12.09 hrs, Volume= 0.414 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: R Tanks

Inflow Area = 0.375 ac, 68.52% Impervious, Inflow Depth > 4.56" for 100-Year event
Inflow = 2.30 cfs @ 12.08 hrs, Volume= 0.142 af
Outflow = 1.29 cfs @ 12.19 hrs, Volume= 0.085 af, Atten= 44%, Lag= 6.3 min
Primary = 1.30 cfs @ 12.19 hrs, Volume= 0.096 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.86' @ 12.21 hrs Surf.Area= 2,703 sf Storage= 3,758 cf

Plug-Flow detention time= 116.5 min calculated for 0.085 af (59% of inflow)
Center-of-Mass det. time= 70.3 min (781.4 - 711.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	1,687 cf	**21.06'W x 128.33'L x 2.69'H Field A** 7,280 cf Overall - 3,062 cf Embedded = 4,218 cf x 40.0% Voids
#2A	92.19'	2,909 cf	**ACF R-Tank HD 1.0** x 689 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 13 Rows of 53 Chambers
		4,596 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.19 hrs HW=93.85' TW=93.87' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 2P: R Tanks

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 3.78" for 100-Year event
Inflow = 2.20 cfs @ 12.19 hrs, Volume= 0.194 af
Outflow = 2.02 cfs @ 12.22 hrs, Volume= 0.192 af, Atten= 8%, Lag= 1.7 min
Primary = 2.02 cfs @ 12.22 hrs, Volume= 0.192 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.90' @ 12.20 hrs Surf.Area= 104 sf Storage= 106 cf

Plug-Flow detention time= 4.4 min calculated for 0.192 af (99% of inflow)
Center-of-Mass det. time= 3.0 min (746.2 - 743.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.94'	94 cf	**6.62'W x 15.73'L x 2.69'H Field A** 281 cf Overall - 44 cf Embedded = 236 cf x 40.0% Voids
#2A	92.19'	42 cf	**ACF R-Tank HD 1.0** x 10 Inside #1 Inside= 15.7"W x 17.3"H => 1.80 sf x 2.35'L = 4.2 cf Outside= 15.7"W x 17.3"H => 1.89 sf x 2.35'L = 4.4 cf 2 Rows of 5 Chambers
		137 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	92.63'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.63' / 92.63' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.83 cfs @ 12.22 hrs HW=93.89' TW=93.52' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 1.83 cfs @ 2.34 fps)

Summary for Pond OCS: outlet control structure

Inflow Area = 0.617 ac, 72.36% Impervious, Inflow Depth > 3.74" for 100-Year event
Inflow = 2.02 cfs @ 12.22 hrs, Volume= 0.192 af
Outflow = 2.02 cfs @ 12.22 hrs, Volume= 0.192 af, Atten= 0%, Lag= 0.0 min
Primary = 2.02 cfs @ 12.22 hrs, Volume= 0.192 af

Routing by Dyn-Stor-Ind method, Time Span= 3.00-15.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 93.52' @ 12.22 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	93.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	93.30'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	92.80'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=2.02 cfs @ 12.22 hrs HW=93.52' TW=0.00' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir**(Weir Controls 1.30 cfs @ 1.52 fps)
—**2=Orifice/Grate** (Orifice Controls 0.09 cfs @ 1.58 fps)
└—**3=Orifice/Grate** (Orifice Controls 0.62 cfs @ 3.57 fps)

Bishop Street Stormwater Inspection and Maintenance Plan

Inspection and Maintenance Contract:

Long-term inspection and maintenance by a DEP approved stormwater maintenance inspector shall be regularly provided under a five-year binding inspection and maintenance contract that must be renewed prior to contract expiration. A legal agreement shall be established with responsibility for inspection and maintenance and should list specific maintenance responsibilities (including timetables) as well as provide for funding for the long-term inspection and maintenance. Debris and sediment buildup shall be removed from the forebay, basin, stone filter, or paver system as needed.

Inspection schedule:

During the first year of operation, filtration BMPs shall be inspected twice annually and following major storm events. Thereafter, the filter should be inspected every six months to ensure that it is draining within 48 hours following a 1-inch storm. Additionally, a storm that fills the system to overflow should be monitored to confirm in drains in no less than 36 hours and within 60 hours.

Vegetated Soil Filter:

Maintenance criteria for the vegetated soil filter are as follows:

- Debris and sediment buildup shall be removed from the vegetated soil filter system as needed. The removed sediments should be disposed in an appropriate manner.
- Mowing of the grassed basin can occur semi-annually to a height of no less than 6 inches. If mowing is desired only hand-held or push-mowers shall be used (no tractors).
- Any bare areas or erosion rills shall be repaired with new media filter or sandy loam then seeded and mulched. Fertilization of the filter area should be avoided unless abslolutely necessary to establish vegetation.
- Harvesting and pruning of excessive growth will need to be done occasionally. Weeding to control unwanted or invasive plants may also be necessary. Add new mulch only as necessary.

- Maintaining good grass cover will minimize clogging with fine sediments and if ponding exceeds 48 hours, the top of the filter bed must be tilled to reestablish the soil's filtration capacity.
- Should water pond on the surface of the filter bed for longer than 72 hours, the top several inches of the filter shall be replaced with fresh material. The removed material shall be disposed properly.

R-Tank Stormwater Detention:

Inspection and Maintenance of the R-Tank shall be in accordance with the manufacturer's recommended practices to provide the performance required by the design. The R-Tank system includes inspection ports and maintenance ports, each of which has a cover at the surface. A visual inspection of all ports should be used to determine the depth of sediments deposited in the R-Tank system. The system should be back-flushed once the sediment accumulation has reached the manufacturer's limits. Once removed, sediment-laden water must be disposed of properly.

Roof Dripline Filter:

The roof dripline filter bed is part of the stormwater management plan and requires maintenance similar to the vegetated soil filter basin. Debris and sediment buildup shall be removed from the stone filter bed system as needed and shall be properly disposed. The filter bed must not be paved over or altered in any way.

Manmade Pervious Surfaces:

Long-term inspection and maintenance by a DEP approved stormwater maintenance inspector shall be regularly provided under a five-year binding inspection and maintenance contract that must be renewed prior to contract expiration. Maintenance criteria for manmade pervious surfaces are as follows:

- Debris and sediment buildup shall be removed from the paver system using a vac truck as needed and shall be disposed properly.

- Remove sediment when the surface infiltration rates of more than 75% of the surface area fall below 10% of the post-installation verified surface infiltration rate.

- Remove sediment when surface ponding remains for more than 24 hours after the storm event in an area larger than 10 square feet.

- Restrain vehicles with muddy wheels from accessing pervious pavement areas.

- Limit salt use for deicing and do not use sand.

- Remove leaves and organic debris in the fall.
- Sweep, vacuum and/or pressure wash pavement twice annually at a minimum.

Inline Roof Drain Filter:

The maintenance of inline roof drain filters shall be in accordance with the manufacturer's recommended requirements to ensure the performance requirements are met. At a minimum, it is recommended that the filters are inspected and cleaned twice per year. Replace the filter cartridge annually. All debris and spent filter material shall be properly disposed.

IAPMO RESEARCH AND TESTING, INC.

5001 East Philadelphia Street, Ontario, California 91761-2816 • (909) 472-4100 Fax (909) 472-4244 • www.iapmo.org

ANSI Accredited Program PRODUCT CERTIFICATION #0202

SCC Accredited CB-P/S OCPS Accrédité CCN

CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

The most updated information on this Certificate of Listing is available online at pld.iapmo.org

Effective Date: September 2014 — Void After: September 2015

Product: In-Line Devices for Downspout Filtration — File No. 6266

Issued To: Bio Clean Environmental Services, Inc.
2972 San Luis Rey Road
Oceanside, CA 92058

Identification: Each unit shall be marked with the manufacturer's name or trademark. This mark shall be legible, readily identified, and applied so as to be permanent. The product shall also bear the maintenance contact information and the UPC® certification mark. The markings shall be located so as to be visible after installation.

Characteristics: In-line devices used for filtration of storm water runoff in structure downspouts. To be installed in accordance with the manufacturer's instructions and the requirements of the latest edition of the Uniform Plumbing Code.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following code(s):
Uniform Plumbing Code (UPC®)

Chairman, Product Certification Committee

CEO, The IAPMO Group

This listing period is based upon the last date of the month indicated on the Effective Date and Void After Date shown above. Any change in material, manufacturing process, marking or design without having first obtained the approval of the Product Certification Committee, or any evidence of non-compliance with applicable codes and standards or of inferior workmanship, may be deemed sufficient cause for revocation of this listing. Production of or reference to this form for advertising purposes may be made only by specific written permission of IAPMO Research and Testing, Inc. Any alteration of this certificate could be grounds for revocation of the listing.

IAPMO RESEARCH AND TESTING, INC.
CERTIFICATE OF LISTING

Void After: September 2015

Product: In-Line Devices for Downspout Filtration — File No. 6266

Issued To: Bio Clean Environmental Services, Inc.

Products are in compliance with the following standard(s):

IGC 214-2009

IAPMO RESEARCH AND TESTING, INC.
CERTIFICATE OF LISTING

Void After: September 2015

Product: In-Line Devices for Downspout Filtration

File No. 6266

Issued To: Bio Clean Environmental Services, Inc.

MODELS:

BC-DF4 (4")
BC-DF6 (6")
BC-DF8 (8")

Downspout Filter

PROVEN STORMWATER TREATMENT TECHNOLOGY

BIO CLEAN ENVIRONMENTAL SERVICES, INC.

Overview

The Bio Clean Downspout Filter is the industry's leading solution for treatment of roof runoff. This technology is used to treat commercial and industrial roof tops along with highrise buildings, parking structures and residential buildings.

Available in 3 sizes, this filter can easily adapt to downspouts 2" to 12" in diameter. The filter comes standard with rubber boots that allow for easy installation to the downspout.

Proven since 2003, the Bio Clean Downspout Filter has been used on hundreds of installations throughout the United States. All internal components are constructed of stainless steel.

The sleek inline design allows the filter to be used in tight spaces. Approved by the IAPMO, this filter can meet all your needs.

Advantages

- 10 Year Warranty
- No Nets or Geofabrics
- Sleek Inline Design
- High Treatment Flow Rate
- High Bypass Flow Rate
- Low Cost

Performance

- 93% Removal of TSS
- 87% Removal of Hydrocarbons
- Effective at Removing Metals, Nutrients and Bacteria (Media Type)

Specifications

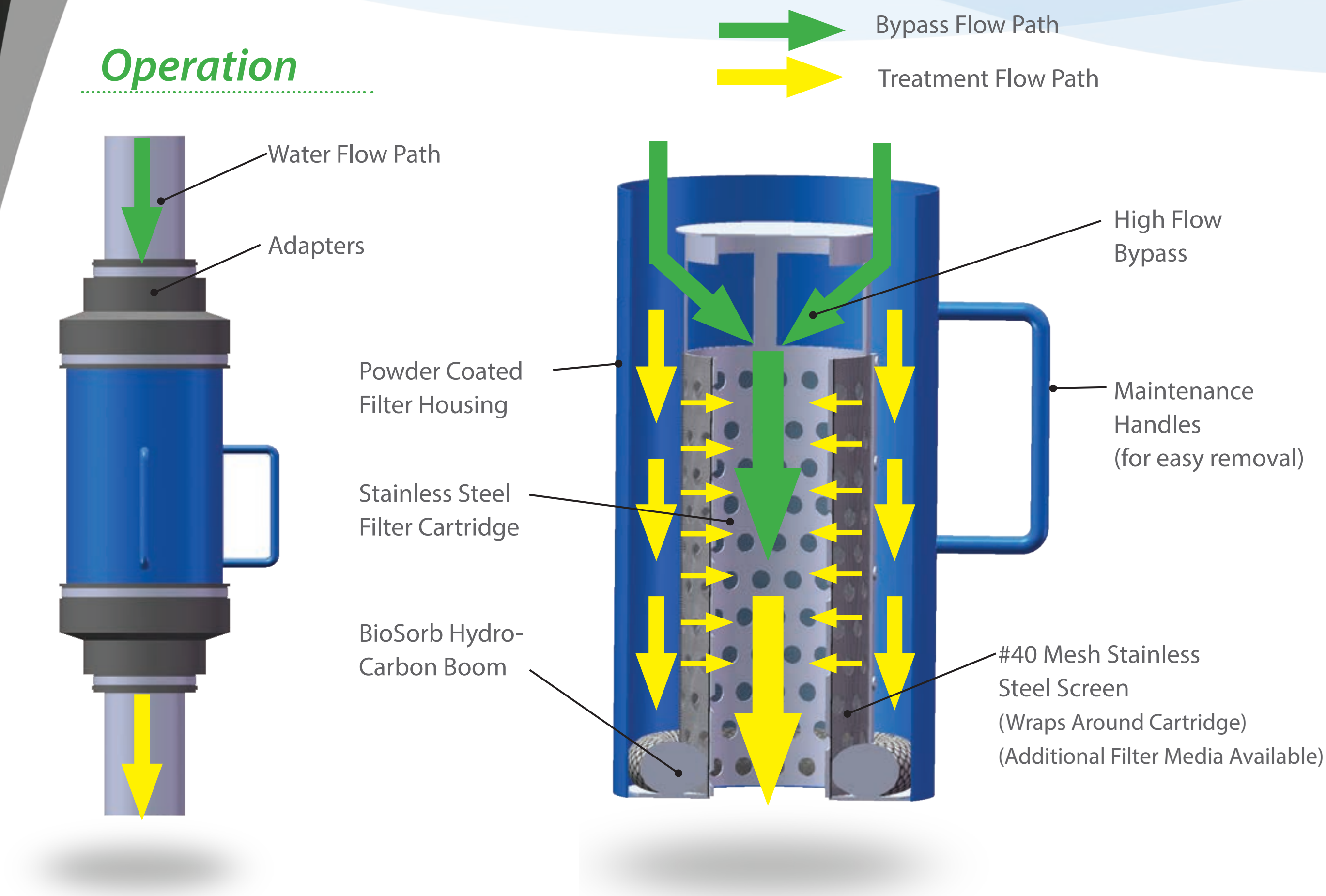
Model #	Inlet ID (dia., in.)	Filter OD (dia., in.)	Storage Cap. (cu. ft.)	Filtered Flow (gpm)	Bypass Flow (gpm)
BC-DF4	4	6.625	0.9	249	566
BC-DF6	6	8.625	0.21	509	1006
BC-DF8	8	8.625	0.21	509	1006
BC-DF10	10	12.75	0.77	1145	2264
BC-DF12	12	12.75	0.77	1145	2264

www.BioCleanEnvironmental.com

Downspout Filter

PROVEN STORMWATER TREATMENT TECHNOLOGY

Operation



Application

Easily Adapts to Square or Rectangle Downspouts

- Commercial
- Residentail
- Parking Structures
- Mixed Use

Fits Inline with Iron, Steel or Plastic Pipe

Approvals

IAPMO Testing & Approval Listing

Installation & Maintenance

See our Website for Installation & Maintenance Manuals at www.BioCleanEnvironmental.com

2972 San Luis Rey Rd
Oceanside, CA 92058
p 760.433.7640 f 760.433.3176
www.BioCleanEnvironmental.com

BIO CLEAN

Bio Clean Downspout Filter TSS & Hydrocarbons Removal Testing

Prepared by

Bio Clean Environmental Services, Inc.

April & June 2007

Testing Laboratory - PAHs

D-Tek Analytical Laboratories, Inc.

9020 Kenamar Drive, Suite 205
San Diego, CA 92121
Phone: 858-566-4542

Table of Contents

Background

A number of specialty post-construction BMPs have been developed in recent years to deal with unique situations and constraints. Situations in which traditional proprietary and non-proprietary BMPs are not feasible nor even possible. Many new and retrofit projects characterized by curb to curb structures, such is the case with taller buildings and parking structures in highly urbanized or down town areas. Due to these constraints, the need for BMPs that can be incorporated into these types of projects has arisen. The majority of the impervious surfaces on these sites are roof tops and parking area. Therefore, a BMP that will address the "pollutants of concern" and related concentrations and forms unique to these impervious areas has been in great demand in recent years. As stormwater regulations become more stringent the demand for BMPs the effectively and feasibly deal with these situations will increase. More importantly, these BMPs will have to be designed to work with the current drainage infrastructure of rooftops and parking structures. The most commonly used method for conveying runoff from these areas are downspouts. Downspouts are a series of vertical pipes the collect runoff from rooftops and parking areas, channels the water either internally or externally of the building and discharges at ground level either to the street or the existing drainage infrastructure usually sub-surface of the street.

Bio Clean Environmental Services has been offering a downspout filter over the past three years to address the need for a stormwater BMP that will effectively treat runoff from rooftops and parking areas. Downspout filters are source controls, being inexpensive, easy to retrofit to most new and existing downspout drainage infrastructures, and keeping pollutants out of the water bodies. Bio Clean Environmental Services, Inc, of Oceanside, California performed testing on a Bio Clean Downspout Filter (BCDF) to determine its pollutant removal effectiveness for TSS and hydrocarbons that are associated with storm water runoff. The hydrocarbon testing (PAHs) was performed on April 25th of 2007. Attached are photographs from the test and the accompanying laboratory test analysis and results performed by D-Tek Analytical Laboratories, Inc. The TSS and turbidity testing was performed on June 3rd, 2007. A full scale laboratory test was performed on a standard BCDF. The particle size gradations where used to represent both coarse and fine total suspended solids. Considering the pollutants usually found in roof runoff are comprised of both coarser roofing material and finer solids associated with atmospheric decomposition and wind blown material, these particle ranges are most closely correlated to actual field conditions.

The Bio Clean Downspout Filter is designed to use numerous media types. The filter is designed to trap sediment, TSS, leaves, organic debris, metals, and hydrocarbons, thereby preventing these pollutants from entering the storm drain system where they would cause detrimental impacts on downstream water bodies. The Bio Clean Downspout Filter is a two piece metal fabricated filtering device. The filters outer shell is made of 1/8th inch powered coated rolled steel. The inner removable filter housing/bypass cone is constructed of 316 stainless steel. The inner cylinder is perforated allowing for media to be wrapped around it. The storage of trapped pollutants occurs in the area between the inner cylinder and outer shell. The capacity of the pollutant capture chamber is approximately 2.94 cubic feet. The overflow capacity of the BCDF is designed to be greater than the peak design flow, thereby insuring that there will be no loss of hydraulic capacity due to the device being inline of the downspout pipe.

Water flowing through the downspout filter first encounters the pollutant capture chamber where runoff passes through the filter media. As mentioned above the media is wrapped around the internal cylinder. If the flow rate through the filter media reaches capacity the higher flows will enter the bypass located in the middle of the top end of the internal cylinder.

Downspout filters such as the BCDF are generally designed to capture hydrocarbons, sediment, and debris. Depending on the specified media the filter can be effective at capturing fine TSS, heavy metals, and nutrients. The Bio Clean Flume Filters standard filter media is a combination of BioSorb booms and X-Tex Filter Fabric. This combination of media allows for very effective removal of pollutants commonly present in stormwater runoff, particularly runoff from rooftops and parking structures.

Methodology – Hydrocarbon Testing

Two tests where performed at separate times. The first test focused on the BioSorb booms removal of TPH (total petroleum hydrocarbons). A test was designed to simulate a rainfall event and measure the ability of a BCDF to remove hydrocarbons. A mock downspout was constructed of 6” SD40 PVC piping. The constructed downspout was approximately seven feet in height, with the filter placed inline approximately half way between the bottom of the collection chamber and the top of the downspout. A new downspout filter installed inline of the downspout (see pictures). A forklift with a 500 gallon tank was allowed to discharge through a 2” valve used to regulate the flow of the discharged batch water into the flume at a rate of 25 gpm. It was observed that the visible hydrocarbons (a rainbow sheen floating on the surface) were present in the influent, prior to the downspout filter and were not visible in the discharge collection chamber (effluent), which indicated that the hydrocarbons were being absorbed by the media booms. The effluent was collected down stream in a container after passing through the filter.

The batch was created by making a concentrated solution of hydrocarbon enriched water. The batch was intended to be mixed in 250 gallons to create a solution of highly contaminated water. This solution was added to the 250 gallon water tank and agitated with a mixer for a period of 15 minutes before the test and also throughout the test period. Once mixed thoroughly a grab sample was taken form the tank. This sample provided the background levels in the tank to be compared to the five tests that were run through the flume filter and its media.

By the use of a flow meter and control valve the flow was maintained at 25 gpm. Each test was conducted for approximately 2 minutes. Each water sample was done by taking three grab samples of effluent water that had passed through the filter. This was done to get an average sample concentration. Water was allowed to flow through the filter for 30 seconds then one third of the sample water was collected in a clean vessel and poured into the sampling bottle. The second and third sample was taken at one minute of flow and the final portion of the sample was taken at approximately 2 minutes as the final amount of water from the test was flowing through the filter.

As part of the initial sample of the influent readings where taken for pH, NTU and temperature. This initial information is as follows: time of testing started at 2:06, wind was 0.9 mph, temperature 79.4, Barometric pressure 1014.3 hPa, starting pH = 9.3 and NTU= 20.5, altitude = 60 feet MSL.

Results

Following is a summary of the results of removal of Total Petroleum Hydrocarbons.

Downspout Filter - Bio Sorb

Run	Pollutant	Influent (mg/L)	Effluent (mg/L)	Percent Reduction
1	TPH	223.5	40.3	81.97%
	pH	7.07	7.22	
2	TPH	223.5	18.4	91.77%
	pH	7.07	7.22	
3	TPH	223.5	31.3	86.00%
	pH	7.07	7.19	
4	TPH	223.5	40.6	81.83%
	pH	7.07	7.19	
5	TPH	223.5	17.26	92.28%
	pH	7.07	7.18	

Pollutant	Average Concentration	Average Removal %
TPH	29.57	86.77%
pH	7.20	

Methodology – TSS Testing – Sil-Co-Sil 106

The second test was performed to measure the Bio Clean Downspouts filters ability to remove TSS from stormwater runoff. As with the last test, a full scale laboratory test was designed to simulate actual field conditions. As described above, a mock downspout was constructed of 6” SD40 PVC piping. The constructed downspout was approximately seven feet in height, with the filter placed inline approximately half way between the bottom of the collection chamber and the top of the downspout. The bottom part of the downspout was constructed with a cut away to allow to the gathering of grab samples. A new downspout filter installed inline of the downspout (see pictures). A forklift with a 500 gallon tank was allowed to discharge through a 2” valve used to regulate the flow of the discharged batch water into the flume at a rate of 25 gpm.

The TSS was measured in two fashions. For this test two separate soil gradations where used to simulate both the fine and coarse TSS associated with stormwater runoff. Exact weights where calculated for the two gradations. For the Sil-Co-Sil 106, exactly 4.67 pounds where weighed out and mixed into the 400 gallons of water present in the water tank. This calculates to precisely 1400 mg/L. The water tank was agitated with a mixer for a period of 15 minutes before the test and also throughout the test period. Once mixed thoroughly a grab sample was taken form the tank and measured for turbidity. Due to the fine nature of the Sil-Co-Sil 106 (mean particle size of 20 microns) turbidity provides an accurate indication of the level of fine TSS present in the water. A grab sample of the mix was taken and measured for turbidity. The resulting reading for the influent concentration was 429 NTUs. A grab sample was taken of the influent prior to each test run to ensure the turbidity level remained constant, the readings ranged from 408 to 437 NTUs throughout the influent samples, indicating consistency in influent concentration. These samples provided the background levels in the tank to be compared to the effluent grab samples of the eight runs. The influent concentration (known by weight) and the relating turbidity reading was plotted against several and readily available correlation studies between TSS and turbidity on particle gradations similar to that of the Sil-Co-Sil 106. Through statistical analysis it was proven with a high level of certainty that the influent concentration and related turbidity reading strongly correlated to the existing data. The r value was greater than .999, which proves the strength of this correlation. Following are the results of this statistical analysis.

Statistical Analysis - Correlation

Pearson Product Moment Correlation - Monitoring Report - Lab Data with Bio Clean Data Point (weight)		
Statistic	Variable Y	Variable X
Mean	128.886667	39.866667
Variance	117954.5665	11085.18222
Standard Error	343.445143	105.286192
Covariance		36147.15156
Correlation		0.999644
Determination		0.999288
T-Test		135.052132

Critical 2-sided T-value (5%)	2.16
2-sided p-value	0
Critical 1-sided T-value (5%)	1.771
1-sided p-value	0
Degrees of Freedom	13
Observations	15

By the use of a flow meter and control valve the flow was maintained at 25 gpm. Each test was conducted for approximately 2 minutes. Each water sample was done in three grab samples of effluent water that had passed through the filter. This was done to get average sample turbidity. Water was allowed to flow through the filter for 30 seconds then one third of the sample water was collected in a clean vessel and poured into the sampling bottle. The second and third sample was taken at one minute of flow and the final portion of the sample was taken at approximately 2 minutes as the final amount of water from the test was flowing through the filter. Following are the results of the turbidity readings gathered from the grab samples.

Results – Sil-Co-Sil 106

TSS - Sil-Co-Sil Testing Log

	TSS (mg/L)**	Turbidity (ntu)*
Influent mg/L	**1400**	**429**
Test Run 1		
Grab 1	**1128.998**	**346**
Grab 2	**1292.148**	**396**
Grab 3	**929.955**	**285**
Average Reduction %	**41.8%**	
Test Run 2		
Grab 1	**956.059**	**293**
Grab 2	**978.9**	**300**
Grab 3	**704.808**	**216**
Average Reduction %	**53.0%**	
Test Run 3		
Grab 1	**952.796**	**292**
Grab 2	**796.172**	**244**
Grab 3	**750.49**	**230**

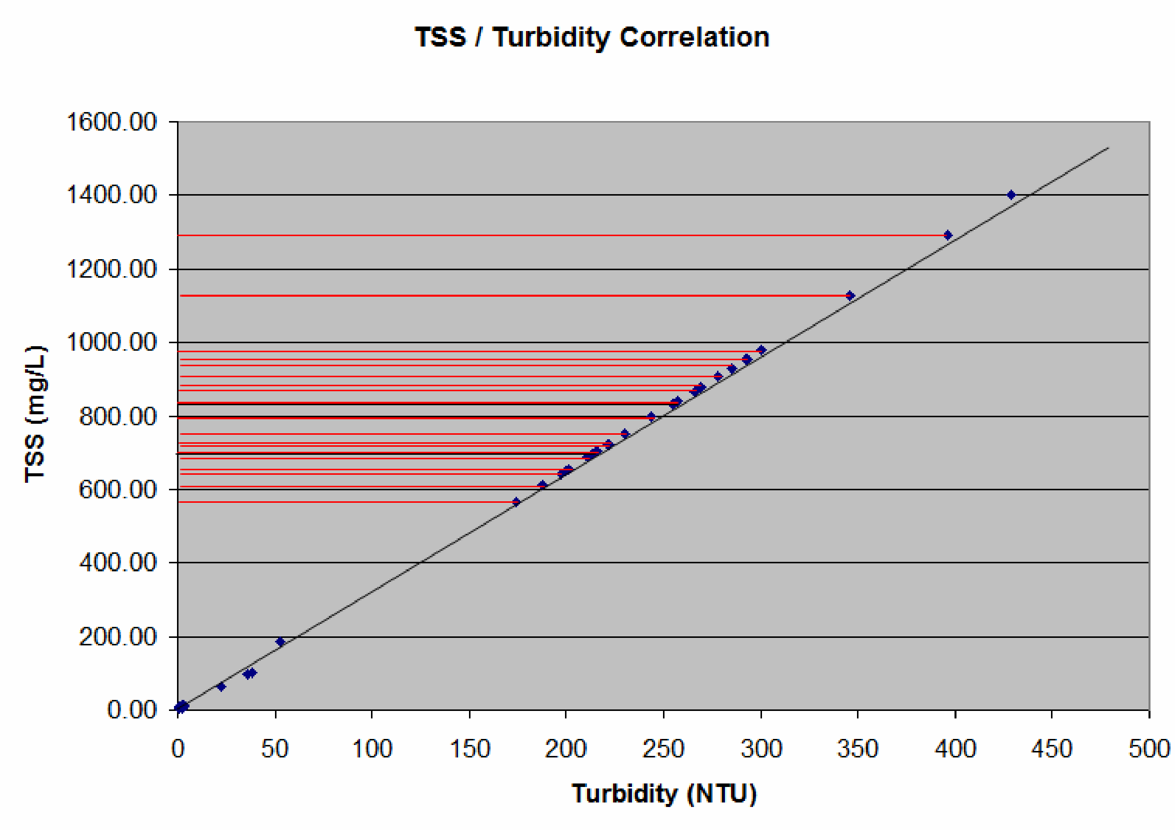
Average Reduction %	**56.0%**	
Test Run 4		
Grab 1	**952.796**	**292**
Grab 2	**838.591**	**257**
Grab 3	**721.123**	**221**
Average Reduction %	**55.7%**	
Test Run 5	**0**	
Grab 1	**832.065**	**255**
Grab 2	**877.747**	**269**
Grab 3	**724.386**	**222**
Average Reduction %	**57.5%**	
Test Run 6		
Grab 1	**907.114**	**278**
Grab 2	**695.019**	**213**
Grab 3	**867.958**	**266**
Average Reduction %	**56.7%**	
Test Run 7		
Grab 1	**655.863**	**201**
Grab 2	**567.762**	**174**
Grab 3	**613.444**	**188**
Average Reduction %	**76.2%**	
Test Run 8		
	688.493	**211**
	642.811	**197**
	652.6	**200**
Average Reduction %	**70.6%**	
Total Average Reduction %	**58.4%**	

***Turbidity (NTU) data was taken during the full scale laboratory testing of the Bio Clean Downspout Filter. During the testing 8 two minute test runs where performed at a flow rate of 25 gpm. 3 grab samples where taken at the 30 second, 1 minute and 1.5 minute intervals.**
**** Approximations based upon Turbidity readings and its proven strong correlation to TSS, particularly particles less than 50 microns. Influent fine TSS concentration (mg/L) batch mix was 1400 mg/L (400 gallons and 4.67 pounds of Sil-Co-Sil 106, mean particle size of 20 microns).**

The TSS concentrations above where calculated by the following statistical analysis.

The Following Scatter Plot compiled from existing laboratory data was used to plot results of the grab samples (turbidity readings) in order to find the related TSS concentration in mg/L.

Scatter Plot



Data Table

TURBIDITY (NTU)	TSS (mg/l)
38	102.60
36	96.60
2	14.60
3	11.40
2	9.60
2	11.20
53	184.30
22	61.60
2	10.00
1	9.00
1	3.40
2	5.20
2	7.20
3	6.60

429	1400.00
346.00	1128
396.00	1292
285.00	929
293.00	956
300.00	978
216.00	704
292.00	952
244.00	796
230.00	750
292.00	952
257.00	838
221.00	721
255.00	832
269.00	877
222.00	724
278.00	907
213.00	695
266.00	867
201.00	655
174.00	567
188.00	613
211.00	688
197.00	642
200.00	652

Methodology – TSS Testing – Sand

Taking into account the quick settling velocities of coarse TSS it was determined that a different method should be employed to accurately measure the Bio Clean Downspout Filters removal of coarser TSS. For this test it was concluded to most accurate method for calculating the removal efficiency of coarse TSS is by weight comparison between the amounts added to the influent and compare it by the amount collected in the filter. As a precautionary measure, any TSS that passed through the filter was collected in a discharge collection chamber. The amount collected by the filter plus the amount collected in the discharge collection chamber would be added to see if the total was equal to the amount added to the influent. Exactly 6.67 pounds of sand where metered into the influent over the 2 minute period of each test run. Approximately .834 pounds of sand were metered into each test run. This method ensured that the concentration of 2000 mg/L would be maintained throughout the entire period of each test run. Following are the results of this test.

Results – Sand

TSS - Sand Testing Log

[redacted]	TSS (mg/L)***
Influent mg/L	2000
Test Run 1	
(in pounds)	0.834
Test Run 2	
(in pounds)	0.834
Test Run 3	
(in pounds)	0.834
Test Run 4	
(in pounds)	0.834
Test Run 5	
(in pounds)	0.834
Test Run 6	
(in pounds)	0.834
Test Run 7	
(in pounds)	0.834
Test Run 8	
(in pounds)	0.834
Total Sand Added (Influent) (lbs)	6.7
Total Sand Collected in Downspout Filter - at Conclusion of Test Run 8 - Dried and Weighed (lbs)	6.2
****Total Reduction %	92.9%

*****To obtain a concentration of 2000 mg/L of TSS (sand) approximately 6.67 pounds of sand needed to be added evenly to 400 gallons of water. Due to sands fast settling time, sand was metered into the influent at a rate of .417 pounds per minute. This was done during the duration of the tests runs, totaling a time of 16 minutes.**
******Calculated by weight difference between sand added and sand removed from Bio Clean Downspout Filter.**

Conclusion

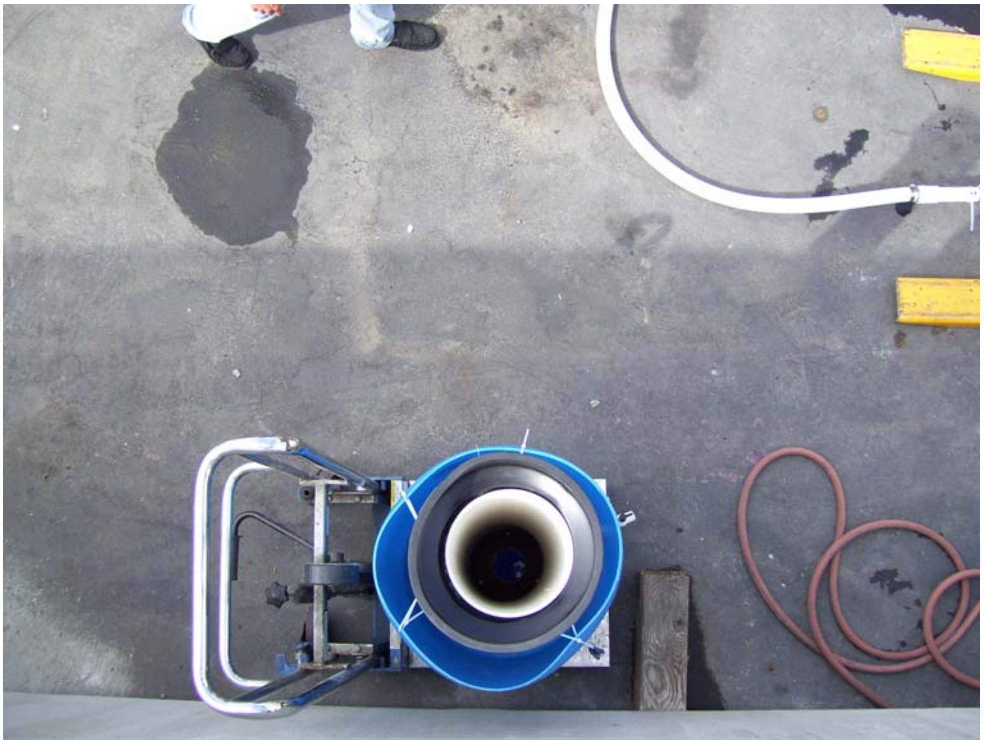
A total of five runs where performed to provide statistical verification of the removal efficiencies of TPH. There was an average effluent concentration of 29.57 mg/l for TPH (total petroleum hydrocarbons), resulting in an average removal efficiency of 86.7% respectively. The Average TSS removal efficiency of Sil-Co-Sil 106 (mean particle size of 20 microns) was approximately 58.4%. The Average TSS removal efficiency of Sand (mean particle size of 250 microns) was approximately 92.9%.The conclusion of the test indicates that the BCFF filter is a very good device for the removal of oil and grease and TPH with removal rates of 86% and an overall removal of TSS through a range of particle sizes of 75.65% (average of Sil-Co-Sil 106 and sand combined). Particle gradations for both the Sil-Co-Sil 106 (fly ash) and sand (sand clay) are provided in appendix B. Also, considering the Bio Clean Downspout Filter utilizes X-Tex fabric as it primary filter media it can be noted that this fabric has a wet sieve size of 86 microns. Thus, the Bio Clean Downspout Filter utilizing the X-Tex fabric has the potential to capture 100% of TSS particles greater than 86 microns up to a peak flow rate of .3 CFS or 135 gpm. This flow rate has been calculated by finding the total surface area of the internal cylinder (which the fabric is wrapped around), equal to 1.2775 square feet times the X-Tex fabric stated flow rate of 106 gpm per square foot.

At the flow rate of 25 gpm, the Bio Clean Downspout Filter had a TSS removal efficiency of 75.65%. The BCDF has sediment removal capabilities rivaling those found in many structural BMPs, at a fraction of the cost, and without disruptive construction. In conclusion the Bio Clean Downspout Filter is invaluable tool that can be used to prevent pollutants from entering our waterways. The Bio Clean Flume Filter has the potential to utilize different media, which may allow this filter to be effective at removing metals and nutrients.

Appendix A

Field Installation

Testing Photos




F-300
GPM
LPM
140
550
120
450
100
350
80
250
40
150
Read Float at Top
Liquid Sp. Gr. 1.0
Calibrated with Water
www.Blue-White.com
FLOW

Appendix B

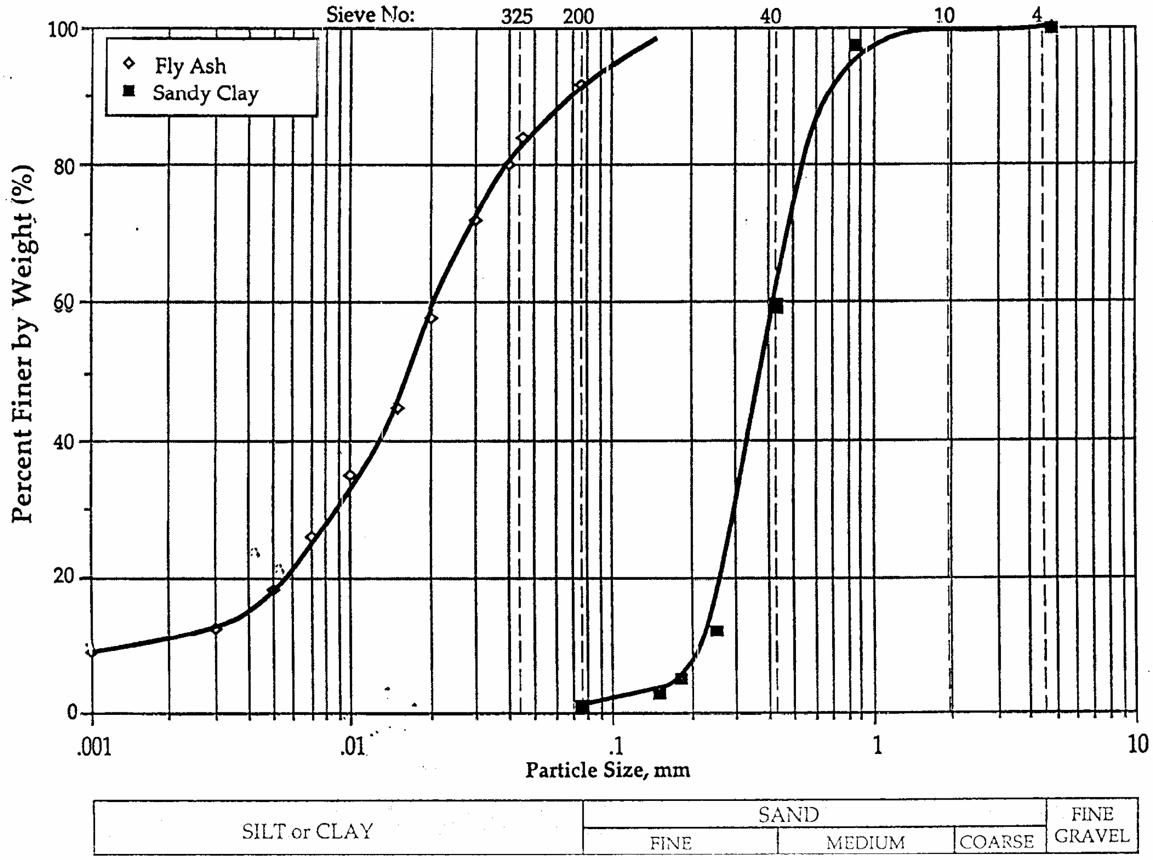
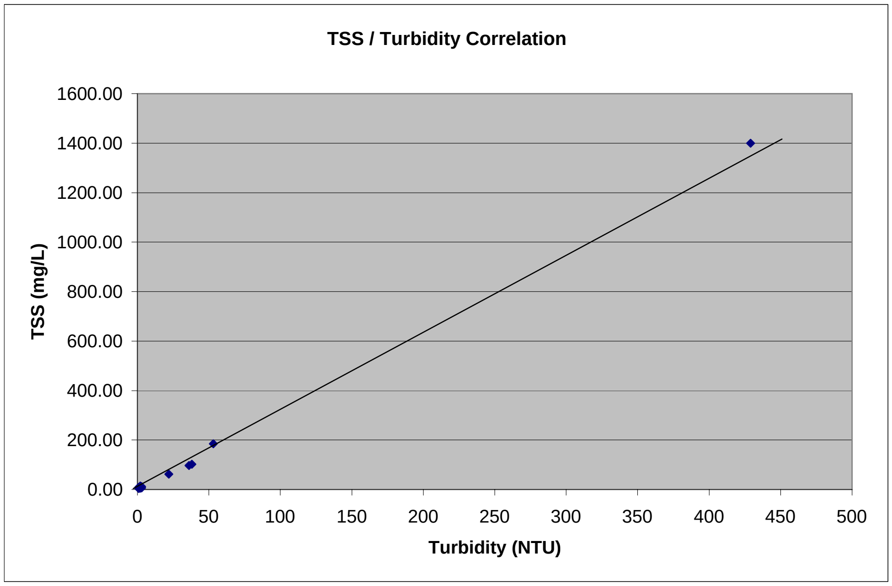


Figure 4.2: Grain Size Distribution Curves of Chosen Sediments for Model Study.

TURBIDITY (NTU)	TSS (mg/l)
38	102.60
36	96.60
2	14.60
3	11.40
2	9.60
2	11.20
53	184.30
22	61.60
2	10.00
1	9.00
1	3.40
2	5.20
2	7.20
3	6.60
429	1400.00



	Column 1	*Column 2*
Column 1	1	
Column 2	0.999644	1

Date	Mon, 04 Jun 2007 10:55:21 -0700
Cite	Wessa, P. (2007), Free Statistics Software, Office for Research Development and Education, version 1.1.21, URL http://www.wessa.net/

Enter (or paste) two different data series delimited by hard returns.

Pearson Product Moment Correlation - Monitoring Report - Lab Data with Bio Clean Data Point (weight)		
Statistic	Variable Y	Variable X
Mean	128.886667	39.866667
Variance	117954.5665	11085.18222
Standard Error	343.445143	105.286192
Covariance		36147.15156
Correlation		0.999644
Determination		0.999288
T-Test		135.052132
Critical 2-sided T-value (5%)		2.16
2-sided p-value		0
Critical 1-sided T-value (5%)		1.771
1-sided p-value		0
Degrees of Freedom		13
Observations		15

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2	14.60
3	11.40
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2	11.20
53	184.30
22	61.60
2	10.00
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1	3.40
2	5.20
2	7.20
3	6.60
429	1400.00
346.00	1128
396.00	1292
285.00	929
293.00	956
300.00	978
216.00	704
292.00	952
244.00	796
230.00	750
292.00	952
257.00	838
221.00	721
255.00	832
269.00	877
222.00	724
278.00	907
213.00	695
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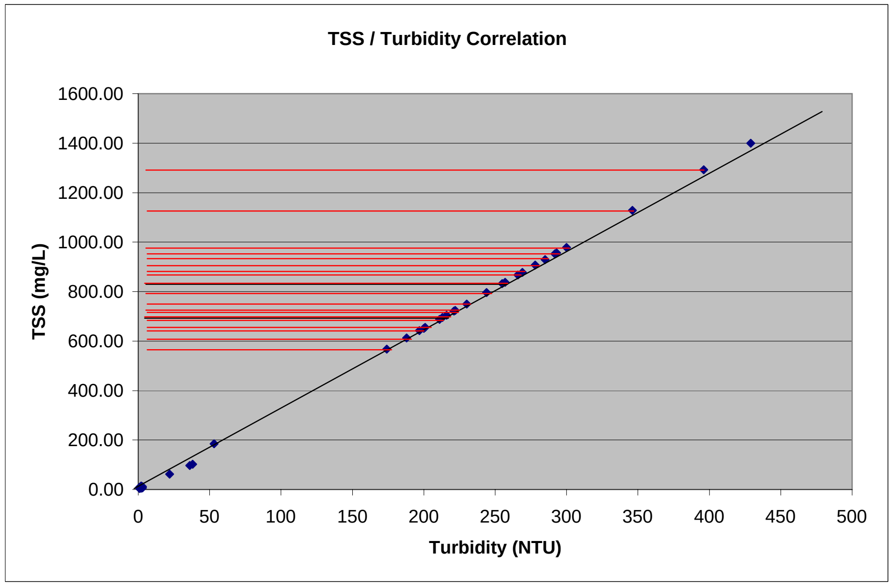
201.00	655
174.00	567
188.00	613
211.00	688
197.00	642
200.00	652



X-TEX ENVIRONMENTAL INNOVATIONS

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Email:
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Physical Test Data- To understand all the physical properties of the X-TEX blanket and to help in developing other applications additional physical testing was conducted.

The table below is a summary of those tests.

Physical Test Results of the X-TEX Blanket

Test	Method	Units	Result
Thickness	ASTM D5199	Mills	115.5
Mass Per Unit Area	ASTM 5261	oz/yd	8.0
Grab Tensile MD	ASTM D4632	lbs	56
Grab Tensile TD	ASTM D4632	lbs	66
Elongation at Peak MD	ASTM D4632	percent	102
Elongation at Peak TD	ASTM D4632	percent	96
Wide Width Tensile MD	ASTM D4595	lbs/in	19
Wide Width Tensile TD	ASTM D4595	lbs/in	24
Elongation at break MD	ASTM D4595	percent	75
Elongation at break TD	ASTM D4595	percent	73
Pucture Resistance	ASTM D4833	lbs	54
Trapezoid Tear Strength MD	ASTM D4533	lbs	26
Trapezoid Tear Strength TD	ASTM D4533	lbs	29
Mullen Burst Strength	ASTM D3786	psi	135
Permittivity(Constant Head)	ASTM D4491	sec-1	1.42
Permeability	ASTM D4491	cm/sec	0.36
Flow Rate	ASTM D4491	gal/ft2	106
Apparent Opening Size	ASTM D4751	mm	100-140
Static Puncture Resistance	ASTM D6241	lbs	175
Wet Sieving	ISO 12956	um	83
Asphalt Retention MD	ASTM D6140	grams/m2	2433
Asphalt Retention TD	ASTM D6140	grams/m2	2305
Note MD = Machine Direction TD = Transverse Direction*			

Total Suspended Solids-Turbidity Correlation in Northeastern Wisconsin Streams

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[1]University of Wisconsin-Green Bay, [2]University of Wisconsin-Milwaukee

http://www.uwgb.edu/watershed

The Lower Fox River watershed monitoring program

AWRA – Wisconsin Section Meeting
Delavan, WI, 3-4 March 2005

Abstract

Knowledge of sediment loading is fundamental to assessing non-point source pollution in streams. The cost of collection and analysis of sediment samples could be reduced if total suspended solids (TSS) can be accurately estimated from continuously monitored turbidity. This poster presents TSS-turbidity correlations for three high sediment-yielding tributaries to the Lower Fox River in northeastern Wisconsin. Continuous turbidity measurements were matched with 195 TSS samples from automated event samplers and manual low-flow samples collected during WY2004. R^2 values for linear regressions exceeded 0.95 for the four sites analyzed. Regressions were site specific and significantly different from each other. Flow did not have a significant effect on the regressions. We hypothesize that differences between sites are due to variances in watershed hydrologic response, soils, bank sediment characteristics and land use/cover. Loads from turbidity-derived TSS concentrations were within 10% of loads calculated using TSS observations.

Introduction and Project Objectives

Estimation of sediment loading in a stream typically requires utilizing automated flow and event samplers to collect a limited number of TSS samples for laboratory analysis. Others have found that continuously monitored turbidity measurements may closely correlate with TSS concentrations in streams (Christensen 2000). Turbidity is a measure of the decrease in transparency of stream water as light is scattered by suspended matter (Ziegler 2002). Because optical sensors can be used to continuously monitor turbidity throughout a storm event, turbidity-derived predictions of TSS may yield an accurate estimate of sediment fluctuations with reduced sample costs. Particle properties, such as color, shape, and size distribution, may impact turbidity readings (Ankcorn 2003). Although general TSS-turbidity relationships have been reported, relationships must be established on a site-by-site basis, and reliability may vary due to water color and suspended particle composition (Packman et al 1999).

This poster presents research conducted on Apple, Ashwaubenon, and Baird Creeks in Northeastern Wisconsin as part of a larger watershed monitoring project (Figure 1). Objectives of this study were to:

1) Establish relationships between real-time turbidity and TSS in Lower Fox River watershed tributaries.
2) Determine if the relationships differed between sites or by flow.
3) Compare turbidity-derived loads to those based on TSS samples.

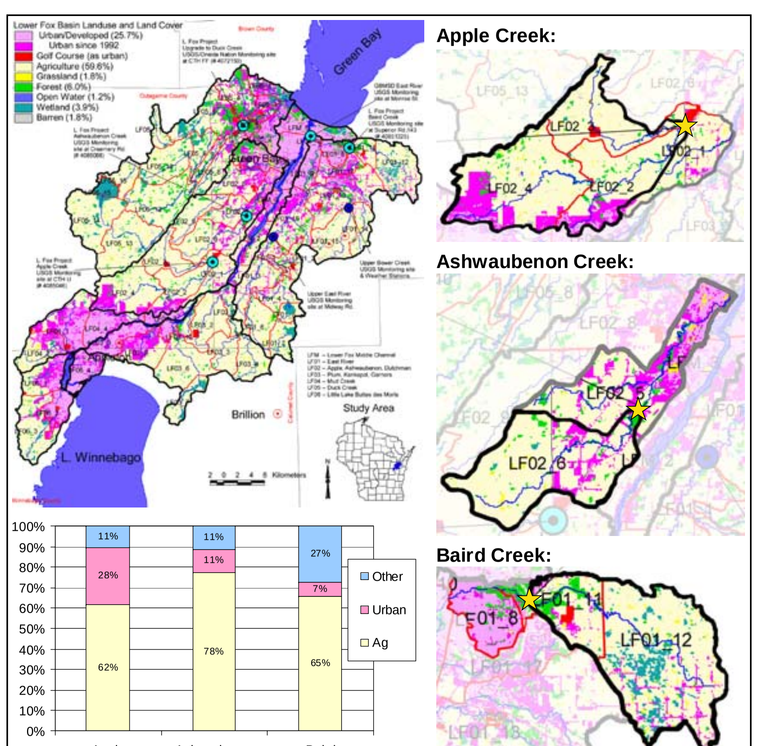

Figure 1. Land use and sampling locations in the Lower Fox River watershed.

Methods

Fully automated flow and water sampling stations were established in cooperation with the Wisconsin USGS Office in 2003. Standard methods were used for gaging streamflow and for collecting, processing, and analyzing water samples (Shelton 1994, Figure 2). Stage-triggered event samples were collected at the USGS gaging stations. In addition, a manually-activated sampler was located at a site upstream of the USGS station on the North Branch of Baird Creek. Biweekly low-flow samples were collected at each site using the equal width increment (EWI) method. YSI-6200 multi-parameter sondes were also deployed at each site and logged T, pH, DO, specific conductance, depth, and turbidity at 10 minute intervals (Figure 3). The optical turbidity sensors had automated wipers to reduce fouling.

Figure 2. Refrigerated ISCO sampler.

Sonde data was processed to exclude anomalous observations due to sediment deposition and equipment-associated false spikes in turbidity. Linear regression analysis was performed using Microsoft Excel 2003 and SAS 9.1 (SAS Institute 2003) to generate predictive relationships between TSS and turbidity. Comparisons were made between sites and between event versus low-flow samples and samples taken on the rising versus falling limbs of flow event hydrographs. There were not sufficient data to test for the significance of seasonality.

Figure 3. YSI-6200 sonde.

Results

Annual precipitation was about 10% below the 30 year average. However, November, May and June were a combined 218 mm (+202%) above average. This rainfall led to several major runoff events during the study period.

Figure 4 shows an example of the automated data and TSS event samples collected at each site. This figure illustrates:

- The dynamic real-time response and variability of turbidity in events.
- The close correlation between turbidity and TSS.
- The need for data processing to remove false-spikes and erratic responses of the optical sensor during high flows.

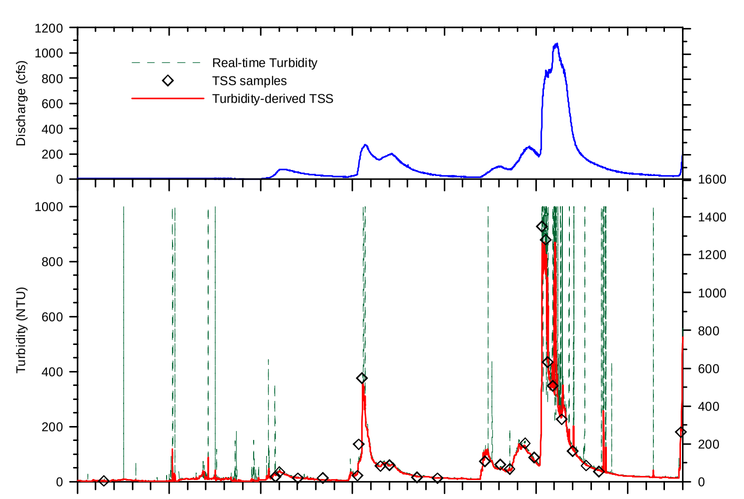

Figure 4. Discharge, TSS concentration, and turbidity data from 28 to 31 April 2004 at the Apple Creek USGS Station.

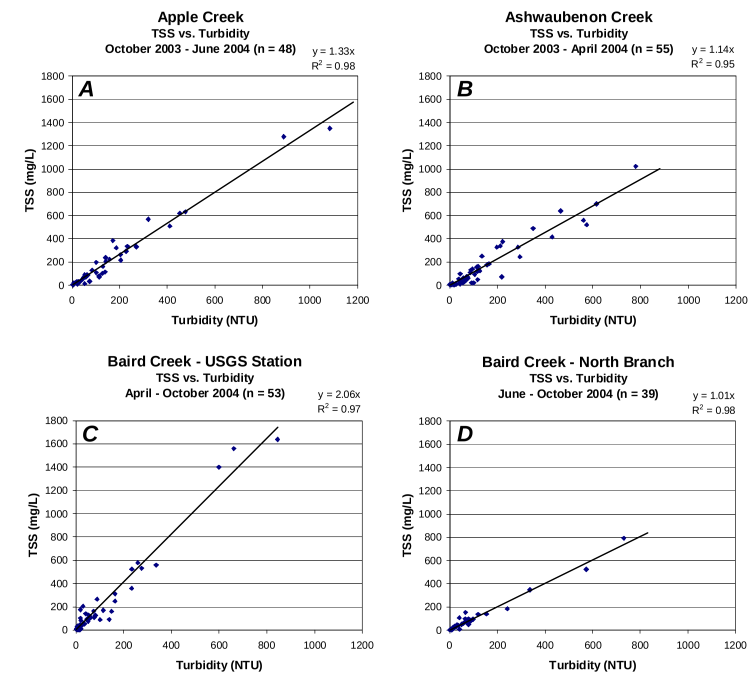

Figure 5. TSS-turbidity relationships for Apple Creek (A), Ashwaubenon Creek (B), Baird Creek USGS Station (C) and the Baird Creek North Branch site (D).

Linear regressions for the four sites are presented in Figure 5. The results show the following:

- The relationship between TSS and turbidity was highly significant at the 0.05 confidence level for all four sites.
- The slope of the TSS vs. turbidity line ranged from 1.01 to 2.06.
- In no case was the intercept significantly different from zero.
- All TSS-turbidity between-site relationships are significantly different from each other at the 0.05 confidence level.
- The Ashwaubenon-Baird (North Branch) relationship was the closest ($p = 0.0178$ compared to $p < 0.0001$ for all others). Statistically, however, they are different from each other.
- Flow (event vs. low-flow) and hydrograph position (rising vs. falling) did not have a significant effect on the regressions.

Load Comparisons

Real-time turbidity measurements from Apple Creek were processed with an algorithm that replaced observations that were >0.3 standard deviations from the running median with a 70-minute median value. These turbidity values were converted to TSS using the Apple Creek regression (TSS = 1.33 x Turbidity) and matched to 15 minute discharge values to calculate instantaneous and daily loads (Figures 5A, 4). The turbidity-derived TSS loads were compared to loads calculated by USGS scientists using TSS observations and graphical interpolation software (metric tons).

Period	Turbidity Loads	USGS Loads	Difference
14 April – 22 May	312	348	-10.2%
14 April – 30 May	2458	2327	+5.7%
10 – 20 June	1170	1125	+4.0%

Figure 6. Baird Creek at Superior Road during a runoff event, Fall 2003.

Figure 7. Event samples showing sediment concentration change during a storm.

Figure 8. Ashwaubenon Creek during May 2004 storm events: (A) May 14, (B) May 23.

Conclusions

- Turbidity of the three creeks within the Lower Fox River Watershed is highly dynamic, and increased turbidity measurements coincided with runoff events and sharp rises in stream discharge.
- Turbidity and TSS concentrations were highly correlated for our data sets, but the TSS-turbidity relationship appears to be site specific. We hypothesize that these differences result from sediment particle properties and varying hydrological responses from urban and agricultural land uses.
- The two Baird Creek sites displayed the largest difference despite being located only 1 mile apart. A study by Fink et al. (2005) found that development and bank erosion on urbanizing tributaries contributed significant amounts, and likely different, sediment particles above the USGS station but below the North Branch site.
- No significant difference was found due to event vs. low-flow or hydrograph position. The effect of seasonality was not analyzed due to lack of data from equipment fouling.
- Turbidity-derived sediment loads were similar (+/- 10%) to TSS sample load methods.

Continuous turbidity monitoring appears to be a reasonable surrogate for TSS prediction in Apple, Ashwaubenon, and Baird Creeks, and may provide long-term, cost effective and rapidly available information on watershed sediment delivery due to changes in land use. Refining multi-probe sonde deployments for turbidity monitoring could contribute to fewer false spikes and/or equipment fouling and, thus, more complete data sets and higher relationship confidence. Research on suspended particle properties would also provide information needed to better explain site-to-site differences in the TSS–turbidity relationships.

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MONITORING REPORT No. 7
DREDGING AND RECLAMATION PROGRAMME IN KINGSTON HARBOUR

Prepared for:
The Port Authority of Jamaica

Prepared by:
T.E.M.N. Limited
April 4th, 2002

BACKGROUND:

Water quality sampling fieldwork was carried out on March 11, 2002, and data from fixed stations at Middle, Angel, and Bustamante beacons was reviewed.

The sampling exercise carried out on March 11, was intended to provide measurement of TSS (total suspended solids)/turbidity in the channel (H1 and H2) where dredging was in progress.

A monitoring flight took place on 18th March and a selection of the photographs taken are attached.

An inspection of the berm at R1 was carried out on March 13th. The R1 bund preparation continued during the period covered by this report. The first sector was completed and work continued in the extension of the berm by PIHL. Significant plume from this activity was noted in our monitoring flight of March 19. The screen around the berm preparation activity was down at the time of our flight and was being repaired.

METHODOLOGY:

Monitoring on March 11 was carried out in the channel near Port Royal, where the dredge Cristoforo Colombo was operating. Other sites monitored included wake of a small container vessel (Heinrich – Plate 1), a site east of Delbert Sicard beacon, and Angel beacon (Figure 1). In order to assess the impact of dredging, sampling was carried out in an identified plume (Plate 2) as soon as the dredge departed, and the same site was re-sampled approximately ½hr later. The sampling sites were designated KTP 1 – 6 (Table 1).

Table 1: Dredging And Reclamation In Kingston Harbour Water Quality Sampling Sites March 22, 2002

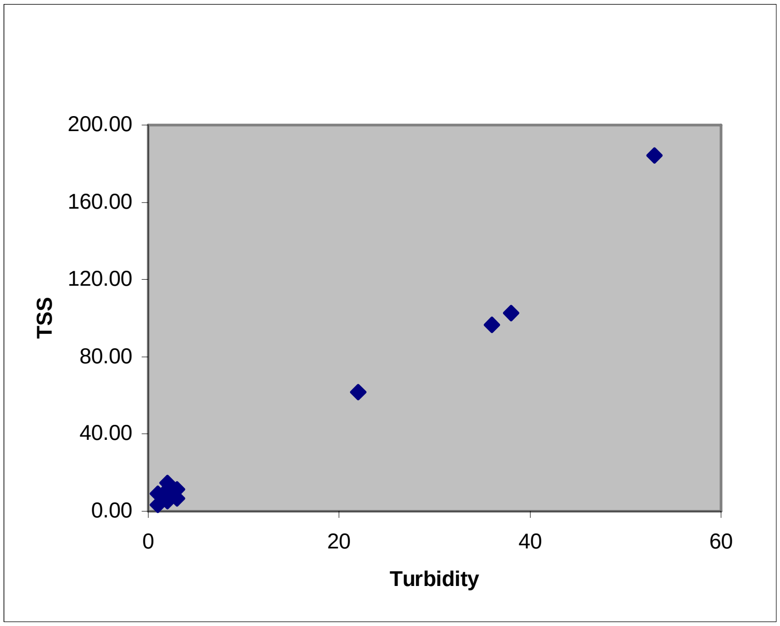
DESCRIPTION N COORD. W COORD	STATION NO.
Wake of Heinrich (Surface) 18^{o} 00.218' 76^{o} 46.736'	1
Dredge Plume North of Dredge 17^{o} 57.417' 76^{o} 50.999'	2
Area recently dredged 17^{o} 57.147' 76^{o} 51.197'	3
West of Delbert Sicard Beacon 17^{o} 56.894' 76^{o} 51.525'	4
Station 3 Resampled 17^{o} 57.150' 76^{o} 51.201'	5
Angel Beacon 17^{o} 57.180' 76^{o} 49.607'	6

Samples were generally collected at three depths (sub-stations) at each site sampled using the Van Dorn sampler. These sub-stations were denoted T (surface sample), M (middle depth), and B (bottom depth). The exception was station 6 - Angel beacon where sampling was confined to the surface.

Samples were analysed by Poly-Diagnostic Centre in accordance with Standard Methods for the Analysis of Water and Waste Water. TSS was determined by filtration of a known sample volume through a dried, pre weighed filter. After filtration, the filter was dried and re-weighed. TSS in mg/l is obtained through a determination of the weight difference of the filter before and after filtration. As a precaution against salt-water interference, filters were rinsed with warm distilled water after filtration of the sample. This precaution was employed in analysing samples collected subsequent to February 18.

Relying on the good correlation between turbidity and TSS determined from the February data (Figure 2) the WQ team was able to collect more samples. Most of these samples were analysed to determine turbidity. TSS was then determined from the plot of TSS vs. turbidity (Figure 2). Turbidity only was determined at Stations 1, 2, and 4, while as a control, turbidity and TSS were measured at stations 3, 5, and 6.

Figure 2: TSS vs Turbidity – February 22nd



OBSERVATION AND RESULTS

During the exercise, sea state was calm, with a light SW wind. There was no visible plume associated with a small container vessel traversing the channel. On approaching sector H1 a plume was observed just north of where the dredge was operating. There was a visible plume remaining after the departure of the dredge.

Laboratory and field data are summarised in Table 2.

Laboratory Results:
Laboratory analysis results indicate a range of TSS for all sites monitored of 3.6–76.1mg/l. The highest values were reported for the dredge site (Station 5) where TSS was determined to be 34.0mg/l at the surface, 43.1mg/l at middle depth, and 78.1mg/l at the bottom. At station 2 (fugitive plume) TSS was 12mg/l at the surface, 32.3mg/l at middle depth and 18.2mg/l at the bottom. In the wake of the small container vessel, TSS was 5.5mg/l at the surface, 3.6mg/l at middle depth, and 6.7mg/l at the bottom. At station 5 (dredge site after 30min) TSS was 7.6mg/l at the surface, 14.6mg/l at middle depth, and 69.2mg/l at the bottom. At station 6 TSS was 9.7mg/l at the surface. At station 4 (west of Sicard beacon) TSS was 13.5mg/l at the surface, and 7.8mg/l below the surface.

Table 2: Kingston Container Terminal Water Quality Data March 11, 2002

STATION NO	TIME	DEPTH (M)	LAB. RESULTS TURBIDITY (NTU)	LAB. RESULTS TSS (mg/l)	FIELD DATA* TSS (mg/l)
1T	1030	0.5		5.5	15
1M		6.5		3.6	5
1B		13.0		6.7	20
2T	1050	0.5		12.0	20
2M		6.0		32.3	10
2B		12.0		18.2	10
3T	1057	0.5	6.0	34.0	50
3M		6.0	7.0	43.1	100
3B		12.5	19.0	78.1	300
4T	1112	0.5		13.5	5
4M		5.0		7.8	5
4B		9.5		7.8	10
5T	1129	0.5	1.0	7.6	20
5M		6.0	3.0	14.6	10
5B		12.5	15.0	69.2	150
6T	1148	0.5	1.0	9.7	5
6M		2.0		-	10
6B		4.0		-	50

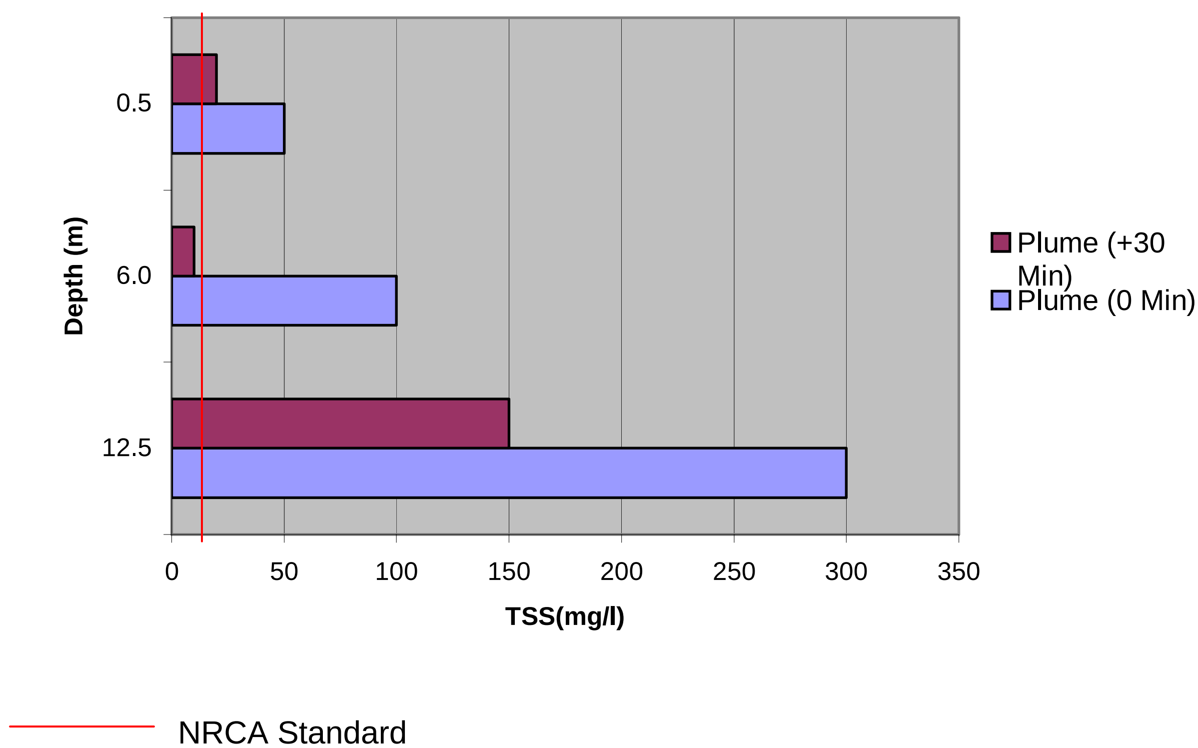
Field Data

Field data collected by Jan De Nul on March 11 indicated a range of 5 – 300mg/l for TSS at the sites monitored. The highest values were determined for Station 3, the dredge site.

At the dredge site TSS was 50mg/l at the surface, 100mg/l at middle depth (6.0M), and 300mg/l at the bottom (12.5M). At this same site approximately thirty minutes later, the values were significantly reduced to 20mg/l at the surface, 10mg/l at middle depth, and 150mg/l at the bottom (Figure 3).

In the wake of the Heinrich, Station 2 TSS was determined to be 15mg/l at the surface, 5mg/l at middle depth (6.5M), and 20mg/l at the bottom (13M).

Figure 3 : TSS Profile at Dredge Site March 11



At Station 3 - the plume north of the dredge site, TSS was determined to be 20mg/l at the surface, and 10mg/l below the surface.

At Station 4 (west of Delbert Sicard beacon), TSS was determined to be 5mg/l at surface and middle, and 10mg/l at the bottom.

At Angel beacon (Station 6) TSS was 5mg/l at the surface, 10mg/l at middle depth (2.0M) and 50mg/l at the bottom (4.0M).

Data from the **fixed stations** indicated a range of 20 – 200mg/l TSS at Middle ground. For March 4, TSS was around 50mg/l increasing to 200mg/l prior to cleaning on March 5. Subsequent to cleaning TSS reading dropped to around 20mg/l increasing to 160mg/l at around 1100 on March 7. TSS remains high even after cleaning on March 8. After cleaning on March 9 however, TSS drops to 20mg/l through March 10.

At Bustamante beacon the range for TSS -was 5 – 40mg/l throughout March 4 to March 10.

CONCLUSION/ENVIRONMENTAL IMPACT

Results indicate that effects of the dredging were confined to the channel. The effect was not noticeable at the sampling location to the west of the dredge site or at Angel beacon.

The significant fall off in TSS at the dredge site over a 30 minute period indicates that the impact from dredging on water quality is significant for a relatively short period. The fact that the bottom values are also significantly higher than at the surface suggests that much of the disturbed material settled rapidly.

Data from the fixed stations suggest that impact from TSS is greater at Middle Ground.

Att. O

SOLID WASTE DISPOSAL

72 Bishop Street will contract with a private hauler for removal of solid waste generated within the building. A waste management room is located on the first floor of the building and accessible from an exterior door along the southwest side of the building. The trash hauler will back into the driveway off of Bishop Street. The hauler will wheel container units to the truck. These units will provide recycling and solid waste disposal.

Please refer to the trash demand analysis for estimated needs.

SNOW REMOVAL

72 Bishop Street will contract with a snow plow company to maintain driveway and sidewalk access after snow storms. Snow can be piled at the edge of the parking lot as shown on the plan or, in extreme situations, hauled off site. Snow will not be placed in wetland areas.

72 Bishop Street TRASH ANALYSIS		
The following analysis is based on MaineHousing guideline of 0.25 cubic yards per week per bedroom. Recycling based on experience of PineTree Waste and Avesta.		
NEEDED TRASH CAPACITY		
		Cubic Yards
# Bedrooms		30
times 0.25 cu. yd. per BR		7.5
TOTAL NEEDED (rounded up)		
without recycling program		**8**
NEEDED RECYCLE CAPACITY		
Max 45% of trash volume		3.6
Max Recycling Capacity		**4**
Min 30% of trash volume		2.4
Minimum Recycling Capacity		**2**
Total Yards Trash with recycling		**6**
PROPOSED DUMPSTER CAPACITY		
Weekly Collection		
TRASH	4 yards	
RECYCLING	2 yards	
TOTAL CAPACITY	6 yards	

LIGHT FIXTURES

Site lighting locations are identified on Sheet L2, Layout Plan. Fixture cut sheets are included in this submission.

SSS SERIES POLES

SQUARE STRAIGHT STEEL

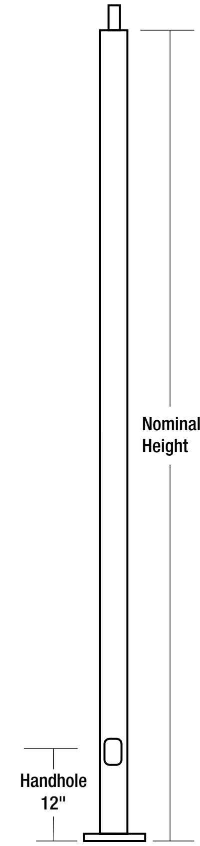
Cat. #		Approvals
Job	Type	

APPLICATIONS

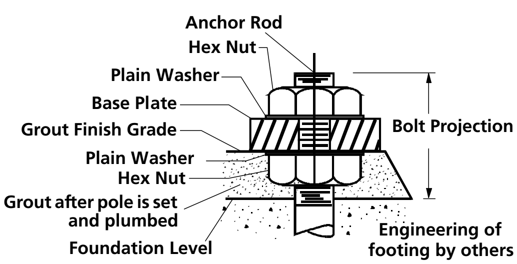
- Lighting installations for side and top mounting of luminaires with effective projected area (EPA) not exceeding maximum allowable loading of the specified pole in its installed geographic location.

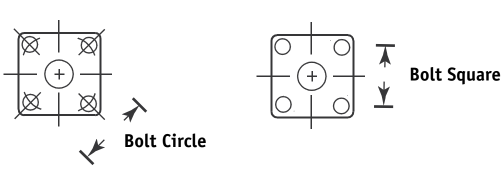
FEATURES

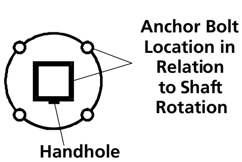
- SHAFT: One-piece straight steel with square cross section, flat sides and minimum 0.36” radius on all corners. Minimum yield of 46,000 psi (ASTM-A500, Grade B). Longitudinal weld seam to appear flush with shaft side wall. Steel base plate with axial bolt circle slots welded flush to pole shaft having minimum yield of 36,000 psi (ATM-A36).
- BASE COVER: Two-piece square aluminum base cover included standard.
- POLE CAP: Pole shaft covered with removable non-metallic cover when applicable. Tenon and post-top configurations also available.
- HAND HOLE: Rectangular steel-reinforced hand hole (2.5” x 4.5”). Pole grounding lug located behind gasketed cover.
- ANCHOR BOLTS: Four galvanized anchor bolts provided per pole with minimum yield of 55,000 psi (modified ASTM-A36). Galvanized hardware with two washers/nuts per bolt for leveling meet or exceed bolt strength.
- FINISH: Durable Lektrocote® TGIC thermoset polyester powder coat paint finish with nominal 3.0 mil thickness. Zinc-rich powder paint prime applied over “white metal” steel substrate cleaned via mechanical shot blast method. Decorative finish coat available in seven standard colors. Custom colors available. RAL number preferable. Internal protective coating available.



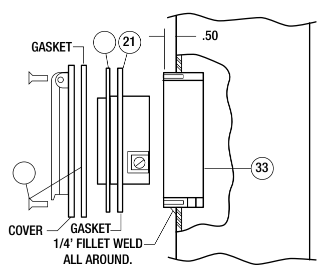
BASE DETAIL







15 AMP GFCI RECEPTACLE & COVER



Q18 OPTION

ORDERING INFORMATION

S	-	S	-	S	-	25	-	40	-	1	-	TA	-	DB
Cross Section		Style		Material		Nominal Length		Nominal Shaft Dia.		Shaft Thickness		Mounting Type		Finish

Catalog Number	Pole Ht. ft	Pole Ht. m	Nominal Shaft Dim.	Wind Load Rating[1] 70 MPH	80 MPH	90 MPH	100 MPH	120 MPH	Wall Thick.	Bolt Circle (Sug.)	Bolt Circle	Bolt Sq.	Base Plate (sq.)	Anchor Bolt Size	Bolt Proj.	Pole Wt (lbs)
SSS-10-40-1-XX-XX	10	3.0	4"	25	25	22	17	11.8	.119"	11"	8 - 11"	5.6 - 7.8"	10.25 x 0.75"	3/4 x 30 x 3"	4"	91
SSS-10-50-1-XX-XX	10	3.0	5"	25	25	25	23	15	.119"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	106
SSS-12-40-1-XX-XX	12	3.7	4"	25	21	16	13.0	8.8	.119"	11"	8 - 11"	5.6 - 7.8"	10.25 x 0.75"	3/4 x 30 x 3"	4"	104
SSS-12-50-1-XX-XX	12	3.7	5"	25	25	23	18	11.8	.119"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	122
SSS-14-40-1-XX-XX	14	4.3	4"	24	18	14.2	11.0	6.8	.119"	11"	8 - 11"	5.6 - 7.8"	10.25 x 0.75"	3/4 x 30 x 3"	4"	116
SSS-14-40-7-XX-XX	14	4.3	4"	25	25	23	18	12.2	.179"	11"	8 1/2 - 12"	6 - 8.4"	11 x 1"	3/4 x 30 x 3"	4"	158
SSS-14-50-1-XX-XX	14	4.3	5"	25	24	19	14.4	9.0	.119"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	138
SSS-16-40-1-XX-XX	16	4.9	4"	16	12.2	9.0	6.8	3.8	.119"	11"	8 - 11"	5.6 - 7.8"	10.25 x 0.75"	3/4 x 30 x 3"	4"	128
SSS-16-40-7-XX-XX	16	4.9	4"	25	20	15	12.2	7.6	.179"	11"	8 1/2 - 12"	6 - 8.4"	11 x 1"	3/4 x 30 x 3"	4"	176
SSS-16-50-1-XX-XX	16	4.9	5"	22	16	12.2	9.2	5.2	.119"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	153
SSS-16-50-7-XX-XX	16	4.9	5"	25	25	24	19	12.4	.179"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	214
SSS-18-40-1-XX-XX	18	5.5	4"	13.8	10.0	7.2	5.2	2.4	.119"	11"	8 - 11"	5.6 - 7.8"	10.25 x 0.75"	3/4 x 30 x 3"	4"	147
SSS-18-40-7-XX-XX	18	5.5	4"	23	17	13.0	10.0	6.0	.179"	11"	10 - 13.5"	7.1 - 9.5"	11 x 1"	3/4 x 30 x 3"	4"	201
SSS-18-50-1-XX-XX	18	5.5	5"	18	13.2	9.6	7.0	3.4	.119"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	175
SSS-18-50-7-XX-XX	18	5.5	5"	25	25	20	16	9.8	.179"	11"	8 1/2 - 12"	6 - 8.4"	12 x 1"	3/4 x 30 x 3"	4"	243
SSS-20-40-1-XX-XX	20	6.1	4"	11.4	8.0	5.6	3.8	1.4	.119"	11"	8 - 11"	5.6 - 7.8"	10.25 x 0.75"	3/4 x 30 x 3"	4"	160
SSS-20-40-7-XX-XX	20	6.1	4"	19	14.6	10.8	8.0	4.4	.179"	11"	8 1/2 - 12"	6 - 8.4"	11 x 1"	3/4 x 30 x 3"	4"	225
SSS-20-50-1-XX-XX	20	6.1	5"	15	10.8	7.6	5.2	2.0	.119"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	191
SSS-20-50-7-XX-XX	20	6.1	5"	25	23	17	13.2	7.6	.179"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	3/4 x 30 x 3"	4"	266
SSS-20-60-7-XX-XX	20	6.1	6"	25	25	24	18	11.2	.179"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1 x 36 x 4"	4"	312
SSS-25-40-1-XX-XX	25	7.6	4"	7.0	4.2	2.2	NR	NR	.119"	11"	8 - 11"	5.6 - 7.8"	10.25 x 0.75"	3/4 x 30 x 3"	4"	190
SSS-25-40-7-XX-XX	25	7.6	4"	13.4	9.4	6.4	4.2	1.4	.179"	11"	8.5 - 12"	6 - 8.4"	11 x 1"	3/4 x 30 x 3"	4"	266
SSS-25-50-1-XX-XX	25	7.6	5"	9.6	6.0	3.4	1.4	NR	.119"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	1 x 36 x 4"	4"	231
SSS-25-50-7-XX-XX	25	7.6	5"	22	15	11.2	7.8	3.4	.179"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	1 x 36 x 4"	4"	324
SSS-25-50-3-XX-XX	25	7.6	5"	25	22	16	12.4	6.6	.250"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	1 x 36 x 4"	4"	437
SSS-25-60-7-XX-XX	25	7.6	6"	25	22	16	11.6	5.6	.179"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1 x 36 x 4"	4"	404
SSS-27-40-7-XX-XX	27	8.2	4"	11.4	7.8	5.0	3.0	NR	.179"	11"	8.5 - 12"	6 - 8.4"	11 x 1"	1 x 36 x 4"	4"	290
SSS-30-40-7-XX-XX	30	9.1	4"	8.2	5.0	2.8	1.2	NR	.179"	11"	8.5 - 12"	6 - 8.4"	11 x 1"	1 x 36 x 4"	4"	313
SSS-30-50-7-XX-XX	30	9.1	5"	14.2	9.4	6.0	3.4	NR	.179"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	1 x 36 x 4"	4"	398
SSS-30-50-3-XX-XX	30	9.1	5"	20	14.6	10.2	6.8	2.4	.250"	11"	10 - 13.5"	7.1 - 9.5"	12 x 1"	1 x 36 x 4"	4"	537
SSS-30-60-7-XX-XX	30	9.1	6"	20	13.8	9.2	5.8	1.2	.179"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1 x 36 x 4"	4"	467
SSS-30-60-3-XX-XX	30	9.1	6"	25	24	17	12.8	6.2	.250"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1.25 x 42 x 6"	4"	630
SSS-35-60-7-XX-XX	35	10.7	6"	14.2	8.4	4.6	1.6	NR	.179"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1 x 36 x 4"	4"	538
SSS-35-60-3-XX-XX	35	10.7	6"	25	17	11.6	7.4	1.8	.250"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1.25 x 42 x 6"	4"	726
SSS-40-60-7-XX-XX	40	12.2	6"	9.0	4.0	NR	NR	NR	.179"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1 x 36 x 4"	4"	614
SSS-40-60-3-XX-XX	40	12.2	6"	18	11.8	6.8	3.2	NR	.250"	12"	11 - 13.5"	7.8 - 9.5"	12 x 1"	1.25 x 42 x 6"	4"	802

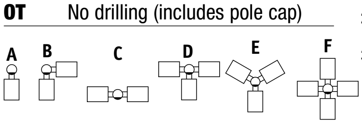
1 Allowable EPA with 1.3 gust factor. To determine max. pole loading weight, multiply allowable EPA by 30 lbs.

NOTE Factory supplied template must be used when setting anchor bolts. Hubbell Lighting will deny any claim for incorrect anchorage placement resulting from failure to use factory supplied template and anchor bolts.

COMPLETE PART NUMBER REQUIRES SHAFT ABOVE PLUS MOUNTING TYPE, FINISH & APPROPRIATE OPTIONS BELOW

MOUNTING TYPE

AX[1]	Side - Single
BX[1]	Side - Double at 90°
CX[1]	Side - Double at 180°
DX[1]	Side - Triple at 90°
FX[1]	Side - Quad at 90°
P1	Pad Mount - Spider Type
P2	Pad Mount - Yoke Type
P3	Pad Mount - Yoke Type (Proformer XL only)
TA	Tenon (2.375" OD)
TB	Tenon (2.875" OD)
TR[2]	Removable Tenon (2.375 x 4.25)
CD	Concord Luminaire
OT	No drilling (includes pole cap)



FINISH

DB	Dark Bronze
BL	Black
WH	White
GR	Gray
PS	Platinum Silver
RD	Red (Premium Color)
FG	Forest Green (Premium Color)
CC	Custom Color (Consult Factory)
PR	Primer Only

1 DRILL PATTERNS: Replace **X** with
1 = Spaulding luminaires with a straight pole (4-bolt),
2 = Cimarron CR1, MSV and Raven Series luminaires.
4 = MSS & DS luminaires,
5 = Spaulding Detroit III luminaires,
6 = DM luminaires

2 Removable tenon used in conjunction with side arm mounting. First specify desired arm configuration followed by the "**TR**" notation. Example: **SSS-25-40-7-C6-TR-DB**

3 Specify option location using logic found on cover.

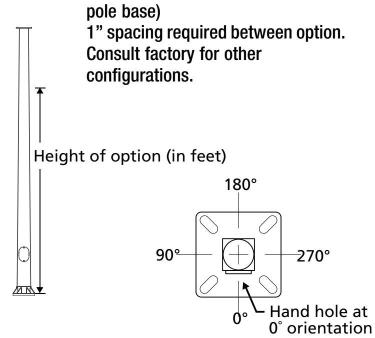
Denotes handhole location

OPTIONS

Q55	Internal Coating (Hubbell Seal)
Q18[3]	15 Amp GFCI Receptacle and Cover
Q22[3]	Extra Handhole
Q26[3]	.5" Coupling
Q27[3]	.75" Coupling
Q30[3]	2" Coupling
Q32[3]	Mid-pole Luminaire Bracket
Q40	Vibration Damper
LAB	Less Anchor Bolts
CSA	CSA Certified (consult factory)

OPTION ORIENTATION

Follow the logic below when ordering location specific options. For each option, include its orientation (in degrees) and its height (in feet). Example: Option Q26 should be ordered as:
SSS-20-40-1-TA-DB-Q26-0-15
(.5" coupling on the handhole/arm side of pole, 15 feet up from the pole base)
1" spacing required between option. Consult factory for other configurations.



Due to our continued efforts to improve our products, product specifications are subject to change without notice.

SPAULDING LIGHTING

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For more information visit our web site: **www.spauldinglighting.com**

Ordering

rev 10.08.2012

Type:

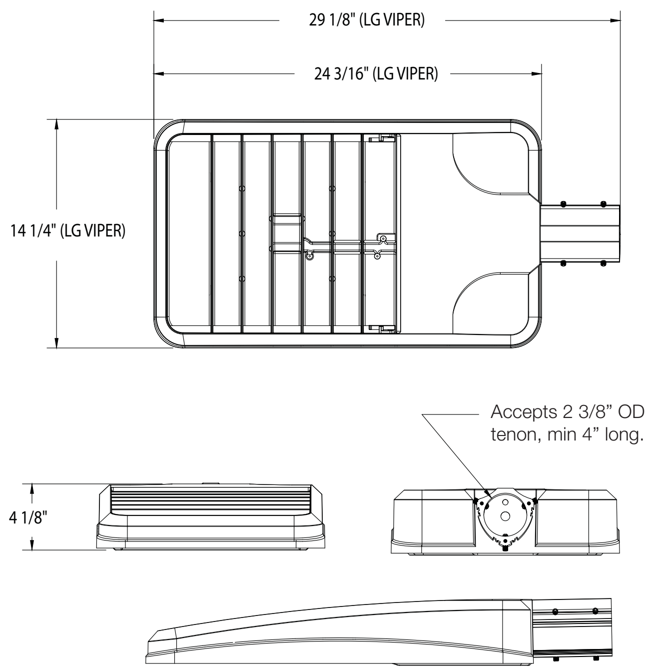
Ordering Code:

Job Name:

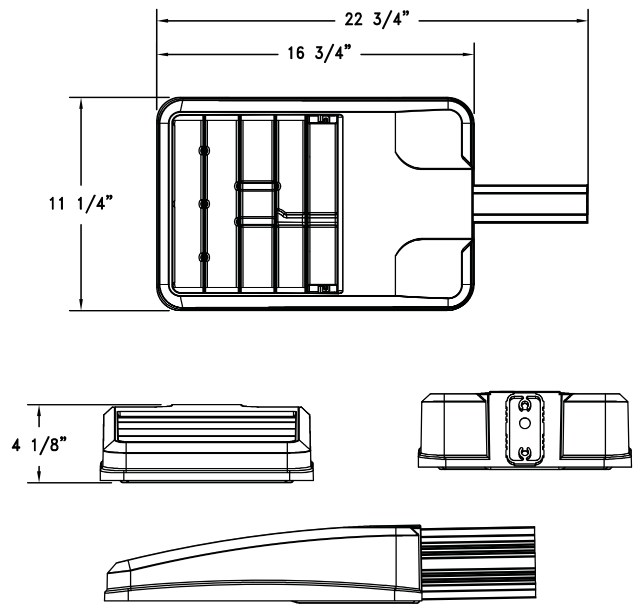
Notes:

VIPER

VP-L (Viper - Large) - *shown with 2" slip fitter (SF2)*	VP-S (Viper - Small) - *shown with rectangular arm (RA)*



weight: 25lbs **epa:** 1 ft^2

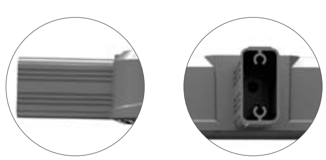


weight: 15lbs **epa:** 0.67 ft^2

ORDERING EXAMPLE: VP-L / 96NB-280 / T5R / UNV / PEC-TL / SF2 / BB

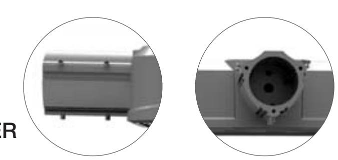
model	engine-watts	optics	voltage	electrical options	mounting	color
VP-S *(small)*	**22NB-50**	**T2** type II	**UNV** 120-277	**PEC-TL** twistlock photocell *(spefiy voltage)*	**SF2** 2-3/8" OD slip-fitter	**BB** black
	22NB-70	**T3** type III	**347**		**PK2** 2-3/8" adjustable knuckle	**BZ** bronze
	30NB-70	**T4** type IV	**480**	**2PF** dual power feed	**RA** rectangular arm	**BW** white
	30NB-90	**T5R** rectangular	**12VDC** *(consult factory)*	standard electrical options	**USA** upswept arm	**BG** green
VP-L *(large)*	**64NB-135**	**T5QW** square wide		LifeShield™ thermal protection	**WB** wall bracket	**BY** gray
	64NB-190	**T5QM** square medium		20k-Surge protection		**MB** metallic bronze
	80NB-180	**T5W** round wide		Dimming Drivers		**MT** metallic titanium
	80NB-235					___ **RAL**
	96NB-220					___ **OTHER**
	96NB-280					

RECTANGULAR ARM



side view *rear view*

2" SLIPFITTER



side view *rear view*

GENERAL: The Beacon Viper luminaire is available in two sizes with a wide choice of different LED wattage configurations and optical distributions designed to replace HID lighting up to 1000W MH or HPS and with 5 different mounting options for application in a wide variety of new and existing installations. Luminaires are suitable for wet locations.

BEZEL OPTICAL SYSTEM: Each Viper luminaire is supplied with an one piece optical cartridge system consisting of an LED engine, LED lamps, optics, gasket and stainless steel bezel. The cartridge is held together with internal brass standoffs soldered to the board so that it can be field replaced as a one piece optical system. Two-piece silicone and microcellular polyurethane foam gasket ensures a weather-proof seal around each individual LED.
The optical cartridge is secured to the die cast housing with fasteners. The optics are held in place without the use of adhesives. The cartridge assembly is available in various lighting distributions using TIR designed acrylic optical lenses over each LED.

LIFESHIELD™ CIRCUIT: Thermal circuit shall protect the luminaire from excessive temperature by interfacing with the 0-10V dimmable drivers to reduce drive current as necessary. The factory-preset temperature limits shall be designed to ensure maximum hours of operation to assure L70 rated lumen maintenance. The device shall activate at a specific, factory-preset temperature, and progressively reduce power over a finite temperature range.

A luminaire equipped with the device may be reliably operated in any ambient temperature up to 55ºC (131ºF). The thermal circuit will allow higher maximum wattages than would be permissible on an unregulated luminaire (if some variation in light output is permissible), without risk of premature LED failure or lumen depreciation. Operation shall be smooth and undetectable to the eye. Thermal circuit shall directly measure the temperature at the LED solder point. Thermal circuit shall consist of surface mounted components mounted on the LED engine (printed circuit board). For maximum simplicity and reliability, the device shall have no dedicated enclosure, circuit board, wiring harness, gaskets, or hardware. Device shall have no moving parts, and shall operate entirely at low voltage. The device shall be located in an area of the luminaire that is protected from the elements. Thermal circuit shall be designed to “fail on”, allowing the luminaire to revert to full power in the event of an interruption of its power supply, or faulty wiring connection to the drivers.
Device shall be able to co-exist with other 0-10V control devices (occupancy sensors, external dimmers, etc.). The device will effectively control the solder point temperature as needed; otherwise it will allow the other control device(s) to function unimpeded.

PRINTED CIRCUIT BOARD (PCB): Aluminum thermal clad board with 0.062” thick aluminum base layer, thermally conductive dielectric layer, 0.0014” thick copper circuit layer circuit layer designed with copper pours to minimize thermal impedance across dielectric. Board will be mounted to the heat sink using minimum 12 #4-40 screws to ensure contact with thermal pad and heat sink. Use of thermal grease will not be allowed.

HOUSING AND LED THERMAL MANAGEMENT: The Viper’ monolithic housing design creates over 4.5 square feet (small Viper) or 7.7 square feet (large Viper) of heat-sinking surface area. Vertical fins, combined with flow-thru openings prevent sediment and moisture buildup on critical heat sinking surfaces without the need for grates, screens or other debris control tactics. The Viper housing, electrical compartment and fitter are made from die cast aluminum that is pre-treated and powder-coated to meet the most rugged industry standards. The finish is corrosion resistant to meet ASTMB-117, resists cracking or loss of adhesion per ASTM D522, resists surface impacts of up to 160 inch-pound. All external hardware is corrosion resistant. The housing serves as a heat-sink for the LED bezel with a separate compartment for the drivers.

ELECTRICAL ASSEMBLY: The fixture electrical compartment shall contain all LED driver components and shall be provided with a push-button terminal block for AC power connections. The housing is designed for an optional twist lock photo control receptacle.

ACCESSIBILITY: Although the Viper luminaire is designed to operate for many years without maintenance, accessibility is a key component in its design. The Drivers are mounted on a removable door that is secured with keyslotted screws and hinges down for convenient access. The drivers are field replaceable using quick disconnects.

DRIVERS: Luminaires are equipped with an LED driver that accepts 100V through 277V, 50 Hz to 60 Hz (UNIV), or a driver that accepts 347V or 480V input. Power factor is .92 at full load. All electrical components are rated at 50,000 hours at full load and 25°C ambient conditions per MIL- 217F Notice 2. Dimming drivers are standard, with connections for external dimming equipment available upon request. Component-to-component wiring within the luminaire may carry no more than 80% of rated load and is listed by UL for use at 600VAC at 50°C or higher. Plug disconnects are listed by UL for use at 600 VAC, 13A or higher. 13A rating applies to primary (AC) side only.

SURGE PROTECTOR: The onboard surge protector shall be a UL recognized component for the United States and Canada and have a surge current rating of 20,000 Amps using the industry standard 8/20 pSec wave. The LSP shall have a clamping voltage of 925V and surge rating of 540J. The case shall be a high-temperature, flame resistant plastic enclosure.

FASTENERS: All fasteners shall be stainless steel. When tamper resistant fasteners are required, spanner HD (snake eye) style shall be provided (special tool required, consult factory).

AGENCY CERTIFICATION: The luminaire shall bear a CSA label and be marked suitable for wet locations.

WARRANTY: Beacon luminaires feature a 5 year limited warranty. Beacon LED luminaires with LED arrays feature a 5 year limited warranty covering the LED arrays. LED drivers are covered by a 5 year limited warranty. PIR sensors carry a 5 year limited warranty from the sensor manufacturer. See Warranty Information on www.beaconproducts.com complete details and exclusions.

Power/Lumens & Distrubutions

Engine	nominal wattage	lumen output (500k) varies by optic	delivered LPW	TM21 reported L95/85C	TM21 calculated L70/85C
VP-S					
VP-S-22NB	50	4700-5300	93-103	60,000	215,000
VP-S-22NB	70	5780-6540	82-93	60,000	215,000
VP-S-30NB	70	6408-7250	91-103	60,000	215,000
VP-S-30NB	90	7700-8717	85-97	60,000	215,000
VP-L					
VP-L-64NB	135	12500-13900	93-103	60,000	215,000
VP-L-64NB	190	16500-18000	86-95	60,000	215,000
VP-L-80NB	180	17000-19000	93-103	60,000	215,000
VP-L-80NB	235	20000-22500	86-95	60,000	215,000
VP-L-96NB	220	20500-22460	93-103	60,000	215,000
VP-L-96NB	280	24700-27000	88-96	60,000	215,000

TM21 is the framework for taking LM-80 data and making useful LED lifetime projections.
Reported and calculated lifetimes shown are based on hours at the time of this printing.
For current Reported and Calculated hours please contact factory of Beacon’s web site.

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Type:	
Project Name:	
Notes:	

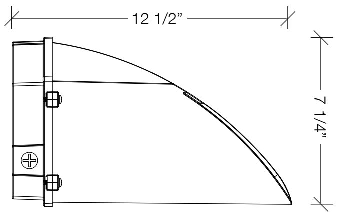
rev. 02.04.2015

TRAVERSE (LED)

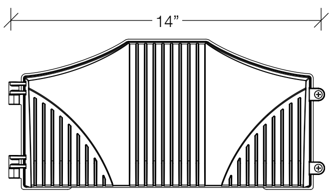
Traverse Wall Pack
Max Weight: 24.0 lbs

	A	B	C	D	E	F	G	H
Sample	*TRV-D*	*60NB-136*	*5K*	*T5R*	*UNV*	*GENIXX*	*PEC*	*BBT*
Ordering	/	/	/	/	/	/	/	

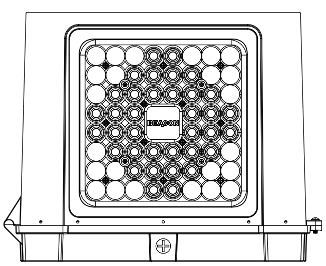
DETAILS

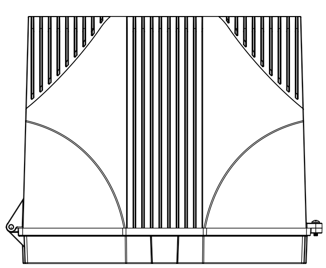


Side View



Front View


Bottom View


Top View

A. MODEL

TRV-D	Traverse down light
TRV-U	Traverse up light (lens req.) [1]

B. ENGINE-WATTS

24NB-27	27 Watts - LED array
24NB-55	55 Watts - LED array
36NB-80	80 Watts - LED array
48NB-110	110 Watts - LED array
60NB-136	136 Watts - LED array

C. CCT - COLOR TEMP

3K	3000K
4K	4000K
5K	5000K (std.)

D. OPTICS

T2	type II
T3	type III
T4	type IV
T5R	type V, rectangular

FLOOD OPTICS

2X2	narrow spot
5X5	medium flood

E. VOLTAGE

UNV	120-277V
347	347V
480	480V

F. CONTROL OPTIONS

GENI-XX	Energeni [7]

G. ELECTRICAL OPTIONS

PEC	photocell, button
2PF	dual power feed [2,3]
MOB	motion sensor 33% or 50% dimming [5,6]
OCS	occupancy sensor (on/off)
BPC	cold weather battery pack [4]

H. COLOR

BBT	basic black textured
BMT	black matte textured
WHT	white textured
MBT	metallic bronze textured
BZT	bronze textured
DBT	dark bronze textured
GYS	gray smooth
DPS	dark platinum smooth
GNT	green textured
MST	metallic silver textured
MTT	metallic titanium textured
OWI	old world iron
RAL	____________

MOB ORDERING INFORMATION: When ordering a fixture with the motion detection option (MOB), please specify the appropriate information. These settings are specified in the ordering as shown in the example below.

TRV-D / 48E-63 / AMB / T5SW / 180 / UNV / **MOB -** 1 to 30 min. **-** 33% or 50% **-** ?? / MT

High to Dim Delay | Low Level | Mounting Height (ft.)

[1] indoor use only
[2] not available on 240NB-27
[3] not available @ 347V or 480V input
[4] 36NB-80 only
[5] not available on 48NB-110
[6] not available on 60NB-136
[7] When ordering Energeni, specify the routine setting code (example GENI-04). See Energeni brochure and instructions for setting table and options. Not available with sensor options.

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TRAVERSE (LED)

Traverse Wall Pack

Max Weight: 24.0 lbs

General: The Beacon TRV luminaire is a wall surface mounted luminaire with a field replaceable LED light engine & optical bezel system. Internal components are totally enclosed in rain-tight and corrosion-resistant die cast aluminum housing. The TRV Luminaire is suitable for wet locations.

Housing/LED Thermal Management: The Beacon TRV luminaire consists of a die cast aluminum two-piece housing. The die cast main (thermal) housing provides direct heat exchange between the LED light engine and the cool outdoor air by drawing heat through integral heat channels and out to the sculptured and functional luminaire surface. LED drivers are thermally isolated from the main housing, mechanically attached and heat sinked to the rear housing The main housing is designed with heat dissipating fins for LED thermal management without the use of metallic screens, cages, or fans. The shape of the main housing is designed to prevent debris accumulation and as a bird nesting deterrent. The back and main housings are designed to hinge open for easy mounting and easy access.

Mounting & Installation: The rear housing (back plate) is designed with various bolt patterns for direct wall mounting or mounting to a recessed 4" junction box. The rear housing has three integral 3/4" NPT power feed locations (bottom and each side) for surface mounted conduit applications. After mounting the rear housing to the wall or junction box, the main housing is designed to hang and hinge closed after connecting the male and female quick connectors. The mounting design permits a simple retrofit to existing wall luminaires that utilize surface mount or recessed junction boxes.

Bezel Optical System: Each Traverse luminaire is supplied with an Optical one piece cartridge system consisting of an LED engine, LED lamps, optics, gasket and stainless steel bezel. The cartridge is held together with internal brass standoffs soldered to the board so that it can be field replaced as a one piece Optical system. A two-piece die cut silicone and polycarbonate foam gasket ensures a weather-proof seal around each individual LED and allows the Traverse luminaire to be rated for high-pressure hose down (IP67) applications.

The optical cartridge is secured to the extruded housing with fasteners and a heat pad to ensure thermal conductivity. The optics are held in place without the use of adhesives and the complete assembly is gasketed for high pressure hose down cleaning. The cartridge assembly is available in various lighting distributions using TIR designed Acrylic optical lenses over each LED.

Printed Circuit Board (PCB): Aluminum thermal clad board with 0.062" thick aluminum base layer "high temperature" HT-06503 or equivalent (subject to change) dielectric (0.003" thick, thermal conductivity of 2.2 W/MK, UL RTI of 140°C) 0.0014" thick copper circuit layer Circuit layer designed with copper pours to minimize thermal impedance across dielectric. Board shall be supplied with QPAD-3 fiberglass reinforced thermal pad 0.005" thick thermal conductivity of 2.0 W/Mk. Continuous use temperature of 180°C UL94 V-0. Board will be mounted to the heat sink using 12 #4-40 screws to ensure contact with thermal pad and heat sink. Use of thermal grease will not be allowed.

LifeShield™ Circuit: (optional) Thermal circuit shall protect the luminaire from excessive temperature by interfacing with its 0-10V dimmable drivers to reduce drive current as necessary. The factory-preset temperature limits shall be designed to ensure maximum hours of operation to assure L70 rated lumen maintenance. The device shall activate at a specific, factory-preset temperature, and progressively reduce power over a finite temperature range in recognition of the effect of reduced current on the internal temperature and longevity of the LEDs and other components.

A luminaire equipped with the device may be reliably operated in any ambient temperature up to 55ºC (131ºF).

The LifeShield™ thermal regulation circuit will allow higher maximum Wattages than would be permissible on an unregulated luminaire (if some variation in light output is permissible), without risk of premature LED failure. Operation shall be smooth and undetectable to the eye. Thermal circuit shall directly measure the temperature at the LED solder point. LifeShield™ shall consist of surface mounted components mounted on the LED engine (printed circuit board). For maximum simplicity and reliability, the device shall have no dedicated enclosure, circuit board, wiring harness, gaskets, or hardware. Device shall have no moving parts, and shall operate entirely at low voltage (NEC Class 2). The device shall be located in an area of the luminaire that is protected from the elements.

LifeShield™ shall be designed to "fail on", allowing the luminaire to revert to full power in the event of an interruption of its power supply, or faulty wiring connection to the drivers.

Device shall be able to co-exist with other 0-10V control devices (occupancy sensors, external dimmers, etc.). The device will effectively control the solder point temperature as needed; otherwise it will allow the other control device(s) to function unimpeded.

Motion Activated Luminaires: Beacon TRV luminaires are available with an optional passive infrared (PIR) motion sensor capable of detecting motion within 24 feet of the sensor, 360° around the luminaire, when placed at an 8 foot mounting height. When no motion is detected for 5 minutes, the Motion Response system reduces the Wattage from 10% to 50% (factory set at 50% reduction) of the maximum Wattage, reducing the light level accordingly. When motion is detected by the PIR sensor, the luminaire returns to full Wattage and full light output. Please contact Beacon Products if project requirements vary from standard configuration.

Electrical: Luminaires are equipped with an LED driver that accepts 100V through 277V, 50 Hz to 60 Hz (UNIV), or a driver that accepts 347V or 480V input. Power factor is .92 at full load. All electrical components are rated at 50,000 hours at full load and 40°C ambient conditions per MIL-217F Notice 2. Optional 0 to 10 volt dimming drivers are available upon request. Component-to-component wiring within the luminaire may carry no more than 80% of rated load and is listed by UL for use at 600VAC at 50°C or higher. Plug disconnects are listed by UL for use at 600 VAC, 15A or higher. 15A rating applies to primary (AC) side only.

Surge Protector: The on-board surge protector shall be a UL recognized component for the United States and Canada and have a surge current rating of 20,000 Amps using the industry standard 8/20 pSec wave. The LSP shall have a clamping voltage of 825V and surge rating of 540J. The case shall be a high-temperature, flame resistant plastic enclosure.

Cold Weather Battery Pack: The emergency driver shall be capable of operating an LED load of up to 23.1 Watts at rated current (700 mA) for a minimum of 90 minutes. It is suitable for damp locations as well as sealed and gasketed fixtures. The BPC shall have 37 Watts of input power and a 54.0 Watts-hour battery capacity and shall comply with emergency standards set forth by the current NEC.

Fasteners: All fasteners shall be stainless steel. When tamper resistant fasteners are required, spanner HD (snake eye) style shall be provided (special tool required, consult factory).

Power Supply/Driver Requirements: U.L. UL1310, Class 2 and UL48 compliant

Color Rendering Index (CRI): Luminaire shall have a minimum CRI of 67 at 5000K.

Operating Environment: Shall be able to operate normally in ambient temperatures from -40°C to 40°C.

Finish: Finish shall be a Beacote V polyester powder-coat electro-statically applied and thermocured. Beacote V finish shall consist of a five stage iron phosphate chemical pretreatment regimen with a polymer primer sealer, oven dry off, and top coated with a thermoset super TGIC polyester powder coat finish. The finish shall meet the AAMA 605.2 performance specification which includes passing a 3000 hour salt spray test for corrosion resistance and resists cracking or loss of adhesion per ASTM D522 and resists surface impacts of up to 160 inch-pound.

Agency Certification: The luminaire shall bear a CSA label and be marked suitable for wet locations.

Warranty: Beacon luminaires feature a 5 year limited warranty. Beacon LED luminaires with LED arrays feature a 5 year limited warranty covering the LED arrays. LED drivers are covered by a 5 year limited warranty. PIR sensors carry a 5 year limited warranty from the sensor manufacturer. See Warranty Information on www.beaconproducts.com complete details and exclusions.

Power/Lumens & Distribution

Engine	Wattage	Delivered Lumens (varies by optic)	Delivered LPW	TM21 Calculated % Lumen Maint. at 100,000 hrs
24NB	27	2752-3014	105-115	96.19%
24NB	55	5138-5500	93-100	96.19%
36NB	80	6935-8215	93-103	94.87%
48NB	110	10240-10950	93-103	92.73%
60NB	136	12800-13700	93-103	85.79%

TM21 is the framework for taking LM-80 data and making useful LED lifetime projections. Reported and Calculated Lifetimes shown are based on hours at the time of this printing. For current Reported and Calculated hours please contact factory or Beacon's web-site.

CCT (COLOR TEMP) Lumen Output Multipliers	CRI (Color Rendering)
5000K = 1.0	min 67 CRI
4000K = .92	min 70 CRI
3000K = .75	min 80 CRI

Due to our continued efforts to improve our products, product specifications are subject to change without notice.

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Type:	
Project Name:	
Notes:	

rev. 02.04.2015

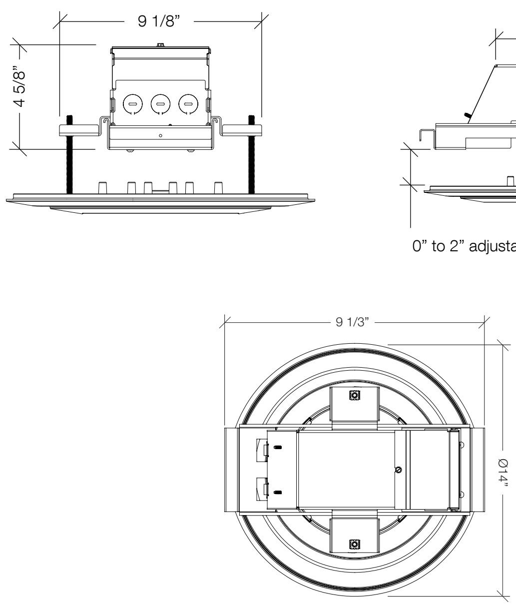
Ceileo (LED)

Recessed Canopy Luminaire

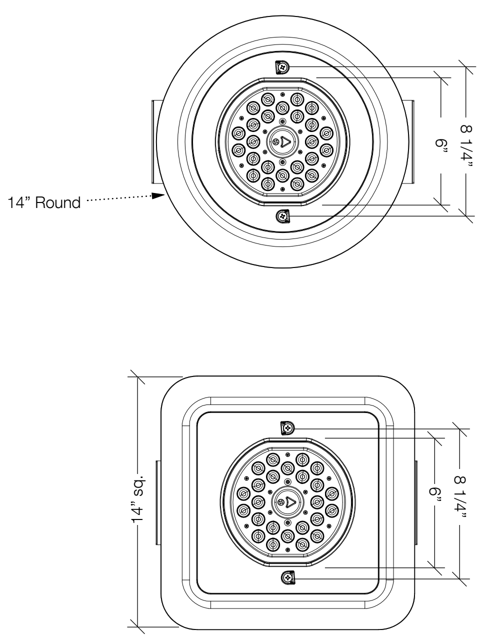
Max Weight: 11 lbs

	A		B		C		D		E		F		G
Sample	*CLO*		*24NB-55*		*5K*		*T5W*		*UNV*		*RD*		*WHT*
Ordering		/		/		/		/		/		/	

HOUSING DIMENSIONS



STYLE DIMENSIONS



A. MODEL

CLO	Ceileo

B. ENGINE-WATTS

24NB-55	55 Watts - LED array

C. CCT - COLOR TEMP

3K	3000K
4K	4000K
5K	5000K *(std.)*

D. OPTICS

5X5	aisle lighter
T5R	type V, rectangular
T5QM	type V, square medium
T5QN	type V, square narrow
T5W	type V, round wide
3x5	vertical flood

E. VOLTAGE

UNV	120-277V

F. STYLE OPTIONS

RD	round
SQ	square

G. COLOR

BBT	basic black textured
BMT	black matte textured
WHT	white textured
MBT	metallic bronze textured
BZT	bronze textured
DBT	dark bronze textured
GYS	gray smooth
DPS	dark platinum smooth
GNT	green textured
MST	metallic silver textured
MTT	metallic titanium textured
OWI	old world iron
RAL	____________

rev. 02.04.2015

Ceileo (LED)

Recessed Canopy Luminaire

Max Weight: 11 lbs

Applications: Ceileo is a commercial grade LED outdoor and indoor canopy downlight that utilizes high powered LEDs utilizing precise efficient optical control and on board wattage and lumen choices. Ceileo is designed to replace up to 175W and 250 Watt HID lamps with 55 watts, and at the same time reduce maintenance by delivery of over 200,000 hours of projected life.

Housing and LED Thermal Management: The Beacon Ceileo luminaire consists of a cast aluminum external housing and recessed driver housing. The cast aluminum housing provides direct-heat exchange between the LED light engine and the cool outdoor air. LED drivers are thermally isolated from the main housing.

The driver and wiring compartments comprise a min 20 gauge corrosion protected steel platform utilizing a J-box with snap-on cover for easy access. Approved for 8 (4 in/4 out) No. 12 AWG conductors rated for 90°C through wiring. The LED cast housing is designed to be easily removed for access and replacement.

LED Light Engine/Bezel: Each Ceileo luminaire is supplied with an optical one piece cartridge system consisting of an LED engine, LED lamps, optics, gasket and stainless steel bezel. The cartridge is held together with internal brass standoffs soldered to the board so that it can be field replaced as a one piece optical system. A die cut foam silicone gasket ensures a weather-proof seal around each individual LED. The cartridge assembly is available in various lighting distributions using TIR designed acrylic optical lenses over each LED.

The Ceileo uses a 24-LED engine that can be field adjusted to four wattages (55, 45, 30,15 watts) and four lumen outputs. The adjustments are made by removing a small screw and using a small screw driver. The light engine comes standard with 70 CRI in 5000k temperature. The Ceileo comes standard with 0-10 OV dimming capability, with flicker-free dimming to 10%.

Institute Thermal Testing: Independent insitute thermal testing shall confirm solder point temperatures not to exceed 55ºC and driver case temperatures not to exceed 60ºC at 55-watts input power. At 30-watts input power solder point temperature shall not exceed 40-C and driver case temperatures not to exceed 55ºC.

Photometrics: The luminaire efficiency rating (LER) shall be a minimum of 95. The luminaire BUG rating shall not exceed B3-U1-G1. Depending on the optic, the peak candle power shall occur at 71 degrees in the vertical shall be no less than 2104. The lumens between 80 to 90 degrees shall not exceed 6%.

Thermal Regulation Circuit: Thermal circuit shall protect the luminaire from excessive temperature by interfacing with its 0-10V dimmable drivers to reduce drive current as necessary. The factory-preset temperature limits shall be designed to ensure maximum hours of operation to assure L70 rated lumen maintenance. The device shall activate at a specific, factory-preset temperature, and progressively reduce power over a finite temperature range in recognition of the effect of reduced current on the internal temperature and longevity of the LEDs and other components.

Operation shall be smooth and undetectable to the eye. Thermal circuit shall directly measure the temperature near the LED solder point. Thermal circuit shall consist of surface mounted components mounted on the LED engine (printed circuit board). For maximum simplicity and reliability, the device shall have no dedicated enclosure, circuit board, wiring harness, gaskets, or hardware. Device shall have no moving parts, and shall operate entirely at low voltage. The device shall be located in an area of the luminaire that is protected from the elements. Thermal circuit shall be designed to "fail on", allowing the luminaire to revert to full power in the event of an interruption of its power supply, or faulty wiring connection to the drivers.

Device shall be able to co-exist with other 0-10V current-sinking control devices (occupancy sensors, external dimmers, etc.). The device will effectively control the solder point temperature as needed; otherwise it will allow the other control device(s) to function unimpeded.

Electrical: Luminaires are equipped with an LED driver that accepts 100V through 277V, 50 Hz to 60 Hz (UNIV). Power factor is min .90 at full load. All electrical components are rated at 50,000 hours at full load and 40ºC ambient conditions per MIL- 217F Notice 2. Component-to -component wiring within the luminaire will carry no more than 80% of rated current and is rated by UL for use at 600VAC at 90°C or higher.

Surge Protector: The on-board surge protector shall be a UL recognized component for the United States and Canada and have a surge current rating of 20,000 Amps using the industry standard 8/20 pSec wave. The LSP shall have a clamping voltage of 825V and surge rating of 540J. The case shall be a high-temperature, flame resistant plastic enclosure.

Fasteners: All fasteners shall be stainless steel. When tamper resistant fasteners are required, spanner HD (snake eye) style shall be provided (special tool required, consult factory).

Color Rendering Index (CRI): Luminaire shall have a minimum CRI of 70 at 5000K.

Operating Environment: Shall be able to operate normally in ambient temperatures from -40˚C to 40˚C.

Finish: Finish shall be a Beacote V polyester powder-coat electro-statically applied and thermocured. Beacote V finish shall consist of a five stage iron phosphate chemical pretreatment regimen with a polymer primer sealer, oven dry off, and top coated with a thermoset super TGIC polyester powder coat finish. The finish shall meet the AAMA 605.2 performance specification which includes passing a 3000 hour salt spray test for corrosion resistance and resists cracking or loss of adhesion per ASTM D522 and resists surface impacts of up to 160 inch-pound.

Agency Certification: The luminaire shall be listed to UL 1598 for use in wet locations.

Warranty: Beacon luminaires feature a 5 year limited warranty. Beacon LED luminaires with LED arrays feature a 5 year limited warranty covering the LED arrays. LED drivers are covered by a 5 year limited warranty. PIR sensors carry a 5 year limited warranty from the sensor manufacturer. See Warranty Information.

Power/Lumens & Distribution

Engine	Wattage	Delivered Lumens (varies by optic)	Delivered LPW	TM21 Calculated % Lumen Maint. at 100,000 hrs
24NB	55	5125-5615	93-100	96.19%

TM21 is the framework for taking LM-80 data and making useful LED lifetime projections. Reported and calculated lifetimes shown are based on hours at the time of this printing. For current reported and calculated hours please contact factory or Beacon's web-site.

CCT (COLOR TEMP) Lumen Output Multipliers	CRI (Color Rendering)
5100K = 1.0	min 67 CRI
4200K = .92	min 70 CRI
3000K = .75	min 80 CRI

Due to our continued efforts to improve our products, product specifications are subject to change without notice.

MTB

Metro LED Bollard

FEATURES

- Each Beacon Metro Bollard is a luminaire with an LED heat sink and an LED engine containing 24 high powered indirect LEDs. Die cast louvers are optional. The LED engine is concealed in shaft to eliminate glare. The optics are narrow beams designed to provide glare free indirect lighting.
- A die cast aluminum dome top secures to a one-piece die cast aluminum top assembly with concealed tamper resistant screws.
- Beacon LED Bollards feature The LED module and heat sink shall be removable and upgradable. The drivers shall be mounted on a removable plate and protected by a 10,000 amp transient surge protector.
- Luminaires are equipped with LED drivers that accepts 100V through 277V, 50 Hz to 60 Hz (UNIV), or a driver that accepts 347V or 480V input. Power factor is .92 at full load.
- The luminaire shall bear a CSA label and be marked suitable for wet locations.

ORDERING INFORMATION

MODEL

MTB	Metro Bollard

HEIGHT (OVERALL)

42	42"
__	Custom

LENS FINISH

AC	Acrylic, Clear
AF	Acrylic, Frosted

ENGINE-WATTS

24NB-55	55 Watts

CCT-COLOR TEMP

5K	5000° K (std.)
4K	4000° K
3K	3000° K

VOLTAGE

UNV	120-277V
347	347V
480	480V
__	Other

OPTICS

IND5	Indirect Type V (360° standard)

TOP OPTIONS

FLT	Flat Top
DMT	Dome Top

OPTIONS

HSS-120	Housing Side Shield 120°
HSS-180	Housing Side Shield 180°
OCS-BI	Microwave Motion Sensor [1]

CONTROL OPTIONS

GENI-XX	Energeni [2]

COLOR

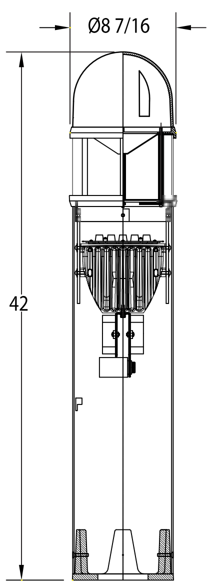
BBT	Basic Black Textured
BMT	Black Matte Textured
WHT	White Textured
MBT	Metallic Bronze Textured
BZT	Bronze Textured
DBT	Dark Bronze Textured
GYS	Gray Smooth
DPS	Dark Platinum Smooth
GNT	Green Textured
MST	Metallic Silver Textured
MTT	Metallic Titanium Textured
OWI	Old World Iron
RAL	____________

[1] **OCS-BI** motion sensor time delay operates ½ LEDs & half power

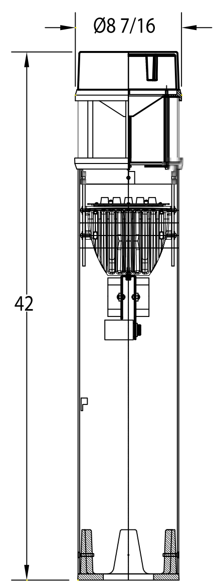
[2] When ordering Energeni, specify the routine setting code (example GENI-04). See Energeni brochure and instructions for setting table and options. Not available with sensor options.

DETAILS

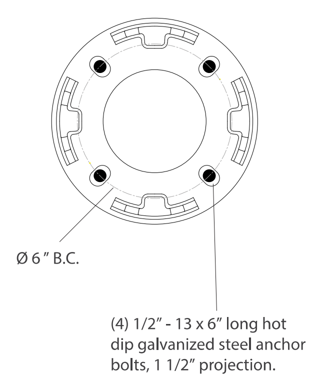
MTB-D



MTB-F



ANCHOR BOLT DETAIL



Environmental Quality Standards

The property is a 52,383 square foot lot with 14,203 SF of forested and shrub scrub wetlands that encumber the southwest portion of the parcel. A small tributary stream begins in the southwest corner of the site that flows southwest. The stream is tributary to Capisic Brook, which has been defined by Maine Department of Environmental Protection (MDEP) as an urban impaired stream. In addition, the City has a watershed management plan in place to protect the watershed.

The project has been developed to minimize the wetland impact and provide a stormwater management plan that responds to the water quality requirements for an urban impaired stream. The total wetland impact will be 3,105 SF. To limit the amount of impact, a retaining wall will be constructed to the extent necessary to construct the limited parking, circulation, underground stormwater treatment infrastructure and safety guard rail. Temporary wetland impacts associated with construction of the wall will be restored to wetland conditions by using saved wetland soils and planting of wetland vegetation.

Att. R

Portland, Maine | Yes. Life's good here.

Portland Police Department

July 11, 2014

Jon Bradley
Associate Director
38 Preble Street
Portland, ME 04101

Sent via email to jbradley@preblestreet.org

Dear Mr. Bradley,

Today I write in support of the successful partnerships between Preble Street Resources and Avesta Housing in providing an exceptional model that offers staff and support to those in need here in Portland. I firmly believe this partnership has increased success rates and improved outcomes for our homeless population.

I understand there is a proposal forthcoming of a housing development opportunity near Morrill's Corner. In light of the process moving forward, I would like to illustrate that a similar development, Logan Place, has successfully served as a tested model with no significant impact on the surrounding neighborhood.

The Portland Police Department believes the working relationship between Preble Street Resources and Avesta Housing continues to provide a valuable service to Portland's homeless population, our visitors, families, friends and neighbors.

Sincerely,

Vernon W. Malloch
Assistant Chief of Police

Att. S

Portland Police Department

Memorandum

To: Helen Donaldson Date: October 10, 2014

From: Asst. Chief Vern Malloch

The Police Department has been asked by Planning Board staff to provide an analysis of calls for service (CFS) at Logan Place, 52 Frederick Street. We have provided raw data showing all the calls for police service from 2005 to September 22, 2014.

Annual CFS in the specified range average 72 with a high of 89 in 2013 and a low of 46 in 2008. As part of the analysis I have reviewed the type of calls and the outcome of some of the more serious call types in order to bring some context to the raw data. A spreadsheet contains the tally for certain call types by year. Not all call types were listed in the spreadsheet. I have focused on those believed to be of significance either because of number or type.

It is important to note that many of the calls fall into the behavioral health or mental health call type. During these calls the role of the police is usually to provide crisis stabilization and assist staff or emergency medical personnel. Call types such as follow ups and check the well-being are often a part of our ongoing efforts in responding to individuals with behavioral health problems.

Between 2005 and 2007 a significant number of CFS related to persons refusing to leave and persons bothering. This number reduced significantly after discussions with staff and policy changes were implemented. These call types remain relatively low in number.

Calls related to drug violations were examined for any patterns. During the period under review there were 38 of these calls. None resulted in arrests or police reports being generated. Five calls reported suspicious activity outside that might have been drug transactions. None were ever substantiated. Six of the calls were suicide attempts or accidental overdoses of prescription medication by residents. The remainder of the drug related CFS were all staff and residents reporting the smell of marijuana coming from various apartments. None of these calls resulted in any police reports or enforcement action. Enforcement of marijuana violations is difficult in residential settings like this because of the use of medical marijuana and an inability to distinguish legal uses from illegal. In 2014 there have been no calls of this nature.

In 2013 and 2014 there were 20 CFS for assaults. This is an alarmingly high number and represents a significant increase over earlier years under review. A closer examination revealed that sixteen of the calls involved the same resident acting as the aggressor toward other residents and staff. He suffers from severe dementia and in many instances he was transported to a hospital for evaluation. Six of the calls resulted in police reports. He was arrested or summonsed several times. None of the assaults resulted in serious injury and the victims never required medical attention. Most of the assaults involved pushing, slapping, or pouring beverages on someone.

In 2014 there were four weapons violations listed. In prior years there had been none. In reviewing the calls two were found to have been reported by residents and involved unknown people on a nearby walking path who were displaying knives or swords. One call was for a person hunting ducks with a firearm along the Fore River. In the fourth incident a resident was arrested for possession of an illegal knife. This was the only weapons call related to Logan Place.

Analysis concludes that calls for service are higher than we would like. On a positive note, few calls resulted in police reports or arrests. None of the CFS were for serious crime types. The majority of CFS examined were generated by staff or residents, not neighbors.

We can anticipate an increase in police calls for service with development of any otherwise vacant parcel. Housing of the chronically homeless as takes place at Logan Place further increases the likelihood of an increase. Data review suggests there has been no negative impact on the neighborhood from a public safety standpoint. Other reports and studies have shown the population targeted for housing in this model draw significantly more police resources when they are homeless.

year	total cfs	RTL/bothe	Behavior	Asst FD	Intox Per	Drugs	Assault	Threat/har	Indecent	Theft	Fight	Weapons
2005	88	29	14	4	6	1	2	6	0	2	0	0
2006	82	23	16	2	4	0	3	3	0	3	1	0
2007	80	15	18	3	5	6	1	4	1	4	0	0
2008	46	4	11	3	2	2	4	3	0	0	0	0
2009	49	4	9	5	2	5	4	1	0	3	0	0
2010	65	5	18	6	0	6	2	3	0	2	0	0
2011	77	11	10	8	4	8	3	4	2	0	0	0
2012	71	4	4	15	1	8	6	5	0	5	1	0
2013	89	7	13	10	1	2	10	4	0	4	1	0
2014	74	6	8	5	6	0	10	1	0	0	2	4