SEBAGO TECHNICS

CIVIL ENGINEERING • SURVEYING • LANDSCAPE ARCHITECTURE

Attachment R

STORMWATER MANAGEMENT PLAN

for

Bay House Phase II
Newbury Street & Hancock Street
Portland, Maine

prepared for

113 Newbury Street, LLC
35 Fay Street, Suite 107B
Boston, MA 02118-4320

Revised
August 29, 2013

STORMWATER MANAGEMENT PLAN
For
Bay House Phase II
Newbury Street & Hancock Street
Portland, Maine

I. Introduction

This Stormwater Management Plan has been prepared to address the potential impacts associated with this project due to the proposed modification in stormwater runoff characteristics. The stormwater management controls that are outlined in this plan have been designed based on commonly accepted engineering methods and to comply with applicable regulatory requirements.

II. Existing Conditions

The site is located on the north side of Newbury Street between India Street & Hancock Street in a commercial/Industrial area of the City. The site is currently used as a parking lot. The parking lot is currently section-off by declining retaining /foundations walls. There are also remains of past building foundations. The surface is combination of asphalt pavement, deteriorating/broken concrete slabs, and gravel pavement. Development area of the site has a moderate slopes ranging from 2% to 7% toward Newbury Street. Stormwater from the site general flow southwesterly down Newbury Street towards India Street.

III. Proposed Development

The Bay House Phase II is a four story structure fronting on Newbury Street. The building is a multi- family structure with 39 units, of which 7 are townhouse units on the ground level, with 32 flats situated on the upper floors. There are 42 parking spaces under and behind the building; a dumpster and bicycle racks are also located in this area. As a result of the proposed improvements, the site will include a development area of approximately 25,168 s.f., of which 8,228 will be new pavement and 16,940 of new building roof area.

IV. Regulatory Requirements

Excerpt from Chapter 500 Stormwater Management Law:

B. General standards.

A project is eligible for an exception from the general standards as follows.

(e) "Stormwater Management Law project including redevelopment. For a project requiring a Stormwater Management Law permit that includes redevelopment of impervious area that was in existence as of November 16, 2005 (the effective date of Chapter 500 revisions), the redevelopment of that impervious area is not required to meet General standards provided the department determines that the new use of the existing impervious area is not likely to increase stormwater impacts resulting from the proposed project's stormwater runoff beyond the level of impact already caused by the runoff from the existing impervious area".

We believe we are exempt, because this is a redevelopment site was in existence prior to November 16, 2005, and the resulting development will not cause any additional stormwater runoff or deteriorate the water quality leaving the site. The actual water quality should improve because the project will be cover with 67% roof area.

V. City of Portland Requirements

The City has asked us to reduce the peak stormwater discharge flows to at or below pre-development rates to coincide with Ocean Gateway stormwater design flow for the treatment tank.

VI. Peak Flow Analysis

This section has been prepared to discuss the management of post-development peak stormwater flow rates. The model was generated to determine peak flows at the existing Drain Manhole at the intersection of Hancock Street and Middle Street.

A. Modeling Technique

To evaluate drainage characteristics in pre-development and post-development conditions, a quantitative analysis was performed to determine peak rates of runoff for the 2-yr, 10-yr, and 25-year storm events. Runoff calculations were performed following the methodology outlined in the United States Department of Agriculture (USDA) Soil Conservation Service's "Urban Hydrology for Small Watersheds, Technical Release #55" and HydroCAD Stormwater Modeling System software. A 24-hour, SCS Type III storm distribution was used for analysis.

The published 24-hour rainfall values for Cumberland County are as follows:

Storm Frequency Precipitation (in./24 hr)	
2-year	3.0
10-year	4.7
25-year	5.5

B. Drainage Characteristics (Pre-Development and Post-Development Watershed Delineation)

To simplify our approach we looked at Bay House II as a separate entity in determining pre & post development peak flow rates. The existing overall watershed by model Woodard & Curran is complex and does not account for areas which have yet to be separated.

Woodard & Curran model suggested a peak runoff for sub-catchment Dev (Bay-House Area) of 1.18cfs for a 1yr storm and 2.63cfs for a 25yr storm. Using these figures as a pre-development peak runoff rate we provided enough subsurface storage to limit discharge below the pre-development rate.

A single study point was utilized to evaluate and compare pre-development and post-development runoff conditions. The study point is located at proposed stormdrain manhole DMH-3 at the intersection Hancock Street & Newbury Street.

The pre & post development area were assumed to be 98% imperious.

A direct entry of 5 minutes was use for a "Time-of-Concentration" for most sub-catchments.

C. Comparison

The watershed delineations, tributary areas and times of concentration associated with the post-development watersheds are different from the pre-development conditions due to the proposed site development, subsurface detention, and grading. Table-1 summarizes the results of the hydrologic analysis and compares pre-development to post-development conditions.

Table 1 – Pre-development vs. Post-development Peak Flow Summary at Hancock St. DMH-3		
	1-year	25-year
	Peak Flow (cfs)	Peak Flow (cfs)
Pre-development PH-2	1.18	2.63
Post-development	1.05	1.83
PH-2	-0.13	-0.80

The result from the table above indicates that the peak rates of runoff in the post-developed condition will decrease slightly. This is a result of subsurface detention.

The existing stormdrain system (24" pipe) in Hancock Street appears to have adequate capacity in a 25yr Storm Event.

IX. Conclusions

This Stormwater Management Plan has been designed with erosion and sedimentation controls, inspection and maintenance procedures and general housekeeping requirements to prevent unreasonable impacts to the surrounding environment and to provide a long-term plan for management of stormwater runoff from the site. Stormwater runoff should be adequately managed for the project if carried out in accordance with the design plans.

Prepared by,

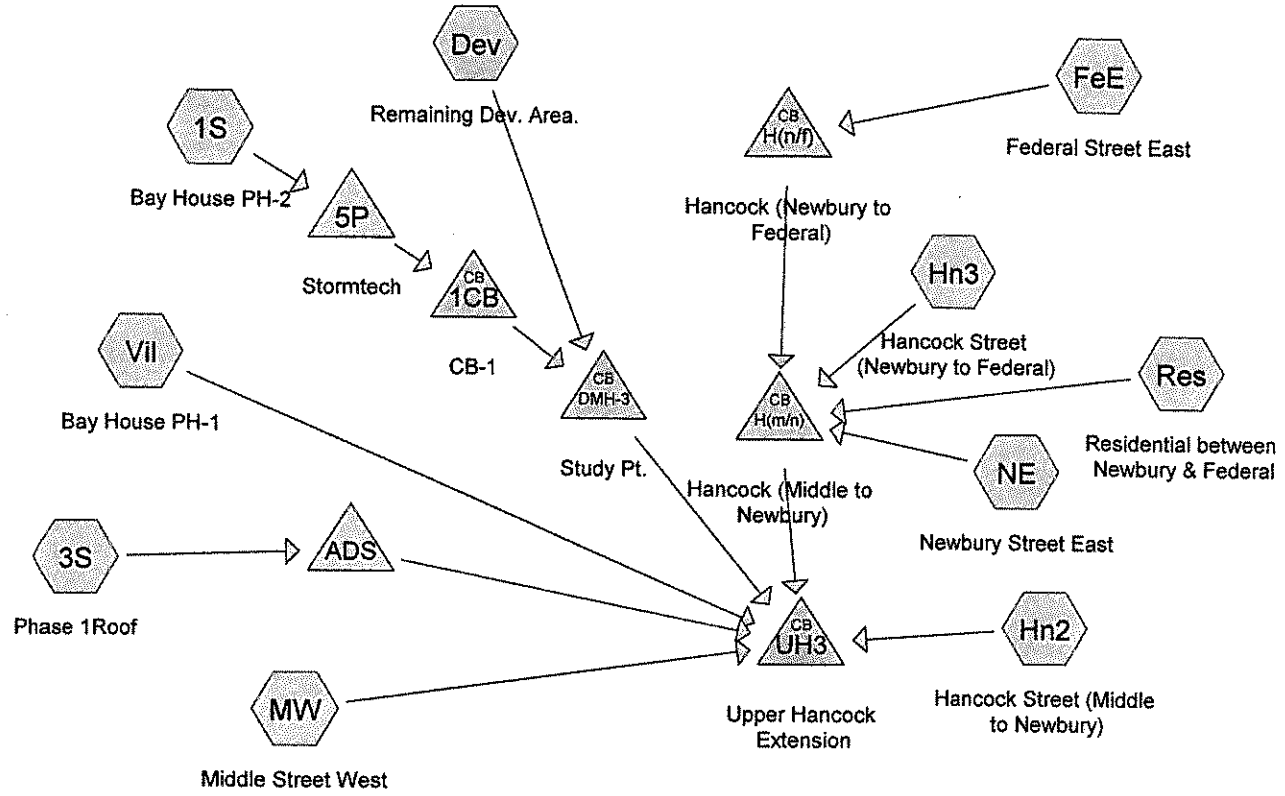
SEBAGO TECHNICS, INC.

Steven A. Groves, CPSWQ
Project Engineer

SAG:jsf
August 3, 2013

Attachment A

Hydrocad Output
Pre- and Post-Development Tr-20 Model



Subcat Reach Pond Link

Drainage Diagram for Hancock Street affects on Ocean Gateway-Full
Prepared by {enter your company name here} 8/30/2013
HydroCAD® 8.00 s/n 001856 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
5.040	98	Paved parking & roofs (1S,3S,Dev,FeE,Hn2,Hn3,MW,NE,Res,Vil)
5.040		

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Bay House PH-2 Runoff Area=0.600 ac Runoff Depth>2.27"
Tc=5.0 min CN=98 Runoff=1.50 cfs 0.113 af

Subcatchment 3S: Phase 1Roof Runoff Area=30,000 sf Runoff Depth>2.27"
Tc=5.0 min CN=98 Runoff=1.72 cfs 0.130 af

Subcatchment Dev: Remaining Dev. Area. Runoff Area=0.190 ac Runoff Depth>2.27"
Flow Length=220' Slope=0.1232 '/' Tc=5.2 min CN=98 Runoff=0.47 cfs 0.036 af

Subcatchment FeE: Federal Street East Runoff Area=0.410 ac Runoff Depth>2.27"
Flow Length=410' Tc=2.3 min CN=98 Runoff=1.13 cfs 0.078 af

Subcatchment Hn2: Hancock Street (Middle to Newbury) Runoff Area=0.280 ac Runoff Depth>2.27"
Flow Length=275' Slope=0.0650 '/' Tc=1.4 min CN=98 Runoff=0.79 cfs 0.053 af

Subcatchment Hn3: Hancock Street (Newbury to Federal) Runoff Area=0.230 ac Runoff Depth>2.27"
Flow Length=185' Tc=1.1 min CN=98 Runoff=0.66 cfs 0.044 af

Subcatchment MW: Middle Street West Runoff Area=0.200 ac Runoff Depth>2.27"
Flow Length=300' Slope=0.0100 '/' Tc=3.3 min CN=98 Runoff=0.53 cfs 0.038 af

Subcatchment NE: Newbury Street East Runoff Area=0.270 ac Runoff Depth>2.27"
Flow Length=425' Tc=2.3 min CN=98 Runoff=0.74 cfs 0.051 af

Subcatchment Res: Residential between Newbury & Federal Runoff Area=1.240 ac Runoff Depth>2.27"
Flow Length=420' Slope=0.0278 '/' Tc=6.0 min CN=98 Runoff=2.99 cfs 0.234 af

Subcatchment Vil: Bay House PH-1 Runoff Area=0.931 ac Runoff Depth>2.27"
Flow Length=240' Slope=0.0740 '/' Tc=5.5 min CN=98 Runoff=2.28 cfs 0.176 af

Pond 1CB: CB-1 Peak Elev=35.21' Inflow=0.59 cfs 0.095 af
15.0" x 303.0' Culvert Outflow=0.59 cfs 0.095 af

Pond 5P: Stormtech Peak Elev=35.41' Storage=2,016 cf Inflow=1.50 cfs 0.113 af
Outflow=0.59 cfs 0.095 af

Pond ADS: Peak Elev=23.40' Storage=571 cf Inflow=1.72 cfs 0.130 af
Primary=0.87 cfs 0.130 af Secondary=0.00 cfs 0.000 af Outflow=0.87 cfs 0.130 af

Pond DMH-3: Study Pt. Peak Elev=31.44' Inflow=1.05 cfs 0.131 af
18.0" x 279.0' Culvert Outflow=1.05 cfs 0.131 af

Pond H(m/n): Hancock (Middle to Newbury) Peak Elev=38.97' Inflow=5.07 cfs 0.407 af
24.0" x 290.0' Culvert Outflow=5.07 cfs 0.407 af

Pond H(n/f): Hancock (Newbury to Federal) Peak Elev=52.48' Inflow=1.13 cfs 0.078 af
18.0" x 180.0' Culvert Outflow=1.13 cfs 0.078 af

Pond UH3: Upper Hancock Extension Peak Elev=20.48' Inflow=10.25 cfs 0.935 af
24.0" x 84.0' Culvert Outflow=10.25 cfs 0.935 af

Total Runoff Area = 5.040 ac Runoff Volume = 0.953 af Average Runoff Depth = 2.27"
0.00% Pervious Area = 0.000 ac 100.00% Impervious Area = 5.040 ac

Subcatchment 1S: Bay House PH-2

Runoff = 1.50 cfs @ 12.07 hrs, Volume= 0.113 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.600	98	Paved parking & roofs
0.600		Impervious Area

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

Subcatchment 3S: Phase 1Roof

Runoff = 1.72 cfs @ 12.07 hrs, Volume= 0.130 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (sf)	CN	Description
30,000	98	Paved parking & roofs
30,000		Impervious Area

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

Subcatchment Dev: Remaining Dev. Area.

Runoff = 0.47 cfs @ 12.07 hrs, Volume= 0.036 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.190	98	Paved parking & roofs
0.190		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	220	0.1232	2.87		**Lag/CN Method,** Contour Length= 1,020' Interval= 1'
3.9					**Direct Entry,**
5.2	220	Total			

Subcatchment FeE: Federal Street East

Runoff = 1.13 cfs @ 12.03 hrs, Volume= 0.078 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.410	98	Paved parking & roofs
0.410		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0450	1.84		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.2	200	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	110	0.0200	9.93	17.56	**Circular Channel (pipe),** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011
2.3	410	Total			

Subcatchment Hn2: Hancock Street (Middle to Newbury)

Runoff = 0.79 cfs @ 12.02 hrs, Volume= 0.053 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.280	98	Paved parking & roofs
0.280		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0650	2.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.6	175	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.4	275	Total			

Subcatchment Hn3: Hancock Street (Newbury to Federal)

Runoff = 0.66 cfs @ 12.02 hrs, Volume= 0.044 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.230	98	Paved parking & roofs
0.230		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0700	2.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	85	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.1	185	Total			

Subcatchment MW: Middle Street West

Runoff = 0.53 cfs @ 12.05 hrs, Volume= 0.038 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.200	98	Paved parking & roofs
0.200		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0100	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.3	300	Total			

Subcatchment NE: Newbury Street East

Runoff = 0.74 cfs @ 12.03 hrs, Volume= 0.051 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.270	98	Paved parking & roofs
0.270		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0400	1.76		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.2	200	0.0175	2.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	125	0.0160	8.89	15.70	**Circular Channel (pipe),** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011
2.3	425	Total			

Subcatchment Res: Residential between Newbury & Federal

Runoff = 2.99 cfs @ 12.08 hrs, Volume= 0.234 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
1.240	98	Paved parking & roofs
1.240		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	420	0.0278	1.55		**Lag/CN Method,** Contour Length= 1,500' Interval= 1'
1.5					**Direct Entry,**
6.0	420	Total			

Subcatchment Vil: Bay House PH-1

Runoff = 2.28 cfs @ 12.08 hrs, Volume= 0.176 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Storm Rainfall=2.50"

Area (ac)	CN	Description
0.931	98	Paved parking & roofs
0.931		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	240	0.0740	2.26		**Lag/CN Method, Lag Method** Contour Length= 3,000' Interval= 1'
3.7					**Direct Entry,**
5.5	240	Total			

Pond 1CB: CB-1

Inflow Area = 0.600 ac, Inflow Depth > 1.91" for 1-Year Storm event
Inflow = 0.59 cfs @ 12.06 hrs, Volume= 0.095 af
Outflow = 0.59 cfs @ 12.06 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min
Primary = 0.59 cfs @ 12.06 hrs, Volume= 0.095 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 35.21' @ 12.06 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	34.80'	**15.0" x 303.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 31.08' S= 0.0123 '/' Cc= 0.900 n= 0.010

Primary OutFlow Max=0.57 cfs @ 12.06 hrs HW=35.20' TW=31.43' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.57 cfs @ 1.69 fps)

Pond 5P: Stormtech

Inflow Area = 0.600 ac, Inflow Depth > 2.27" for 1-Year Storm event
Inflow = 1.50 cfs @ 12.07 hrs, Volume= 0.113 af
Outflow = 0.59 cfs @ 12.06 hrs, Volume= 0.095 af, Atten= 61%, Lag= 0.0 min
Primary = 0.59 cfs @ 12.06 hrs, Volume= 0.095 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 35.41' @ 12.35 hrs Surf.Area= 2,380 sf Storage= 2,016 cf
Flood Elev= 39.15' Surf.Area= 2,380 sf Storage= 5,261 cf

Plug-Flow detention time= 145.2 min calculated for 0.095 af (84% of inflow)
Center-of-Mass det. time= 79.0 min (839.5 - 760.5)

Volume	Invert	Avail.Storage	Storage Description
#1	34.15'	2,046 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 70
			8,330 cf Overall - 3,216 cf Embedded = 5,114 cf x 40.0% Voids
#2	34.65'	3,216 cf	**44.6"W x 30.0"H x 7.12'L StormTech SC-740** x 70 Inside #1
		5,261 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
34.15	34	0	0
37.65	34	119	119

Device	Routing	Invert	Outlet Devices
#1	Primary	34.15'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	36.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.00 cfs @ 12.06 hrs HW=35.19' TW=35.20' (Dynamic Tailwater)
├─**1=Orifice/Grate** (Controls 0.00 cfs)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond ADS:

Inflow Area = 0.689 ac, Inflow Depth > 2.27" for 1-Year Storm event
Inflow = 1.72 cfs @ 12.07 hrs, Volume= 0.130 af
Outflow = 0.87 cfs @ 12.19 hrs, Volume= 0.130 af, Atten= 49%, Lag= 7.3 min
Primary = 0.87 cfs @ 12.19 hrs, Volume= 0.130 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 23.40' @ 12.19 hrs Surf.Area= 880 sf Storage= 571 cf
Flood Elev= 25.50' Surf.Area= 0 sf Storage= 2,262 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 2.9 min (763.4 - 760.5)

Volume	Invert	Avail.Storage	Storage Description
#1	22.50'	2,262 cf	**36.0"D x 20.00'L Horizontal Cylinder** x 16

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**12.0" x 11.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 22.00' S= 0.0136 '/' Cc= 0.900 n= 0.012
#2	Device 1	25.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 5.0' Crest Height
#3	Device 1	22.15'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Secondary	27.10'	**24.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.87 cfs @ 12.19 hrs HW=23.40' TW=20.08' (Dynamic Tailwater)
↑**1=Culvert** (Passes 0.87 cfs of 2.59 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
3=Orifice/Grate (Orifice Controls 0.87 cfs @ 5.01 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=22.50' TW=19.01' (Dynamic Tailwater)
↑**4=Orifice/Grate** (Controls 0.00 cfs)

Pond DMH-3: Study Pt.

Inflow Area = 0.790 ac, Inflow Depth > 1.99" for 1-Year Storm event
Inflow = 1.05 cfs @ 12.06 hrs, Volume= 0.131 af
Outflow = 1.05 cfs @ 12.06 hrs, Volume= 0.131 af, Atten= 0%, Lag= 0.0 min
Primary = 1.05 cfs @ 12.06 hrs, Volume= 0.131 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 31.44' @ 12.06 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.98'	**18.0" x 279.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 18.62' S= 0.0443 '/' Cc= 0.900 n= 0.010

Primary OutFlow Max=1.03 cfs @ 12.06 hrs HW=31.43' TW=20.48' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 1.03 cfs @ 2.29 fps)

Pond H(m/n): Hancock (Middle to Newbury)

Inflow Area = 2.150 ac, Inflow Depth > 2.27" for 1-Year Storm event
Inflow = 5.07 cfs @ 12.05 hrs, Volume= 0.407 af
Outflow = 5.07 cfs @ 12.05 hrs, Volume= 0.407 af, Atten= 0%, Lag= 0.0 min
Primary = 5.07 cfs @ 12.05 hrs, Volume= 0.407 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 38.97' @ 12.05 hrs
Flood Elev= 44.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**24.0" x 290.0' long Culvert** Ke= 0.500 Outlet Invert= 19.11' S= 0.0651 '/' Cc= 0.900 n= 0.011

Primary OutFlow Max=5.07 cfs @ 12.05 hrs HW=38.97' TW=20.45' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 5.07 cfs @ 3.35 fps)

Pond H(n/f): Hancock (Newbury to Federal)

Inflow Area = 0.410 ac, Inflow Depth > 2.27" for 1-Year Storm event
Inflow = 1.13 cfs @ 12.03 hrs, Volume= 0.078 af
Outflow = 1.13 cfs @ 12.03 hrs, Volume= 0.078 af, Atten= 0%, Lag= 0.0 min
Primary = 1.13 cfs @ 12.03 hrs, Volume= 0.078 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 52.48' @ 12.03 hrs
Flood Elev= 58.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**18.0" x 180.0' long Culvert** Ke= 0.500 Outlet Invert= 38.00' S= 0.0778 '/' Cc= 0.900 n= 0.011

Primary OutFlow Max=1.12 cfs @ 12.03 hrs HW=52.47' TW=38.96' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 1.12 cfs @ 2.34 fps)

Pond UH3: Upper Hancock Extension

Inflow Area = 5.040 ac, Inflow Depth > 2.23" for 1-Year Storm event
Inflow = 10.25 cfs @ 12.06 hrs, Volume= 0.935 af
Outflow = 10.25 cfs @ 12.06 hrs, Volume= 0.935 af, Atten= 0%, Lag= 0.0 min
Primary = 10.25 cfs @ 12.06 hrs, Volume= 0.935 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 20.48' @ 12.06 hrs
Flood Elev= 24.91'

Device	Routing	Invert	Outlet Devices
#1	Primary	19.01'	**24.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 16.49' S= 0.0300 '/' Cc= 0.900 n= 0.012

Primary OutFlow Max=10.24 cfs @ 12.06 hrs HW=20.48' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 10.24 cfs @ 4.13 fps)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Bay House PH-2 Runoff Area=0.600 ac Runoff Depth>5.26"
Tc=5.0 min CN=98 Runoff=3.35 cfs 0.263 af

Subcatchment 3S: Phase 1Roof Runoff Area=30,000 sf Runoff Depth>5.26"
Tc=5.0 min CN=98 Runoff=3.84 cfs 0.302 af

Subcatchment Dev: Remaining Dev. Area. Runoff Area=0.190 ac Runoff Depth>5.26"
Flow Length=220' Slope=0.1232 '/' Tc=5.2 min CN=98 Runoff=1.05 cfs 0.083 af

Subcatchment FeE: Federal Street East Runoff Area=0.410 ac Runoff Depth>5.26"
Flow Length=410' Tc=2.3 min CN=98 Runoff=2.52 cfs 0.180 af

Subcatchment Hn2: Hancock Street (Middle to Newbury) Runoff Area=0.280 ac Runoff Depth>5.26"
Flow Length=275' Slope=0.0650 '/' Tc=1.4 min CN=98 Runoff=1.78 cfs 0.123 af

Subcatchment Hn3: Hancock Street (Newbury to Federal) Runoff Area=0.230 ac Runoff Depth>5.26"
Flow Length=185' Tc=1.1 min CN=98 Runoff=1.47 cfs 0.101 af

Subcatchment MW: Middle Street West Runoff Area=0.200 ac Runoff Depth>5.26"
Flow Length=300' Slope=0.0100 '/' Tc=3.3 min CN=98 Runoff=1.19 cfs 0.088 af

Subcatchment NE: Newbury Street East Runoff Area=0.270 ac Runoff Depth>5.26"
Flow Length=425' Tc=2.3 min CN=98 Runoff=1.66 cfs 0.118 af

Subcatchment Res: Residential between Newbury & Federal Runoff Area=1.240 ac Runoff Depth>5.26"
Flow Length=420' Slope=0.0278 '/' Tc=6.0 min CN=98 Runoff=6.68 cfs 0.543 af

Subcatchment Vil: Bay House PH-1 Runoff Area=0.931 ac Runoff Depth>5.26"
Flow Length=240' Slope=0.0740 '/' Tc=5.5 min CN=98 Runoff=5.10 cfs 0.408 af

Pond 1CB: CB-1 Peak Elev=35.34' Inflow=0.99 cfs 0.245 af
15.0" x 303.0' Culvert Outflow=0.99 cfs 0.245 af

Pond 5P: Stormtech Peak Elev=36.44' Storage=3,860 cf Inflow=3.35 cfs 0.263 af
Outflow=0.99 cfs 0.245 af

Pond ADS: Peak Elev=25.26' Storage=2,176 cf Inflow=3.84 cfs 0.302 af
Primary=1.44 cfs 0.302 af Secondary=0.00 cfs 0.000 af Outflow=1.44 cfs 0.302 af

Pond DMH-3: Study Pt. Peak Elev=31.60' Inflow=1.83 cfs 0.328 af
18.0" x 279.0' Culvert Outflow=1.83 cfs 0.328 af

Pond H(m/n): Hancock (Middle to Newbury) Peak Elev=39.58' Inflow=11.35 cfs 0.942 af
24.0" x 290.0' Culvert Outflow=11.35 cfs 0.942 af

Pond H(n/f): Hancock (Newbury to Federal) Peak Elev=52.74' Inflow=2.52 cfs 0.180 af
18.0" x 180.0' Culvert Outflow=2.52 cfs 0.180 af

Pond UH3: Upper Hancock Extension Peak Elev=22.09' Inflow=21.81 cfs 2.191 af
24.0" x 84.0' Culvert Outflow=21.81 cfs 2.191 af

Total Runoff Area = 5.040 ac Runoff Volume = 2.209 af Average Runoff Depth = 5.26"
0.00% Pervious Area = 0.000 ac 100.00% Impervious Area = 5.040 ac

Subcatchment 1S: Bay House PH-2

Runoff = 3.35 cfs @ 12.07 hrs, Volume= 0.263 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.600	98	Paved parking & roofs
0.600		Impervious Area

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

Subcatchment 3S: Phase 1Roof

Runoff = 3.84 cfs @ 12.07 hrs, Volume= 0.302 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (sf)	CN	Description
30,000	98	Paved parking & roofs
30,000		Impervious Area

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

Subcatchment Dev: Remaining Dev. Area.

Runoff = 1.05 cfs @ 12.07 hrs, Volume= 0.083 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.190	98	Paved parking & roofs
0.190		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	220	0.1232	2.87		**Lag/CN Method,** Contour Length= 1,020' Interval= 1'
3.9					**Direct Entry,**
5.2	220	Total			

Subcatchment FeE: Federal Street East

Runoff = 2.52 cfs @ 12.03 hrs, Volume= 0.180 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.410	98	Paved parking & roofs
0.410		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0450	1.84		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.2	200	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	110	0.0200	9.93	17.56	**Circular Channel (pipe),** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011
2.3	410	Total			

Subcatchment Hn2: Hancock Street (Middle to Newbury)

Runoff = 1.78 cfs @ 12.02 hrs, Volume= 0.123 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.280	98	Paved parking & roofs
0.280		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0650	2.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.6	175	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.4	275	Total			

Subcatchment Hn3: Hancock Street (Newbury to Federal)

Runoff = 1.47 cfs @ 12.02 hrs, Volume= 0.101 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.230	98	Paved parking & roofs
0.230		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0700	2.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	85	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.1	185	Total			

Subcatchment MW: Middle Street West

Runoff = 1.19 cfs @ 12.05 hrs, Volume= 0.088 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.200	98	Paved parking & roofs
0.200		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0100	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.3	300	Total			

Subcatchment NE: Newbury Street East

Runoff = 1.66 cfs @ 12.03 hrs, Volume= 0.118 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.270	98	Paved parking & roofs
0.270		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0400	1.76		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.2	200	0.0175	2.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	125	0.0160	8.89	15.70	**Circular Channel (pipe),** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011
2.3	425	Total			

Subcatchment Res: Residential between Newbury & Federal

Runoff = 6.68 cfs @ 12.08 hrs, Volume= 0.543 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
1.240	98	Paved parking & roofs
1.240		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	420	0.0278	1.55		**Lag/CN Method,** Contour Length= 1,500' Interval= 1'
1.5					**Direct Entry,**
6.0	420	Total			

Subcatchment Vil: Bay House PH-1

Runoff = 5.10 cfs @ 12.08 hrs, Volume= 0.408 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.931	98	Paved parking & roofs
0.931		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	240	0.0740	2.26		**Lag/CN Method, Lag Method** Contour Length= 3,000' Interval= 1'
3.7					**Direct Entry,**
5.5	240	Total			

Pond 1CB: CB-1

Inflow Area = 0.600 ac, Inflow Depth > 4.89" for 25-Year Storm event
Inflow = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af
Outflow = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af, Atten= 0%, Lag= 0.0 min
Primary = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 35.34' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	34.80'	**15.0" x 303.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 31.08' S= 0.0123 '/' Cc= 0.900 n= 0.010

Primary OutFlow Max=0.99 cfs @ 12.37 hrs HW=35.34' TW=31.49' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.99 cfs @ 1.97 fps)

Pond 5P: Stormtech

Inflow Area = 0.600 ac, Inflow Depth > 5.26" for 25-Year Storm event
Inflow = 3.35 cfs @ 12.07 hrs, Volume= 0.263 af
Outflow = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af, Atten= 70%, Lag= 18.1 min
Primary = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 36.44' @ 12.37 hrs Surf.Area= 2,380 sf Storage= 3,860 cf
Flood Elev= 39.15' Surf.Area= 2,380 sf Storage= 5,261 cf

Plug-Flow detention time= 105.5 min calculated for 0.245 af (93% of inflow)
Center-of-Mass det. time= 67.6 min (812.7 - 745.1)

Volume	Invert	Avail.Storage	Storage Description
#1	34.15'	2,046 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 70 8,330 cf Overall - 3,216 cf Embedded = 5,114 cf x 40.0% Voids
#2	34.65'	3,216 cf	**44.6"W x 30.0"H x 7.12'L StormTech SC-740** x 70 Inside #1
		5,261 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
34.15	34	0	0
37.65	34	119	119

Device	Routing	Invert	Outlet Devices
#1	Primary	34.15'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	36.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.99 cfs @ 12.37 hrs HW=36.44' TW=35.34' (Dynamic Tailwater)
├─**1=Orifice/Grate** (Orifice Controls 0.99 cfs @ 5.05 fps)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond ADS:

Inflow Area = 0.689 ac, Inflow Depth > 5.26" for 25-Year Storm event
Inflow = 3.84 cfs @ 12.07 hrs, Volume= 0.302 af
Outflow = 1.44 cfs @ 12.29 hrs, Volume= 0.302 af, Atten= 62%, Lag= 12.9 min
Primary = 1.44 cfs @ 12.29 hrs, Volume= 0.302 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 25.26' @ 12.29 hrs Surf.Area= 523 sf Storage= 2,176 cf
Flood Elev= 25.50' Surf.Area= 0 sf Storage= 2,262 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 8.3 min (753.4 - 745.1)

Volume	Invert	Avail.Storage	Storage Description
#1	22.50'	2,262 cf	**36.0"D x 20.00'L Horizontal Cylinder** x 16

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**12.0" x 11.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 22.00' S= 0.0136 '/' Cc= 0.900 n= 0.012
#2	Device 1	25.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 5.0' Crest Height
#3	Device 1	22.15'	**4.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Secondary	27.10'	**24.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.44 cfs @ 12.29 hrs HW=25.26' TW=20.47' (Dynamic Tailwater)
↑**1=Culvert** (Passes 1.44 cfs of 4.82 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
3=Orifice/Grate (Orifice Controls 1.44 cfs @ 8.26 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=22.50' TW=19.01' (Dynamic Tailwater)
↑**4=Orifice/Grate** (Controls 0.00 cfs)

Pond DMH-3: Study Pt.

Inflow Area = 0.790 ac, Inflow Depth > 4.98" for 25-Year Storm event
Inflow = 1.83 cfs @ 12.09 hrs, Volume= 0.328 af
Outflow = 1.83 cfs @ 12.09 hrs, Volume= 0.328 af, Atten= 0%, Lag= 0.0 min
Primary = 1.83 cfs @ 12.09 hrs, Volume= 0.328 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 31.60' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.98'	**18.0" x 279.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 18.62' S= 0.0443 '/' Cc= 0.900 n= 0.010

Primary OutFlow Max=1.83 cfs @ 12.09 hrs HW=31.60' TW=21.92' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 1.83 cfs @ 2.67 fps)

Pond H(m/n): Hancock (Middle to Newbury)

Inflow Area = 2.150 ac, Inflow Depth > 5.26" for 25-Year Storm event
Inflow = 11.35 cfs @ 12.05 hrs, Volume= 0.942 af
Outflow = 11.35 cfs @ 12.05 hrs, Volume= 0.942 af, Atten= 0%, Lag= 0.0 min
Primary = 11.35 cfs @ 12.05 hrs, Volume= 0.942 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 39.58' @ 12.05 hrs
Flood Elev= 44.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.00'	**24.0" x 290.0' long Culvert** Ke= 0.500 Outlet Invert= 19.11' S= 0.0651 '/' Cc= 0.900 n= 0.011

Primary OutFlow Max=11.34 cfs @ 12.05 hrs HW=39.57' TW=22.07' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 11.34 cfs @ 4.27 fps)

Pond H(n/f): Hancock (Newbury to Federal)

Inflow Area = 0.410 ac, Inflow Depth > 5.26" for 25-Year Storm event
Inflow = 2.52 cfs @ 12.03 hrs, Volume= 0.180 af
Outflow = 2.52 cfs @ 12.03 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min
Primary = 2.52 cfs @ 12.03 hrs, Volume= 0.180 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 52.74' @ 12.03 hrs
Flood Elev= 58.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**18.0" x 180.0' long Culvert** Ke= 0.500 Outlet Invert= 38.00' S= 0.0778 '/' Cc= 0.900 n= 0.011

Primary OutFlow Max=2.51 cfs @ 12.03 hrs HW=52.73' TW=39.55' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 2.51 cfs @ 2.92 fps)

Pond UH3: Upper Hancock Extension

Inflow Area = 5.040 ac, Inflow Depth > 5.22" for 25-Year Storm event
Inflow = 21.81 cfs @ 12.06 hrs, Volume= 2.191 af
Outflow = 21.81 cfs @ 12.06 hrs, Volume= 2.191 af, Atten= 0%, Lag= 0.0 min
Primary = 21.81 cfs @ 12.06 hrs, Volume= 2.191 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 22.09' @ 12.06 hrs
Flood Elev= 24.91'

Device	Routing	Invert	Outlet Devices
#1	Primary	19.01'	**24.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 16.49' S= 0.0300 '/' Cc= 0.900 n= 0.012

Primary OutFlow Max=21.81 cfs @ 12.06 hrs HW=22.09' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 21.81 cfs @ 6.94 fps)

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.790	98	Paved parking & roofs (1S,Dev)
0.790		**TOTAL AREA**

Summary for Subcatchment 1S: Bay House PH-2

Runoff = 3.35 cfs @ 12.07 hrs, Volume= 0.263 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.600	98	Paved parking & roofs
0.600		Impervious Area

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

Summary for Subcatchment Dev: Remaining Dev. Area.

Runoff = 1.05 cfs @ 12.07 hrs, Volume= 0.083 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.50"

Area (ac)	CN	Description
0.190	98	Paved parking & roofs
0.190		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	220	0.1232	2.87		**Lag/CN Method,** Contour Length= 1,020' Interval= 1'
3.9					**Direct Entry,**
5.2	220	Total			

Summary for Pond 1CB: CB-1

Inflow Area = 0.600 ac,100.00% Impervious, Inflow Depth > 4.89" for 25-Year Storm event
Inflow = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af
Outflow = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af, Atten= 0%, Lag= 0.0 min
Primary = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 35.34' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	34.80'	**15.0" x 303.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 31.08' S= 0.0123 '/' Cc= 0.900 n= 0.010

Primary OutFlow Max=0.99 cfs @ 12.37 hrs HW=35.34' TW=31.49' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 0.99 cfs @ 1.97 fps)

Summary for Pond 5P: Stormtech

Inflow Area = 0.600 ac,100.00% Impervious, Inflow Depth > 5.26" for 25-Year Storm event
Inflow = 3.35 cfs @ 12.07 hrs, Volume= 0.263 af
Outflow = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af, Atten= 70%, Lag= 18.1 min
Primary = 0.99 cfs @ 12.37 hrs, Volume= 0.245 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 36.44' @ 12.37 hrs Surf.Area= 2,380 sf Storage= 3,860 cf
Flood Elev= 39.15' Surf.Area= 2,380 sf Storage= 5,261 cf

Plug-Flow detention time= 105.5 min calculated for 0.245 af (93% of inflow)
Center-of-Mass det. time= 67.6 min (812.7 - 745.1)

Volume	Invert	Avail.Storage	Storage Description
#1	34.15'	2,046 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 70 8,330 cf Overall - 3,216 cf Embedded = 5,114 cf x 40.0% Voids
#2	34.65'	3,216 cf	**44.6"W x 30.0"H x 7.12'L StormTech SC-740** x 70 Inside #1
		5,261 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
34.15	34	0	0
37.65	34	119	119

Device	Routing	Invert	Outlet Devices
#1	Primary	34.15'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	36.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.99 cfs @ 12.37 hrs HW=36.44' TW=35.34' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.99 cfs @ 5.05 fps)
└—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DMH-3: Study Pt.

Inflow Area = 0.790 ac,100.00% Impervious, Inflow Depth > 4.98" for 25-Year Storm event
Inflow = 1.83 cfs @ 12.09 hrs, Volume= 0.328 af
Outflow = 1.83 cfs @ 12.09 hrs, Volume= 0.328 af, Atten= 0%, Lag= 0.0 min
Primary = 1.83 cfs @ 12.09 hrs, Volume= 0.328 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 31.60' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.98'	**18.0" x 279.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 18.62' S= 0.0443 '/' Cc= 0.900 n= 0.010

Primary OutFlow Max=1.83 cfs @ 12.09 hrs HW=31.60' TW=21.92' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 1.83 cfs @ 2.67 fps)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Bay House PH-2 Runoff Area=0.600 ac 100.00% Impervious Runoff Depth>2.27"
Tc=5.0 min CN=98 Runoff=1.50 cfs 0.113 af

Subcatchment Dev: Remaining Dev. Area. Runoff Area=0.190 ac 100.00% Impervious Runoff Depth>2.27"
Flow Length=220' Slope=0.1232 '/' Tc=5.2 min CN=98 Runoff=0.47 cfs 0.036 af

Pond 1CB: CB-1 Peak Elev=35.21' Inflow=0.59 cfs 0.095 af
15.0" x 303.0' Culvert Outflow=0.59 cfs 0.095 af

Pond 5P: Stormtech Peak Elev=35.41' Storage=2,016 cf Inflow=1.50 cfs 0.113 af
Outflow=0.59 cfs 0.095 af

Pond DMH-3: Study Pt. Peak Elev=31.44' Inflow=1.05 cfs 0.131 af
18.0" x 279.0' Culvert Outflow=1.05 cfs 0.131 af

Total Runoff Area = 0.790 ac Runoff Volume = 0.149 af Average Runoff Depth = 2.27"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.790 ac

Attachment B

Inspection, Maintenance and Housekeeping Plan

07754

INSPECTION, MAINTENANCE, AND HOUSEKEEPING PLAN

The Bay House Phase II
Newbury/Hancock Street
Portland, Maine

Introduction

The owner of the proposed site is 113 Newbury Street, LLC. The owner's address is 113 Newbury Street, LLC, 35 Fay Street, Suite 107B, Boston, MA 02118-4320; the telephone number is (617) 482-3006. The owner of the proposed project will be responsible for the maintenance of all stormwater management structures, the establishment of any contract services required to implement the program, and the keeping of records and maintenance logbook.

The Owner is responsible for conducting maintenance and maintaining records in accordance with this maintenance plan and any conditions of approval imposed by the Planning Board. Records of all inspections and maintenance work accomplished must be maintained.

The following plan outlines the anticipated inspection, maintenance, and housekeeping procedures for the erosion and sedimentation controls as well as stormwater management devices for the project site. Also, this plan outlines several housekeeping requirements that shall be followed during and after construction. These procedures should be followed in order to ensure the intended function of the designed measures and to prevent unreasonable adverse impacts to the surrounding environment.

The procedures outlined in the Inspection, Maintenance, and Housekeeping Plan are provided as an overview of the anticipated practices to be used on this site. In some instances, additional measures may be required due to unexpected conditions. For additional details on any of the erosion and sedimentation control measures or stormwater management devices to be utilized on this project, refer to the most recently revised edition of the "Maine Erosion and Sedimentation Control BMP" manual and/or the "Stormwater Management for Maine: Best Management Practices" manual as published by the MDEP.

During Construction

1. **Inspection:** During the construction process, it is the Contractor's responsibility to comply with the inspection and maintenance procedures outlined in this section. These responsibilities include inspecting disturbed and impervious areas, erosion control measures, materials storage areas that are exposed to precipitation, and locations where vehicles enter or exit the site. These areas shall be inspected at least once a week as well as before and after a storm event, and prior to completing permanent stabilization measures. A person with knowledge of erosion and stormwater control, including the standards and conditions in any applicable permits, shall conduct the inspections.

2. **Maintenance:** All measures shall be maintained in an effective operating condition until areas are permanently stabilized. If Best Management Practices (BMPs) need to be maintained or modified, additional BMPs are necessary, or other corrective action is needed, implementation must be completed within seven (7) calendar days and prior to any storm event (rainfall).

3. **Documentation:** A log summarizing the inspections and any corrective action taken must be maintained on-site. The log must include the name(s) and qualifications of the person making the inspections, the date(s) of the inspections, and major observations about the operation and maintenance of erosion and sedimentation controls, material storage areas, and vehicle access points to the site. Major observations must include BMPs that need maintenance, BMPs that failed to operate as designed or proved inadequate for a particular location, and locations where additional BMPs are needed. For each BMP requiring maintenance, BMP needing replacement, and location needing additional BMPs, note in the log the corrective action taken and when it was taken.

   The log must be made accessible to the appropriate regulatory agency upon request. The permittee shall retain a copy of the log for a period of at least three (3) years from the completion of permanent stabilization.

4. **Specific Inspection and Maintenance Tasks:** The following is a list of erosion control and stormwater management measures and the specific inspection and maintenance tasks to be performed during construction.

   A. <u>Sediment Barriers:</u>

   - Hay bale barriers, silt fences, and filter berms shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.
   - If the fabric on a silt fence or filter barrier should decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, it shall be replaced.
   - Sediment deposits should be removed after each storm event. They must be removed before deposits reach approximately one-half the height of the barrier.
   - Filter berms shall be reshaped as needed.
   - Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required should be dressed to conform to the existing grade, prepared, and seeded.

   B. <u>Temporary Storm Drain Inlet Protection:</u>

   - The inlet protection structure shall be inspected before each rain event and repaired as necessary.
   - Sediment shall be removed and the storm drain sediment barrier restored to its original dimensions when the sediment has accumulated to half of the design depth of the trap.

- Structures shall be removed upon permanent stabilization of the tributary area.
- Upon removal of the structure, all accumulated sediments downstream of the structure shall be cleaned from the storm drain system.

C. Stabilized Construction Entrances/Exits:

- The exit shall be maintained in a condition that will prevent tracking of sediment onto public rights-of-way.
- When the control pad becomes ineffective, the stone shall be removed along with the collected soil material. The entrance should then be reconstructed.
- Areas that have received mud-tracking or sediment deposits shall be swept or washed. Washing shall be done on an area stabilized with aggregate, which drains into an approved sediment-trapping device (not into storm drains, ditches, or waterways).

D. Temporary Seed and Mulch:

- Mulched areas should be inspected after rain events to check for rill erosion.
- If less than 90% of the soil surface is covered by mulch, additional mulch shall be applied in bare areas.
- In applications where seeding and mulch have been applied in conjunction with erosion control blankets, the blankets must be inspected after rain events for dislocation or undercutting.
- Mulch shall continue to be reapplied until 95% of the soil surface has established temporary vegetative cover.

5. **Housekeeping:** The following general performance standards apply to the proposed project.

A. Spill Prevention: Controls must be used to prevent pollutants from being discharged from materials on-site, including storage practices to minimize exposure of the materials to stormwater, and appropriate spill prevention, containment, and response planning and implementation.

B. Groundwater Protection: During construction, liquid petroleum products and other hazardous materials with the potential to contaminate groundwater may not be stored or handled in areas of the site draining to an infiltration area. An "infiltration area" is any area of the site that by design or as a result of soils, topography and other relevant factors, accumulates runoff that infiltrates into the soil. Dikes, berms, sumps, and other forms of secondary containment that prevent discharge to groundwater may be used to isolate portions of the site for the purposes of storage and handling of these materials.

C. Fugitive Sediment and Dust: Actions must be taken to insure that activities do not result in noticeable erosion of soils or fugitive dust emissions during or after construction. Oil may not be used for dust control.

D. Debris and Other Materials: Litter, construction debris, and chemicals exposed to stormwater must be prevented from becoming a pollutant source.

E. Trench or Foundation Dewatering: Trench dewatering is the removal of water from trenches, foundations, cofferdams, ponds, and other areas within the construction area that retain water after excavation. In most cases, the collected water is heavily silted and hinders correct and safe construction practices. The collected water must be removed from the ponded area, either through gravity or pumping, and must be spread through natural wooded buffers or removed to areas that are specifically designed to collect the maximum amount of sediment possible, like a cofferdam sedimentation basin. Avoid allowing the water to flow over disturbed areas of the site. Equivalent measures may be taken if approved.

After Construction

1. **Inspection:** After construction, it is the responsibility of the owner or assigned heirs to comply with the inspection, maintenance, and housekeeping procedures outlined in this section. All measures must be maintained in effective operating condition. A person with knowledge of erosion and stormwater control, including the standards and conditions in all applicable permits, shall conduct the inspections.

2. **Specific Inspection, Maintenance, and Housekeeping Tasks:** The following is a list of permanent erosion control and stormwater management measures and the inspection, maintenance, and housekeeping tasks to be performed after construction.

   A. Vegetated Areas:

   - Inspect vegetated areas, particularly slopes and embankments, early in the growing season or after heavy rains to identify active or potential erosion problems.
   - Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

   B. Catch Basins:

   - Inspect and, if required, clean-out catch basins at least once a year, preferably in early spring.
   - Clean out must include the removal and legal disposal of accumulated sediments and debris at the bottom of the basin, at any inlet grates, at any inflow channels to the basin, and at any pipes between basins.

C. Winter Sanding:

- Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring.
- Accumulations on pavement may be removed by pavement sweeping.
- Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader or other acceptable method.

D. Culverts:

- Inspect culverts in the spring, in the late fall, and after heavy rains to remove any obstructions to flow.
- Remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit.
- Inspect and repair any erosion damage at the culvert's inlet and outlet.

E. Storm Treat Units

- Inspect annually for sediment accumulation and change the inlet grit filter within the sedimentation chamber.
- Remove and dispose of sediment when the depth of sediment within the sediment chamber reaches 6 inches.
- On an annual basis check discharge rate from the units and re-calibrate as necessary to maintain a discharge of 2 gallons per minute per tank.
- Observe the wetland plant conditions during the growing season and supplement plantings, as needed

3. **Documentation:** A log summarizing the inspections and any corrective action taken must be maintained. The log must include the name(s) and qualifications of the person making the inspections, the date(s) of the inspections, and major observations about the operation and maintenance of controls. Major observations must include BMPs that need maintenance, BMPs that failed to operate as designed or proved inadequate for a particular location, and locations where additional BMPs are needed. For each BMP requiring maintenance, BMP needing replacement, and location needing additional BMPs, note in the log the corrective action taken and when it was taken. The log must be made accessible to the appropriate regulatory agency upon request. A sample "Stormwater Inspection and Maintenance Form" has been included as Attachment 1 of this Inspection, Maintenance, and Housekeeping Plan.

Attachments

Attachment 1 – Sample Stormwater Inspection and Maintenance Form

MAINTENANCE LOG

The Bay House Phase II
Newbury/Hancock Street
Portland, Maine

This log is intended to accompany the stormwater Inspection, Maintenance and Housekeeping Plan for the proposed Bay House Phase II at 113 Newbury Street in Portland, Maine. The following items shall be checked, cleaned and maintained on a regular basis as specified in the Maintenance Plan and as described in the table below. This log shall be kept on file for a minimum of five (5) years and shall be available for review by the municipality. Qualified personnel familiar with drainage systems and soils shall perform all inspections. Attached is a copy of the construction and post-construction maintenance logs.

	INSPECTOR NAME	DATE PERFOMRED	SUGGESTED INTERVAL
Vegetated Areas			
Inspect all slopes and embankments			Annually
Replant bare areas or areas with sparse growth			Annually
Roadways and Parking Surfaces			
Clear accumulated winter sand along roadways			Annually
Sweep pavement to remove sediment			Annually
Culverts & Catch Basins			
Remove accumulated sediments and debris at the inlet, outlet, within conduit			Annually
Repair any erosion at inlet and outlet			Annually
Sump Depth			Annually
StormTech			
Inspect Isolator Row for sediment accumulation			Annually
Remove sediment chamber			As needed
Remove and dispose of sediment			As needed