

---

## **Stormwater Management Report**

# ***BHMA Bernon Music Center***

*48 Woodbridge Street*

*South Hadley, Massachusetts 01075*

---

### **Prepared for:**

Berkshire Hills Music Academy  
48 Woodbridge Street  
South Hadley, MA 01075

### **Prepared by:**

Doucet & Associates, Inc.  
136 West Street, Suite 103  
Northampton, MA 01060

### **Project:**

1491-001

### **Submitted on:**

January 22, 2016  
*Revised March 3, 2016*

# Table of Contents

<b>Stormwater Management Report</b> .....	<b>1</b>
Introduction .....	1
Comparison of Pre- and Post-Development Conditions .....	1
Existing Conditions.....	1
Proposed Conditions.....	2
Hydrologic Analysis.....	2
Stormwater Quality.....	3
Regulatory Compliance with MADEP Stormwater Management Standards and Guidelines .....	4

**Exhibits:**

- Exhibit A: Existing Conditions Drainage Areas
- Exhibit B: Proposed Conditions Drainage Areas
- Exhibit C: HydroCAD Model Routing Diagram

**Appendix A – HydroCAD Output for 2-Year Storm Event**

**Appendix B – HydroCAD Output for 10-Year Storm Event**

**Appendix C – HydroCAD Output for 100-Year Storm Event**

**Appendix D – Erosion and Sedimentation Control Plan & Operation and Maintenance Plan**

**Appendix E – Supplemental Calculations**

**Appendix F – Geotechnical Field Investigation Data**

**Appendix G – Illicit Discharge Compliance Statement**

## **INTRODUCTION**

Doucet & Associates, Inc. (D&A), on behalf of Berkshire Hills Music Academy (BHMA), has prepared this Stormwater Management Report for the proposed Bernon Music Center located at 48 Woodbridge Street in the Town of South Hadley. The land is identified by the Assessor's Office as Parcel 52-180.

This parcel is located on the west side of Woodbridge Street (Route 116), near the intersection of Meadow Lane. The proposed project will include an approximately 7,400 square foot building, with associated parking and utility infrastructure. Stormwater management measures will be implemented to balance pre- and post-development peak runoff rates, provide groundwater recharge, and provide water quality treatment for the entire developed area of the site.

This report describes the proposed stormwater management system and details the methodology used in designing the system components.

## **COMPARISON OF PRE- AND POST-DEVELOPMENT SITE CONDITIONS**

In order to evaluate the impact of the proposed site improvements, existing conditions were first considered. Information from an Existing Conditions Survey by Harold L. Eaton and Associates, Inc. showing existing site features and topography was used to delineate subcatchments. The attached Existing and Proposed Drainage Exhibits provide the breakdown of subcatchment areas for the existing and developed site conditions and site drainage characteristics. The HydroCAD Drainage Diagram displays the set-up and routing of each subsubcatchment for existing and proposed conditions to their respective discharge points. An "analysis point" is the furthest downstream point for runoff from any proposed drainage area modifications; the wetland areas to the south and east of the subject parcel.

### **EXISTING CONDITIONS**

The site is located at 48 Woodbridge Street and is zoned Residence A-1. The site is currently used by Berkshire Hills Music Academy, with operations in the historic Skinner Estate house. Additional buildings include a garage and the foundation of a recently demolished barn. Soils at the site are mapped as Windsor Loamy Sand and Agawam Fine Sandy Loam. The development will be built on a three acre portion of parcel 52-180. The existing estate house sits at a local high point; the proposed development area generally slopes downhill, south to north, from elevation 280 to 250. Site slopes vary between 3% and 17%.

Stormwater runoff generated within the proposed development area flows overland to the north and west of the site. The existing site is divided into three subsubcatchments which are summarized in this report.

## **PROPOSED CONDITIONS**

The proposed project will include a  $\pm 7,400$  square foot building, modification and expansion of an existing access drive, associated parking and utility infrastructure. Site access will continue from a secondary entrance off Woodbridge Street. The proposed conditions analyses limits are approximately the same as the existing conditions limits totaling  $\pm 7.6$  acres. There are six subcatchment areas where stormwater runoff is collected and ultimately discharged from the site.

Stormwater is collected from the access drive to an open vegetated swale, which conveys runoff into a rain garden in the northeast corner of the site. The rain garden includes a raised outlet device to mitigate the peak flow rates generated by the 2-, 10-, and 100-year storms. An existing catch basin has also been relocated to accommodate the increased width of the improved access drive. Runoff from this catch basin and the rain garden are then discharged to a final swale to direct runoff away from down-gradient neighbors, improving existing conditions.

Runoff from the rooftop is collected by roof drains and piped to the swale.

Stormwater runoff from the western subcatchment flows overland, mimicking existing conditions. This area was modeled to the extent of surveyed contour limits, however the BHMA property continues for an additional  $\pm 30$  acres in this direction.

## **HYDROLOGIC ANALYSIS**

The Existing and Proposed Conditions Stormwater runoff has been analyzed using the HydroCAD Stormwater modeling computer program. This program utilizes Soil Conservation Service techniques outlined in Technical Release No. 20 (TR-20) to predict Stormwater runoff for given design storms. Evaluations were performed based upon a Type III, 24-hour storm for the 2-, 10- and 100-year storm events. The analysis is performed by modeling the drainage area as subcatchments, reaches and ponds. A subcatchment is an area of land that produces runoff that drains to a reach or a pond. A reach is generally a uniform stream or concentrated storm flow and is often used as analyses evaluation points. A pond is generally defined as a pond, swamp, underground detention/infiltration facility or dam, which impounds water from one or more sources.

Model subcatchments have been delineated using Soil Conservation Service methods. Curve Numbers based upon the type of development and soil classifications were used to estimate the runoff volumes. The time of concentration for each of the subcatchments coupled with the runoff characteristics have been used to generate the peak storm flow for each area. The detailed information and results are included within the Appendices of this report. The following table represents hydrologic model analyses results for both the EXISTING and PROPOSED CONDITIONS:

**Table 1: Summary of Existing and Proposed Flow Rates**

ANALYSIS POINT	STORM EVENT (YR.)	RAINFALL (INCHES)	EXISTING CONDITIONS PEAK FLOW RATE (CFS)	PROPOSED CONDITIONS PEAK FLOW RATE (CFS)	REDUCTION IN PEAK FLOW RATES (CFS)
A - Western	2	3.0	0.00	0.00	0.00
	10	4.5	0.04	0.05	+0.01*
	100	6.4	0.56	0.68	+0.12*
B - Northern	2	3.0	0.01	0.00	0.01
	10	4.5	0.44	0.12	0.32
	100	6.4	3.18	3.17	0.01

Rainfall Data for Hampshire County taken from the MADEP Hydrology Handbook for Conservation Commissioners, Appendix F.

\*The model predicts an extremely small increase of peak flow rates for the Western subcatchment during the 10- and 100-year storm. There is an additional ±30 acres of BHMA property beyond the subcatchment limits. It is D&A's opinion that such slight increases approach zero before reaching abutting properties to the west.

As demonstrated in Table 3, the analysis predicts that peak flow rates discharging from this site for the "PROPOSED CONDITIONS" have been mitigated for each design storm at each analysis point.

**STORMWATER QUALITY**

In order to enhance the quality of Stormwater leaving this site and to comply with the South Hadley Stormwater Management Bylaw and the Stormwater Design Manual, runoff from the proposed access drive will be directed to a rain garden. Pretreatment is provided via the open vegetated swale, or a 5-foot-wide sod strip in the immediate vicinity of the rain garden.

The rain garden is expected to mitigate proposed improvements for peak flow rates, groundwater recharge and water quality as described in this report when compared to existing conditions.

In addition, as required under the provisions of the Clean Water Act, the applicant will be seeking coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit. As such, a detailed Stormwater Pollution Prevention Plan (SWPPP) will be developed and permit coverage attained prior to construction. The SWPPP will further address all short term and long-term Stormwater Management measures to be employed at this site. Erosion and Sediment Control drawings are included within the submitted project drawing set.

## **REGULATORY COMPLIANCE WITH MADEP STORMWATER MANAGEMENT STANDARDS AND GUIDELINES**

The *Massachusetts Wetlands Protection Act* (M.G.L.c.131, s.40) and its implementing Regulations (310 CMR 10.00) set forth specific performance standards for stormwater discharging to a Resource Area or its Buffer Zone. The pertinent performance standards, with explanations of the proposed performance standards and the proposed project's compliance with these standards, have been documented as per the guidance set forth in the *Massachusetts Stormwater Handbook*, and are as follows. Refer to Appendix E for additional supporting calculations:

***Standard #1 - No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.***

No new stormwater conveyances are proposed to discharge untreated stormwater directly to, or cause erosion in, wetlands or waters of the Commonwealth. Stormwater runoff generated on site will be treated with best management practices (BMP's) to achieve sediment and contaminate removal rates prior to final discharge. Proposed BMP's include:

- Open vegetated swale (grassed swale – pretreatment)
- Sod strip (pretreatment)
- Rain Garden

Any stormwater that is not infiltrated will be discharged from the proposed BMP's through rip-rapped end sections to prevent erosion and dissipate energy, thereby protecting the outlet areas from erosion and scour. See Appendix E for supporting sizing calculations.

***Standard #2 - Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.***

Based on the hydraulic analysis, the proposed development is designed to be compliant with Standard 2. The proposed subcatchments have been modeled to analyze the same areas as the existing conditions. As stated in the hydraulic analysis provided within this report, model post-development peak discharge rates have been mitigated. The project is not located within a watershed subject to damage by flooding during the 2-year or 10-year 24-hour storm event, nor is it located adjacent to a water body or watercourse subject to adverse impacts from flooding during the 100-year 24-hour storm event. Refer to Table 1 for the breakdown of peak flow mitigation between the 2-, 10-, and 100-year storm events.

***Standard #3 - Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development site conditions based on soil types.***

The proposed design is anticipated to comply with Standard 3 through recharge from the rain garden. NRCS-mapped soils on site include Windsor Fine Sandy Loam classified as Hydrologic Soil Group "A," and Agawam Fine Sandy Loam classified as Hydrologic Group "B." Geotechnical field investigations were conducted on January 14, 2016. Soil Textural

Analysis confirms that the site is consistent with NRCS maps and depth to seasonal high groundwater was established.

The required recharge volume is 0.6 inches of runoff per impervious square foot. The calculated required recharge volume is 1,215 cf. The rain garden has been designed to store this volume and are expected to fully drain within 72 hours (see supporting calculations in Appendix E). The site is not located adjacent to areas classified as contaminated, sites that have an Activity and Use Limitation (AUL), solid waste landfills, nor is it near a Zone II or Interim Wellhead Protection Area of a public water supply. The project is not located within a basin or sub-basin that has been categorized as under high or medium stress by the Massachusetts Water Resources Commission.

***Standard #4 - For new development, stormwater management systems must be designed to remove 80-percent of the average annual load (post development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when: Suitable non-structural practices for source control and pollution prevention are implemented; Stormwater management best management practices (BMPs) are sized to capture the prescribed runoff volume; and Stormwater management BMPs are maintained as designed.***

Stormwater runoff generated on site will be treated with BMP's to achieve 90% TSS removal prior to final discharge. Proposed BMP's include:

- Open vegetated swale (grassed swale – pretreatment)
- Sod strip (pretreatment)
- Rain Garden

The rain garden is outfitted with a raised outlet device. This allows for greater detention within the rain garden, providing infiltration of the required recharge and water quality volumes, and the mitigation of peak flow rates.

***Standard #5 - Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs (listed in guidelines). The use of infiltration practices without pretreatment is prohibited.***

As the project is not associated with a Land Use with Higher Potential Pollutant load, this standard is not applicable.

***Standard #6 - Stormwater discharges to critical areas must utilize certain stormwater management BMP's approved for critical areas (listed in guidelines). Critical areas are Outstanding Resource Waters (ORW's), shellfish beds, swimming beaches, cold-water fisheries and recharge areas for public drinking water supplies.***

As the site it is not within a Critical Area, this standard is not applicable.

***Standard #7 - Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.***

This is a partially redeveloped site; however, the stormwater system has been designed to meet all Stormwater Management Standards.

***Standard #8 - Erosion and sediment controls must be implemented to prevent impacts during construction and land disturbance activities.***

Erosion and Sedimentation Control Plans (ESCP) have been created to mitigate pollutant sources during construction activities. Notes addressing stabilization of disturbed areas have been included in the plans and provide direction for minimizing disturbed areas. Erosion control silt fence barriers and straw wattles along with other stabilization measures are the primary BMP's used and are shown in order to protect down-gradient areas from suspended sediment. Further, this project will require permit coverage through the US EPA National Discharge Elimination System (NPDES). As such, all erosion and sedimentation design and procedures must comply with all applicable design guidance documents.

***Standard #9 - All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed.***

The Long Term Operation and Maintenance Plan has been created to comply with the required measures set forth in 2008 *MA Stormwater Management Manual*. The aforementioned ESCP in Standard 8 will address any pollution prevention measures not specified within the Long Term Operation and Maintenance Plan. A copy of the Long Term Operation and Maintenance Plan is provided in Appendix D and shall become part of the ownership documents for onsite BMP's. As part of the plan, a complete description of the protocols for installation, maintenance, and cleaning of each BMP has been included.

***Standard #10 – All illicit discharges to the stormwater management system are prohibited.***

No known or suspected illicit discharges are conveyed to or through the stormwater management system at the project site. Measures to prevent illicit discharges have been implemented as part of the Operation and Maintenance Plan. An Illicit Discharge Compliance Statement is included in Appendix G. Refer to the full site plan set for the locations of all drainage systems and wastewater management practices.

EXHIBITS

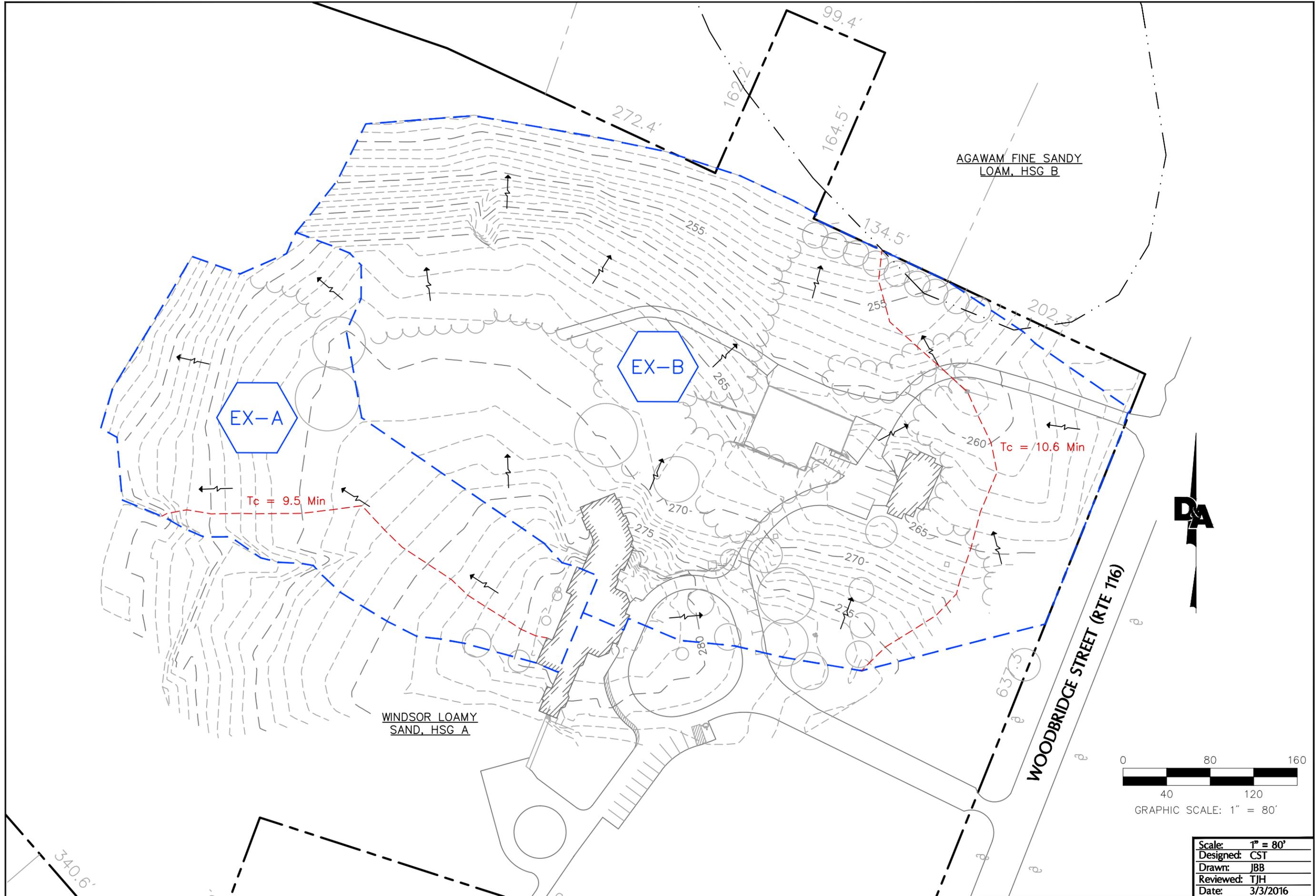
EXHIBIT A: EXISTING CONDITIONS DRAINAGE AREAS

EXHIBIT B: PROPOSED CONDITIONS DRAINAGE AREAS

EXHIBIT C: HYDROCAD ROUTING DIAGRAM

P:\1491-001\engineering\drainage\1491-001\_DR.dwg  
User: JBB  
Plot Date/Time: Mar. 03, 16 - 15:46:32

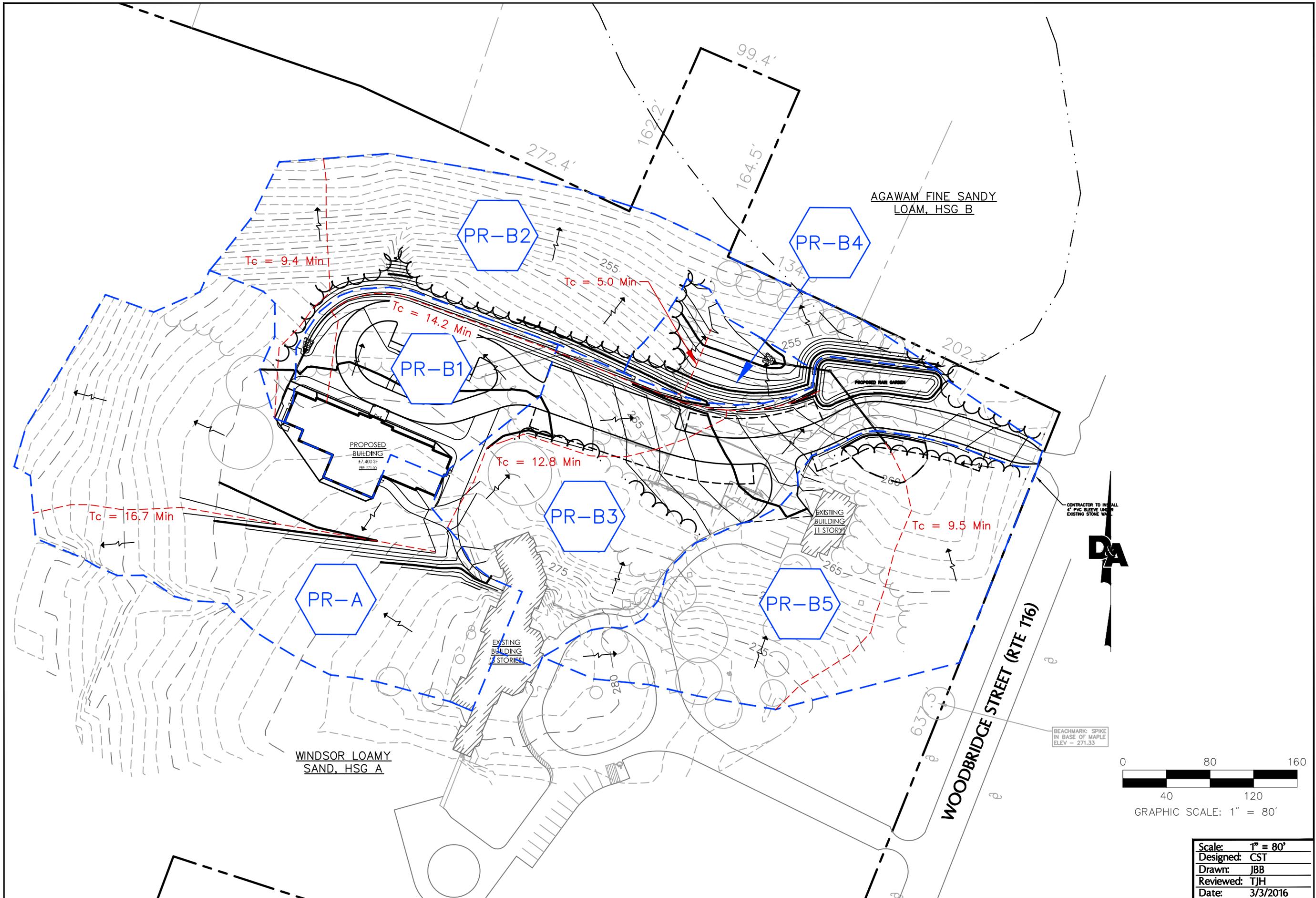
P:\1491-001\engineering\drainage\1491-001\_DR.dwg  
User: JBB  
Plot Date/Time: Mar. 03, 16 - 15:46:32



P:\1491-001\engineering\drainage\1491-001\_DR.dwg

P:\1491-001\engineering\drainage\1491-001 DR.dwg  
 User: jbb  
 Plot Date: 3/16/2016 10:44:20

P:\1491-001\engineering\drainage\1491-001 DR.dwg  
 User: jbb  
 Plot Date: 3/16/2016 10:44:20



P:\1491-001\engineering\drainage\1491-001 DR.dwg

Scale:	1" = 80'
Designed:	CST
Drawn:	JBB
Reviewed:	TJH
Date:	3/3/2016



Western Drainage Area



Northern Drainage Area



Western Drainage Area



Northern Swale



Eastern Swale



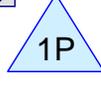
Outlet Swale



Eastern Drainage Area



Northern Overland



Rain Garden



Catch Basin



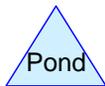
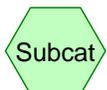
Analysis Point A



Analysis Point B



Outlet Swale



**Drainage Diagram for BHMA Bernon Music Center REV**  
 Prepared by Doucet & Associates, Inc., Printed 3/3/2016  
 HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

APPENDIX A:  
HYDROCAD OUTPUT FOR  
2-YEAR STORM EVENT

**BHMA Bernon Music Center REV**

Prepared by Doucet &amp; Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

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

Printed 3/3/2016

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-A: Western Drainage Area** Runoff Area=83,204 sf 2.08% Impervious Runoff Depth=0.00"  
Flow Length=396' Tc=9.5 min CN=40 Runoff=0.00 cfs 0.000 af

**Subcatchment EX-B: Northern Drainage** Runoff Area=247,879 sf 10.12% Impervious Runoff Depth>0.02"  
Flow Length=473' Tc=10.6 min CN=44 Runoff=0.01 cfs 0.007 af

**Subcatchment PR-A: Western Drainage Area** Runoff Area=92,430 sf 4.59% Impervious Runoff Depth>0.00"  
Flow Length=373' Tc=16.7 min CN=41 Runoff=0.00 cfs 0.000 af

**Subcatchment PR-B1: Northern Swale** Runoff Area=31,011 sf 57.03% Impervious Runoff Depth>0.85"  
Flow Length=558' Tc=12.2 min CN=73 Runoff=0.53 cfs 0.051 af

**Subcatchment PR-B2: Northern Overland** Runoff Area=65,092 sf 0.30% Impervious Runoff Depth=0.00"  
Flow Length=256' Tc=9.4 min CN=37 Runoff=0.00 cfs 0.000 af

**Subcatchment PR-B3: Eastern Swale** Runoff Area=67,832 sf 32.01% Impervious Runoff Depth>0.24"  
Flow Length=409' Tc=12.8 min CN=57 Runoff=0.15 cfs 0.032 af

**Subcatchment PR-B4: Outlet Swale** Runoff Area=10,883 sf 0.00% Impervious Runoff Depth=0.00"  
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.000 af

**Subcatchment PR-B5: Eastern Drainage** Runoff Area=63,824 sf 11.39% Impervious Runoff Depth>0.02"  
Flow Length=301' Tc=9.5 min CN=44 Runoff=0.00 cfs 0.002 af

**Reach 1R: Outlet Swale** Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af  
n=0.022 L=110.0' S=0.0200 '/' Capacity=35.78 cfs Outflow=0.00 cfs 0.000 af

**Reach AP-A: Analysis Point A** Inflow=0.00 cfs 0.000 af  
Outflow=0.00 cfs 0.000 af

**Reach AP-B: Analysis Point B** Inflow=0.00 cfs 0.000 af  
Outflow=0.00 cfs 0.000 af

**Pond 1P: Rain Garden** Peak Elev=258.27' Storage=1,082 cf Inflow=0.60 cfs 0.082 af  
Discarded=0.11 cfs 0.082 af Primary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.082 af

**Pond 2P: Catch Basin** Peak Elev=258.69' Storage=3 cf Inflow=0.00 cfs 0.002 af  
Discarded=0.00 cfs 0.002 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.002 af

**BHMA Bernon Music Center REV**

Prepared by Doucet &amp; Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

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

Printed 3/3/2016

**Summary for Subcatchment EX-A: Western Drainage Area**

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
1,730	98	Roofs, HSG A
8,594	36	Woods, Fair, HSG A
72,880	39	>75% Grass cover, Good, HSG A
83,204	40	Weighted Average
81,474		97.92% Pervious Area
1,730		2.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
3.0	296	0.0570	1.67		<b>Shallow Concentrated Flow, 296' Shallow</b> Short Grass Pasture Kv= 7.0 fps
9.5	396	Total			

**Summary for Subcatchment EX-B: Northern Drainage Area**

Runoff = 0.01 cfs @ 21.12 hrs, Volume= 0.007 af, Depth&gt; 0.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
14,301	98	Paved parking, HSG A
10,782	98	Roofs, HSG A
132,112	36	Woods, Fair, HSG A
86,181	39	>75% Grass cover, Good, HSG A
2,910	76	Gravel roads, HSG A
1,593	60	Woods, Fair, HSG B
247,879	44	Weighted Average
222,796		89.88% Pervious Area
25,083		10.12% Impervious Area

**BHMA Bernon Music Center REV**

Prepared by Doucet & Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

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

Printed 3/3/2016

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		<b>Shallow Concentrated Flow, 67' Shallow</b> Short Grass Pasture Kv= 7.0 fps
2.3	143	0.0420	1.02		<b>Shallow Concentrated Flow, 143' Shallow</b> Woodland Kv= 5.0 fps
0.4	96	0.0100	4.54	3.56	<b>Pipe Channel, 96' Pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.7	67	0.0900	1.50		<b>Shallow Concentrated Flow, 67' Shallow</b> Woodland Kv= 5.0 fps
10.6	473	Total			

**Summary for Subcatchment PR-A: Western Drainage Area**

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
1,001	98	Paved parking, HSG A
3,239	98	Roofs, HSG A
8,263	36	Woods, Fair, HSG A
79,927	39	>75% Grass cover, Good, HSG A
92,430	41	Weighted Average
88,190		95.41% Pervious Area
4,240		4.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
3.2	273	0.0400	1.40		<b>Shallow Concentrated Flow, 273' Shallow</b> Short Grass Pasture Kv= 7.0 fps
16.7	373	Total			

**Summary for Subcatchment PR-B1: Northern Swale**

Runoff = 0.53 cfs @ 12.19 hrs, Volume= 0.051 af, Depth> 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

**BHMA Bernon Music Center REV**

Prepared by Doucet & Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

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

Printed 3/3/2016

Area (sf)	CN	Description
11,358	98	Paved parking, HSG A
6,329	98	Roofs, HSG A
13,324	39	>75% Grass cover, Good, HSG A
31,011	73	Weighted Average
13,324		42.97% Pervious Area
17,687		57.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0300	0.11		<b>Sheet Flow, 7' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.2	8	0.0200	0.80		<b>Sheet Flow, 8' Sheet</b> Smooth surfaces n= 0.011 P2= 3.00"
7.6	70	0.0200	0.15		<b>Sheet Flow, 70' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
2.3	218	0.0040	1.57	0.79	<b>Trap/Vee/Rect Channel Flow, 218' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
0.7	125	0.0160	3.15	1.57	<b>Trap/Vee/Rect Channel Flow, 125' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
0.4	130	0.0400	4.98	2.49	<b>Trap/Vee/Rect Channel Flow, 130' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
12.2	558	Total			

**Summary for Subcatchment PR-B2: Northern Overland**

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
198	98	Paved parking, HSG A
52,852	36	Woods, Fair, HSG A
10,453	39	>75% Grass cover, Good, HSG A
1,422	60	Woods, Fair, HSG B
167	61	>75% Grass cover, Good, HSG B
65,092	37	Weighted Average
64,894		99.70% Pervious Area
198		0.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0350	0.21		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
1.3	156	0.1500	1.94		<b>Shallow Concentrated Flow, 156' Shallow</b> Woodland Kv= 5.0 fps
9.4	256	Total			

**BHMA Bernon Music Center REV**

Prepared by Doucet &amp; Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

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

Printed 3/3/2016

**Summary for Subcatchment PR-B3: Eastern Swale**

Runoff = 0.15 cfs @ 12.43 hrs, Volume= 0.032 af, Depth&gt; 0.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
18,167	98	Paved parking, HSG A
3,545	98	Roofs, HSG A
10,594	36	Woods, Fair, HSG A
35,526	39	>75% Grass cover, Good, HSG A
67,832	57	Weighted Average
46,120		67.99% Pervious Area
21,712		32.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0250	0.18		<b>Sheet Flow, 100' Sheet Flow</b> Grass: Short n= 0.150 P2= 3.00"
2.5	142	0.0180	0.94		<b>Shallow Concentrated Flow, 142' Shallow</b> Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0380	3.96		<b>Shallow Concentrated Flow, 40' Shallow</b> Paved Kv= 20.3 fps
0.4	39	0.0510	1.58		<b>Shallow Concentrated Flow, 39' Shallow</b> Short Grass Pasture Kv= 7.0 fps
0.4	88	0.0500	3.51	0.44	<b>Trap/Vee/Rect Channel Flow, 88' Channel</b> Bot.W=0.00' D=0.25' Z= 2.0 '/' Top.W=1.00' n= 0.022 Earth, clean & straight
12.8	409	Total			

**Summary for Subcatchment PR-B4: Outlet Swale**

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
10,883	39	>75% Grass cover, Good, HSG A
10,883		100.00% Pervious Area

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

**BHMA Bernon Music Center REV**

Prepared by Doucet & Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

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

Printed 3/3/2016

**Summary for Subcatchment PR-B5: Eastern Drainage Area**

Runoff = 0.00 cfs @ 21.11 hrs, Volume= 0.002 af, Depth> 0.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
5,418	98	Paved parking, HSG A
1,851	98	Roofs, HSG A
28,353	36	Woods, Fair, HSG A
28,202	39	>75% Grass cover, Good, HSG A
63,824	44	Weighted Average
56,555		88.61% Pervious Area
7,269		11.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		<b>Shallow Concentrated Flow, 67' Shallow</b> Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0370	0.96		<b>Shallow Concentrated Flow, 134' Shallow</b> Woodland Kv= 5.0 fps
9.5	301	Total			

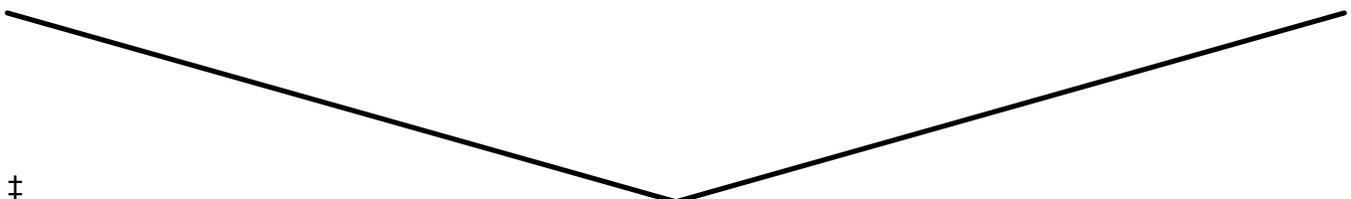
**Summary for Reach 1R: Outlet Swale**

Inflow Area = 3.984 ac, 26.89% Impervious, Inflow Depth = 0.00" for 2-Year event  
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af  
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs / 2  
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min  
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 5.00 hrs  
Average Depth at Peak Storage= 0.00'  
Bank-Full Depth= 1.00', Capacity at Bank-Full= 35.78 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight  
Side Slope Z-value= 6.0 ' / ' Top Width= 12.00'  
Length= 110.0' Slope= 0.0200 ' / '  
Inlet Invert= 254.10', Outlet Invert= 251.90'



‡

**BHMA Bernon Music Center REV**

Prepared by Doucet &amp; Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

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

Printed 3/3/2016

**Summary for Reach AP-A: Analysis Point A**

Inflow Area = 2.122 ac, 4.59% Impervious, Inflow Depth > 0.00" for 2-Year event  
 Inflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af  
 Outflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

**Summary for Reach AP-B: Analysis Point B**

Inflow Area = 5.478 ac, 19.64% Impervious, Inflow Depth = 0.00" for 2-Year event  
 Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af  
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

**Summary for Pond 1P: Rain Garden**

Inflow Area = 2.269 ac, 39.86% Impervious, Inflow Depth > 0.44" for 2-Year event  
 Inflow = 0.60 cfs @ 12.22 hrs, Volume= 0.082 af  
 Outflow = 0.11 cfs @ 13.99 hrs, Volume= 0.082 af, Atten= 82%, Lag= 106.5 min  
 Discarded = 0.11 cfs @ 13.99 hrs, Volume= 0.082 af  
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 258.27' @ 13.99 hrs Surf.Area= 1,800 sf Storage= 1,082 cf

Plug-Flow detention time= 109.0 min calculated for 0.082 af (99% of inflow)  
 Center-of-Mass det. time= 106.9 min ( 1,012.1 - 905.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	257.50'	7,155 cf	<b>Custom Stage Data (Conic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
257.50	923	0	0	923
258.00	1,613	626	626	1,616
259.00	2,366	1,978	2,604	2,385
260.00	3,259	2,801	5,404	3,298
260.50	3,750	1,751	7,155	3,800

Device	Routing	Invert	Outlet Devices
#1	Primary	254.60'	<b>12.0" Round Culvert</b> L= 50.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.60' / 254.10' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.50'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	260.00'	<b>8.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50

**BHMA Bernon Music Center REV**

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

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64  
 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74  
 #4 Discarded 257.50' **2.410 in/hr Exfiltration over Wetted area**  
 Conductivity to Groundwater Elevation = 252.00'

**Discarded OutFlow** Max=0.11 cfs @ 13.99 hrs HW=258.27' (Free Discharge)  
 ↑4=Exfiltration ( Controls 0.11 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=257.50' (Free Discharge)  
 ↑1=Culvert (Passes 0.00 cfs of 5.17 cfs potential flow)  
 ↑2=Orifice/Grate ( Controls 0.00 cfs)  
 ↑3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond 2P: Catch Basin**

Inflow Area = 1.465 ac, 11.39% Impervious, Inflow Depth > 0.02" for 2-Year event  
 Inflow = 0.00 cfs @ 21.11 hrs, Volume= 0.002 af  
 Outflow = 0.00 cfs @ 21.56 hrs, Volume= 0.002 af, Atten= 0%, Lag= 27.0 min  
 Discarded = 0.00 cfs @ 21.56 hrs, Volume= 0.002 af  
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 258.69' @ 21.56 hrs Surf.Area= 51 sf Storage= 3 cf

Plug-Flow detention time= 17.6 min calculated for 0.002 af (96% of inflow)  
 Center-of-Mass det. time= 8.9 min ( 1,201.7 - 1,192.8 )

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	5,098 cf	<b>Custom Stage Data (Conic)</b> Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	360	60	60	360	
260.00	2,319	1,198	1,258	2,323	
261.00	5,599	3,840	5,098	5,610	

Device	Routing	Invert	Outlet Devices
#1	Primary	255.50'	<b>12.0" Round Culvert</b> L= 80.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 255.50' / 254.70' S= 0.0100 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.71'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	<b>2.410 in/hr Exfiltration over Wetted area</b> Conductivity to Groundwater Elevation = 0.00'

**BHMA Bernon Music Center REV**

Prepared by Doucet & Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

---

*Type III 24-hr 2-Year Rainfall=3.00"*

Printed 3/3/2016

**Discarded OutFlow** Max=0.00 cfs @ 21.56 hrs HW=258.69' (Free Discharge)

↑**3=Exfiltration** ( Controls 0.00 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=258.50' (Free Discharge)

↑**1=Culvert** (Passes 0.00 cfs of 5.14 cfs potential flow)

↑**2=Orifice/Grate** ( Controls 0.00 cfs)

APPENDIX B:  
HYDROCAD OUTPUT FOR  
10-YEAR STORM EVENT

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-A: Western Drainage Area** Runoff Area=83,204 sf 2.08% Impervious Runoff Depth>0.14"  
Flow Length=396' Tc=9.5 min CN=40 Runoff=0.04 cfs 0.022 af

**Subcatchment EX-B: Northern Drainage** Runoff Area=247,879 sf 10.12% Impervious Runoff Depth>0.26"  
Flow Length=473' Tc=10.6 min CN=44 Runoff=0.44 cfs 0.123 af

**Subcatchment PR-A: Western Drainage Area** Runoff Area=92,430 sf 4.59% Impervious Runoff Depth>0.16"  
Flow Length=373' Tc=16.7 min CN=41 Runoff=0.05 cfs 0.029 af

**Subcatchment PR-B1: Northern Swale** Runoff Area=31,011 sf 57.03% Impervious Runoff Depth>1.89"  
Flow Length=558' Tc=12.2 min CN=73 Runoff=1.25 cfs 0.112 af

**Subcatchment PR-B2: Northern Overland** Runoff Area=65,092 sf 0.30% Impervious Runoff Depth>0.07"  
Flow Length=256' Tc=9.4 min CN=37 Runoff=0.01 cfs 0.008 af

**Subcatchment PR-B3: Eastern Swale** Runoff Area=67,832 sf 32.01% Impervious Runoff Depth>0.85"  
Flow Length=409' Tc=12.8 min CN=57 Runoff=0.96 cfs 0.110 af

**Subcatchment PR-B4: Outlet Swale** Runoff Area=10,883 sf 0.00% Impervious Runoff Depth>0.11"  
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.002 af

**Subcatchment PR-B5: Eastern Drainage** Runoff Area=63,824 sf 11.39% Impervious Runoff Depth>0.26"  
Flow Length=301' Tc=9.5 min CN=44 Runoff=0.12 cfs 0.032 af

**Reach 1R: Outlet Swale** Avg. Flow Depth=0.11' Max Vel=1.40 fps Inflow=0.11 cfs 0.014 af  
n=0.022 L=110.0' S=0.0200 '/' Capacity=35.78 cfs Outflow=0.11 cfs 0.014 af

**Reach AP-A: Analysis Point A** Inflow=0.05 cfs 0.029 af  
Outflow=0.05 cfs 0.029 af

**Reach AP-B: Analysis Point B** Inflow=0.12 cfs 0.022 af  
Outflow=0.12 cfs 0.022 af

**Pond 1P: Rain Garden** Peak Elev=259.55' Storage=4,024 cf Inflow=2.19 cfs 0.222 af  
Discarded=0.20 cfs 0.175 af Primary=0.11 cfs 0.012 af Outflow=0.30 cfs 0.186 af

**Pond 2P: Catch Basin** Peak Elev=259.32' Storage=242 cf Inflow=0.12 cfs 0.032 af  
Discarded=0.04 cfs 0.031 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.031 af

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Subcatchment EX-A: Western Drainage Area**

Runoff = 0.04 cfs @ 13.82 hrs, Volume= 0.022 af, Depth&gt; 0.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,730	98	Roofs, HSG A
8,594	36	Woods, Fair, HSG A
72,880	39	>75% Grass cover, Good, HSG A
83,204	40	Weighted Average
81,474		97.92% Pervious Area
1,730		2.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
3.0	296	0.0570	1.67		<b>Shallow Concentrated Flow, 296' Shallow</b> Short Grass Pasture Kv= 7.0 fps
9.5	396	Total			

**Summary for Subcatchment EX-B: Northern Drainage Area**

Runoff = 0.44 cfs @ 12.47 hrs, Volume= 0.123 af, Depth&gt; 0.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
14,301	98	Paved parking, HSG A
10,782	98	Roofs, HSG A
132,112	36	Woods, Fair, HSG A
86,181	39	>75% Grass cover, Good, HSG A
2,910	76	Gravel roads, HSG A
1,593	60	Woods, Fair, HSG B
247,879	44	Weighted Average
222,796		89.88% Pervious Area
25,083		10.12% Impervious Area

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		<b>Shallow Concentrated Flow, 67' Shallow</b> Short Grass Pasture Kv= 7.0 fps
2.3	143	0.0420	1.02		<b>Shallow Concentrated Flow, 143' Shallow</b> Woodland Kv= 5.0 fps
0.4	96	0.0100	4.54	3.56	<b>Pipe Channel, 96' Pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.7	67	0.0900	1.50		<b>Shallow Concentrated Flow, 67' Shallow</b> Woodland Kv= 5.0 fps
10.6	473	Total			

**Summary for Subcatchment PR-A: Western Drainage Area**

Runoff = 0.05 cfs @ 13.77 hrs, Volume= 0.029 af, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,001	98	Paved parking, HSG A
3,239	98	Roofs, HSG A
8,263	36	Woods, Fair, HSG A
79,927	39	>75% Grass cover, Good, HSG A
92,430	41	Weighted Average
88,190		95.41% Pervious Area
4,240		4.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
3.2	273	0.0400	1.40		<b>Shallow Concentrated Flow, 273' Shallow</b> Short Grass Pasture Kv= 7.0 fps
16.7	373	Total			

**Summary for Subcatchment PR-B1: Northern Swale**

Runoff = 1.25 cfs @ 12.18 hrs, Volume= 0.112 af, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Area (sf)	CN	Description
11,358	98	Paved parking, HSG A
6,329	98	Roofs, HSG A
13,324	39	>75% Grass cover, Good, HSG A
31,011	73	Weighted Average
13,324		42.97% Pervious Area
17,687		57.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0300	0.11		<b>Sheet Flow, 7' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.2	8	0.0200	0.80		<b>Sheet Flow, 8' Sheet</b> Smooth surfaces n= 0.011 P2= 3.00"
7.6	70	0.0200	0.15		<b>Sheet Flow, 70' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
2.3	218	0.0040	1.57	0.79	<b>Trap/Vee/Rect Channel Flow, 218' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
0.7	125	0.0160	3.15	1.57	<b>Trap/Vee/Rect Channel Flow, 125' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
0.4	130	0.0400	4.98	2.49	<b>Trap/Vee/Rect Channel Flow, 130' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
12.2	558	Total			

**Summary for Subcatchment PR-B2: Northern Overland**

Runoff = 0.01 cfs @ 15.33 hrs, Volume= 0.008 af, Depth> 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
198	98	Paved parking, HSG A
52,852	36	Woods, Fair, HSG A
10,453	39	>75% Grass cover, Good, HSG A
1,422	60	Woods, Fair, HSG B
167	61	>75% Grass cover, Good, HSG B
65,092	37	Weighted Average
64,894		99.70% Pervious Area
198		0.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0350	0.21		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
1.3	156	0.1500	1.94		<b>Shallow Concentrated Flow, 156' Shallow</b> Woodland Kv= 5.0 fps
9.4	256	Total			

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Subcatchment PR-B3: Eastern Swale**

Runoff = 0.96 cfs @ 12.22 hrs, Volume= 0.110 af, Depth&gt; 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
18,167	98	Paved parking, HSG A
3,545	98	Roofs, HSG A
10,594	36	Woods, Fair, HSG A
35,526	39	>75% Grass cover, Good, HSG A
67,832	57	Weighted Average
46,120		67.99% Pervious Area
21,712		32.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0250	0.18		<b>Sheet Flow, 100' Sheet Flow</b> Grass: Short n= 0.150 P2= 3.00"
2.5	142	0.0180	0.94		<b>Shallow Concentrated Flow, 142' Shallow</b> Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0380	3.96		<b>Shallow Concentrated Flow, 40' Shallow</b> Paved Kv= 20.3 fps
0.4	39	0.0510	1.58		<b>Shallow Concentrated Flow, 39' Shallow</b> Short Grass Pasture Kv= 7.0 fps
0.4	88	0.0500	3.51	0.44	<b>Trap/Vee/Rect Channel Flow, 88' Channel</b> Bot.W=0.00' D=0.25' Z= 2.0 '/' Top.W=1.00' n= 0.022 Earth, clean & straight
12.8	409	Total			

**Summary for Subcatchment PR-B4: Outlet Swale**

Runoff = 0.00 cfs @ 14.69 hrs, Volume= 0.002 af, Depth&gt; 0.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
10,883	39	>75% Grass cover, Good, HSG A
10,883		100.00% Pervious Area

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

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Subcatchment PR-B5: Eastern Drainage Area**

Runoff = 0.12 cfs @ 12.45 hrs, Volume= 0.032 af, Depth> 0.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
5,418	98	Paved parking, HSG A
1,851	98	Roofs, HSG A
28,353	36	Woods, Fair, HSG A
28,202	39	>75% Grass cover, Good, HSG A
63,824	44	Weighted Average
56,555		88.61% Pervious Area
7,269		11.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		<b>Shallow Concentrated Flow, 67' Shallow</b> Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0370	0.96		<b>Shallow Concentrated Flow, 134' Shallow</b> Woodland Kv= 5.0 fps
9.5	301	Total			

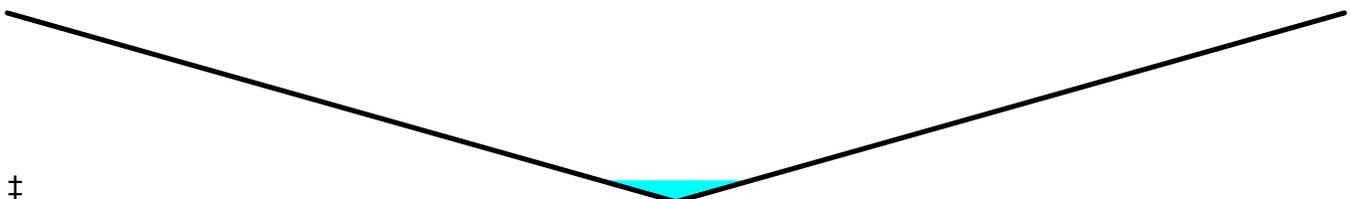
**Summary for Reach 1R: Outlet Swale**

Inflow Area = 3.984 ac, 26.89% Impervious, Inflow Depth > 0.04" for 10-Year event  
Inflow = 0.11 cfs @ 13.60 hrs, Volume= 0.014 af  
Outflow = 0.11 cfs @ 13.64 hrs, Volume= 0.014 af, Atten= 0%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs / 2  
Max. Velocity= 1.40 fps, Min. Travel Time= 1.3 min  
Avg. Velocity = 0.67 fps, Avg. Travel Time= 2.7 min

Peak Storage= 9 cf @ 13.62 hrs  
Average Depth at Peak Storage= 0.11'  
Bank-Full Depth= 1.00', Capacity at Bank-Full= 35.78 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight  
Side Slope Z-value= 6.0 ' / ' Top Width= 12.00'  
Length= 110.0' Slope= 0.0200 ' / '  
Inlet Invert= 254.10', Outlet Invert= 251.90'



‡

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Reach AP-A: Analysis Point A**

Inflow Area = 2.122 ac, 4.59% Impervious, Inflow Depth > 0.16" for 10-Year event  
 Inflow = 0.05 cfs @ 13.77 hrs, Volume= 0.029 af  
 Outflow = 0.05 cfs @ 13.77 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

**Summary for Reach AP-B: Analysis Point B**

Inflow Area = 5.478 ac, 19.64% Impervious, Inflow Depth > 0.05" for 10-Year event  
 Inflow = 0.12 cfs @ 13.66 hrs, Volume= 0.022 af  
 Outflow = 0.12 cfs @ 13.66 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

**Summary for Pond 1P: Rain Garden**

Inflow Area = 2.269 ac, 39.86% Impervious, Inflow Depth > 1.17" for 10-Year event  
 Inflow = 2.19 cfs @ 12.20 hrs, Volume= 0.222 af  
 Outflow = 0.30 cfs @ 13.60 hrs, Volume= 0.186 af, Atten= 86%, Lag= 84.0 min  
 Discarded = 0.20 cfs @ 13.60 hrs, Volume= 0.175 af  
 Primary = 0.11 cfs @ 13.60 hrs, Volume= 0.012 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 259.55' @ 13.60 hrs Surf.Area= 2,837 sf Storage= 4,024 cf

Plug-Flow detention time= 230.9 min calculated for 0.186 af (84% of inflow)  
 Center-of-Mass det. time= 161.0 min ( 1,035.2 - 874.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	257.50'	7,155 cf	<b>Custom Stage Data (Conic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
257.50	923	0	0	923
258.00	1,613	626	626	1,616
259.00	2,366	1,978	2,604	2,385
260.00	3,259	2,801	5,404	3,298
260.50	3,750	1,751	7,155	3,800

Device	Routing	Invert	Outlet Devices
#1	Primary	254.60'	<b>12.0" Round Culvert</b> L= 50.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.60' / 254.10' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.50'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	260.00'	<b>8.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50

**BHMA Bernon Music Center REV**

Type III 24-hr 10-Year Rainfall=4.50"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64  
 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74  
 #4 Discarded 257.50' **2.410 in/hr Exfiltration over Wetted area**  
 Conductivity to Groundwater Elevation = 252.00'

**Discarded OutFlow** Max=0.20 cfs @ 13.60 hrs HW=259.55' (Free Discharge)  
 ↑ **4=Exfiltration** ( Controls 0.20 cfs)

**Primary OutFlow** Max=0.10 cfs @ 13.60 hrs HW=259.55' (Free Discharge)  
 ↑ **1=Culvert** (Passes 0.10 cfs of 7.04 cfs potential flow)  
 ↑ **2=Orifice/Grate** (Weir Controls 0.10 cfs @ 0.71 fps)  
 ↑ **3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Summary for Pond 2P: Catch Basin**

Inflow Area = 1.465 ac, 11.39% Impervious, Inflow Depth > 0.26" for 10-Year event  
 Inflow = 0.12 cfs @ 12.45 hrs, Volume= 0.032 af  
 Outflow = 0.04 cfs @ 15.04 hrs, Volume= 0.031 af, Atten= 61%, Lag= 155.5 min  
 Discarded = 0.04 cfs @ 15.04 hrs, Volume= 0.031 af  
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 259.32' @ 15.04 hrs Surf.Area= 802 sf Storage= 242 cf

Plug-Flow detention time= 73.6 min calculated for 0.031 af (97% of inflow)  
 Center-of-Mass det. time= 59.1 min ( 1,039.6 - 980.5 )

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	5,098 cf	<b>Custom Stage Data (Conic)</b> Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	360	60	60	360	
260.00	2,319	1,198	1,258	2,323	
261.00	5,599	3,840	5,098	5,610	

Device	Routing	Invert	Outlet Devices
#1	Primary	255.50'	<b>12.0" Round Culvert</b> L= 80.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 255.50' / 254.70' S= 0.0100 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.71'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	<b>2.410 in/hr Exfiltration over Wetted area</b> Conductivity to Groundwater Elevation = 0.00'

**BHMA Bernon Music Center REV**

Prepared by Doucet & Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

---

*Type III 24-hr 10-Year Rainfall=4.50"*

Printed 3/3/2016

**Discarded OutFlow** Max=0.04 cfs @ 15.04 hrs HW=259.32' (Free Discharge)

↑**3=Exfiltration** ( Controls 0.04 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=258.50' (Free Discharge)

↑**1=Culvert** (Passes 0.00 cfs of 5.14 cfs potential flow)

↑**2=Orifice/Grate** ( Controls 0.00 cfs)

APPENDIX C:  
HYDROCAD OUTPUT FOR  
100-YEAR STORM EVENT

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-A: Western Drainage Area** Runoff Area=83,204 sf 2.08% Impervious Runoff Depth>0.63"  
Flow Length=396' Tc=9.5 min CN=40 Runoff=0.56 cfs 0.100 af

**Subcatchment EX-B: Northern Drainage** Runoff Area=247,879 sf 10.12% Impervious Runoff Depth>0.89"  
Flow Length=473' Tc=10.6 min CN=44 Runoff=3.18 cfs 0.423 af

**Subcatchment PR-A: Western Drainage Area** Runoff Area=92,430 sf 4.59% Impervious Runoff Depth>0.69"  
Flow Length=373' Tc=16.7 min CN=41 Runoff=0.68 cfs 0.122 af

**Subcatchment PR-B1: Northern Swale** Runoff Area=31,011 sf 57.03% Impervious Runoff Depth>3.42"  
Flow Length=558' Tc=12.2 min CN=73 Runoff=2.32 cfs 0.203 af

**Subcatchment PR-B2: Northern Overland** Runoff Area=65,092 sf 0.30% Impervious Runoff Depth>0.45"  
Flow Length=256' Tc=9.4 min CN=37 Runoff=0.25 cfs 0.056 af

**Subcatchment PR-B3: Eastern Swale** Runoff Area=67,832 sf 32.01% Impervious Runoff Depth>1.92"  
Flow Length=409' Tc=12.8 min CN=57 Runoff=2.59 cfs 0.249 af

**Subcatchment PR-B4: Outlet Swale** Runoff Area=10,883 sf 0.00% Impervious Runoff Depth>0.57"  
Tc=5.0 min CN=39 Runoff=0.06 cfs 0.012 af

**Subcatchment PR-B5: Eastern Drainage** Runoff Area=63,824 sf 11.39% Impervious Runoff Depth>0.89"  
Flow Length=301' Tc=9.5 min CN=44 Runoff=0.84 cfs 0.109 af

**Reach 1R: Outlet Swale** Avg. Flow Depth=0.39' Max Vel=3.19 fps Inflow=2.96 cfs 0.229 af  
n=0.022 L=110.0' S=0.0200 '/' Capacity=35.78 cfs Outflow=2.94 cfs 0.229 af

**Reach AP-A: Analysis Point A** Inflow=0.68 cfs 0.122 af  
Outflow=0.68 cfs 0.122 af

**Reach AP-B: Analysis Point B** Inflow=3.17 cfs 0.285 af  
Outflow=3.17 cfs 0.285 af

**Pond 1P: Rain Garden** Peak Elev=259.96' Storage=5,277 cf Inflow=4.87 cfs 0.452 af  
Discarded=0.23 cfs 0.202 af Primary=2.57 cfs 0.189 af Outflow=2.80 cfs 0.391 af

**Pond 2P: Catch Basin** Peak Elev=259.82' Storage=887 cf Inflow=0.84 cfs 0.109 af  
Discarded=0.10 cfs 0.075 af Primary=0.39 cfs 0.028 af Outflow=0.49 cfs 0.103 af

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Subcatchment EX-A: Western Drainage Area**

Runoff = 0.56 cfs @ 12.33 hrs, Volume= 0.100 af, Depth&gt; 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
1,730	98	Roofs, HSG A
8,594	36	Woods, Fair, HSG A
72,880	39	>75% Grass cover, Good, HSG A
83,204	40	Weighted Average
81,474		97.92% Pervious Area
1,730		2.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
3.0	296	0.0570	1.67		<b>Shallow Concentrated Flow, 296' Shallow</b> Short Grass Pasture Kv= 7.0 fps
9.5	396	Total			

**Summary for Subcatchment EX-B: Northern Drainage Area**

Runoff = 3.18 cfs @ 12.21 hrs, Volume= 0.423 af, Depth&gt; 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
14,301	98	Paved parking, HSG A
10,782	98	Roofs, HSG A
132,112	36	Woods, Fair, HSG A
86,181	39	>75% Grass cover, Good, HSG A
2,910	76	Gravel roads, HSG A
1,593	60	Woods, Fair, HSG B
247,879	44	Weighted Average
222,796		89.88% Pervious Area
25,083		10.12% Impervious Area

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		<b>Shallow Concentrated Flow, 67' Shallow</b> Short Grass Pasture Kv= 7.0 fps
2.3	143	0.0420	1.02		<b>Shallow Concentrated Flow, 143' Shallow</b> Woodland Kv= 5.0 fps
0.4	96	0.0100	4.54	3.56	<b>Pipe Channel, 96' Pipe</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.7	67	0.0900	1.50		<b>Shallow Concentrated Flow, 67' Shallow</b> Woodland Kv= 5.0 fps
10.6	473	Total			

**Summary for Subcatchment PR-A: Western Drainage Area**

Runoff = 0.68 cfs @ 12.42 hrs, Volume= 0.122 af, Depth&gt; 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
1,001	98	Paved parking, HSG A
3,239	98	Roofs, HSG A
8,263	36	Woods, Fair, HSG A
79,927	39	>75% Grass cover, Good, HSG A
92,430	41	Weighted Average
88,190		95.41% Pervious Area
4,240		4.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
3.2	273	0.0400	1.40		<b>Shallow Concentrated Flow, 273' Shallow</b> Short Grass Pasture Kv= 7.0 fps
16.7	373	Total			

**Summary for Subcatchment PR-B1: Northern Swale**

Runoff = 2.32 cfs @ 12.17 hrs, Volume= 0.203 af, Depth&gt; 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Area (sf)	CN	Description
11,358	98	Paved parking, HSG A
6,329	98	Roofs, HSG A
13,324	39	>75% Grass cover, Good, HSG A
31,011	73	Weighted Average
13,324		42.97% Pervious Area
17,687		57.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0300	0.11		<b>Sheet Flow, 7' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.2	8	0.0200	0.80		<b>Sheet Flow, 8' Sheet</b> Smooth surfaces n= 0.011 P2= 3.00"
7.6	70	0.0200	0.15		<b>Sheet Flow, 70' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
2.3	218	0.0040	1.57	0.79	<b>Trap/Vee/Rect Channel Flow, 218' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
0.7	125	0.0160	3.15	1.57	<b>Trap/Vee/Rect Channel Flow, 125' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
0.4	130	0.0400	4.98	2.49	<b>Trap/Vee/Rect Channel Flow, 130' Channel Flow</b> Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
12.2	558	Total			

**Summary for Subcatchment PR-B2: Northern Overland**

Runoff = 0.25 cfs @ 12.41 hrs, Volume= 0.056 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
198	98	Paved parking, HSG A
52,852	36	Woods, Fair, HSG A
10,453	39	>75% Grass cover, Good, HSG A
1,422	60	Woods, Fair, HSG B
167	61	>75% Grass cover, Good, HSG B
65,092	37	Weighted Average
64,894		99.70% Pervious Area
198		0.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0350	0.21		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
1.3	156	0.1500	1.94		<b>Shallow Concentrated Flow, 156' Shallow</b> Woodland Kv= 5.0 fps
9.4	256	Total			

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Subcatchment PR-B3: Eastern Swale**

Runoff = 2.59 cfs @ 12.20 hrs, Volume= 0.249 af, Depth&gt; 1.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
18,167	98	Paved parking, HSG A
3,545	98	Roofs, HSG A
10,594	36	Woods, Fair, HSG A
35,526	39	>75% Grass cover, Good, HSG A
67,832	57	Weighted Average
46,120		67.99% Pervious Area
21,712		32.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0250	0.18		<b>Sheet Flow, 100' Sheet Flow</b> Grass: Short n= 0.150 P2= 3.00"
2.5	142	0.0180	0.94		<b>Shallow Concentrated Flow, 142' Shallow</b> Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0380	3.96		<b>Shallow Concentrated Flow, 40' Shallow</b> Paved Kv= 20.3 fps
0.4	39	0.0510	1.58		<b>Shallow Concentrated Flow, 39' Shallow</b> Short Grass Pasture Kv= 7.0 fps
0.4	88	0.0500	3.51	0.44	<b>Trap/Vee/Rect Channel Flow, 88' Channel</b> Bot.W=0.00' D=0.25' Z= 2.0 ' /' Top.W=1.00' n= 0.022 Earth, clean & straight
12.8	409	Total			

**Summary for Subcatchment PR-B4: Outlet Swale**

Runoff = 0.06 cfs @ 12.29 hrs, Volume= 0.012 af, Depth&gt; 0.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
10,883	39	>75% Grass cover, Good, HSG A
10,883		100.00% Pervious Area

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

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Subcatchment PR-B5: Eastern Drainage Area**

Runoff = 0.84 cfs @ 12.19 hrs, Volume= 0.109 af, Depth> 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
5,418	98	Paved parking, HSG A
1,851	98	Roofs, HSG A
28,353	36	Woods, Fair, HSG A
28,202	39	>75% Grass cover, Good, HSG A
63,824	44	Weighted Average
56,555		88.61% Pervious Area
7,269		11.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		<b>Sheet Flow, 100' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		<b>Shallow Concentrated Flow, 67' Shallow</b> Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0370	0.96		<b>Shallow Concentrated Flow, 134' Shallow</b> Woodland Kv= 5.0 fps
9.5	301	Total			

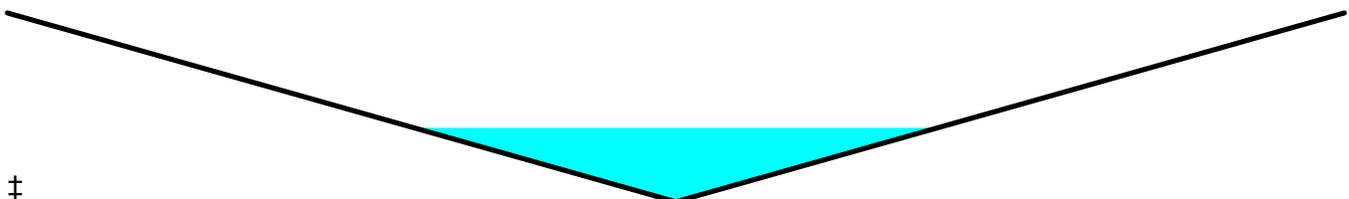
**Summary for Reach 1R: Outlet Swale**

Inflow Area = 3.984 ac, 26.89% Impervious, Inflow Depth > 0.69" for 100-Year event  
Inflow = 2.96 cfs @ 12.48 hrs, Volume= 0.229 af  
Outflow = 2.94 cfs @ 12.49 hrs, Volume= 0.229 af, Atten= 1%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs / 2  
Max. Velocity= 3.19 fps, Min. Travel Time= 0.6 min  
Avg. Velocity = 1.18 fps, Avg. Travel Time= 1.6 min

Peak Storage= 101 cf @ 12.48 hrs  
Average Depth at Peak Storage= 0.39'  
Bank-Full Depth= 1.00', Capacity at Bank-Full= 35.78 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight  
Side Slope Z-value= 6.0 ' / ' Top Width= 12.00'  
Length= 110.0' Slope= 0.0200 ' / '  
Inlet Invert= 254.10', Outlet Invert= 251.90'



‡

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

**Summary for Reach AP-A: Analysis Point A**

Inflow Area = 2.122 ac, 4.59% Impervious, Inflow Depth > 0.69" for 100-Year event  
 Inflow = 0.68 cfs @ 12.42 hrs, Volume= 0.122 af  
 Outflow = 0.68 cfs @ 12.42 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

**Summary for Reach AP-B: Analysis Point B**

Inflow Area = 5.478 ac, 19.64% Impervious, Inflow Depth > 0.62" for 100-Year event  
 Inflow = 3.17 cfs @ 12.49 hrs, Volume= 0.285 af  
 Outflow = 3.17 cfs @ 12.49 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

**Summary for Pond 1P: Rain Garden**

Inflow Area = 2.269 ac, 39.86% Impervious, Inflow Depth > 2.39" for 100-Year event  
 Inflow = 4.87 cfs @ 12.19 hrs, Volume= 0.452 af  
 Outflow = 2.80 cfs @ 12.43 hrs, Volume= 0.391 af, Atten= 42%, Lag= 14.9 min  
 Discarded = 0.23 cfs @ 12.43 hrs, Volume= 0.202 af  
 Primary = 2.57 cfs @ 12.43 hrs, Volume= 0.189 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 259.96' @ 12.43 hrs Surf.Area= 3,221 sf Storage= 5,277 cf

Plug-Flow detention time= 127.9 min calculated for 0.390 af (86% of inflow)  
 Center-of-Mass det. time= 67.7 min ( 921.5 - 853.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	257.50'	7,155 cf	<b>Custom Stage Data (Conic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
257.50	923	0	0	923
258.00	1,613	626	626	1,616
259.00	2,366	1,978	2,604	2,385
260.00	3,259	2,801	5,404	3,298
260.50	3,750	1,751	7,155	3,800

Device	Routing	Invert	Outlet Devices
#1	Primary	254.60'	<b>12.0" Round Culvert</b> L= 50.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.60' / 254.10' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.50'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	260.00'	<b>8.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50

**BHMA Bernon Music Center REV**

Type III 24-hr 100-Year Rainfall=6.40"

Prepared by Doucet & Associates, Inc.

Printed 3/3/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

			Coef. (English)	2.43	2.54	2.70	2.69	2.68	2.68	2.66	2.64	2.64
				2.64	2.65	2.65	2.66	2.66	2.68	2.70	2.74	
#4	Discarded	257.50'	<b>2.410 in/hr Exfiltration over Wetted area</b>									
			Conductivity to Groundwater Elevation = 252.00'									

**Discarded OutFlow** Max=0.23 cfs @ 12.43 hrs HW=259.96' (Free Discharge)

↑**4=Exfiltration** ( Controls 0.23 cfs)

**Primary OutFlow** Max=2.56 cfs @ 12.43 hrs HW=259.96' (Free Discharge)

↑**1=Culvert** (Passes 2.56 cfs of 7.35 cfs potential flow)  
 ↑**2=Orifice/Grate** (Orifice Controls 2.56 cfs @ 3.26 fps)  
 ↑**3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Summary for Pond 2P: Catch Basin**

Inflow Area =	1.465 ac, 11.39% Impervious, Inflow Depth > 0.89" for 100-Year event
Inflow =	0.84 cfs @ 12.19 hrs, Volume= 0.109 af
Outflow =	0.49 cfs @ 12.53 hrs, Volume= 0.103 af, Atten= 42%, Lag= 20.2 min
Discarded =	0.10 cfs @ 12.53 hrs, Volume= 0.075 af
Primary =	0.39 cfs @ 12.53 hrs, Volume= 0.028 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 259.82' @ 12.53 hrs Surf.Area= 1,845 sf Storage= 887 cf

Plug-Flow detention time= 86.4 min calculated for 0.103 af (95% of inflow)  
 Center-of-Mass det. time= 60.6 min ( 976.4 - 915.8 )

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	5,098 cf	<b>Custom Stage Data (Conic)</b> Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	360	60	60	360	
260.00	2,319	1,198	1,258	2,323	
261.00	5,599	3,840	5,098	5,610	

Device	Routing	Invert	Outlet Devices
#1	Primary	255.50'	<b>12.0" Round Culvert</b> L= 80.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 255.50' / 254.70' S= 0.0100 1/1 Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.71'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	<b>2.410 in/hr Exfiltration over Wetted area</b> Conductivity to Groundwater Elevation = 0.00'

**BHMA Bernon Music Center REV**

Prepared by Doucet & Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

---

*Type III 24-hr 100-Year Rainfall=6.40"*

Printed 3/3/2016

**Discarded OutFlow** Max=0.10 cfs @ 12.53 hrs HW=259.82' (Free Discharge)

↑**3=Exfiltration** ( Controls 0.10 cfs)

**Primary OutFlow** Max=0.38 cfs @ 12.53 hrs HW=259.82' (Free Discharge)

↑**1=Culvert** (Passes 0.38 cfs of 6.23 cfs potential flow)

↑**2=Orifice/Grate** (Weir Controls 0.38 cfs @ 1.09 fps)

APPENDIX D:  
EROSION AND SEDIMENTATION CONTROL PLAN  
& OPERATION AND MAINTENANCE PLAN

**LONG-TERM OPERATION AND MAINTENANCE PLAN  
PROCEDURES TO BE FOLLOWED FOR BHMA BERNON MUSIC CENTER  
48 WOODBRIDGE STREET, SOUTH HADLEY, MA**

***BACKGROUND***

Maintenance of the onsite stormwater management system is vital to the successful treatment of stormwater ultimately leaving this site. This plan is intended to assist in maintaining stormwater controls to reduce stormwater pollution generated in the parking area of the property.

***DURING CONSTRUCTION***

An Erosion & Sediment Control Plan has been prepared and included in the permit drawing set to outline measures designed to address all facets of sediment and erosion control during construction. Some of the measures included in these plans are as follows:

- Silt fence and straw wattles
- Construction entrance
- Temporary seeding for stabilization of exposed soils
- Excavated sediment traps
- Inlet protection at catch basins

In addition, as required under the provisions of the Clean Water Act, the applicant will be seeking coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit. As such, a detailed Stormwater Pollution Prevention Plan (SWPPP) will be developed and permit coverage attained prior to construction. The SWPPP will further address all short and long term Stormwater Management measures to be employed at this site.

*January 18, 2016*

***POST CONSTRUCTION***

*Stormwater Management System Owner:*

The Owner,

Berkshire Hills Music Academy  
48 Woodbridge Street  
South Hadley, MA 01075

shall own the stormwater management system.

*Party Responsible for Operation and Maintenance:*

The Manager,

Berkshire Hills Music Academy  
48 Woodbridge Street  
South Hadley, MA 01075

shall be responsible for financing maintenance and emergency repairs of the stormwater management system, and shall employ this document to notify future property owners of the presence of the stormwater management system and the requirement for proper operation and maintenance.

***INSPECTION AND MAINTENANCE***

1. Sod Strip
  - A. Mow the sod strip as needed.
  - B. Remove trash and debris bi-annually.
  
2. Grassed Channel
  - A. Visually inspect the channel annually. Make sure vegetation is adequate and slopes are not eroding. Check for rilling and gullyng. Repair eroded areas and revegetate as necessary.
  - B. Mow on an as-needed basis so that the grass height does not exceed 6 inches. Set mower blades no lower than 3 inches.
  - C. Remove trash and debris prior to mowing.
  - D. Check the channel for sediment accumulation on a yearly basis and clean as needed. Use hand methods (i.e. a shovel) to minimize disturbance to vegetation and underlying soils.

3. Rain Garden
  - A. Visually inspect soil and repair eroded areas monthly. Re-mulch void areas as needed. Remove litter and debris monthly.
  - B. Mulch annually in the spring.
  - C. Remove dead vegetation annually; either fall or spring.
  - D. Replace dead vegetation annually in the spring.
  - E. Prune vegetation annually; either spring or fall.
  - F. Replace entire media and all vegetation as needed; late spring/early summer.
  - G. Do not store snow in the rain garden; care must be taken during plowing operations.
  
4. Area Drains, Stormwater Piping & Rain Garden Overflow Weir
  - A. Remove trash and debris bi-annually.
  - B. Remove sediment from piping as needed.

***OPERATIONS AND MAINTENANCE BUDGET***

A budget to implement the long-term operation and maintenance plan has not yet been developed.

  
Owner's Signature

APPENDIX E:  
SUPPLEMENTAL CALCULATIONS

## **SUPPLEMENTAL CALCULATIONS**

The following calculations have been performed to accompany the Stormwater Management Report for the proposed BHMA Bernon Music Center in South Hadley, MA. The required computations have been completed per *Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standards*.

### **STANDARD 1**

There are no discharges to a wetland on site. The discharge to Reach 1 in the HydroCAD model has a peak flow rate of 0.00 cfs in the 2-year storm. To prevent erosion or scour, a riprap apron was sized to dissipate the energy. The 100-year peak flow rate of 2.95 cfs from a 12" pipe was used.

$$D_{50} = 0.2D \left[ \frac{Q}{(\sqrt{g})(D^{2.5})} \right]^{4/3} \left( \frac{D}{TW} \right)$$
$$D_{50} = 0.2(1 \text{ ft}) \left[ \frac{2.95 \text{ cfs}}{\left( \sqrt{32.2 \text{ ft/s}^2} \right) (1 \text{ ft})^{2.5}} \right]^{4/3} \left( \frac{1 \text{ ft}}{0.25 \text{ ft}} \right) = 0.33 \text{ ft} = 4.0 \text{ in}$$

Use Class 2  $D_{50} = 6 \text{ in}$

Apron Length =  $4D = 4(1 \text{ ft}) = 4 \text{ ft}$

Apron Depth =  $3.3D_{50} = 1.65 \text{ ft}$ , use 1.7 ft

Apron width is a function of the apron geometry. 5 ft was used.

### **STANDARD 2**

Peak rate attenuation computations are presented in the HydroCAD output. See Appendices A, B, and C.

### **STANDARD 3**

The project will add 24,292 sf of new impervious area to the site. The site consists of Hydrologic Soil Group (HSG) type A soils. The Required Recharge Volume (Rv) is:

$$F = 0.6''$$

$$Rv = F \times \text{impervious area}$$

$$Rv = \left( \frac{0.6''}{12''/ft} \right) (24,292 \text{ sf}) = 1,215 \text{ cf}$$

The proposed rain garden will accommodate the recharge requirement of the site. 5,404 cf of storage is provided at elevation 260.0; see Pond 1P in the HydroCAD output.

Calculations for the drawdown of the rain garden are shown below. A Rawls Rate of 2.41 inches/hour is used per Table 2.3.3. in *Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standards*.

$$\text{Time}_{\text{drawdown}} = \frac{Rv}{(K)(\text{BottomArea})}$$
$$\text{Time}_{1P} = \frac{5,404 \text{ cf}}{\left( \frac{2.41 \text{ in}}{\text{hr}} \right) \left( \frac{1 \text{ ft}}{12 \text{ in}} \right) (923 \text{ sf})} = 29.2 \text{ hr}$$

### **STANDARD 4**

The Required Water Quality Volume (V<sub>WQ</sub>) for the site is calculated below. The site is not classified as a LUHPPL, so the half-inch rule is used for this calculation:

$$V_{WQ} = \left( \frac{D_{WQ}}{12 \text{ in}/ft} \right) (A_{IMP})$$
$$V_{WQ} = \left( \frac{0.5 \text{ in}}{12 \text{ in}/ft} \right) (24,292 \text{ sf}) = 1,012 \text{ cf}$$

The proposed rain garden will provide the Water Quality Volume requirement of the site. 5,404 cf of storage is provided at elevation 260.0; see Pond 1P in the HydroCAD output.

Sizing for the Grassed Channel Water Quality Volume is provided at the end of this section.

### **STANDARD 5**

This site is not classified as a LUHPPL. As such, the half-inch rule was used when calculating the Required Water Quality Volume.

### **STANDARD 6**

Not Applicable.

### **STANDARD 7**

Not Applicable.

### **STANDARD 8**

See Appendix D for Erosion & Sedimentation Control Plans.

### **STANDARD 9**

See Appendix D for the Long-Term Operation and Maintenance Plan.

### **STANDARD 10**

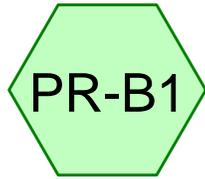
See Appendix G for the Illicit Discharge Compliance Statement.

### **GRASSED CHANNEL WATER QUALITY VOLUME**

The proposed grassed channel has been modeled in HydroCAD to demonstrate compliance with the Massachusetts Stormwater Handbook design requirements. The grassed channel has been modeled as three separate reaches, differentiated by the average slope over each leg. A water quality event of 1-inch runoff was used, as ½-inch runoff was too small to produce a meaningful result. Results are summarized below:

Reach	Inlet Elevation	Outlet Elevation	Average Slope (ft/ft)	Max Velocity (fps)	Hydraulic Residence Time (min)
2R	266.87	266.00	0.004	0.34	10.6
3R	266.00	264.00	0.016	0.57	3.6
4R	264.00	259.00	0.039	0.83	2.6
				<b>TOTAL</b>	<b>16.8 min</b>

The grassed channel has been designed so that the velocity does not exceed 1 foot per second (fps) during the 24-hour storm associated with the water quality event, even when the conservative 1-inch storm was used. This design storm provides more than 9 minutes of Hydraulic Residence Time within the channel, increasing the likelihood of achieving 50% TSS removal efficiency, and demonstrating this BMP provides sufficient pretreatment for the rain garden.



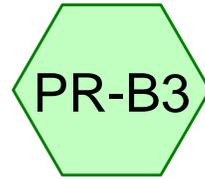
Northern Swale



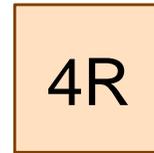
Grassed Channel Upper



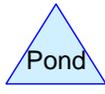
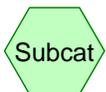
Grassed Channel Middle



Eastern Swale



Grassed Channel Lower



**Grassed Channel WQV**

Type III 24-hr WQ Rainfall=1.00"

Prepared by Doucet & Associates, Inc.

Printed 3/2/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Page 2

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points  
Runoff by SCS TR-20 method, UH=SCS  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment PR-B1: Northern Swale</b>	Runoff Area=31,011 sf 57.03% Impervious Runoff Depth>0.02" Flow Length=85' Tc=8.8 min CN=73 Runoff=0.00 cfs 0.001 af
<b>Subcatchment PR-B3: Eastern Swale</b>	Runoff Area=67,832 sf 32.01% Impervious Runoff Depth=0.00" Flow Length=321' Tc=12.4 min CN=57 Runoff=0.00 cfs 0.000 af
<b>Reach 2R: Grassed Channel Upper</b>	Avg. Flow Depth=0.05' Max Vel=0.34 fps Inflow=0.00 cfs 0.001 af n=0.022 L=218.0' S=0.0040 '/' Capacity=31.69 cfs Outflow=0.00 cfs 0.001 af
<b>Reach 3R: Grassed Channel Middle</b>	Avg. Flow Depth=0.04' Max Vel=0.57 fps Inflow=0.00 cfs 0.001 af n=0.022 L=125.0' S=0.0160 '/' Capacity=63.45 cfs Outflow=0.00 cfs 0.001 af
<b>Reach 4R: Grassed Channel Lower</b>	Avg. Flow Depth=0.03' Max Vel=0.83 fps Inflow=0.00 cfs 0.001 af n=0.022 L=130.0' S=0.0385 '/' Capacity=98.38 cfs Outflow=0.00 cfs 0.001 af

**Grassed Channel WQV**

Type III 24-hr WQ Rainfall=1.00"

Prepared by Doucet &amp; Associates, Inc.

Printed 3/2/2016

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Page 3

**Summary for Subcatchment PR-B1: Northern Swale**

Runoff = 0.00 cfs @ 15.16 hrs, Volume= 0.001 af, Depth&gt; 0.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr WQ Rainfall=1.00"

Area (sf)	CN	Description
11,358	98	Paved parking, HSG A
6,329	98	Roofs, HSG A
13,324	39	>75% Grass cover, Good, HSG A
31,011	73	Weighted Average
13,324		42.97% Pervious Area
17,687		57.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0300	0.11		<b>Sheet Flow, 7' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
0.2	8	0.0200	0.80		<b>Sheet Flow, 8' Sheet</b> Smooth surfaces n= 0.011 P2= 3.00"
7.6	70	0.0200	0.15		<b>Sheet Flow, 70' Sheet</b> Grass: Short n= 0.150 P2= 3.00"
8.8	85	Total			

**Summary for Subcatchment PR-B3: Eastern Swale**

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr WQ Rainfall=1.00"

Area (sf)	CN	Description
18,167	98	Paved parking, HSG A
3,545	98	Roofs, HSG A
10,594	36	Woods, Fair, HSG A
35,526	39	>75% Grass cover, Good, HSG A
67,832	57	Weighted Average
46,120		67.99% Pervious Area
21,712		32.01% Impervious Area

## Grassed Channel WQV

Prepared by Doucet & Associates, Inc.

HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Type III 24-hr WQ Rainfall=1.00"

Printed 3/2/2016

Page 4

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0250	0.18		<b>Sheet Flow, 100' Sheet Flow</b> Grass: Short n= 0.150 P2= 3.00"
2.5	142	0.0180	0.94		<b>Shallow Concentrated Flow, 142' Shallow</b> Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0380	3.96		<b>Shallow Concentrated Flow, 40' Shallow</b> Paved Kv= 20.3 fps
0.4	39	0.0510	1.58		<b>Shallow Concentrated Flow, 39' Shallow</b> Short Grass Pasture Kv= 7.0 fps
12.4	321	Total			

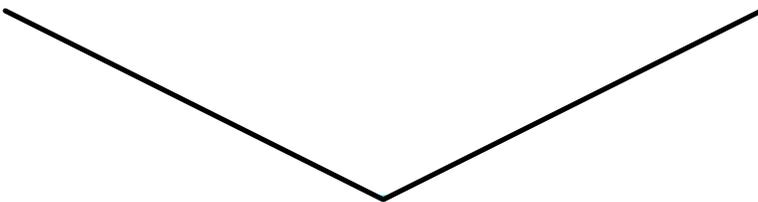
### Summary for Reach 2R: Grassed Channel Upper

Inflow Area = 0.712 ac, 57.03% Impervious, Inflow Depth > 0.02" for WQ event  
Inflow = 0.00 cfs @ 15.16 hrs, Volume= 0.001 af  
Outflow = 0.00 cfs @ 15.47 hrs, Volume= 0.001 af, Atten= 0%, Lag= 18.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Max. Velocity= 0.34 fps, Min. Travel Time= 10.6 min  
Avg. Velocity = 0.31 fps, Avg. Travel Time= 11.9 min

Peak Storage= 1 cf @ 15.29 hrs  
Average Depth at Peak Storage= 0.05'  
Bank-Full Depth= 2.00', Capacity at Bank-Full= 31.69 cfs

0.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight  
Side Slope Z-value= 2.0 ' ' Top Width= 8.00'  
Length= 218.0' Slope= 0.0040 ' '  
Inlet Invert= 266.87', Outlet Invert= 266.00'



### Summary for Reach 3R: Grassed Channel Middle

Inflow Area = 0.712 ac, 57.03% Impervious, Inflow Depth > 0.02" for WQ event  
Inflow = 0.00 cfs @ 15.47 hrs, Volume= 0.001 af  
Outflow = 0.00 cfs @ 15.58 hrs, Volume= 0.001 af, Atten= 0%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Max. Velocity= 0.57 fps, Min. Travel Time= 3.6 min  
Avg. Velocity = 0.54 fps, Avg. Travel Time= 3.9 min

Peak Storage= 0 cf @ 15.52 hrs  
Average Depth at Peak Storage= 0.04'  
Bank-Full Depth= 2.00', Capacity at Bank-Full= 63.45 cfs

## Grassed Channel WQV

Prepared by Doucet & Associates, Inc.

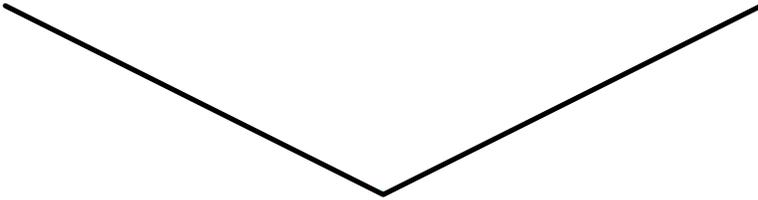
HydroCAD® 9.10 s/n 02019 © 2010 HydroCAD Software Solutions LLC

Type III 24-hr WQ Rainfall=1.00"

Printed 3/2/2016

Page 5

0.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight  
Side Slope Z-value= 2.0 '/' Top Width= 8.00'  
Length= 125.0' Slope= 0.0160 '/'  
Inlet Invert= 266.00', Outlet Invert= 264.00'



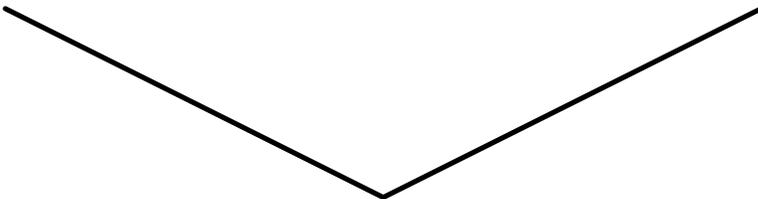
### Summary for Reach 4R: Grassed Channel Lower

Inflow Area =	2.269 ac, 39.86% Impervious, Inflow Depth > 0.01" for WQ event
Inflow =	0.00 cfs @ 15.58 hrs, Volume= 0.001 af
Outflow =	0.00 cfs @ 15.66 hrs, Volume= 0.001 af, Atten= 0%, Lag= 4.8 min

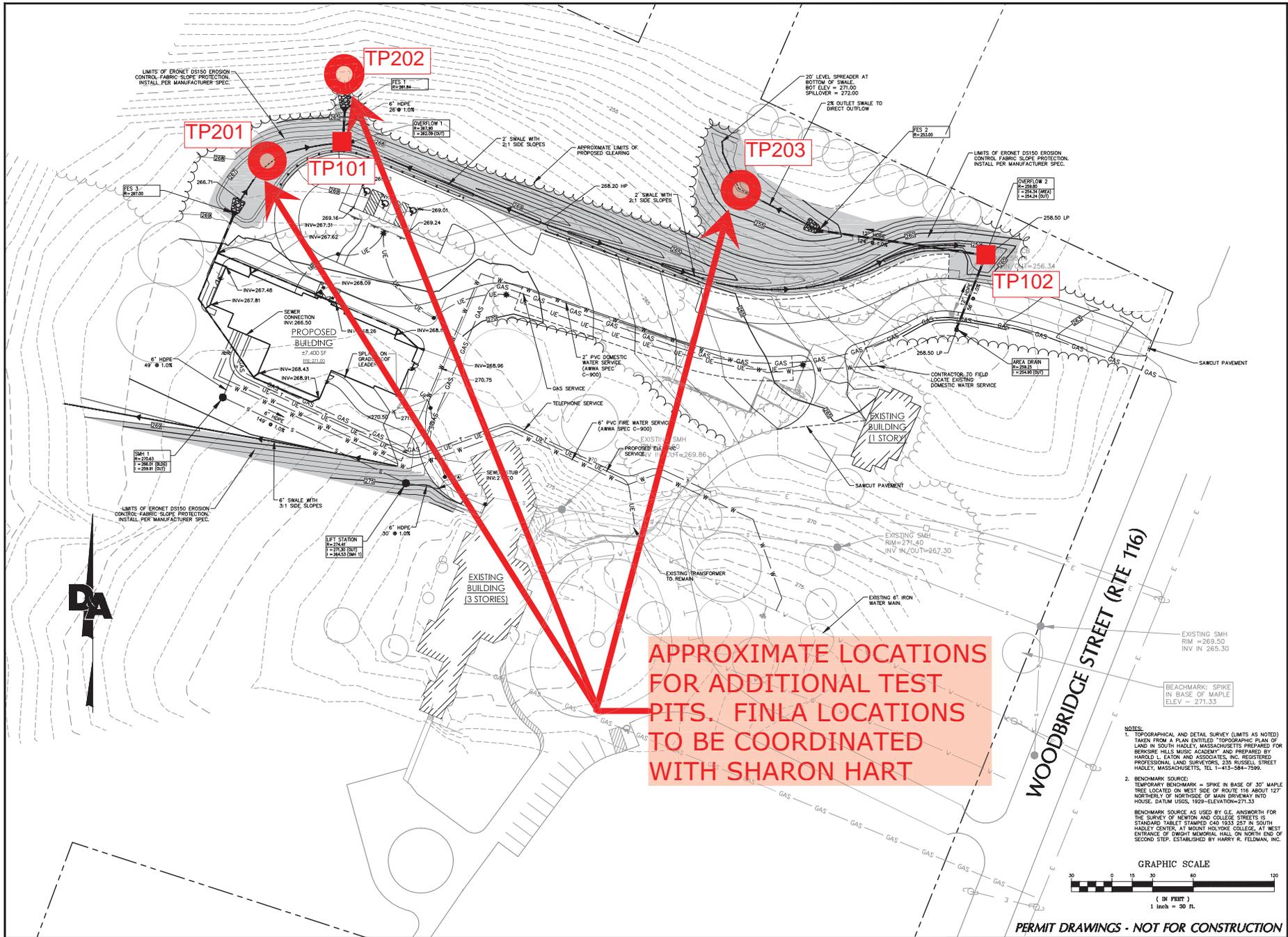
Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs  
Max. Velocity= 0.83 fps, Min. Travel Time= 2.6 min  
Avg. Velocity = 0.76 fps, Avg. Travel Time= 2.8 min

Peak Storage= 0 cf @ 15.62 hrs  
Average Depth at Peak Storage= 0.03'  
Bank-Full Depth= 2.00', Capacity at Bank-Full= 98.38 cfs

0.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight  
Side Slope Z-value= 2.0 '/' Top Width= 8.00'  
Length= 130.0' Slope= 0.0385 '/'  
Inlet Invert= 264.00', Outlet Invert= 259.00'

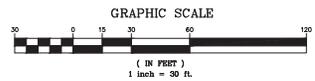


APPENDIX F:  
GEOTECHNICAL FIELD INVESTIGATION DATA



**APPROXIMATE LOCATIONS FOR ADDITIONAL TEST PITS. FINLA LOCATIONS TO BE COORDINATED WITH SHARON HART**

- NOTES:**
1. TOPOGRAPHICAL AND DETAIL SURVEY (LIMITS AS NOTED) TAKEN FROM A PLAN ENTITLED "TOPOGRAPHIC PLAN OF LAND IN SOUTH HADLEY, MASSACHUSETTS PREPARED FOR BERKSHIRE HILLS MUSIC ACADEMY" AND PREPARED BY HARRY D. FAYON AND ASSOCIATES, INC. REGISTERED PROFESSIONAL LAND SURVEYORS, 250 RUSSELL STREET HADLEY, MASSACHUSETTS, TEL. 413-584-7599.
  2. BENCHMARK SOURCE: TEMPORARY BENCHMARK = SPIKE IN BASE OF 30' MAPLE TREE LOCATED ON WEST SIDE OF ROUTE 116 ABOUT 127' NORTHERLY OF NORTHSIDE OF MAIN DRIVEWAY INTO HOUSE. DATUM UGSS, 1928-ELEVATION=271.33
- BENCHMARK SOURCE AS USED BY G.E. ANSWORTH FOR THE SURVEY OF NEWTON AND COLLEGE STREETS IS STANDARD TABLE STAMPED C40 1933 257 N SOUTH HADLEY CENTER, AT MOUNT HOLYOKE COLLEGE, AT WEST ENTRANCE OF DWIGHT MEMORIAL HALL ON NORTH END OF SECOND STEP, ESTABLISHED BY HARRY R. FELDMAN, INC.



**PERMIT DRAWINGS - NOT FOR CONSTRUCTION**

NO.	DATE	DESCRIPTION

**Site Grading & Utility Plan**

**Berkshire Hills Music Academy**  
**Bernon Music Center**  
 48 Woodbridge Street  
 South Hadley, MA 01075



Scale: 1" = 30'  
 Designed: CST  
 Drawn: JB  
 Reviewed: JH  
 Date: 1/22/2016

**SHEET**  
**C-5**  
 5 of 12  
 Project No: 1491-001

**Project** Berkshire Hills Music Academy Performing Arts Building  
**Location** 48 Woodbridge Street, South Hadley, MA  
**Client** Berkshire Hills Music Academy  
**Contractor** Seaboard Drilling, Inc.  
**Equipment Used** Mini Excavator

**File No.** 42826-000  
**H&A Rep** P. Dunaj  
**Date** 15 Jan 2016  
**Weather** Clear, 30's

**Ground El.:** 267.0 (est.)      **Location:** See Plan      **Groundwater depths/entry rates (in./min.):** NOT OBSERVED  
**El. Datum:** NGVD 1929

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests				
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			ML	Dark brown loamy sandy SILT with roots, no odor, dry	-	-	-	10	25	65				
1				-TOPSOIL-										
		265.7 1.3	SP- SM	Orange-brown poorly-graded SAND and silt, no odor, dry	-	-	5	5	60	30				
				-SUBSOIL-										
2		265.0 2.0	SM	Gray SILT with sand and gravel, no odor, dry	10	15	5	5	15	50				
				-GLACIAL TILL-										
		264.5 2.5		-TOP OF BEDROCK- BOTTOM OF EXPLORATION 2.5 FT										

<b>Obstructions:</b> -	<b>Remarks:</b> -	<b>Field Tests</b>			
		Dilatancy	R - Rapid	S - Slow	N - None
		Toughness	L - Low	M - Medium	H - High
		Plasticity	N - Nonplastic    L - Low    M - Medium    H - High		
		Dry Strength	N - None    L - Low    M - Medium    H - High    V - Very High		

<b>Standing Water in Completed Pit</b>		<b>Boulders</b>			<b>Test Pit Dimensions (ft)</b>	
at depth	NOT OBSERVED	Diameter (in.)	Number	Approx. Vol. (cu.ft)	Pit Length x Width (ft)	6x3
measured after	hours elapsed	12 to 24	=	=	Pit Depth (ft)	2.5
		over 24	=	=		

**NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.**

**Project** Berkshire Hills Music Academy Performing Arts Building  
**Location** 48 Woodbridge Street, South Hadley, MA  
**Client** Berkshire Hills Music Academy  
**Contractor** Seaboard Drilling, Inc.  
**Equipment Used** Mini Excavator

**File No.** 42826-000  
**H&A Rep** P. Dunaj  
**Date** 14 Jan 2016  
**Weather** Clear, 30's

**Ground El.:** 260.0 (est.)  
**El. Datum:** NGVD 1929

**Location:** See Plan

**Groundwater depths/entry rates (in./min.):**

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests				
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			ML	Dark brown loamy sandy SILT with roots, no odor, dry	-	-	-	10	20	70				
		258.8 1.2		-TOPSOIL-										
			SP- SM	Yellow-brown poorly-graded SAND, no odor, dry	-	-	-	15	70	15				
2				-SUBSOIL-										
		257.2 2.8		-SUBSOIL-										
			SP	Light brown poorly-graded SAND with silt, no odor, dry	-	-	-	7	82	11				
4				-GLACIO FLUVIAL DEPOSITS-										
		252.8 7.2		-GLACIO FLUVIAL DEPOSITS-										
			SW- SM	Red-brown well-graded SAND with gravel and silt, no odor, moist	10	15	10	20	20	25				
				-GLACIAL TILL-										
8		252.0 8.0		-TOP OF BEDROCK- BOTTOM OF EXPLORATION 8.0 FT										

<b>Obstructions:</b> -	<b>Remarks:</b> -	<b>Field Tests</b>
		Dilatancy R - Rapid S - Slow N - None Toughness L - Low M - Medium H - High Plasticity N - Nonplastic L - Low M - Medium H - High Dry Strength N - None L - Low M - Medium H - High V - Very High

<b>Standing Water in Completed Pit</b>			<b>Boulders</b>			<b>Test Pit Dimensions (ft)</b>	
at depth	7.5	ft	Diameter (in.)	Number	Approx. Vol. (cu.ft)	Pit Length x Width (ft)	10x3
measured after	0.5	hours elapsed	12 to 24	=	=	Pit Depth (ft)	8.0
			over 24	=	=		

**NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.**

**Project** Berkshire Hills Music Academy Performing Arts Building  
**Location** 48 Woodbridge Street, South Hadley, MA  
**Client** Berkshire Hills Music Academy  
**Contractor** GML Construction, Inc.  
**Equipment Used** Mini - Excavator

**File No.** 42826-000  
**H&A Rep** P. Dunaj  
**Date** 3 Mar 2016  
**Weather** Sunny, 30's

**Ground El.:** 266.5 (est.)  
**El. Datum:** NGVD 1929

**Location:** See Plan

**Groundwater depths/entry rates (in./min.):** NOT OBSERVED

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests				
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			ML	Dark brown/black loamy sandy SILT with roots, no odor, dry	-	-	-	10	25	65				
1		265.1 1.4		-TOPSOIL-										
			SM	Dark brown to gray poorly-graded SAND and SILT, no odor, dry	-	-	5	5	60	30				
2				-SUBSOIL-										
3		263.5 3.0		-BEDROCK-										
		263.0 3.5		BOTTOM OF EXPLORATION 3.5 FT										

<b>Obstructions:</b> -	<b>Remarks:</b> -	<b>Field Tests</b>			
		Dilatancy	R - Rapid	S - Slow	N - None
		Toughness	L - Low	M - Medium	H - High
		Plasticity	N - Nonplastic L - Low M - Medium H - High		
		Dry Strength	N - None L - Low M - Medium H - High V - Very High		

<b>Standing Water in Completed Pit</b>		<b>Boulders</b>			<b>Test Pit Dimensions (ft)</b>	
at depth	NOT OBSERVED	Diameter (in.)	Number	Approx. Vol. (cu.ft)	Pit Length x Width (ft)	6x2.5
measured after	hours elapsed	12 to 24	=	=	Pit Depth (ft)	3.5
		over 24	=	=		

**NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.**

**Project** Berkshire Hills Music Academy Performing Arts Building  
**Location** 48 Woodbridge Street, South Hadley, MA  
**Client** Berkshire Hills Music Academy  
**Contractor** GML Construction, Inc.  
**Equipment Used** Mini - Excavator

**File No.** 42826-000  
**H&A Rep** P. Dunaj  
**Date** 3 Mar 2016  
**Weather** Sunny, 30's

**Ground El.:** 260.0 (est.)  
**El. Datum:** NGVD 1929

**Location:** See Plan

**Groundwater depths/entry rates (in./min.):** NOT OBSERVED

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests				
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			ML	Dark brown/black loamy SILT with roots, no odor, dry	-	-	-	10	20	70				
1														
2														
3		257.0 3.0		-TOPSOIL/FILL-										
		256.7 3.3		-BEDROCK-										
				BOTTOM OF EXPLORATION 3.3 FT										

**Obstructions:** -

**Remarks:** -

Field Tests			
Dilatancy	R - Rapid	S - Slow	N - None
Toughness	L - Low	M - Medium	H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High		
Dry Strength	N - None	L - Low	M - Medium H - High V - Very High

**Standing Water in Completed Pit**  
 at depth NOT OBSERVED ft  
 measured after \_\_\_\_\_ hours elapsed

**Boulders**  
 Diameter (in.) Number Approx. Vol. (cu.ft)  
 12 to 24 =  
 over 24 =

**Test Pit Dimensions (ft)**  
 Pit Length x Width (ft) 2x2.5  
 Pit Depth (ft) 3.3

**NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.**

**Project** Berkshire Hills Music Academy Performing Arts Building  
**Location** 48 Woodbridge Street, South Hadley, MA  
**Client** Berkshire Hills Music Academy  
**Contractor** GML Construction, Inc.  
**Equipment Used** Mini - Excavator

**File No.** 42826-000  
**H&A Rep** P. Dunaj  
**Date** 3 Mar 2016  
**Weather** Sunny, 30's

**Ground El.:** 255.5 (est.)  
**El. Datum:** NGVD 1929

**Location:** See Plan

**Groundwater depths/entry rates (in./min.):**

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests				
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			ML	Dark brown loamy sandy SILT with roots, no odor, dry	-	-	-	10	20	70				
1		254.0		-TOPSOIL-										
1.5		1.5	SP- SM	Yellow/orange-brown poorly-graded silty SAND with trace roots, no odor, moist	-	-	-	15	70	15				
2														
3		252.2		-SUBSOIL-										
3.3		3.3	SP	Light brown to gray-brown poorly-graded SAND with silt, no odor, moist	-	-	-	10	80	10				
4														
4.5		251.0		-GLACIOFLUVIAL DEPOSITS-										
4.5		4.5	SW- SM	Red-brown well-graded SAND with gravel and silt, no odor, moist to wet	10	15	10	20	20	25				
5														
6														
7		248.7		-GLACIAL TILL-										
6.8		248.5		-BEDROCK-										
7.0		7.0		BOTTOM OF EXPLORATION 7.0 FT										

<b>Obstructions:</b> -	<b>Remarks:</b> -	<b>Field Tests</b>
		Dilatancy R - Rapid S - Slow N - None Toughness L - Low M - Medium H - High Plasticity N - Nonplastic L - Low M - Medium H - High Dry Strength N - None L - Low M - Medium H - High V - Very High

<b>Standing Water in Completed Pit</b>			<b>Boulders</b>			<b>Test Pit Dimensions (ft)</b>	
at depth	4.5	ft	Diameter (in.)	Number	Approx. Vol. (cu.ft)	Pit Length x Width (ft)	8x2.5
measured after	1.5	hours elapsed	12 to 24	=	=	Pit Depth (ft)	7.0
			over 24	=	=		

**NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.**

APPENDIX G:  
ILLCIT DISCHARGE COMPLIANCE STATEMENT

ILLICIT DISCHARGE COMPLIANCE STATEMENT  
Berkshire Hills Music Academy – Bernon Music Center  
48 Woodbridge Street, South Hadley, MA

In order to satisfy the requirements of the Massachusetts Department of Environmental Protection Stormwater Standard No. 10, this Illicit Discharge Statement is being submitted as verification that there appear to be no illicit discharges currently occurring at the site and also to prevent any possible future illicit discharges to the stormwater management system serving the site.

Recent visits to the project site have revealed that there are no known or suspected illicit discharges that are conveyed to or through the stormwater management system at the project site. As part of these site visits, the developed portions of the property – in particular the stormwater collection system - were observed for any evidence of ongoing or historic illicit discharges. No such evidence was found.

There are no known wastewater discharges, process wastes, raw materials, toxic pollutants, hazardous substances, oil, grease or other petroleum based substances present on the site that comingle with the stormwater runoff from the site.

Measures to prevent any possible future illicit discharges have been implemented as part of the Operation and Maintenance Plan.



Stamp of signing professional Engineer

---

Registered Professional Engineer

1/22/2016

Date