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October 24, 2014

Mr. Mike Gowing  
Chair of the Board of Selectman  
Town of Acton  
472 Main Street  
Acton, MA 01720

RE: Nitsch Project #10079  
Continuation of Use  
37 Knox Trail  
Acton, MA

Dear Mr. Gowing:

On behalf of Concord Public Schools, Nitsch Engineering is pleased to submit revised plans based on Town of Acton's comments for the Application for Continuation of Use at 37 Knox Trail in Acton, Massachusetts. Comments were received from the Acton Engineering Department, Zoning Enforcement and Assistant Town Planner, Water Supply District of Acton, and the Acton Fire Department. Nitsch Engineering is providing the following information for your review:

1. HydroCAD Output with summary of calculations;
2. Pre- and Post-Development Drainage Areas;
3. Soil Test Pit Log (Form 11);
4. Stormwater Operation and Maintenance Plan; and
5. Plan Set revised through October 24, 2014, including the following:
  - a. Cover Sheet – C0.0;
  - b. Site Plan – C1.0;
  - c. Turning Movements – C2.0;
  - d. Details – C3.0;
  - e. Snow Storage Plan – C4.0; and
  - f. Topographic Plan of Land.

Nitsch Engineering included three (3) hard copies to the Planning Department with this letter and will provide the plans electronically in Portable Document Format (PDF) to Scott Mutch, Town of Acton Zoning Enforcement Officer and Assistant Town Planner, on October 24, 2014.

Nitsch Engineering performed a test pit at the 37 Knox Trail site at the location of the rain garden as requested by the Acton Engineering Department and the Acton Water Department. The test pit information indicated a well-draining soil. Nitsch Engineering revised the rain garden grading to maintain the hydrant location and existing cover over the water line as requested by the Acton Water Department. A representative from the Acton Water Department was present before the test pit was excavated and left the site before excavation began.

Nitsch Engineering received fire truck turning information from the Acton Planning Department in an e-mail, dated October 15, 2014, which was used to create the turning movement drawing for 37 Knox Trail on Sheet C2.0.

Nitsch Engineering reviewed the comments and updated the plans and calculations. Nitsch Engineering offers the following responses, noting that the numbering conventions from the comment letters are being followed:

## RESPONSES TO ENGINEERING DEPARTMENT COMMENTS

Nitsch Engineering's response corresponds to comments from the Acton Engineer's e-mail, dated October 6, 2014.

3. Nitsch Engineering performed a test pit in accordance with the Stormwater Handbook Regulations and found that the area for the rain garden is a well-drained soil (hydrologic soil group of A). Nitsch Engineering used an infiltration rate of 2.41 inches per hour which is more conservative than the 8.27 inches per hour allowed by the Stormwater Handbook. In addition, groundwater and seasonal high groundwater was not observed after digging 10 feet below grade. A trench permit was applied for and received on October 14, 2014 for this work.
4. Nitsch Engineering provided revised pre- and post-development HydroCAD calculations for review.
9. Nitsch Engineering notes that the Town of Concord agrees to contribute to the sidewalk fund.
11. Nitsch Engineering provided a revised snow storage plan, Sheet C-4.0, as requested.

## RESPONSE TO ZONING AND PLANNING DEPARTMENT COMMENTS

1. Nitsch Engineering added a bicycle parking area for three (3) bicycles as required under the Zoning Bylaw Section 6.3.7. The bicycle parking takes up one (1) car parking space. Nitsch Engineering was able to maintain the 41 parking spaces at 37 Knox Trail after configuring the bicycle parking.
2. The Planning Board notes that the new impervious surface should not be located within 10 feet of the Acton/Concord town line as stated in Regulation 6.7.2. Nitsch Engineering recommends that a condition of approval be granted to allow pavement up to the town line once the WR Grace land is under control by the Town of Concord.

## RESPONSE TO NATURAL RESOURCES DIRECTOR COMMENTS

1. Nitsch Engineering received a mark-up of the bio-retention detail indicating a filter fabric layer between the sand layer and pea stone layer. As a practice, Nitsch Engineering does not include filter fabric at this location due to the potential for clogging. The pea stone acts as a choker course or a natural 'filter fabric' between the bio-retention sand, which acts as a filter, and the crushed stone.

## RESPONSE TO ACTON WATER SUPPLY DISTRICT COMMENTS

1. Nitsch Engineering provided an Operation and Maintenance plan for the proposed bio-retention and existing catch basins at 37 Knox Trail as part of this re-submittal.
2. Nitsch Engineering does not agree that stormwater from Knox Trail should be directed on the abutting WR Grace property. In addition to creating easement and ownership impacts, the WR Grace property is a few feet higher than the 37 Knox Trail property, which would make sending stormwater an impractical solution. The addition of a bio-retention system that captures the entire existing parking lot provides pollution reduction, infiltration of up to 90% of rain events and reduces rate and volume into the Knox Trail closed drainage system up to the 100-year storm event. This is a significant improvement over the existing stormwater condition.
3. Nitsch Engineering notes that the Town of Concord will address the groundwater monitoring well request.

Town of Acton: Nitsch Project #10079  
October 24, 2014  
Page 3 of 3

4. The Surveyor revised the existing conditions plan to show the fire hydrant and approximate location of the water line in Knox Trail and connection to the hydrant based on a conversation with Acton Water Department personnel in the field on October 15, 2014 prior to the test pit excavation.

There are no other improvements proposed for the site at this time.

Nitsch Engineering respectfully requests that the 37 Knox Trail project be conditionally approved at the next Board of Selectman's hearing.

Please let me know if you have any questions.

Very truly yours,

**Nitsch Engineering, Inc.**



Steven Ventresca, PE, LEED® AP BD+C  
Project Manager

SV/fmk

cc: File, Concord Public Schools

Q:\10079 CPS Acton Depot\Civil\Project Data\Special Permit Application\10079 BOS Letter-2014-10-24.docx

## LONG-TERM POLLUTION PREVENTION PLAN AND STORMWATER OPERATION AND MAINTENANCE PLAN

37 Knox Trail, Acton, MA

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### FIGURES

Figure 1 – Snow Storage Plan (Sheet C4.0)

## **1.0 INTRODUCTION**

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The purpose of this document is to specify the pollution prevention measures and stormwater management system operation and maintenance for the 37 Knox Trail site. The Responsible Party indicated below shall implement the management practices outlined in this document and proactively conduct operations at the project site in an environmentally responsible manner. Compliance with this Manual does not in any way dismiss the responsible party, owner, property manager, or occupants from compliance with other applicable federal, state or local laws.

Responsible Party: Town of Concord  
Dick Fowler  
135 Keyes Road, Concord, MA 01742  
978-318-3221

This Document has been prepared in compliance with Standards 4 and 9 of the 2008 Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards, which state:

### Standard 4:

The Long Term Pollution Prevention Plan shall include the proper procedures for the following:

- Good housekeeping
- Storing materials and waste products inside or under cover
- Vehicle washing
- Routine inspections of stormwater best management practices
- Spill prevention and response
- Maintenance of lawns, gardens, and other landscaped areas
- Pet waste management
- Operation and management of septic systems
- Proper management of deicing chemicals and snow

### Standard 9:

The Long-Term Operation and Maintenance Plan shall at a minimum include:

- Stormwater management system(s) owner(s)
- The party or parties responsible for operation and maintenance, including how future property owners shall be notified of the presence of the stormwater management system and the requirement for operation and maintenance
- The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks
- A plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point
- A description of public safety features
- An estimated operations and maintenance budget

## **2.0 LONG-TERM POLLUTION PREVENTION PLAN**

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The Responsible Party shall implement the following good housekeeping procedures at the project site to reduce the possibility of accidental releases and to reduce safety hazards.

### **2.1 Storage of Hazardous Materials**

To prevent leaks and spills, keep hazardous materials and waste products under cover or inside. Use drip pans or spill containment systems to prevent chemicals from entering the drainage system. Inspect storage areas for materials and waste products at least once per year to determine amount and type of the material on site, and if the material requires disposal.

Securely store liquid petroleum products and other liquid chemicals in federally- and state-approved containers. Restrict access to maintenance personnel and administrators.

### **2.2 Storage of Waste Products**

Collect and store all waste materials in securely lidded dumpster(s) or other secure containers as applicable to the material. Keep dumpster lids closed and the areas around them clean. Do not fill the dumpsters with liquid waste or hose them out. Sweep areas around the dumpster regularly and put the debris in the garbage, instead of sweeping or hosing it into the parking lot. Legally dispose of collected waste on a regular basis.

Segregate liquid wastes, including motor oil, antifreeze, solvents, and lubricants, from solid waste and recycle through hazardous waste disposal companies, whenever possible. Separate oil filters, batteries, tires, and metal filings from grinding and polishing metal parts from common trash items and recycle. These items are not trash and are illegal to dump. Contact a hazardous waste hauler for proper disposal to a hazardous waste collection center.

### **2.3 Spill Prevention and Response**

Implement spill response procedures for releases of significant materials such as fuels, oils, or chemical materials onto the ground or other area that could reasonably be expected to discharge to surface or groundwater.

- For minor spills, keep fifty (50) gallon spill control kits and Speedy Dry at all shop and work areas.
- Immediately contact applicable Federal, State, and local agencies for reportable quantities as required by law.
- Immediately perform applicable containment and cleanup procedures following a spill release.
- Promptly remove and dispose of all material collected during the response in accordance with Federal, State and local requirements. A licensed emergency response contractor may be required to assist in cleanup of releases depending on the amount of the release, and the ability of the Contractor to perform the required response.
- Reportable quantities of chemicals, fuels, or oils are established under the Clean Water Act and enforced through Massachusetts Department of Environmental Protection (DEP).

### **2.4 Minimize Soil Erosion**

Soil erosion facilitates mechanical transport of nutrients, pathogens, and organic matter to surface water bodies. Repair all areas where erosion is occurring throughout the project site. Stabilize bare soil with riprap, seed, mulch, or vegetation.

## **2.5 Maintenance of Lawns, Gardens, and other Landscaped Areas**

Pesticides and fertilizers shall not be used in the landscaped areas associated with the project site and shall not be stored on-site. Dumping of lawn wastes, brush or leaves or other materials or debris is not permitted in any Resource Area. Grass clippings, pruned branches and any other landscaped waste should be disposed of or composted in an appropriate location. No irrigation shall be used in the landscaped areas for this project.

## **2.6 Management of Deicing Chemicals and Snow**

The qualified contractor selected for snow plowing and deicing shall be made fully aware of the requirements of this section.

No road salt (sodium chloride) shall be stored on-site. The use of magnesium chloride de-icing product with a 0.5 to 1.0 percent sodium chloride mix for snow and ice treatment is permitted. The product shall be stored in a locked room inside the building and shall be used at exterior stairs and walkways. The snow plow contractor shall adhere to these magnesium chloride use and storage requirements.

During typical snow plowing operations, snow shall be pushed to the designated snow removal areas noted on the Snow Storage Plan (Figure 2). Snow shall not be stockpiled in wetland resource areas or the 100-foot Buffer Zone, catch basins, or bioretention basins, . In severe conditions where snow cannot be stockpiled on site, the snow shall be removed from the site and properly disposed of in accordance with DEP Guideline BRP601-01.

Use of sand is permitted only for impervious roadways and parking areas. If sand is applied, the snow plowed from impervious areas shall not be stored on porous asphalt.

Before winter begins, the property owner and the contractor shall review snow plowing, deicing, and stockpiling procedures. Areas designated for stockpiling should be cleaned of any debris. Street and parking lot sweeping should be followed in accordance with the Operation and Maintenance Plan.

## **2.7 Coordination with other Permits and Requirements**

Certain conditions of other approvals affecting the long term management of the property shall be considered part of this Long Term Pollution Prevention Plan. The Owner shall become familiar with those documents and comply with the guidelines set forth in those documents.

### **3.0 STORMWATER MANAGEMENT SYSTEM OPERATION AND MAINTENANCE PLAN**

#### **3.1 Introduction**

This Operation and Maintenance Plan (O&M Plan) for 37 Knox Trail site is required under Standard 9 of the 2008 MassDEP Stormwater Handbook to provide best management practices for implementing maintenance activities for the stormwater management system in a manner that minimizes impacts to wetland resource areas.

The Owner shall implement this O&M Plan and proactively conduct operations at the site in an environmentally responsible manner. Compliance with this O&M Plan does not in any way dismiss the Owner from compliance with other applicable Federal, State or local laws.

Routine maintenance during construction and post-development phases of the project, as defined in the Operation and Maintenance Plan, shall be permitted without amendment to the Order of Conditions. A continuing condition in the Certificate of Compliance shall ensure that maintenance can be performed without triggering further filings under the Wetlands Protection Act.

All stormwater best management practices (BMPs) shall be operated and maintained in accordance with the design plans and the Operation and Maintenance Plan approved by the issuing authority. The Owner shall:

- a. Maintain an operation and maintenance log for the last three years, including inspections, repairs, replacement and disposal (for disposal the log shall indicate the type of material and the disposal location). This is a rolling log in which the responsible party records all operation and maintenance activities for the past three years.
- b. Make this log available to the Engineering and Water Departments upon request; and
- c. Allow members and agents of the Engineering and Water Departments to enter and inspect the premises to evaluate and ensure that the Owner complies with the Operation and Maintenance requirements for each BMP.

#### **3.2 Stormwater Operation and Maintenance Requirements**

Inspect and maintain the stormwater management system as directed below. Refer to the Stormwater Management System Location Map (Figure 1) for the location of each component of the system. Repairs to any component of the system shall be made as soon as possible to prevent any potential pollutants (including silt) from entering the resource areas.

##### Deep Sump and Hooded Catch Basins

Inspect catch basins four times per year, including after the foliage season. Other inspection and maintenance requirements include:

- Remove organic material, sediment and hydrocarbons four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.
- Always clean out catch basins after street sweeping. If any evidence of hydrocarbons is found during inspection, the material immediately remove using absorbent pads or other suitable measures and dispose of legally. Remove other accumulated debris as necessary.
- Transport and disposal of accumulated sediment off-site shall be in accordance with applicable local, state and federal guidelines and regulations.

Area Drains

Inspect area drains at least once per month and remove debris from the grate. Clean out accumulated sediments at least once per year and more frequently as necessary.

Bioretention Areas

Perform annual maintenance of all components of the bioretention area, including plants, soil, and mulch. Table 1, below, outlines recommended maintenance activities.

**Table 1. Bioretention area maintenance recommendations**

<b>Location</b>	<b>Description</b>	<b>Frequency</b>	<b>Time of Year</b>
Surface	Inspect and remove trash	Monthly	Year round
Soil	Inspect and repair erosion	Monthly	Year round
Organic Layer	Remulch void areas	Annually	Spring
	Remove previous mulch layer before applying new layer (optional)	Annually	Spring
Plants	Water vegetation at end of day for 14 consecutive days after planting	Immediately after planting	As needed
	Remove and replace all dead and diseased vegetation that cannot be treated	Annually	Spring
	Treat all diseased trees and shrubs	As needed	Variable

During and after storm events, record the length of time standing water remains in the bioretention areas. If the time is greater than 72 hours, thoroughly inspect the basins for signs of clogging and develop a corrective action plan. The corrective action plan, prepared by a qualified professional, will outline procedures to restore infiltrative function. The owner of the site shall take immediate action to implement these corrective measures.

**3.3 Street Sweeping**

Perform street sweeping at least twice per year, whenever there is significant debris present on roads and parking lots. Street sweeping shall occur in the spring and fall. Sweepings must be handled and disposed of properly according to the Town of Acton DPW.

**3.4 Repair of the Stormwater Management System**

The stormwater management system shall be maintained. The repair of any component of the system shall be made as soon as possible to prevent any potential pollutants including silt from entering the resource areas or the existing closed drainage system.

**3.5 Reporting**

The Owner shall maintain a record of drainage system inspections and maintenance (per this Plan) and submit a yearly report to the Acton Engineering and Water Departments.

**STORMWATER MANAGEMENT SYSTEM INSPECTION FORM**

---

<b>37 Knox Trail Acton, MA</b>		Inspected by: _____ Date: _____
Component	Status/Inspection	Action Taken
Deep Sump Catch Basins, Area Drains and Drain Manholes		
Bioretention Basin		
General site conditions – evidence of erosion, etc.		

**SUBMIT COPIES OF STORMWATER MANAGEMENT SYSTEM INSPECTION FORM TO THE  
ACTON ENGINEERING AND WATER DEPARTMENTS WITH THE YEARLY REPORT.**



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- ▲ Sustainable Site Consulting
- ▲ Planning
- ▲ GS

PREPARED FOR:  
**CONCORD PUBLIC SCHOOLS**  
 120 MERIAM ROAD CONCORD, MA 01742

37 KNOX TRAIL ACTON, MA 01720

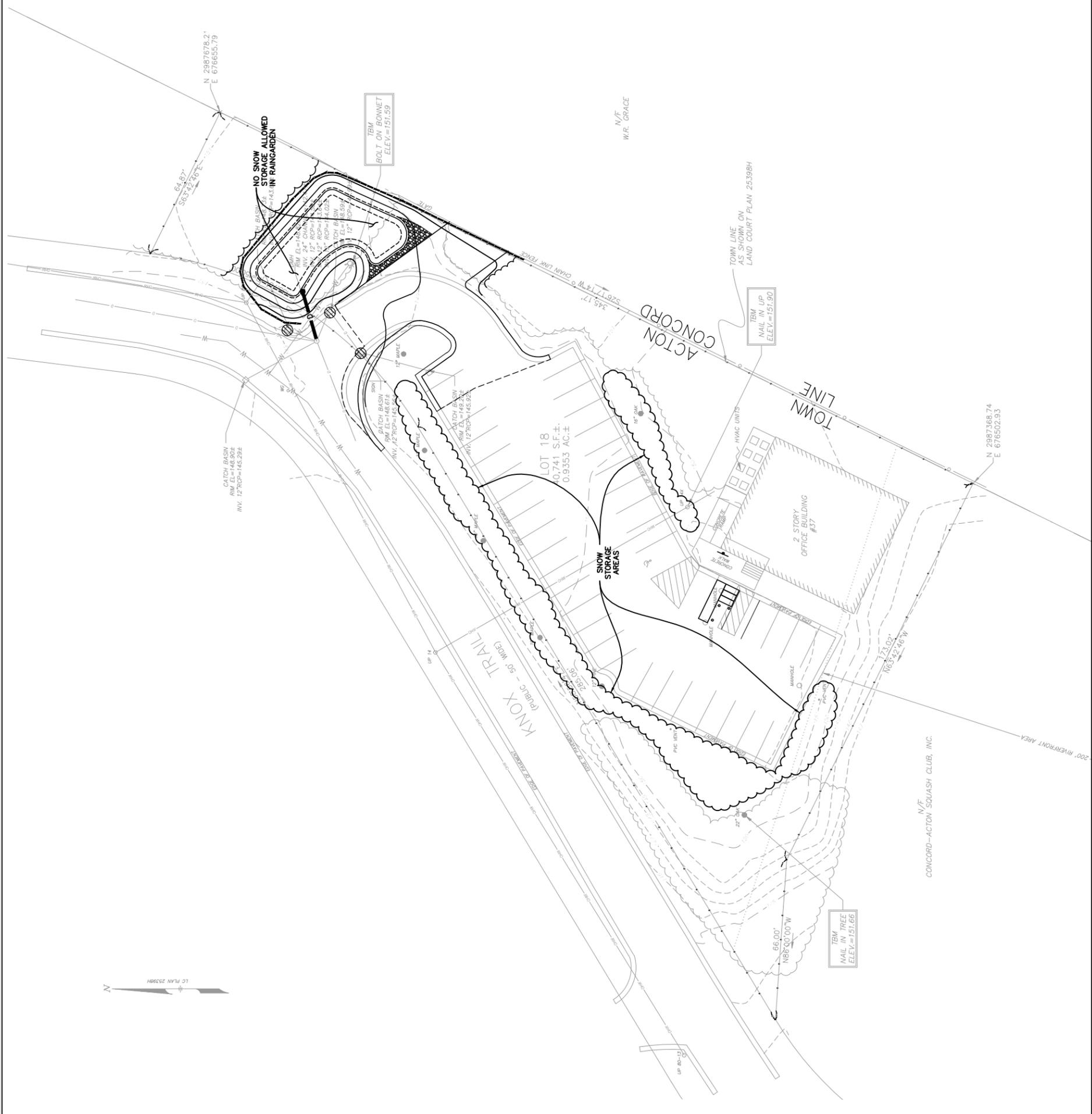
**SNOW STORAGE**

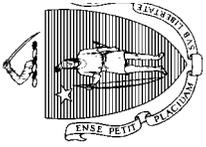
REV.	COMMENTS	DATE
2	TOWN'S COMMENTS	10/24/14
1	TOWN'S COMMENTS	10/6/14

REVISIONS

NITSCH PROJECT #	10079
FILE	0079CLC.DWG
SCALE	1" = 20'
DATE	07/03/2014
PROJECT MANAGER	SV
SURVEYOR	
DRAFTED BY	NGG
CHECKED BY	SV

**C4.0**





# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Date: October 15, 2014  
 Weather: Cloudy, 70°±  
 Location: 37 Knox Trail, Acton, MA  
 FOR DRAINAGE PURPOSES ONLY

Deep Observation Hole Number: 1 at elevation 150± (NAVD88) or 150.81 (NGVD)

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-11	A	10YR 2/2	-	-	-	SANDY LOAM	-	-	GRANULAR	VERY FRIABLE	
11-28	Bw	10YR 6/6	-	-	-	LOAMY SAND	-	-	SUB ANG BLOCKY	VERY FRIABLE	
28-52	C1	5Y 6/4	-	-	-	SAND COARSE	30%	5%	LOOSE	MASSIVE	
52-120	C2	2.5Y 7/4	-	-	-	FINE SAND	-	3%	LOOSE	MASSIVE	

Additional Notes: NO GROUNDWATER AND NO REDOX NOTED IN THE TEST PIT.



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### EXISTING DRAINAGE AREAS

REV.	COMMENTS	DATE
2	TOWN'S COMMENTS	02/24/14
1	TOWN'S COMMENTS	06/24/14

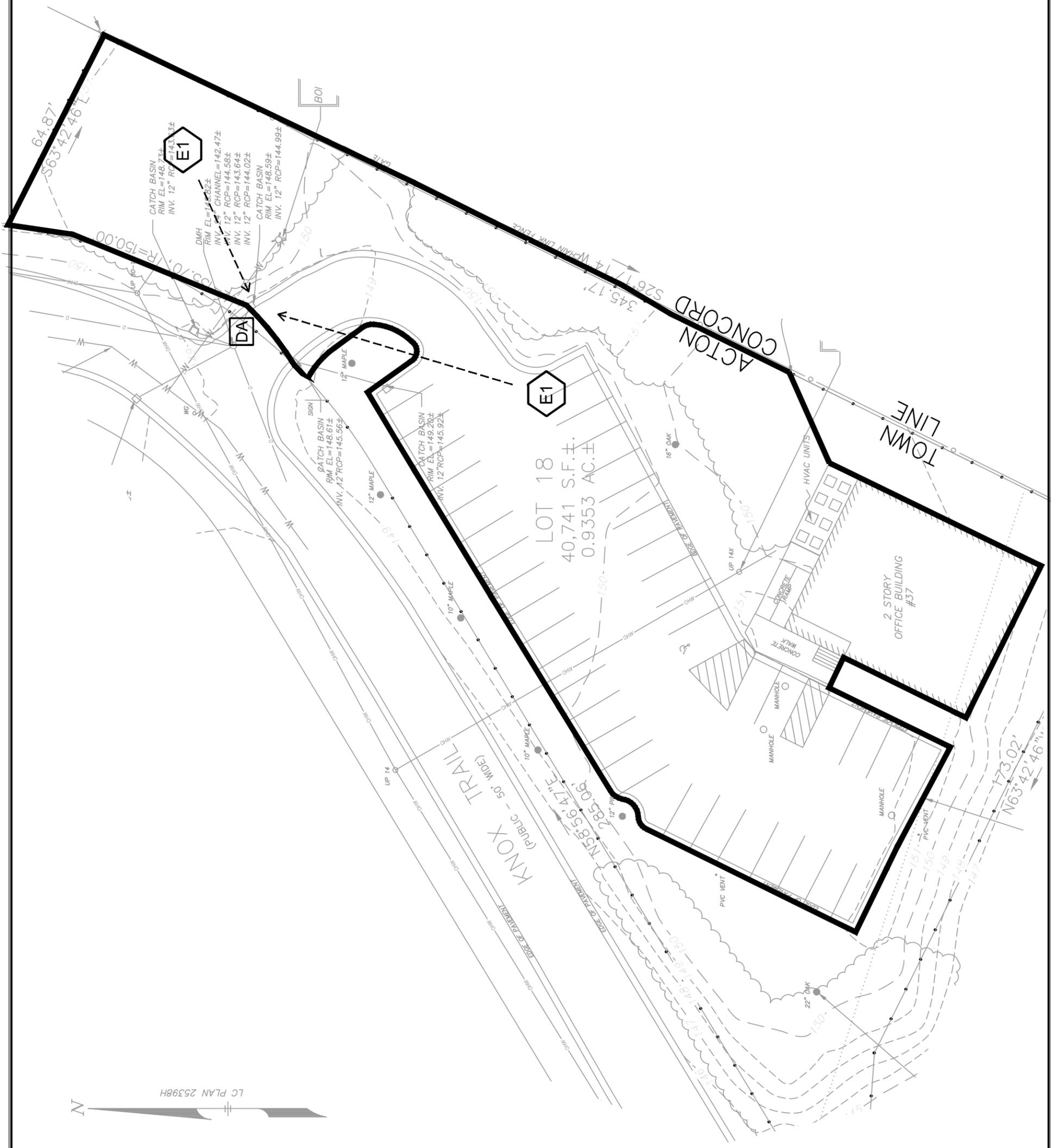
  

REVISIONS	
NO.	DESCRIPTION

NITSCH PROJECT #	10079
FILE	10079CLO.DWG
SCALE	NTS
DATE	07/03/2014
PROJECT MANAGER	SV
SURVEYOR	NGG
DRAFTED BY	SV
CHECKED BY	SV

# EX





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**PROPOSED DRAINAGE AREAS**

REV.	COMMENTS	DATE
2	TOWN'S COMMENTS	07/24/14
1	TOWN'S COMMENTS	07/16/14

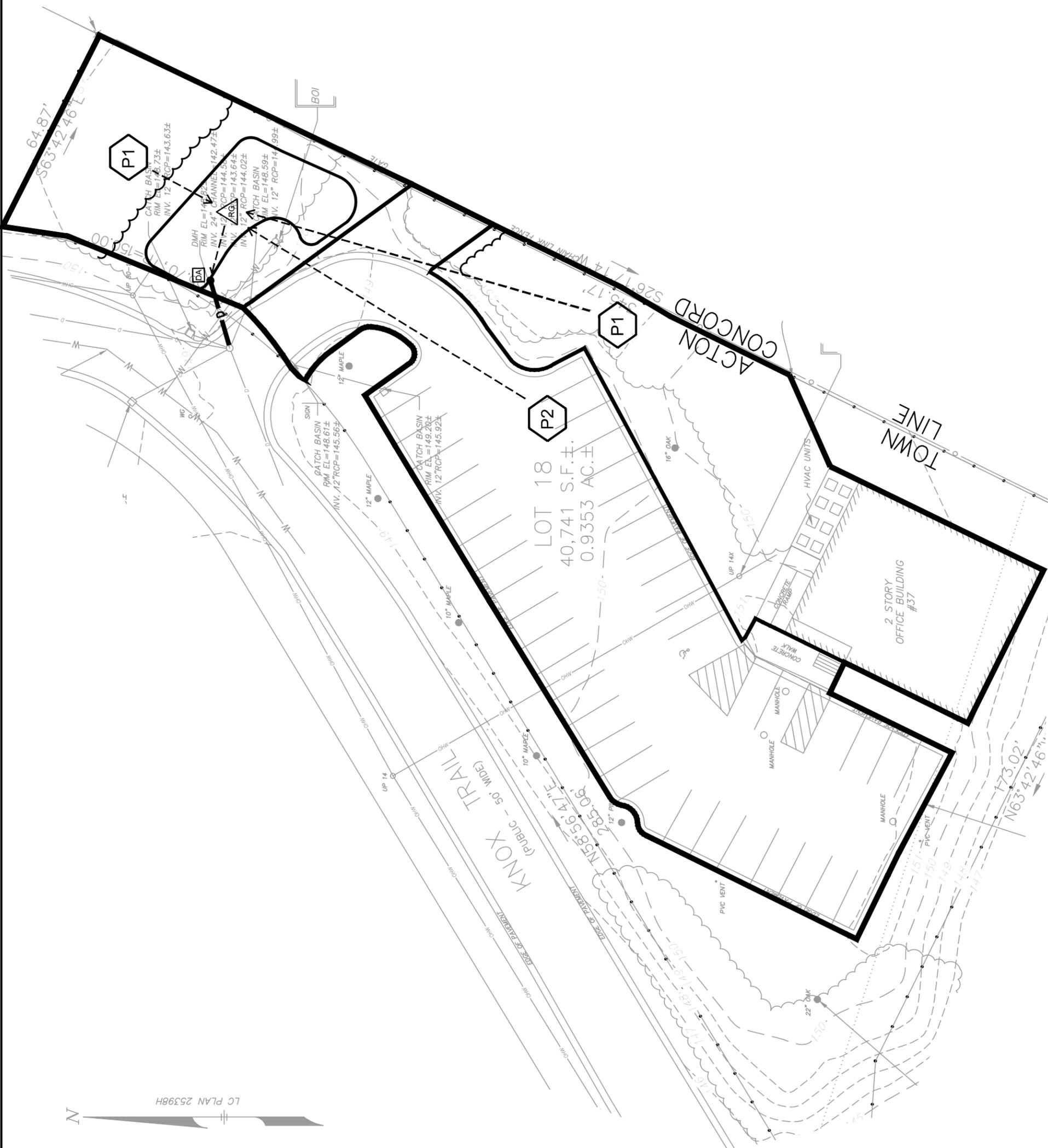
  

REVISIONS	DATE

NITSCH PROJECT #	10079
FILE:	10079CLO.DWG
SCALE:	NTS
DATE:	07/03/2014
PROJECT MANAGER:	SV
SURVEYOR:	
DRAFTED BY:	NGG
CHECKED BY:	SV

**PR**



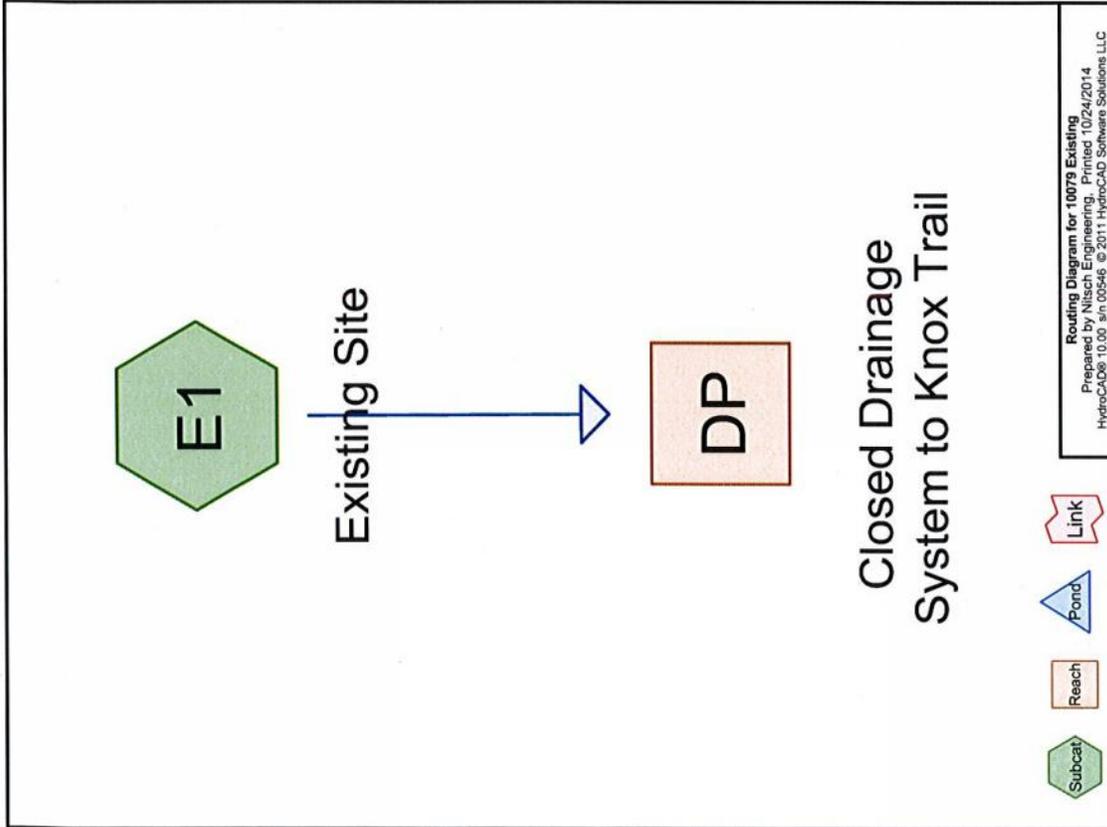
LC PLAN 25398H

	Storm Event – Rate, cfs				1 inch
	2-year	10-year	25-year	100-year	
<b>Existing</b>					
	0.60	1.39	1.89	2.68	0.00
<b>Proposed</b>					
	0.00	0.81	1.55	2.36	0.00

	Storm Event – volume, a/f				1 inch
	2-year	10-year	25-year	100-year	
<b>Existing</b>					
	0.046	0.098	0.132	0.186	0.002
<b>Proposed</b>					
	0.002	0.036	0.059	0.099	0.00

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.266	30	Woods, Good, HSG A (E1)
0.409	98	Building and Parking Lot, HSG A (E1)



**10079 Existing**

Prepared by Nitsch Engineering

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**10079 Existing**

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Page 4

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.675	HSG A	E1
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	

**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.409	0.000	0.000	0.000	0.000	0.409	Building and Parking	Lot E1
0.266	0.000	0.000	0.000	0.000	0.266	Woods, Good	E1

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment E1: Existing Site  
 Runoff Area=29,405 sf 60.64% Impervious Runoff Depth>0.82"  
 Tc=5.0 min CN=71 Runoff=0.60 cfs 0.046 af

Reach DP: Closed Drainage System to Knox Trail  
 Inflow=0.60 cfs 0.046 af  
 Outflow=0.60 cfs 0.046 af

Summary for Subcatchment E1: Existing Site

Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.046 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 2-YEAR Rainfall=3.10"

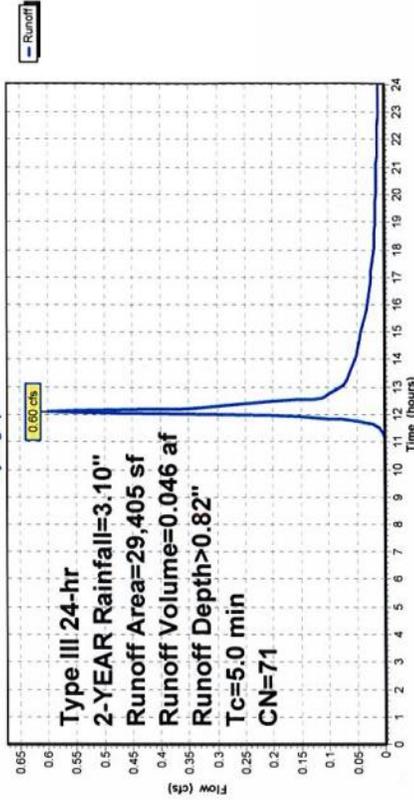
Area (sf)	CN	Description
17,832	98	Building and Parking Lot, HSG A
11,573	30	Woods, Good, HSG A
29,405	71	Weighted Average
11,573		39.36% Pervious Area
17,832		60.64% Impervious Area

Tc Length Slope Velocity Capacity Description  
 (min) (feet) (ft/ft) (ft/sec) (cfs)

5.0 Direct Entry, Direct Entry

Subcatchment E1: Existing Site

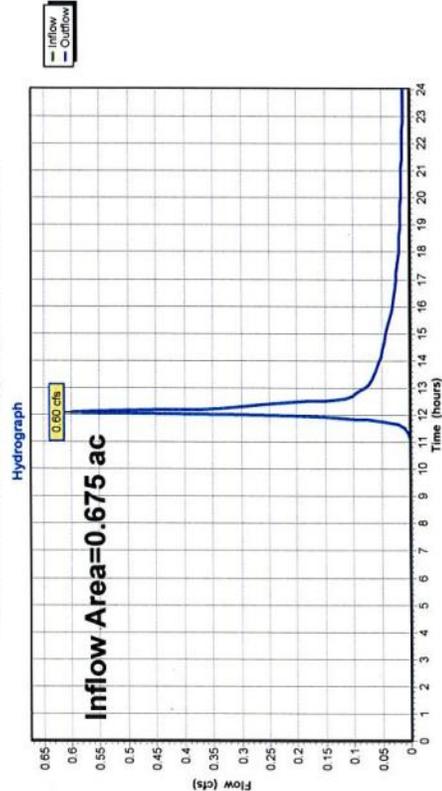
Hydrograph



**Summary for Reach DP: Closed Drainage System to Knox Trail**

Inflow Area = 0.675 ac, 60.64% Impervious, Inflow Depth > 0.82" for 2-YEAR event  
 Inflow = 0.60 cfs @ 12.09 hrs, Volume= 0.046 af  
 Outflow = 0.60 cfs @ 12.09 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

**Reach DP: Closed Drainage System to Knox Trail**



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment E1: Existing Site  
 Runoff Area=29,405 sf 60.64% Impervious Runoff Depth>1.74"  
 Tc=5.0 min CN=71 Runoff=1.39 cfs 0.098 af

**Reach DP: Closed Drainage System to Knox Trail**

Inflow=1.39 cfs 0.098 af  
 Outflow=1.39 cfs 0.098 af

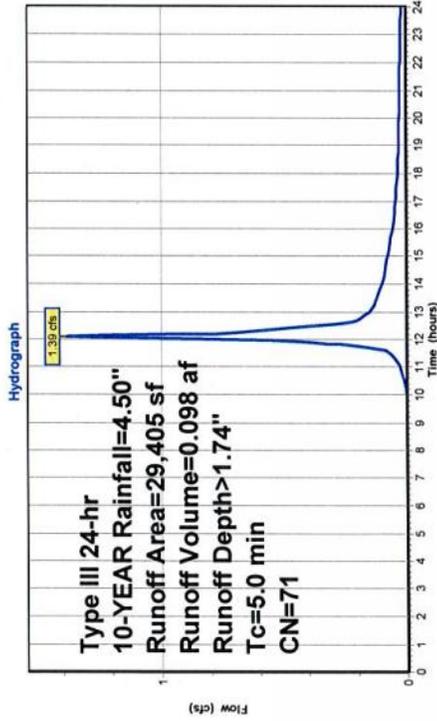
**Summary for Subcatchment E1: Existing Site**

Runoff = 1.39 cfs @ 12.08 hrs, Volume= 0.098 af, Depth> 1.74"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 10-YEAR Rainfall=4.50"

Area (sf)	CN	Description
17,832	98	Building and Parking Lot, HSG A
11,573	30	Woods, Good, HSG A
29,405	71	Weighted Average
11,573		39.36% Pervious Area
17,832		60.64% Impervious Area

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

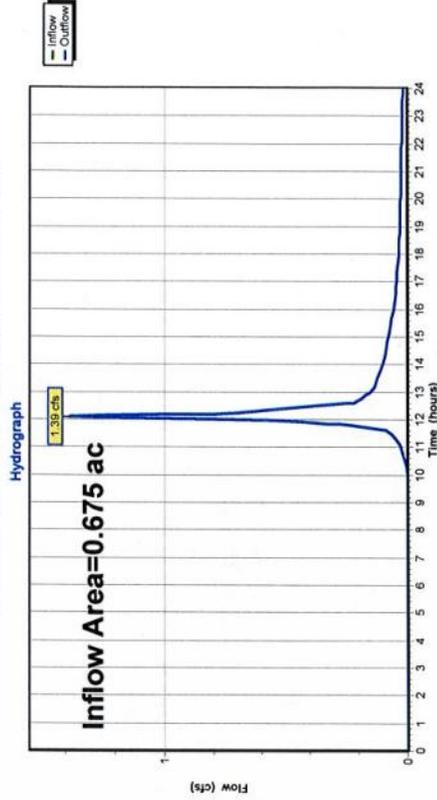
**Subcatchment E1: Existing Site**



**Summary for Reach DP: Closed Drainage System to Knox Trail**

Inflow Area = 0.675 ac, 60.64% Impervious, Inflow Depth > 1.74" for 10-YEAR event  
 Inflow = 1.39 cfs @ 12.08 hrs, Volume= 0.098 af  
 Outflow = 1.39 cfs @ 12.08 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

**Reach DP: Closed Drainage System to Knox Trail**



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site  
 Runoff Area=29,405 sf 60.64% impervious Runoff Depth>2.34"  
 Tc=5.0 min CN=71 Runoff=1.89 cfs 0.132 af

Reach DP: Closed Drainage System to Knox Trail  
 Inflow=1.89 cfs 0.132 af  
 Outflow=1.89 cfs 0.132 af

Summary for Subcatchment E1: Existing Site

Runoff = 1.89 cfs @ 12.08 hrs, Volume= 0.132 af, Depth> 2.34"

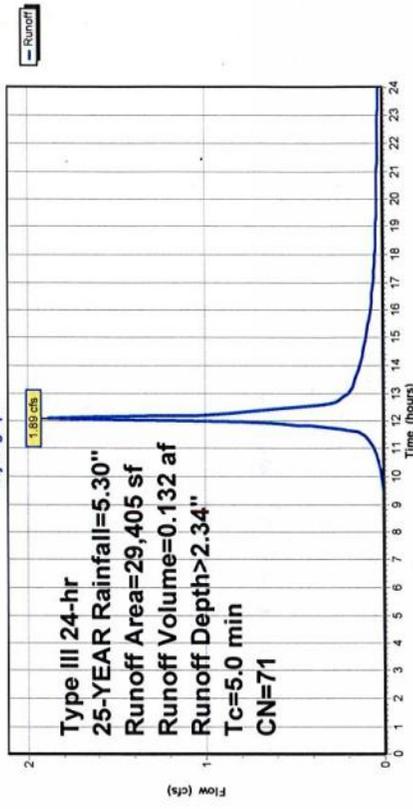
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 25-YEAR Rainfall=5.30"

Area (sf)	CN	Description
17,832	98	Building and Parking Lot, HSG A
11,573	30	Woods, Good, HSG A
29,405	71	Weighted Average
11,573		39.36% Pervious Area
17,832		60.64% Impervious Area

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

Subcatchment E1: Existing Site

Hydrograph



**Summary for Reach DP: Closed Drainage System to Knox Trail**

Inflow Area = 0.675 ac, 60.64% Impervious, Inflow Depth > 2.34" for 25-YEAR event  
 Inflow = 1.89 cfs @ 12.08 hrs, Volume= 0.132 af  
 Outflow = 1.89 cfs @ 12.08 hrs, Volume= 0.132 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS

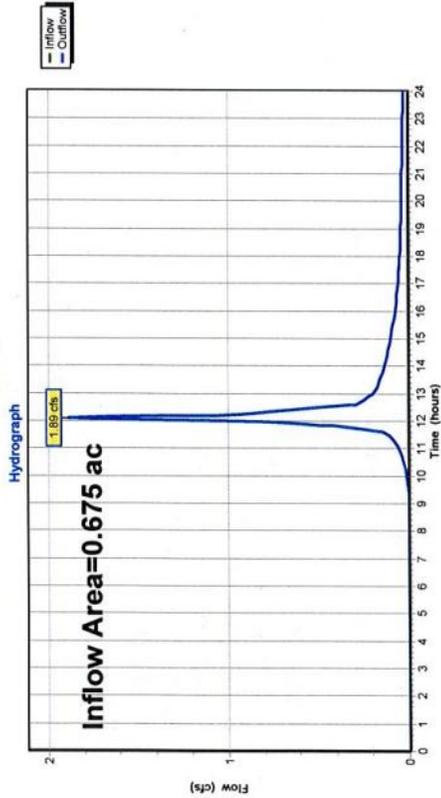
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment E1: Existing Site** Runoff Area=29,405 sf 60.64% Impervious Runoff Depth>3.30"  
 Tc=5.0 min CN=71 Runoff=2.68 cfs 0.186 af

Inflow=2.68 cfs 0.186 af  
 Outflow=2.68 cfs 0.186 af

**Reach DP: Closed Drainage System to Knox Trail**

**Reach DP: Closed Drainage System to Knox Trail**



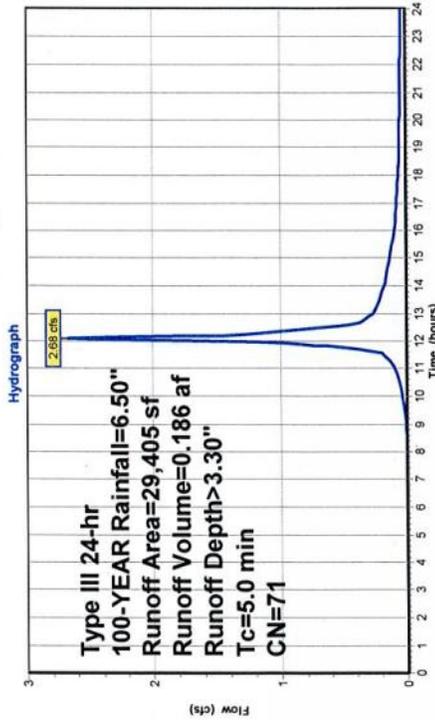
**Summary for Subcatchment E1: Existing Site**

Runoff = 2.68 cfs @ 12.08 hrs, Volume= 0.186 af, Depth> 3.30"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 100-YEAR Rainfall=6.50"

Area (sf)	CN	Description
17,832	98	Building and Parking Lot, HSG A
11,573	30	Woods, Good, HSG A
29,405	71	Weighted Average
11,573		39.36% Pervious Area
17,832		60.64% Impervious Area

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

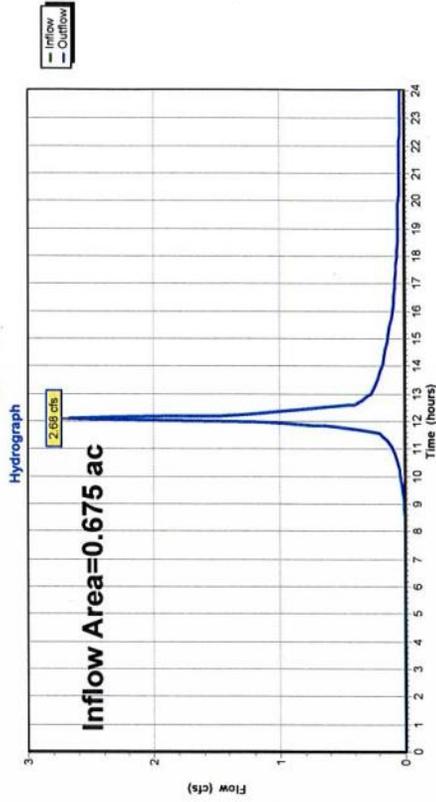
**Subcatchment E1: Existing Site**



**Summary for Reach DP: Closed Drainage System to Knox Trail**

Inflow Area = 0.675 ac, 60.64% Impervious, Inflow Depth > 3.30" for 100-YEAR event  
 Inflow = 2.68 cfs @ 12.08 hrs, Volume= 0.186 af  
 Outflow = 2.68 cfs @ 12.08 hrs, Volume= 0.186 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

**Reach DP: Closed Drainage System to Knox Trail**



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment E1: Existing Site  
 Runoff Area=29,405 sf 60.64% Impervious Runoff Depth>0.04"  
 Tc=5.0 min CN=71 Runoff=0.00 cfs 0.002 af

Reach DP: Closed Drainage System to Knox Trail  
 Inflow=0.00 cfs 0.002 af  
 Outflow=0.00 cfs 0.002 af

Summary for Subcatchment E1: Existing Site

Runoff = 0.00 cfs @ 13.67 hrs, Volume= 0.002 af, Depth> 0.04"

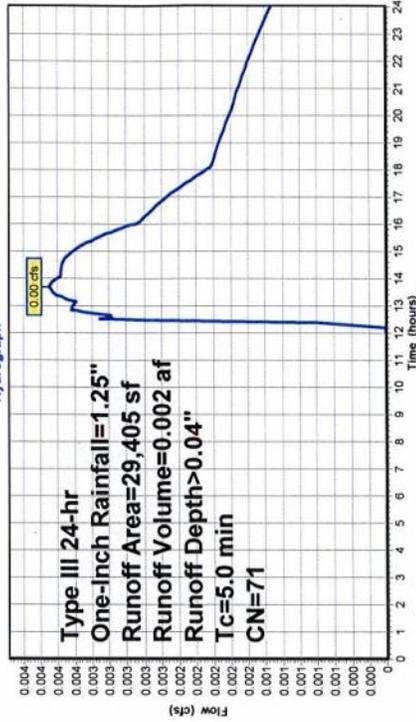
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr One-Inch Rainfall=1.25"

Area (sf)	CN	Description
17,832	98	Building and Parking Lot, HSG A
11,573	30	Woods, Good, HSG A
29,405	71	Weighted Average
11,573		39.36% Pervious Area
17,832		60.64% Impervious Area

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

Subcatchment E1: Existing Site

Hydrograph



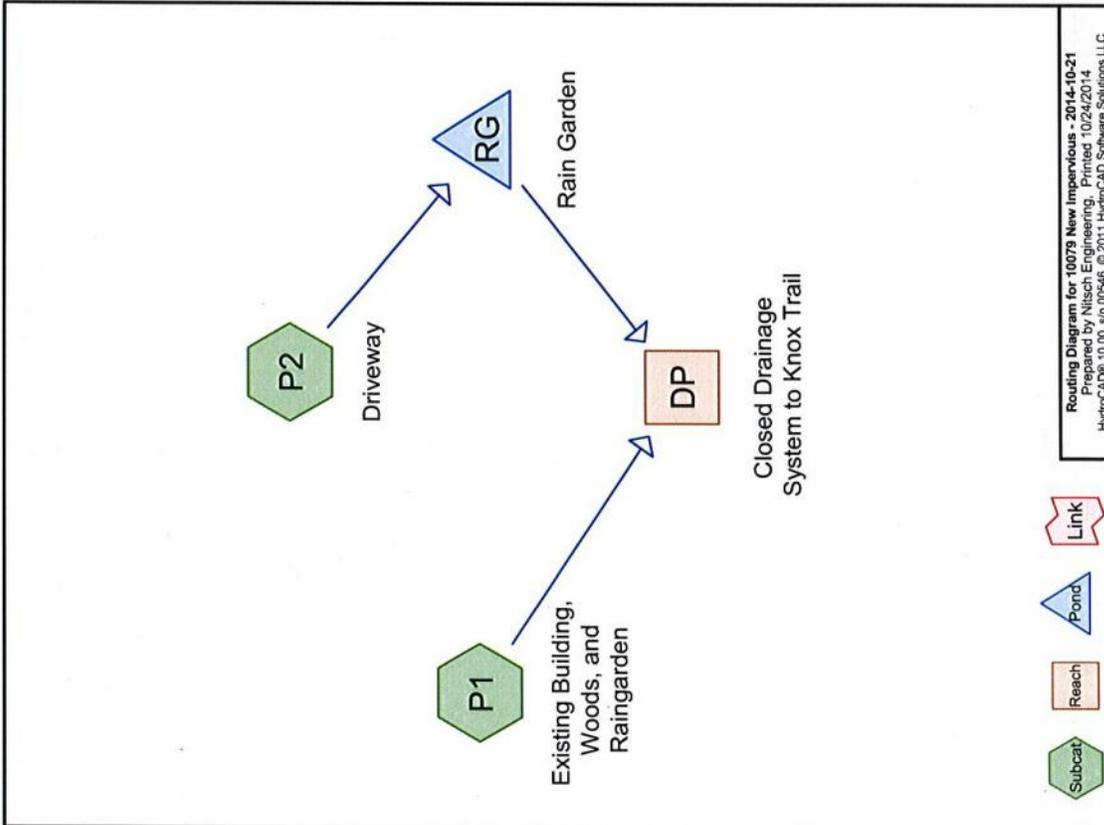


**10079 New Impervious - 2014-10-21**

Prepared by Nitsch Engineering  
 HydroCAD® 10.00 s/n 00546 © 2011 HydroCAD Software Solutions LLC

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.191	30	Woods, Good, HSG A (P1)
0.057	39	>75% Grass cover, Good, HSG A (P1)
0.083	98	Building, HSG A (P1)
0.344	98	Paved parking, HSG A (P2)



Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.675	HSG A	P1, P2
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.083	0.000	0.000	0.000	0.000	0.083	Building	P1
0.057	0.000	0.000	0.000	0.000	0.057	>75% Grass cover, Good	P1
0.344	0.000	0.000	0.000	0.000	0.344	Paved parking	P2
0.191	0.000	0.000	0.000	0.000	0.191	Woods, Good	P1

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment P1: Existing Building.** Runoff Area=14,415 sf 25.08% Impervious Runoff Depth>0.09"  
 Tc=5.0 min CN=49 Runoff=0.00 cfs 0.002 af

**Subcatchment P2: Driveway** Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>2.87"  
 Tc=5.0 min CN=98 Runoff=1.06 cfs 0.082 af

**Reach DP: Closed Drainage System to Knox Trail**  
 Inflow=0.00 cfs 0.002 af  
 Outflow=0.00 cfs 0.002 af

**Pond RG: Rain Garden** Discarded=0.08 cfs 0.082 af Peak Elev=148.48' Storage=1,464 cf Inflow=1.06 cfs 0.082 af  
 Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.082 af

**Summary for Subcatchment P1: Existing Building, Woods, and Raingarden**

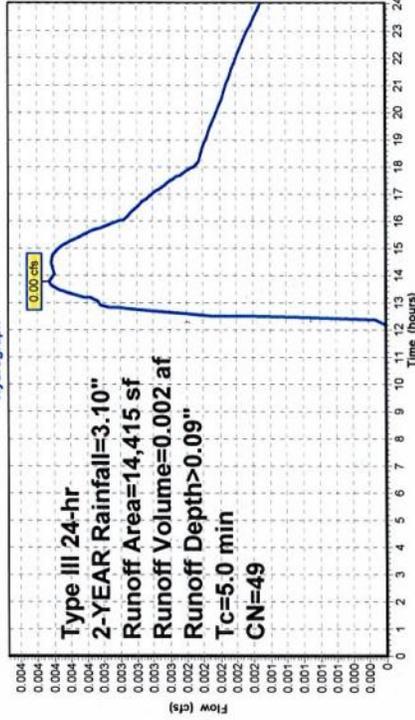
Runoff = 0.00 cfs @ 13.79 hrs, Volume= 0.002 af, Depth> 0.09"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
3,615	98	Building, HSG A
8,300	30	Woods, Good, HSG A
2,500	39	>75% Grass cover, Good, HSG A
14,415	49	Weighted Average
10,800		74.92% Pervious Area
3,615		25.08% Impervious Area

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

**Subcatchment P1: Existing Building, Woods, and Raingarden**

Hydrograph



**Summary for Subcatchment P2: Driveway**

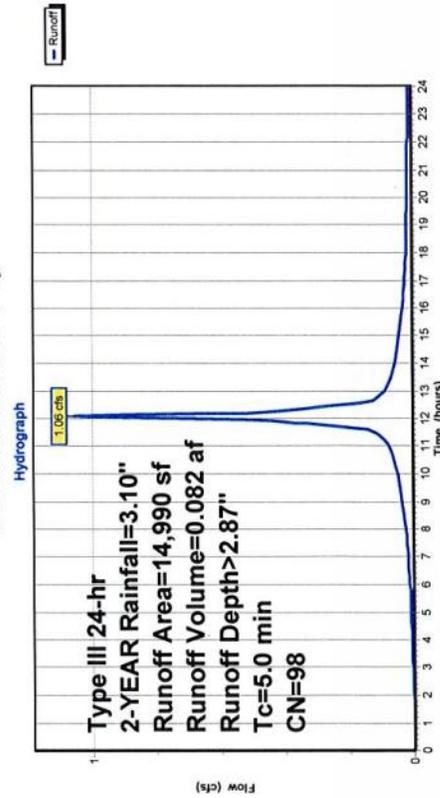
Runoff = 1.06 cfs @ 12.07 hrs, Volume= 0.082 af, Depth> 2.87"  
 Runoff by SCS TR-20 method, UH=S-C-S, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990	100.00%	Impervious Area

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

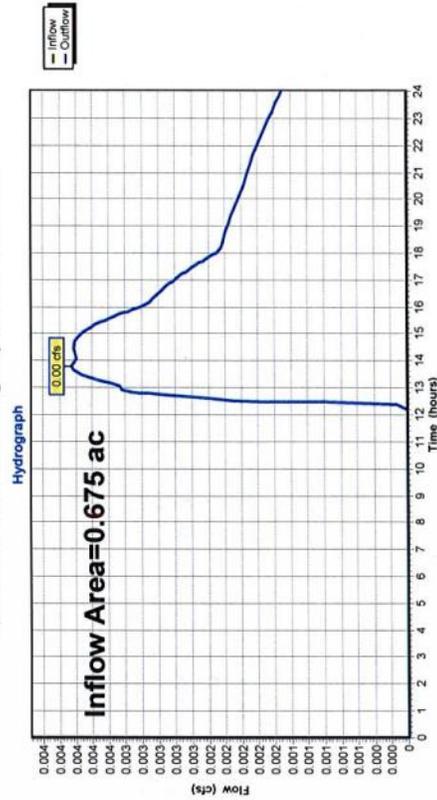
**Subcatchment P2: Driveway**



**Summary for Reach DP: Closed Drainage System to Knox Trail**

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 0.04" for 2-YEAR event  
 Inflow = 0.00 cfs @ 13.79 hrs, Volume= 0.002 af  
 Outflow = 0.00 cfs @ 13.79 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

**Reach DP: Closed Drainage System to Knox Trail**



**Summary for Pond RG: Rain Garden**

Inflow Area = 0.344 ac, 100.00% Impervious, Inflow Depth > 2.87" for 2-YEAR event  
 Inflow = 1.06 cfs @ 12.07 hrs, Volume= 0.082 af  
 Outflow = 0.08 cfs @ 13.02 hrs, Volume= 0.082 af, Atten= 92%, Lag= 56.8 min  
 Discarded = 0.08 cfs @ 13.02 hrs, Volume= 0.082 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 148.48' @ 13.02 hrs Surf.Area= 1,503 sf Storage= 1,464 cf

Plug-Flow detention time= 152.6 min calculated for 0.082 af (100% of inflow)  
 Center-of-Mass det. time= 151.9 min ( 907.7 - 755.8 )

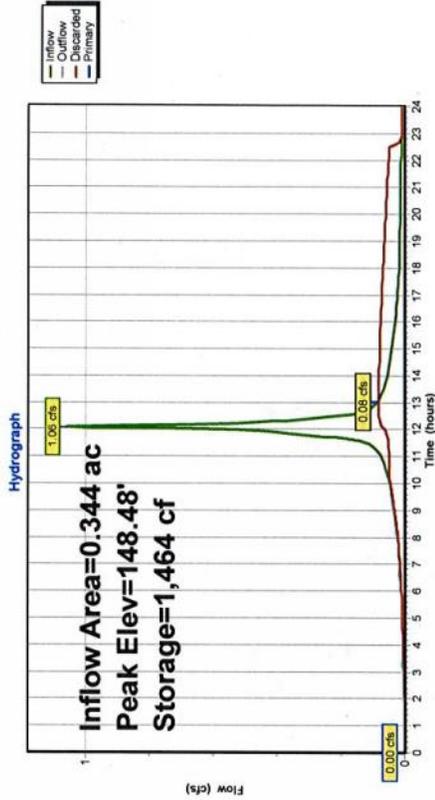
Volume	Invert	Avail. Storage	Storage Description
#1	147.25'	1,890 cf	Rain Garden (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)
147.25	880	0	0
148.75	1,640	1,890	1,890

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	2,410 in/hr Exfiltration over Surface area
#2	Primary	144.50'	12.0" Round New Drain to existing DMH L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133 1/4" Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	24.0" Horiz. Dome Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 13.02 hrs HW=148.48' (Free Discharge)  
 1-1=Exfiltration (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=147.25' (Free Discharge)  
 1-2=New Drain to existing DMH (Passes 0.00 cfs of 4.48 cfs potential flow)  
 1-3=Dome Grate ( Controls 0.00 cfs)

**Pond RG: Rain Garden**



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P1: Existing Building,** Runoff Area=14,415 sf 25.08% Impervious Runoff Depth>0.46"  
 Tc=5.0 min CN=49 Runoff=0.08 cfs 0.013 af

**Subcatchment P2: Driveway** Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>4.26"  
 Tc=5.0 min CN=98 Runoff=1.54 cfs 0.122 af

**Reach DP: Closed Drainage System to Knox Trail**  
 Inflow=0.81 cfs 0.036 af  
 Outflow=0.81 cfs 0.036 af

**Pond RG: Rain Garden** Peak Elev=148.61' Storage=1.663 cf Inflow=1.54 cfs 0.122 af  
 Discarded=0.09 cfs 0.098 af Primary=0.73 cfs 0.023 af Outflow=0.82 cfs 0.121 af

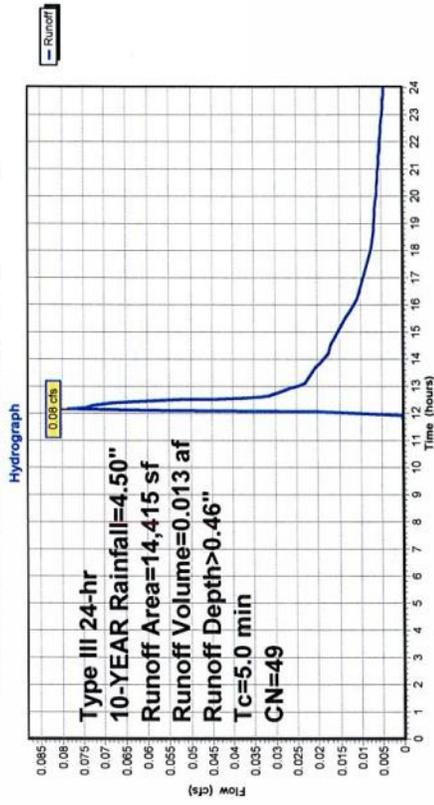
**Summary for Subcatchment P1: Existing Building, Woods, and Raingarden**

Runoff = 0.08 cfs @ 12.14 hrs, Volume= 0.013 af, Depth> 0.46"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 10-YEAR Rainfall=4.50"

Area (sf)	CN	Description
3,615	98	Building, HSG A
8,300	30	Woods, Good, HSG A
2,500	39	>75% Grass cover, Good, HSG A
14,415	49	Weighted Average
10,800		74.92% Pervious Area
3,615		25.08% Impervious Area

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

**Subcatchment P1: Existing Building, Woods, and Raingarden**



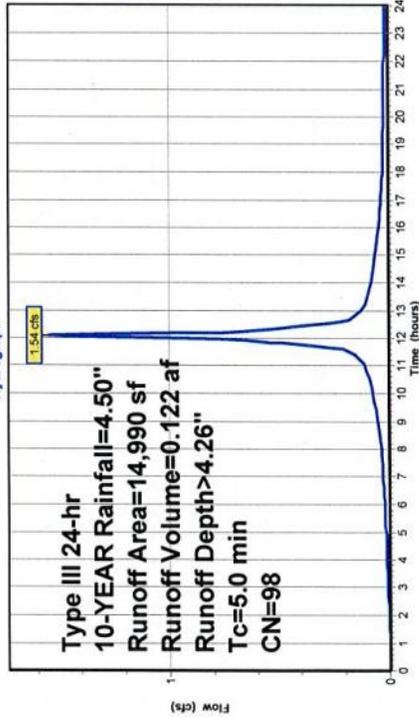
Summary for Subcatchment P2: Driveway

Runoff = 1.54 cfs @ 12.07 hrs, Volume= 0.122 af, Depth> 4.26"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 10-YEAR Rainfall=4.50"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990	100.00%	Impervious Area

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

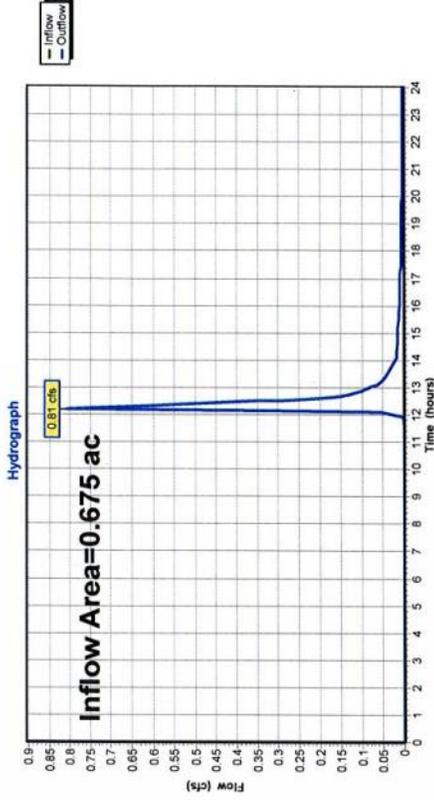
Subcatchment P2: Driveway



Summary for Reach DP: Closed Drainage System to Knox Trail

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 0.63" for 10-YEAR event  
 Inflow = 0.81 cfs @ 12.20 hrs, Volume= 0.036 af  
 Outflow = 0.81 cfs @ 12.20 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



**Summary for Pond RG: Rain Garden**

Inflow Area = 0.344 ac, 100.00% Impervious, Inflow Depth > 4.26" for 10-YEAR event  
 Inflow = 1.54 cfs @ 12.07 hrs, Volume= 0.122 af  
 Outflow = 0.82 cfs @ 12.20 hrs, Volume= 0.121 af, Atten= 47%, Lag= 7.6 min  
 Discarded = 0.09 cfs @ 12.20 hrs, Volume= 0.098 af  
 Primary = 0.73 cfs @ 12.20 hrs, Volume= 0.023 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 148.61' @ 12.20 hrs Surf.Area= 1,568 sf Storage= 1,663 cf

Plug-Flow detention time= 135.0 min calculated for 0.121 af (99% of inflow)  
 Center-of-Mass det. time= 128.8 min ( 877.3 - 748.5 )

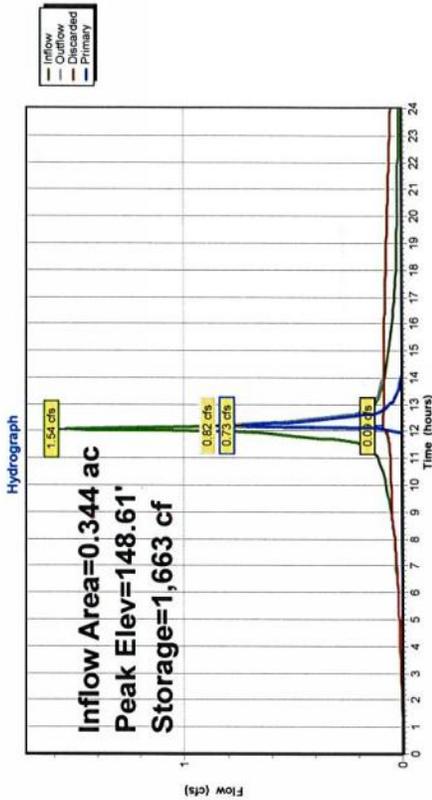
Volume	Invert	Avail. Storage	Storage Description
#1	147.25'	1,890 cf	Rain Garden (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	880	0	0
148.75	1,640	1,890	1,890

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	2,410 in/hr Exfiltration over Surface area
#2	Primary	144.50'	12.0" Round New Drain to existing DMH L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133:7 Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	24.0" Horiz. Dome Grate C= 0.600 Limited to weir flow at low heads

Discarded Outflow Max=0.09 cfs @ 12.20 hrs HW=148.61' (Free Discharge)  
 1-Exfiltration (Exfiltration Controls 0.09 cfs)

Primary Outflow Max=0.73 cfs @ 12.20 hrs HW=148.61' (Free Discharge)  
 2-New Drain to existing DMH (Passes 0.73 cfs of 5.67 cfs potential flow)  
 3-Dome Grate (Weir Controls 0.73 cfs @ 1.08 fps)

**Pond RG: Rain Garden**



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Existing Building, Runoff Area=14,415 sf 25.08% Impervious Runoff Depth>0.76"  
 Tc=5.0 min CN=49 Runoff=0.19 cfs 0.021 af

Subcatchment P2: Driveway Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>5.06"  
 Tc=5.0 min CN=98 Runoff=1.82 cfs 0.145 af

Reach DP: Closed Drainage System to Knox Trail Inflow=1.55 cfs 0.059 af  
 Outflow=1.55 cfs 0.059 af

Pond RG: Rain Garden Peak Elev=148.66' Storage=1,751 cf Inflow=1.82 cfs 0.145 af  
 Discarded=0.09 cfs 0.103 af Primary=1.36 cfs 0.038 af Outflow=1.45 cfs 0.141 af

**Summary for Subcatchment P1: Existing Building, Woods, and Raingarden**

Runoff = 0.19 cfs @ 12.11 hrs, Volume= 0.021 af, Depth> 0.76"

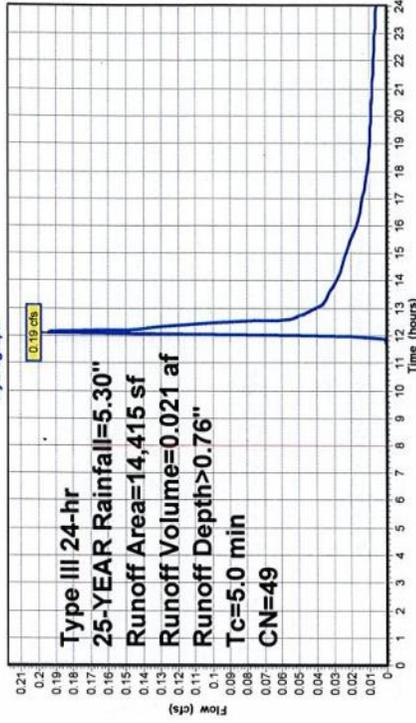
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 25-YEAR Rainfall=5.30"

Area (sf)	CN	Description
3,615	98	Building, HSG A
8,300	30	Woods, Good, HSG A
2,500	39	>75% Grass cover, Good, HSG A
14,415	49	Weighted Average
10,800		74.92% Pervious Area
3,615		25.08% Impervious Area

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

**Subcatchment P1: Existing Building, Woods, and Raingarden**

Hydrograph



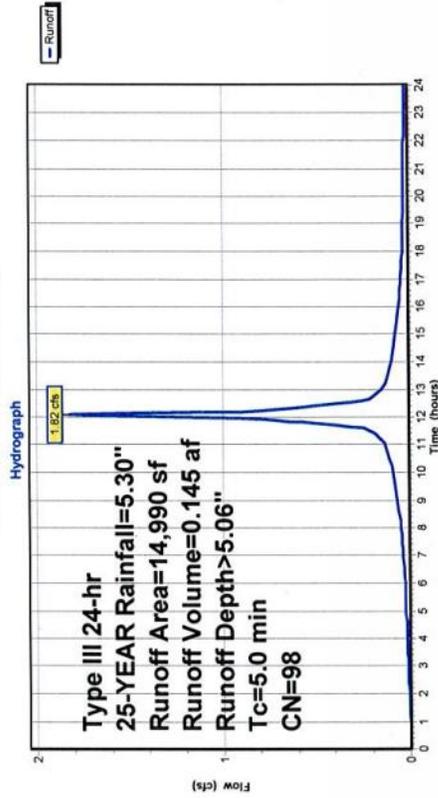
**Summary for Subcatchment P2: Driveway**

Runoff = 1.82 cfs @ 12.07 hrs, Volume= 0.145 af, Depth> 5.06"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 25-YEAR Rainfall=5.30"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990	100.00%	Impervious Area

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

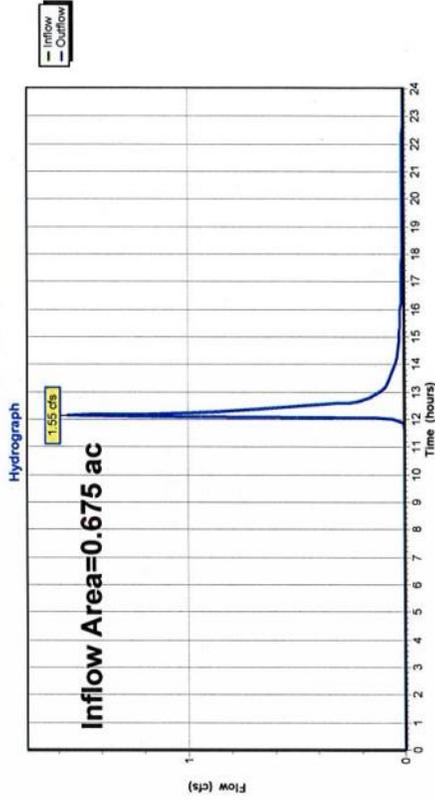
**Subcatchment P2: Driveway**



**Summary for Reach DP: Closed Drainage System to Knox Trail**

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 1.05" for 25-YEAR event  
 Inflow = 1.55 cfs @ 12.13 hrs, Volume= 0.059 af  
 Outflow = 1.55 cfs @ 12.13 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

**Reach DP: Closed Drainage System to Knox Trail**



**Summary for Pond RG: Rain Garden**

Inflow Area = 0.344 ac, 100.00% Impervious, Inflow Depth > 5.06" for 25-YEAR event  
 Inflow = 1.82 cfs @ 12.07 hrs, Volume= 0.145 af  
 Outflow = 1.45 cfs @ 12.13 hrs, Volume= 0.141 af, Atten= 20%, Lag= 3.7 min  
 Discarded = 0.09 cfs @ 12.13 hrs, Volume= 0.103 af  
 Primary = 1.36 cfs @ 12.13 hrs, Volume= 0.038 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 148.66' @ 12.13 hrs Surf.Area= 1,597 sf Storage= 1,751 cf

Plug-Flow detention time= 126.8 min calculated for 0.141 af (97% of inflow)  
 Center-of-Mass det. time= 110.1 min ( 855.9 - 745.8 )

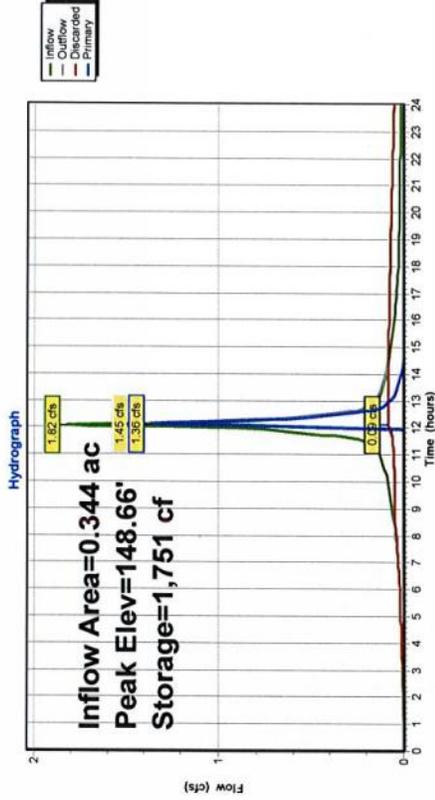
Volume	Invert	Avail.Storage	Storage Description
#1	147.25'	1,890 cf	Rain Garden (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	880	0	0
148.75	1,640	1,890	1,890

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	2,410 in/hr Exfiltration over Surface area
#2	Primary	144.50'	12.0" Round New Drain to existing DMH L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	24.0" Horiz. Dome Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.09 cfs @ 12.13 hrs HW=148.66' (Free Discharge)  
 1=Exfiltration (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=1.30 cfs @ 12.13 hrs HW=148.66' (Free Discharge)  
 2=New Drain to existing DMH (Passes 1.30 cfs of 5.71 cfs potential flow)  
 3=Dome Grate (Weir Controls 1.30 cfs @ 1.30 fps)

**Pond RG: Rain Garden**



**Summary for Subcatchment P1: Existing Building, Woods, and Raingarden**

Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.036 af, Depth> 1.32"

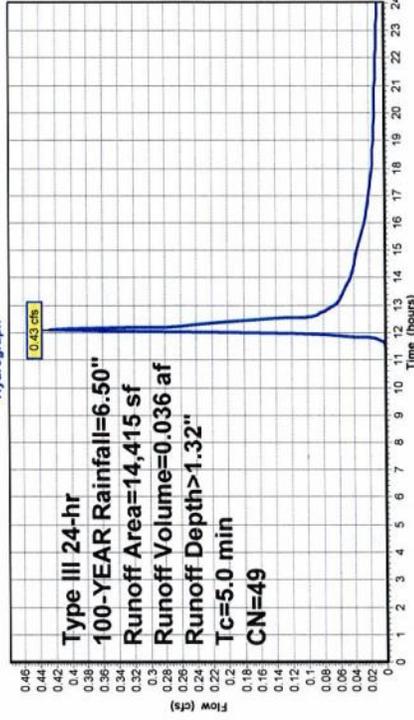
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 100-YEAR Rainfall=6.50"

Area (sf)	CN	Description
3,615	98	Building, HSG A
8,300	30	Woods, Good, HSG A
2,500	39	>75% Grass cover, Good, HSG A
14,415	49	Weighted Average
10,800		74.92% Pervious Area
3,615		25.08% Impervious Area

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

**Subcatchment P1: Existing Building, Woods, and Raingarden**

Hydrograph



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P1: Existing Building,** Runoff Area=14,415 sf, 25.08% Impervious, Runoff Depth>1.32"  
 Tc=5.0 min, CN=49, Runoff=0.43 cfs, 0.036 af

**Subcatchment P2: Driveway** Runoff Area=14,990 sf, 100.00% Impervious, Runoff Depth>6.26"  
 Tc=5.0 min, CN=98, Runoff=2.24 cfs, 0.179 af

**Reach DP: Closed Drainage System to Knox Trail**  
 Inflow=2.36 cfs, 0.099 af  
 Outflow=2.36 cfs, 0.099 af

**Pond RG: Rain Garden** Discarded=0.09 cfs, 0.110 af, Primary=1.95 cfs, 0.062 af, Storage=1.821 cf, Inflow=2.24 cfs, 0.179 af  
 Peak Elev=148.71', Outflow=2.04 cfs, 0.172 af

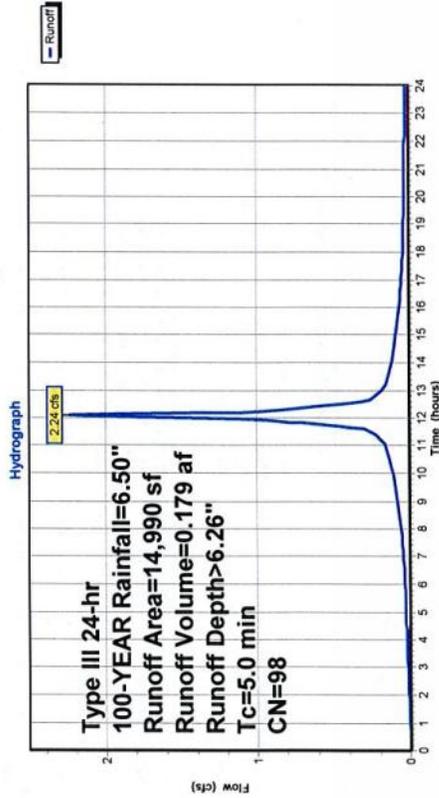
Summary for Subcatchment P2: Driveway

Runoff = 2.24 cfs @ 12.07 hrs, Volume= 0.179 af, Depth> 6.26"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr 100-YEAR Rainfall=6.50"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990		100.00% Impervious Area

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

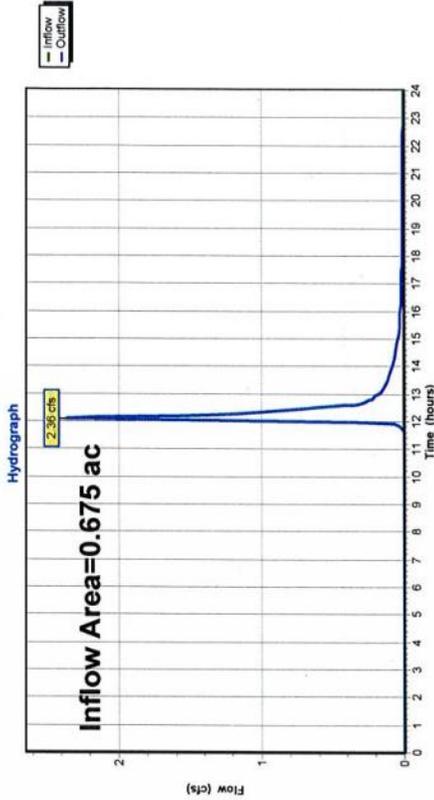
Subcatchment P2: Driveway



Summary for Reach DP: Closed Drainage System to Knox Trail

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth > 1.75" for 100-YEAR event  
 Inflow = 2.36 cfs @ 12.10 hrs, Volume= 0.099 af  
 Outflow = 2.36 cfs @ 12.10 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach DP: Closed Drainage System to Knox Trail



**Summary for Pond RG: Rain Garden**

Inflow Area = 0.344 ac, 100.00% Impervious, Inflow Depth > 6.26" for 100-YEAR event  
 Inflow = 2.24 cfs @ 12.07 hrs, Volume= 0.179 af  
 Outflow = 2.04 cfs @ 12.10 hrs, Volume= 0.172 af, Atten= 9%, Lag= 1.9 min  
 Discarded = 0.09 cfs @ 12.10 hrs, Volume= 0.110 af  
 Primary = 1.95 cfs @ 12.10 hrs, Volume= 0.062 af

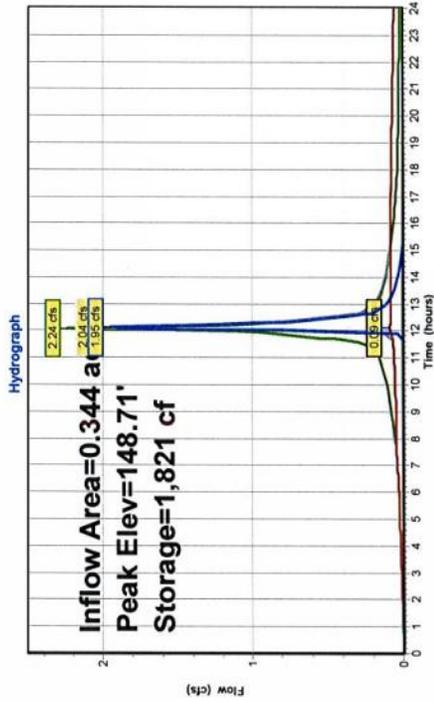
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 148.71' @ 12.10 hrs Surf.Area= 1,619 sf Storage= 1,821 cf  
 Plug-Flow detention time= 113.3 min calculated for 0.172 af (96% of inflow)  
 Center-of-Mass det. time= 89.3 min ( 832.0 - 742.7 )

Volume	Invert	Avail. Storage	Storage Description
#1	147.25'	1,890 cf	Rain Garden (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)
147.25	880	0	0
148.75	1,640	1,890	1,890

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	2,410 in/hr Exfiltration over Surface area
#2	Primary	144.50'	12.0" Round New Drain to existing DMH L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	24.0" Horiz. Dome Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.09 cfs @ 12.10 hrs HW=148.71' (Free Discharge)  
 1-1=Exfiltration (Exfiltration Controls 0.09 cfs)  
 Primary OutFlow Max=1.91 cfs @ 12.10 hrs HW=148.71' (Free Discharge)  
 2-2=New Drain to existing DMH (Passes 1.91 cfs of 5.75 cfs potential flow)  
 3-3=Dome Grate (Weir Controls 1.91 cfs @ 1.48 fps)

**Pond RG: Rain Garden**



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P1: Existing Building,** Runoff Area=14,415 sf 25.08% Impervious Runoff Depth=0.00"  
 Tc=5.0 min CN=49 Runoff=0.00 cfs 0.000 af

**Subcatchment P2: Driveway** Runoff Area=14,990 sf 100.00% Impervious Runoff Depth>1.03"  
 Tc=5.0 min CN=96 Runoff=0.40 cfs 0.030 af

**Reach DP: Closed Drainage System to Knox Trail** Inflow=0.00 cfs 0.000 af  
 Outflow=0.00 cfs 0.000 af

**Pond RG: Rain Garden** Discarded=0.06 cfs 0.030 af Peak Elev=147.65' Storage=396 cf Inflow=0.40 cfs 0.030 af  
 Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.030 af

**Summary for Subcatchment P1: Existing Building, Woods, and Raingarden**

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

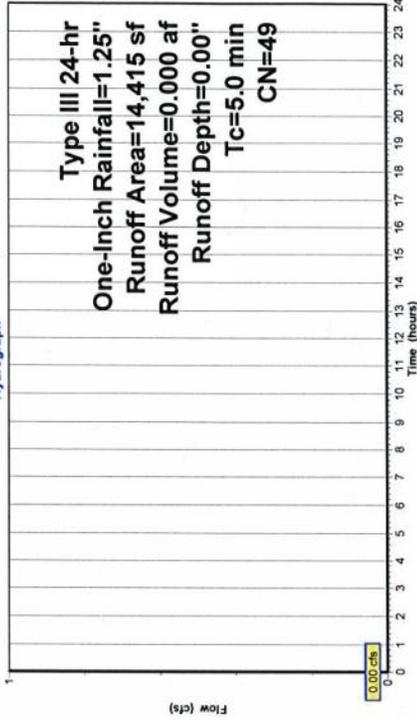
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr One-Inch Rainfall=1.25"

Area (sf)	CN	Description
3,615	98	Building, HSG A
8,300	30	Woods, Good, HSG A
2,500	39	>75% Grass cover, Good, HSG A
14,415	49	Weighted Average
10,800		74.92% Pervious Area
3,615		25.08% Impervious Area

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

**Subcatchment P1: Existing Building, Woods, and Raingarden**

Hydrograph



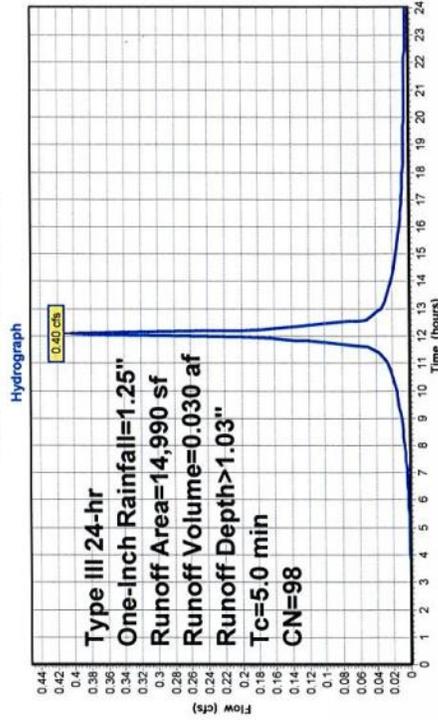
**Summary for Subcatchment P2: Driveway**

Runoff = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af, Depth> 1.03"  
 Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs  
 Type III 24-hr One-Inch Rainfall=1.25"

Area (sf)	CN	Description
14,990	98	Paved parking, HSG A
14,990		100.00% Impervious Area

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

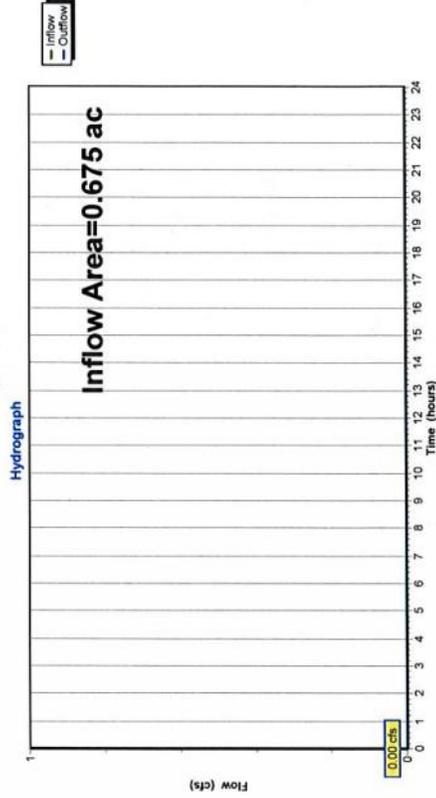
**Subcatchment P2: Driveway**



**Summary for Reach DP: Closed Drainage System to Knox Trail**

Inflow Area = 0.675 ac, 63.27% Impervious, Inflow Depth = 0.00" for One-Inch event  
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min  
 Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

**Reach DP: Closed Drainage System to Knox Trail**



**Summary for Pond RG: Rain Garden**

Inflow Area = 0.344 ac, 100.00% Impervious, Inflow Depth > 1.03" for One-Inch event  
 Inflow = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af  
 Outflow = 0.06 cfs @ 12.56 hrs, Volume= 0.030 af, Atten= 85%, Lag= 29.0 min  
 Discarded = 0.06 cfs @ 12.56 hrs, Volume= 0.030 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2  
 Peak Elev= 147.65' @ 12.56 hrs Surf.Area= 1,084 sf Storage= 396 cf  
 Plug-Flow detention time= 44.6 min calculated for 0.030 af (100% of inflow)  
 Center-of-Mass det. time= 44.1 min ( 823.5 - 779.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	147.25'	1,890 cf	Rain Garden (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
147.25	880	0	0
148.75	1,640	1,890	1,890

Device	Routing	Invert	Outlet Devices
#1	Discarded	147.25'	2.410 in/hr Exfiltration over Surface area
#2	Primary	144.50'	12.0" Round New Drain to existing DMH L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 144.50' / 144.30' S= 0.0133' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	148.50'	24.0" Horiz. Dome Grate C= 0.600 Limited to weir flow at low heads

Discarded Outflow Max=0.06 cfs @ 12.56 hrs HW=147.65' (Free Discharge)  
 1-1=Exfiltration (Exfiltration Controls 0.06 cfs)  
 Primary Outflow Max=0.00 cfs @ 0.00 hrs HW=147.25' (Free Discharge)  
 2-New Drain to existing DMH (Passes 0.00 cfs of 4.48 cfs potential flow)  
 3=Dome Grate ( Controls 0.00 cfs)

**Pond RG: Rain Garden**

