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CIVIL & TRAFFIC ENGINEERS / PLANNERS / SURVEYORS / GIS ANALYSTS / LANDSCAPE ARCHITECTS
Serving Connecticut, Massachusetts, & Rhode Island

Traffic Impact Statement
Glastonbury Glen
A Planned Area Development
Prepared For:
Horse Shoe Lane Associates, LLC
Orchard Street Lot E-3AA & Hebron Avenue Lot S-54
Glastonbury, Connecticut
DPI Project Number 3628
September 18, 2017

Introduction

The applicant, Horse Shoe Lane Associates, LLC is under agreement with the property owner, Catholic Cemeteries Assoc. of the Archdiocese of Hartford, Inc, to acquire a portion of a 62.51 Acre tract of land. The existing property is located on Orchard Street and Hebron Avenue. The applicant will acquire a 15.5+/- acre tract for a proposed 18-unit residential development. The remaining portion of the land, 47.0+/- acres will be retained by the property owner.

An existing 50 FT wide frontage area connecting Orchard Street to the larger rear portion of Orchard Street Lot E-3AA, will be used to provide vehicular access to the proposed 18-unit residential development via a 22 FT wide private road.

Refer to site plans entitled "**Glastonbury Glen Site Plan**", dated **September 18th, 2017 as amended**, prepared by Design Professionals Inc. accompanying this report, for information regarding the proposed property development.

Existing Traffic

The proposed 15.50 acre tract can primarily be classified as an undeveloped wood land area and currently generates no traffic flow. The location for the proposed site drive is approximately 1,400 FT from the intersection of Orchard Street and State Route 94, Hebron Ave. The State of Connecticut Department of Transportation (ConnDOT) maintains a system of automated traffic counters on state highways and other selected roadways. In order to assess impacts of the proposed development on existing traffic conditions, the 2012 (latest) ConnDOT Traffic Count data was obtained for two stations along State Route 94 in the vicinity of the project site. See **Appendix A** for the 2012 ConnDOT Vicinity Map showing station numbers and Traffic Count Data. The ConnDOT Traffic Count Data for State Route 94 was observed as follows:

Station 149 (West of Orchard Street)

- ADT (East Bound + West Bound) = 8200 + 8500 = **16,7000**
- AM Peak (East Bound + West Bound @ 8 AM) = 353 + 1025 = **1378**
- PM Peak (East Bound + West Bound @ 5 PM) = 1067 + 630 = **1697**

Station 31 (East of Orchard Street)

- ADT = **13,900** (Directional Counts not provided by the State)
- AM Peak (7 AM) = **1300**
- PM Peak (5 PM) = **1479**

The 2012 ConnDOT data values will serve as the baseline for assessing how the proposed 18-unit residential development will affect the surrounding roadway network. The methodology used to determine this is explained in the sections below.

Site Generated Traffic & Distribution

Proposed Traffic Volumes:
Projected trip estimates were approximated based on studies published in the Institute of Transportation Engineers (ITE) Trip Generation Manual 9th Edition. The manual provides Average and Fitted Curve trip generation estimates based on over 340 case studies for **Single Family Detached Houses (ITE Land Use Code 210)**. Both estimate approaches were calculated and averaged together to determine the expected trip generation from the proposed 18-single family dwelling units. See **Appendix B** for the ITE trip generation estimates for weekday daily trips, AM-peak, and PM-peak hour trip data sheets with calculations outlining how the trip generation estimates were derived. ITE estimated values were calculated as follows:

Daily Weekday Trips	**AM Weekday Peak Hour Trips**	**PM Peak Weekday Hour Trips**
Entering: 98 Trips	Entering: 6 Trips	Entering: 14 Trips
Exiting: 98 Trips	Exiting: 15 Trips	Exiting: 8 Trips
Total = 196 Trips	Total = 21 Trips	Total = 22 Trips

Distribution:
Site traffic distribution patterns were based on labor force data published in The Connecticut Economic Resource Center's [CERC] 2017 Town Profile for Glastonbury (included in **Appendix C**). The report determined that the vast majority of Glastonbury residents commute to either Hartford, Glastonbury, East Hartford, Manchester, Farmington, Rocky Hill, or West Hartford for work. When considering the proposed project site, State Route 2 would be the most probable destination or point of origin for someone leaving our returning to the proposed development during peak hours. As such, distribution onto Existing Roadways is assumed to be 100% to the west along State Route 94, Hebron Ave. With the intersection of Orchard Street and State Route 94 being un-signalized, it is expected that during peak hour periods, commuters leaving the proposed development, and plan on heading west on Route 94 to reach Route 2; will take a left out of the site, and head to the signalized intersection at Hebron Ave and Tara Drive via Cavan Lane (See site ConnDOT vicinity map in **Appendix A**). The signalized intersection at Tara Drive and State Route 2 is in proximity to the site, which enables utilization by the new residents of Glastonbury Glen to safely turn onto Route 94 (West Bound) during peak hours. During the peak

hour, the signalized intersection is expected to receive an additional 22 vehicle trips or approximately 1 additional trip per 3 minutes.

Impact Analysis

In order to assess impacts to the surrounding road way network, a % of increase to the existing traffic along State Route 94 was determined based on the expected increases to the previously listed ConnDOT Traffic Count Data. As discussed in the preceding section, State Route 2 would be the most probable destination and point of origin for commuters, hence, the analysis assumed that 100% of people leaving & entering the site will be heading to or returning from State Route 2. ConnDOT Traffic Station #149 was selected as the location of analysis being that all commuters from the development site would inadvertently cross this area as they head to or return from State Route 2. For the sake of analysis, it was assumed that the total determined trip generations would reach the station during the same peak hour window and thus could be added in hole to the reported ConnDOT traffic count data, i.e. total AM peak trips & total PM peak trips were considered instead of evaluating entering and existing trips separately. The following table summarizes the results:

	2012 COUNT DATA			ITE TRIP GENERATION FOR SINGLE FAMILY DETACHED HOUSES (210)			% Increase to ADT	% Increase to AM Peak	% Increase to PM Peak
	ADT	AM PEAK	PM PEAK	ADT	AM PEAK	PM PEAK			
CONNDOT STATION 149	16,700	1378	1697	196	21	22	1.2%	1.5%	1.3%

* % Increase = 100% x (ITE Value = Change in Traffic) / (2012 Count Data)

The analysis shows that the addition of the proposed Glastonbury Glen's Traffic will have a very small impact on the surround roadway network. The expected increase to daily traffic, AM peak hour, and PM peak hour traffic is only expected to be 1.2%, 1.5%, and 1.3% respectively. To further outline additional traffic, only 22 additional trips per hour, approximately 1 car every 3 mins will be added.

Sight Distance

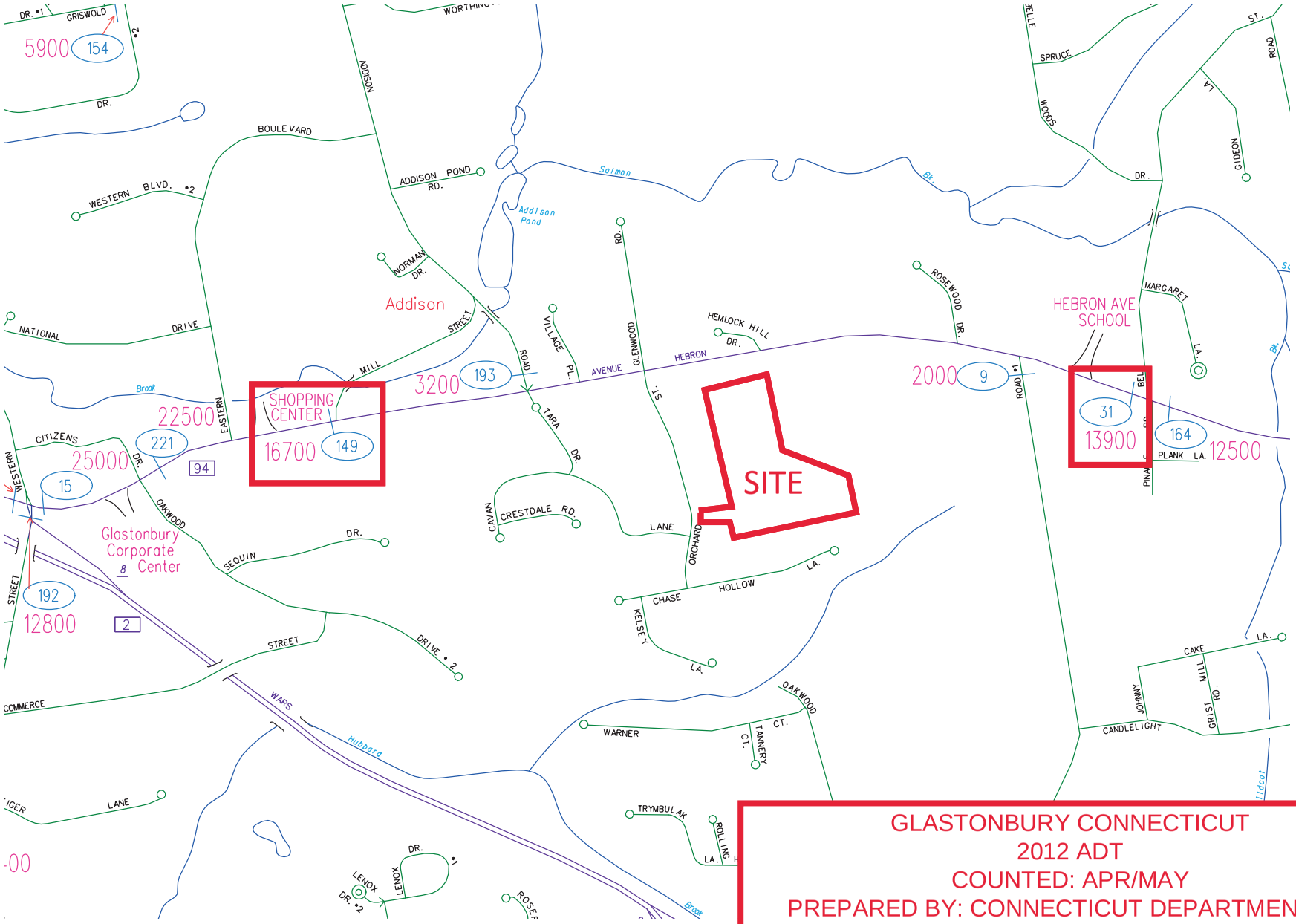
Connecticut DOT provides guidelines for acceptable sightline distances for vehicles turning from a stopped condition onto a 2-lane roadway. The analysis indicates that sight line distances will be adequate for passenger vehicles exiting the proposed Glastonbury Glen site. For a passenger vehicle on a 25 MPH road 280 FT is required. It was determined by field investigation that this site distance is accommodated at the location of the proposed private road for the development.

Conclusion:

As seen from the analysis, the proposed 18-unit development will generate minimal traffic. Average daily trips to the adjacent roadway system will be increased by 196 trips per day (1.2% increase), AM peak trips will be increased by 21 trips (1.5% increase), and PM peak trips will be

increased by 22 Trips (1.3% increase). This is a minimal impact with an average addition of about 1 car per 3 minutes during the peak hours. It is expected that this will not result in an observable impact to the surrounding roadway network. Additionally, adequate site distance is also provided for the proposed development.

APENDIX A
2012 ConnDOT Vicinity Map and Traffic Count Data



GLASTONBURY CONNECTICUT
2012 ADT
COUNTED: APR/MAY
PREPARED BY: CONNECTICUT DEPARTMENT OF TRANSPORTATION
ACCEPTED AS OF DEC. 31, 2010
(PRINT OF ORCHARD STREET AREA)

YEAR 2012

STA NO 053 0149

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF POLICY AND PLANNING
PLANNING INVENTORY AND DATA

TRAFFIC RECORDER DATA

TOWN OF GLASTONBURY ROUTE 94 DIRECTION E

WEST OF MILL STREET

DAY	SUN	MON	TUE	WED	THU	FRI	SAT
DATE	0	0	04/24/2012	04/25/2012	0	0	0
TYPE							
HOUR							
	2012 ADT = 8200		ACF = NA				
	**********						
12A	0	0	0	29	0	0	0
01A	0	0	0	23	0	0	0
02A	0	0	0	6	0	0	0
03A	0	0	0	7	0	0	0
04A	0	0	0	9	0	0	0
05A	0	0	0	52	0	0	0
06A	0	0	183	0	0	0	0
07A	0	0	300	0	0	0	0
08A	0	0	353	0	0	0	0
09A	0	0	387	0	0	0	0
10A	0	0	362	0	0	0	0
11A	0	0	467	0	0	0	0
12P	0	0	515	0	0	0	0
01P	0	0	483	0	0	0	0
02P	0	0	624	0	0	0	0
03P	0	0	727	0	0	0	0
04P	0	0	926	0	0	0	0
05P	0	0	1067	0	0	0	0
06P	0	0	801	0	0	0	0
07P	0	0	526	0	0	0	0
08P	0	0	457	0	0	0	0
09P	0	0	245	0	0	0	0
10P	0	0	138	0	0	0	0
11P	0	0	72	0	0	0	0
TOT	0	0	8633	126	0	0	0

YEAR 2012

STA NO 053 0149

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF POLICY AND PLANNING
PLANNING INVENTORY AND DATA

TRAFFIC RECORDER DATA

TOWN OF GLASTONBURY ROUTE 94 DIRECTION W

WEST OF MILL STREET

DAY	SUN	MON	TUE	WED	THU	FRI	SAT
DATE	0	0	04/24/2012	04/25/2012	0	0	0
TYPE							
HOUR							

2012 ADT = 8500 ACF = NA

****

12A	0	0	0	10	0	0	0
01A	0	0	0	12	0	0	0
02A	0	0	0	4	0	0	0
03A	0	0	0	17	0	0	0
04A	0	0	0	52	0	0	0
05A	0	0	0	191	0	0	0
06A	0	0	566	0	0	0	0
07A	0	0	1021	0	0	0	0
08A	0	0	1025	0	0	0	0
09A	0	0	684	0	0	0	0
10A	0	0	492	0	0	0	0
11A	0	0	516	0	0	0	0
12P	0	0	502	0	0	0	0
01P	0	0	527	0	0	0	0
02P	0	0	500	0	0	0	0
03P	0	0	564	0	0	0	0
04P	0	0	582	0	0	0	0
05P	0	0	630	0	0	0	0
06P	0	0	458	0	0	0	0
07P	0	0	340	0	0	0	0
08P	0	0	199	0	0	0	0
09P	0	0	119	0	0	0	0
10P	0	0	47	0	0	0	0
11P	0	0	31	0	0	0	0
TOT	0	0	8803	286	0	0	0

YEAR 2012

STA NO 053 0031

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF POLICY AND PLANNING
PLANNING INVENTORY AND DATA

TRAFFIC RECORDER DATA

TOWN OF GLASTONBURY

ROUTE 94

DIRECTION B

WEST OF BELL STREET

DAY	SUN	MON	TUE	WED	THU	FRI	SAT
DATE	0	04/23/2012	04/24/2012	0	0	0	0
TYPE							
HOUR							
	2012 ADT = 13900		ACF = NA				
	**********						
12A	0	0	29	0	0	0	0
01A	0	0	18	0	0	0	0
02A	0	0	7	0	0	0	0
03A	0	0	16	0	0	0	0
04A	0	0	54	0	0	0	0
05A	0	0	203	0	0	0	0
06A	0	0	525	0	0	0	0
07A	0	1300	0	0	0	0	0
08A	0	1223	0	0	0	0	0
09A	0	833	0	0	0	0	0
10A	0	694	0	0	0	0	0
11A	0	771	0	0	0	0	0
12P	0	830	0	0	0	0	0
01P	0	759	0	0	0	0	0
02P	0	923	0	0	0	0	0
03P	0	1149	0	0	0	0	0
04P	0	1309	0	0	0	0	0
05P	0	1479	0	0	0	0	0
06P	0	1031	0	0	0	0	0
07P	0	672	0	0	0	0	0
08P	0	475	0	0	0	0	0
09P	0	283	0	0	0	0	0
10P	0	131	0	0	0	0	0
11P	0	60	0	0	0	0	0
TOT	0	13922	852	0	0	0	0

APPENDIX B
ITE Trip Generation estimates

Single-Family Detached Housing
(210)

Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

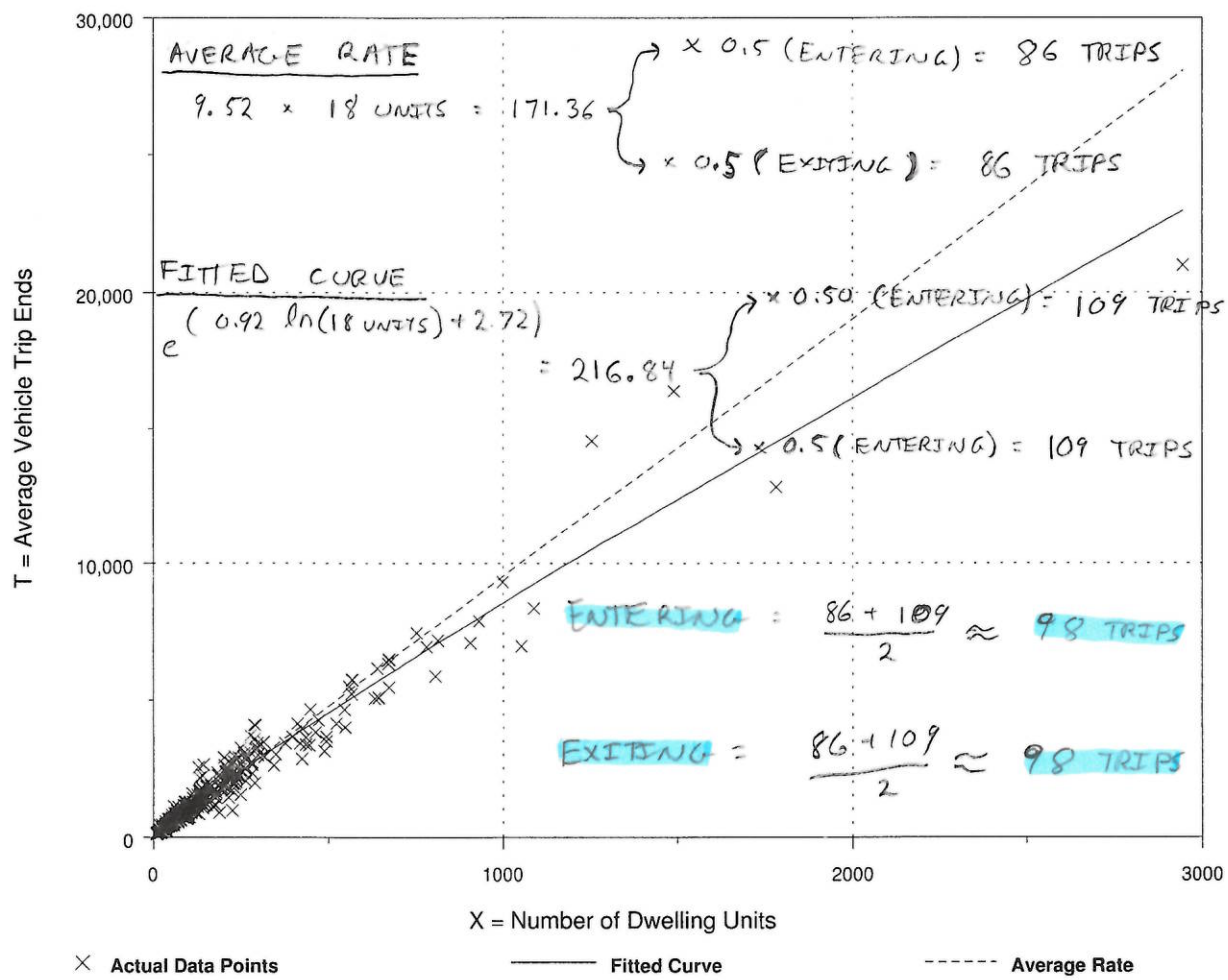
18 UNITS

Number of Studies: 355
Avg. Number of Dwelling Units: 198
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.52	4.31 - 21.85	3.70

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.72 $R^2 = 0.95$

Single-Family Detached Housing
(210)

Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
A.M. Peak Hour of Generator

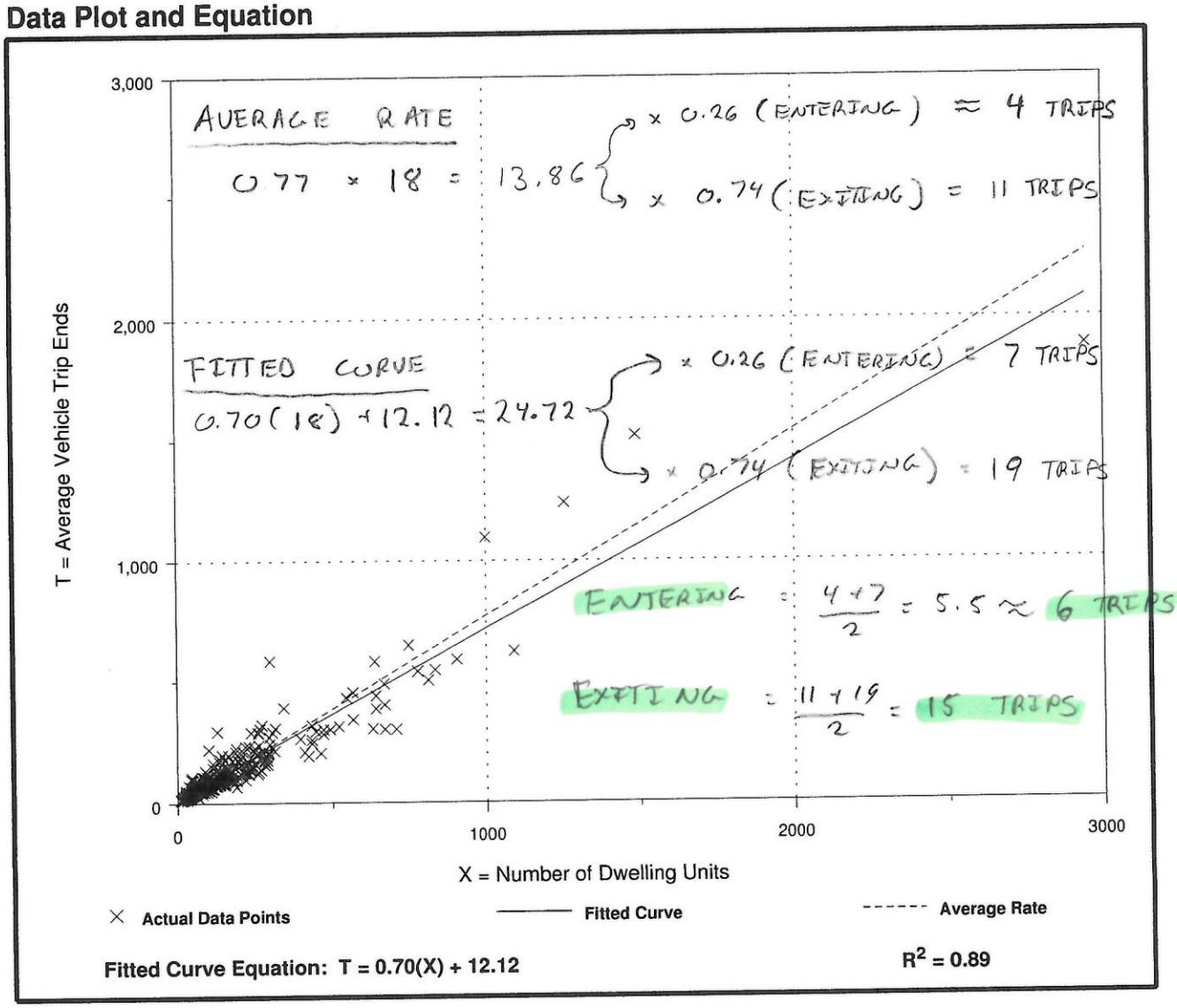
18 UNITS

Number of Studies: 343
Avg. Number of Dwelling Units: 180
Directional Distribution: 26% entering, 74% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.77	0.33 - 2.27	0.91

Data Plot and Equation



Fitted Curve Equation: T = 0.70(X) + 12.12

R^2 = 0.89

Single-Family Detached Housing
(210)

Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
P.M. Peak Hour of Generator

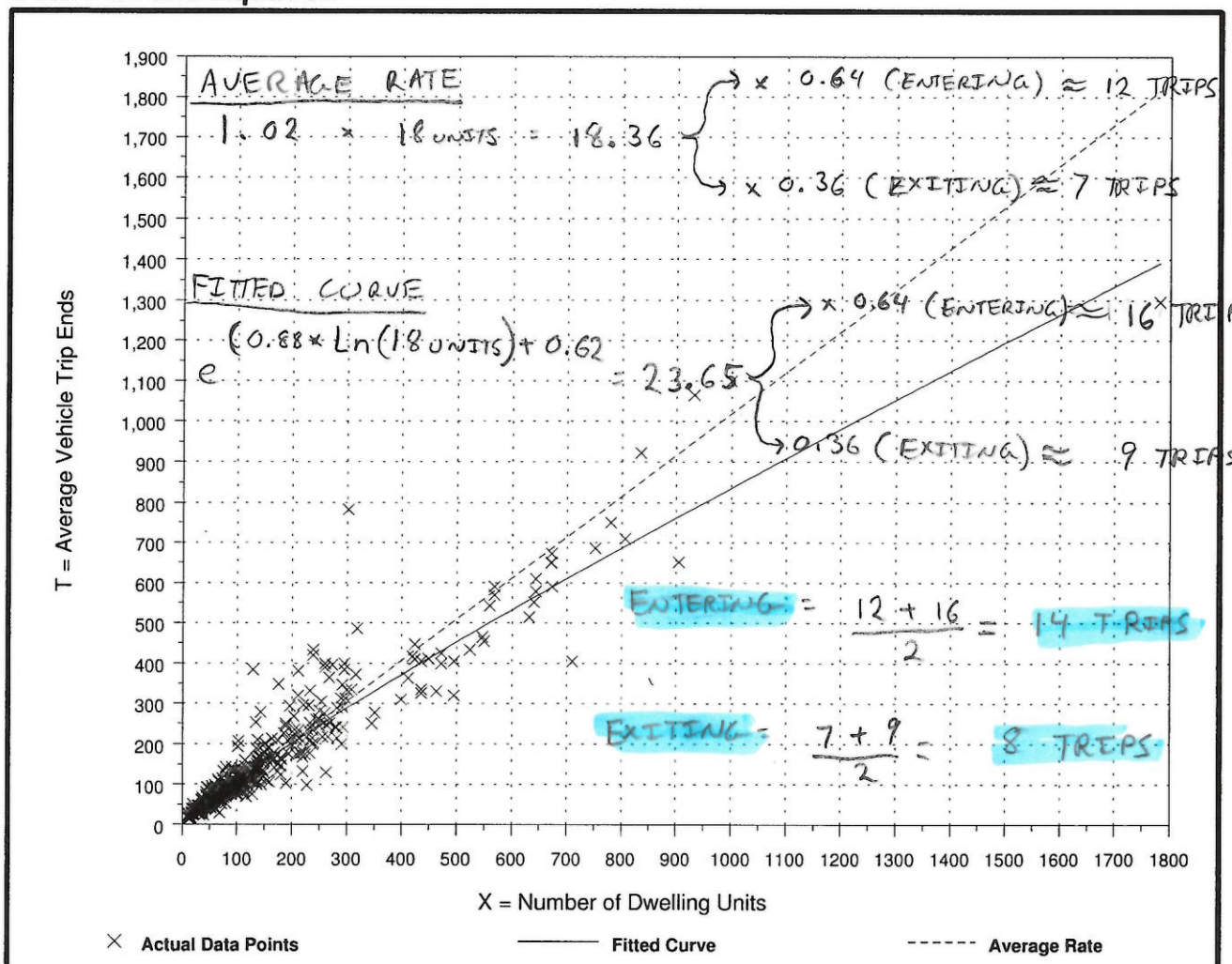
18 UNITS

Number of Studies: 362
Avg. Number of Dwelling Units: 174
Directional Distribution: 64% entering, 36% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
1.02	0.42 - 2.98	1.05

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.88 Ln(X) + 0.62 **R^2 = 0.91**

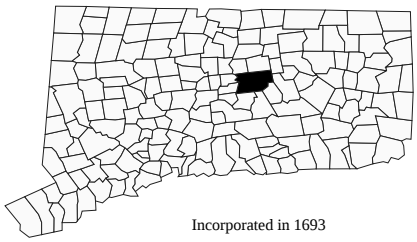
APPENDIX C
CERC 2017 Town Profile for Glastonbury

Glastonbury, Connecticut

CERC Town Profile 2017 *Produced by The CT Data Collaborative*

Town Hall
2155 Main Street
Glastonbury, CT 06033
(860) 652-7500

Belongs To
Hartford County
LMA Hartford
Capitol Region Planning Area



Incorporated in 1693

Demographics

Population

	Town	County	State
2000	31,876	857,183	3,405,565
2010	34,427	894,014	3,574,097
2011-2015	34,685	896,943	3,593,222
2020	34,810	925,492	3,604,591
'15 - '20 Growth / Yr	0.1%	0.6%	0.1%

	Town	County	State
Land Area (sq. miles)	51	735	4,842
Pop./Sq. Mile (2011-2015)	677	1,220	742
Median Age (2011-2015)	44	40	40
Households (2011-2015)	13,121	346,362	1,352,583
Med. HH Inc. (2011-2015)	$109,018	$66,395	$70,331

Race/Ethnicity (2011-2015)

	Town	County	State
White Alone, Non-Hispanic	29,290	573,000	2,487,119
Black Alone, Non-Hispanic	628	120,172	370,501
Asian	3,105	42,973	150,670
Native American	10	2,284	8,908
Other/Multi-Race	1,009	79,673	283,800
Hispanic (Any Race)	1,335	148,744	526,508

	Town	County	State
Poverty Rate (2011-2015)	3.7%	11.9%	10.5%

Educational Attainment (2011-2015)

	Town		State	
High School Graduate	3,532	15%	673,973	27%
Associates Degree	1,463	6%	183,289	7%
Bachelors or Higher	14,736	62%	925,607	38%

Age Distribution (2011-2015)

	0-4		5-14		15-24		25-44		45-64		65+		Total	
Town	1,811	5%	4,952	14%	4,116	12%	7,034	20%	11,426	33%	5,346	15%	34,685	100%
County	48,910	5%	111,512	12%	118,057	13%	227,598	25%	253,499	28%	137,367	15%	896,943	100%
State	191,445	5%	446,058	12%	492,864	14%	885,518	25%	1,035,059	29%	542,278	15%	3,593,222	100%

Economics

Business Profile (2015)

Sector	Units	Employment
Total - All Industries	1,397	16,621
23 - Construction	96	792
31-33 - Manufacturing	37	721
44-45 - Retail Trade	114	1,829
52 - Finance and Insurance	168	2,001
62 - Health Care and Social Assistance	138	1,861
Total Government	26	1,829

Top Five Grand List (2014)

	Amount
Connecticut Light and Power Inc.	$33,662,630
Flanders Somerset LLC	$23,254,100
Connecticut Mutual Life Ins	$17,646,800
Realty Associates	$16,466,200
Brixmor Residual Shoppers at Fox Run	$14,825,300
Net Grand List (SFY 2014-2015)	$3,832,589,412

Major Employers (2014)

Town of Glastonbury
Ikon/Office Solutions
Salmon Brook Nursing & Rehab
Open Solutions
Super Stop & Shop

Education

2016-2017 School Year

	Grades	Enrollment
Glastonbury School District	PK-12	5,996

Smarter Balanced Test Percent Above Goal (2015-2016)

	Grade 3		Grade 4		Grade 8	
	Town	State	Town	State	Town	State
Math	81.5%	52.8%	73.4%	47.9%	73.0%	40.3%
ELA	79.6%	53.9%	76.5%	55.5%	78.3%	55.5%

Pre-K Enrollment (PSIS)

	2016-2017
Glastonbury School District	50

4-Year Cohort Graduation Rate (2014-2015)

	All	Female	Male
Connecticut	87.2%	90.1%	84.4%
Glastonbury School District	97.7%	98.4%	97.0%

Rate of Chronic Absenteeism (2015-2016)

	All
Connecticut	9.6%
Glastonbury School District	2.7%

No representation or warranties, expressed or implied, are given regarding the accuracy of this information.

Glastonbury, Connecticut

CERC Town Profile 2017

Connecticut Economic Resource Center

Government

Government Form: Council - Manager

Total Revenue (2015)	$160,239,746
Tax Revenue	$137,088,886
Non-tax Revenue	$23,150,860
Intergovernmental	$18,421,311
Per Capita Tax (2015)	$3,941
As % of State Average	141.2%

Total Expenditures (2015)	$154,714,285
Education	$107,377,221
Other	$47,337,064
Total Indebtedness (2015)	$80,473,325
As % of Expenditures	52.0%
Per Capita	$2,321
As % of State Average	95.5%

Annual Debt Service (2015)	$10,673,414
As % of Expenditures	6.9%
Eq. Net Grand List (2015)	$5,749,528,717
Per Capita	$165,798
As % of State Average	111.9%
Moody's Bond Rating (2015)	Aaa
Actual Mill Rate (2015)	35.65
Equalized Mill Rate (2015)	23.77
% of Net Grand List Com/Ind (2015)	14.4%

Housing/Real Estate

Housing Stock (2011-2015)

	Town	County	State
Total Units	13,722	374,453	1,491,786
% Single Unit (2011-2015)	73.3%	55.1%	59.2%
New Permits Auth (2015)	41	892	6,077
As % Existing Units	0.3%	0.2%	0.4%
Demolitions (2015)	9	201	1,230
Home Sales (2013)	412	6,413	26,310
Median Price	$346,300	$236,400	$270,500
Built Pre-1950 share	15.6%	27.8%	29.3%
Owner Occupied Dwellings	10,673	224,000	906,227
As % Total Dwellings	81.3%	64.7%	67.0%
Subsidized Housing (2015)	759	54,471	172,556

Distribution of House Sales (2013)

	Town	County	State
Less than $100,000	9	804	3,417
$100,000-$199,999	36	2,420	7,522
$200,000-$299,999	113	1,548	6,031
$300,000-$399,999	99	810	3,380
$400,000 or More	155	831	5,960

Labor Force

Place of Residence (2015)

	Town	County	State
Labor Force	18,749	473,272	1,890,506
Employed	18,033	445,154	1,782,269
Unemployed	716	28,118	108,237
Unemployment Rate	3.8%	5.9%	5.7%

Place of Work (2015)

	Town	County	State
Units	1,397	27,205	116,246
Total Employment	16,621	504,843	1,662,822
2012-'15 AAGR	107.3%	108.7%	100.0%
Mfg Employment	721	51,375	79,612

Connecticut Commuters (2014)

Commuters Into Town From:		Town Residents Commuting To:	
Glastonbury, CT	2,778	Hartford, CT	3,194
East Hartford, CT	1,106	Glastonbury, CT	2,778
Manchester, CT	957	East Hartford, CT	1,276
Hartford, CT	853	Manchester, CT	744
West Hartford, CT	507	Farmington, CT	562
Wethersfield, CT	458	Rocky Hill, CT	527
Middletown, CT	393	West Hartford, CT	513

Other Information

Crime Rate (2014)

	Town	State
Per 100,000 residents	940	2,167

Library (2016)

	Town
Circulation per Capita	11.82
Internet Use per Visit	0.10

Distance to Major Cities

	Miles
Hartford	9
Providence	59
Boston	90
New York City	102
Montreal	271

Residential Utilities

Electric Provider

Eversource Energy
(800) 286-2000

Gas Provider

CNG Corp
(860) 727-3000

Water Provider

Municipal Provider
Local Contact

Cable Provider

Cox Communications, Manchester
(800) 955-9515

Families Receiving (2014)

	Town
Temporary Family Assistance (TFA)	21

Population Receiving (2014)

	Town
Supplemental Nutrition Assistance Program (SNAP)	552

profiles.ctdata.org

No representation or warranties, expressed or implied, are given regarding the accuracy of this information.

design professionals INC

P.O. BOX 1167
21 JEFFREY DRIVE
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FAX: 860.291.8757
www.designprofessionalsinc.com

CIVIL & TRAFFIC ENGINEERS / PLANNERS / SURVEYORS / GIS ANALYSTS / LANDSCAPE ARCHITECTS
Serving Connecticut, Massachusetts, & Rhode Island

September 21, 2017

Town Council
c/o Town Clerk
Glastonbury Town Hall
Engineering Division
2155 Main Street
Glastonbury, CT 06033

Re: Zone Change and PUD
Glastonbury Glen
Orchard Street
Horseshoe Lane Associates, LLC

Dear, Councilors;

On behalf of the Applicant, Horseshoe Lanes Associates, Inc, Design Professionals Inc. is pleased to submit the enclosed Applications for a Zone Change (from Rural Residential to Residence Zone AA) and an Application for a Planned Area Development. The Applicant is under agreement with the property owner, Catholic Cemeteries Assoc. of the Archdiocese of Hartford, Inc, to obtain a portion of a 62.51 Acre tract of land. The existing property is located on Orchard Street and Hebron Avenue. The Applicant will acquire a 15.5+/- acre tract for a proposed 18-unit residential development. The remaining portion of the land, 47.0+/- acres will be retained by the property owner. The tract is referenced on the Glastonbury's Tax Assessors map as lots E-3AA & S-54 for the Orchard Street and Hebron Avenue parcels respectively.

The Applicant has been coordinating with various town departments and the development has evolved based upon feedback and recommendations that have been received to date. Most recently, we have received comments from the Engineering Department and would like to take this opportunity to formally address them as we believe these are the only remaining unaddressed comments that we have received from the Towns Staff.

As previously stated, Design Professionals Inc. is in receipt of comments from the Engineering Department which are outlined in a memo to Stephen Braun, Assistant Town Engineering, from Greg Mahoney, Senior Engineering Technician, dated September 18, 2017 (attached hereto for your reference). The Applicant offers the following in response to same. For convenience, the responses outlined below are numbered to coincide with the referenced comment memo. The following responses coincide with numbered comments:

Engineer review (9-18-2017)

1. Acknowledged, final plans will be signed and stamped (ink & impression).
2. The requested note has been added to sheets 4-9.
3. An approval letter sheet has been added to the site plan set (sheet #2). Please note that written approvals and/or permits have not been received to date but will be added to this once received, and will be provided to the town for final record.
4. The requested note has been added to zoning table (sheet #1).
5. The town approval block has been added to all sheets.

6. The Soil Scientist Certification has been added to sheets #4 thru #9.
7. The proposed development is not a subdivision; therefore, the requested note has not been added to the plan. This was confirmed with Greg Mahoney of the Engineering Department.
8. Coordinate labels have been added to the Lot Line Modification plan and also sheet #4; Benchmarks have been labeled on Lot Line Modification Plan and sheets 4, 5, 7 and 8.
9. Acknowledged, upon approval of final plans a Total Construction Cost Estimate will be prepared.
10. The requested sign have added to sheet #4.
11. Baseline labels have been added to sheet #4.
12. Site Distances were field verified and have been added to plans, see sheet #4
13. Additional cleanouts along the foundation drains have been added and were discussed with Greg Mahoney of the engineering department.
14. The underdrain has been extended into Forebay and the spillway (forebay) portion of the berm is specified as being rip rap. This will allow the forebay to properly drain to prevent standing water.
15. The requested sanitary sewer lateral has been added to the site plans as depicted on sewer maps supplied by Town, no conflict exists, see sheet #7.
16. Limit and area of sawcut have been depicted on sheet #4.
17. The requested air release valve has been added to the sewer force main, see sheet #7 and #8. A detail has also been provided, see sheet #11.
18. No building structure is proposed in association with the pump station. The emergency generator will be pad mounted and screened from the roadway with vegetation, as well as the exterior weather proof control panel enclosure which will be mounted on a post.
19. The requested sewer lateral has been modified to connect to the sewer manholes.
20. The requested note has been added to sheet 34 (note 4), sheet #5-#7 (note 6), sheet #8 (note 5) and sheet # 9 (note 5).
21. The requested note was added to Plan & Profile sheet #8 (note 6).
22. The requested detail has been added to sheet #11.
23. Pump station inverts on the detail sheet have been modified to be consistent with the utility plans.
24. The location of the 4" PVC underdrain pipe has been modified on the plan as well as the detail to show a connection point on the back/outfall side of the weir wall of the outlet control. The 18" outlet pipe was modified to specify RCP.
25. The requested pipe segment has been changed to RCP.
26. The requested cross section with flood elevation relating to specific storm events has been added to sheet #12.
27. WQV added to sheet #6 and the basin section detail on sheet #12.
28. Inspection covers and TF elevations were added to sheet #6. The requested frame detail was added to sheet #12.
29. Pipe size changed from 12" to 15" as requested.
30. Outlet protection sizing calculations have been added to Stormwater Management Report.
31. The requested note has been added to Plan & Profile sheet #8 (note 7).
32. Sanitary Sewer Maintenance Schedule has been added to sheets 3 & 7. Also, attached here to is a comprehensive Operation and Maintenance Plan for the entire development which also includes, stormwater, landscaping, and snow removal as well as the responsible party (Homeowners Association).
33. The requested note has been added to sheet #5 thru #7 (note 4) #8 (note 3) as well as sheet #10. Attached here to is a comprehensive Operation and Maintenance Plan for the entire

development which also includes, stormwater, landscaping, and snow removal as well as the responsible party (Homeowners Association).

34. The requested note has been added to sheet #5 thru #7 (note 5) #8 (note 4) as well as sheet #10. Attached here to is a comprehensive Operation and Maintenance Plan for the entire development which also includes, stormwater, landscaping, and snow removal as well as the responsible party (Homeowners Association).

If any additional information is needed or any additional questions arise, please feel free to contact us at 860-291-8755.

Sincerely,

James A. Bernardino
Director of Engineering

To: Stephen M. Braun P.E.- Assistant Town Engineer

From: Greg Mahoney-Senior Engineering Technician

Date: September 18, 2017

Re: Glastonbury Glen-Orchard Street
Horseshoe Lane Associates, LLC
Lots E-3AA and S-54

Plan Date: 5/29/2017

Revised To: 7/11/2017

Designer: Design Professionals
21 Jeffery Drive
P.O. Box 167
South Windsor, CT. 06074
James A. Bernardino, P.E.
1-860-291-8755

1. Final plans are to be signed and stamped (ink & impression) by the Professional Engineer, Land Surveyor, or Architect, as appropriate to the plan sheet.
2. Add the Town of Glastonbury Standard Inspection Note to all appropriate plans.

   NOTE:
   THE CONTRACTOR SHALL NOTIFY THE TOWN OF GLASTONBURY ENGINEERING DIVISION 24 HOURS PRIOR TO BEGINNING ANY STORM DRAINAGE, SANITARY SEWER INSTALLATION, ROADWAY PREPARATION, PAVING, SIDEWALK, CURBING, OR ANY EXCAVATION IN THE TOWN RIGHT-OF-WAY TO SCHEDULE INSPECTIONS. THE DIVISION CAN BE REACHED BETWEEN 8:00 AM-4:30 PM MONDAY THRU FRIDAY AT (860) 652-7735.

3. Add Approval Letter Sheet to the plan set.
4. Provide a note on the cover sheet that this project is located within a Groundwater Protection Zone 1.
5. Provide Community Development Approval Block to all applicable sheets to be filed.
6. Add Soil Scientist Certification signature block to all applicable sheets.
7. Add Surveyor statement: "The Subdivision Regulations of the Town of Glastonbury, Town Plan and Zoning Commission are part of this plan and approval of this plan is contingent on compliance with all requirements of the said Subdivision Regulations." to all applicable sheets.
8. Provide NAD 83 coordinates labeled at four points on the subdivision perimeter. Provide (2) Benchmarks on all appropriate sheets.

9. Final plans require submittal of a Total Construction Cost Estimate utilizing ConnDOT Estimating Methodology and Weighted Unit Prices for all construction items.
10. Add “No Outlet” and “Private Road” sign to sheet C-SP1.
11. Provide labels for the proposed baseline geometry on applicable sheets. Label PC, PT’s etc.
12. Verify Intersection Site Distance requirements are met at the Orchard Street Intersection.
13. Add additional Cleanouts to the footing drain system for future maintenance. Provide additional STMH structures for the footing drain system at major junction points (Between Units 7 & 8, Between Units 1 & 2, Between Units 16 & 17, Near STMH #1) for future maintenance.
14. Extend 4” PVC Basin underdrain into the fore bay area to eliminate long term standing water. Add a clean out to the end for future maintenance.
15. Add the sewer lateral location for House # 104 Orchard Street. Determine if there are and conflicts with the proposed work in that area.
16. Show the limits and label area of sawcut and permanent pavement repair required in Orchard Street to make all utility connections.
17. Add an Air Release MH at the Force Main High Point on sheet C-UT1. Add standard detail to appropriate sheet.
18. Investigate if the proposed sewage pump station will be housed within a shed type structure to keep all equipment out of the elements, ease of maintenance and security.
19. Connect proposed sewer laterals for Units 3,4,5 & 16 to the nearest SMH to provide an easily accessible outlet.
20. Provide a note stating “All construction shall be in accordance with Town of Glastonbury Specifications or as approved by the Town Engineer” to all applicable sheets.
21. Provide a note stating what the existing baseline was created from. TOG GIS topo supplemented with field topo?
22. Add Temporary Subdivision Road Sign detail.
23. Verify inverts shown on the pump station detail match inverts shown on other sheets.
24. Clarify the location of the 4” PVC underdrain inlet show on the Outlet Control Structure and plan sheets. 4” PVC needs to be installed on the outlet side of the partition wall to allow the pond to be able to drain down. Revise plans accordingly. Edit the label for the 18” outlet pipe shown on the Outlet Control Structure detail to state RCP.
25. Revise 12” HDPE from CB #8 to existing CB to be RCP. No HDPE allowed within the Town R.O.W.
26. Provide a section through the detention pond labeling Peak Flow elevations by year.
27. Label the WQV attained for each storm drainage feature. (Drywells, Fore Bay, and Basin)
28. Provide inspection port manhole frame/covers to grade for each drywell for maintenance purposes. Label all TF’s on sheet C-DR1. Provide a detail for the frame and cover to be utilized.
29. Increase 12” HDPE to 15” from CL-DI #11 to CL-DI #13. Drainage comps show this pipe at almost full capacity.
30. Provide Outlet Protection sizing computations in the Stormwater Management Report.
31. Maintain an 18” clear distance between all proposed and existing utilities.
32. Provide a maintenance schedule for all sanitary sewer facilities. Add schedule to appropriate plans.

33. Provide a note on all applicable plans that ownership and maintenance of the stormwater facilities are the responsibility of the Homeowners Association.
34. Provide a note on all applicable plans that ownership and maintenance of the sanitary sewer facilities are the responsibility of the Homeowners Association.

Note: Revised plans may generate more comments based on plan changes reflected from this review.

Stormwater Management Report

Glastonbury Glen
Site Plan

Lot E-3AA Orchard Street &
Lot S-54 Hebron Avenue
Glastonbury, CT

Prepared for:

Horseshoe Lane Associates, LLC
18-3 Arthur Drive
South Windsor, CT

Prepared by:

Design Professionals, Inc.
21 Jeffrey Drive
South Windsor, CT

May 29, 2017
Revised to: September 18, 2017

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B Post-Development Drainage HydroCAD Report
C NRCS Soil Map & Data
D Onsite Storm Sewers Analysis
E Orchard Street Capacity Analysis
F Water Quality Calculations
    Water Quality Volume & Flow Calculations
    Water Quality Basin & Drywell Stage Storage Reports
G Drainage Area Maps
    Existing Drainage Areas (Pre)
    Proposed Drainage Areas (Post)
    Test Pit Exhibit
        Field Soil Logs
        Groundwater Monitoring Logs
        Falling Head Tests
H Outlet Protection Calculation Sheets

Introduction

Applicant Horseshoe Lane Associates, LLC is proposing to develop a 62.51 Acre tract of land comprised of two parcels located on Orchard Street and Hebron Avenue. The tracts are referenced on the Glastonbury's Tax Assessors map as Lots E-3AA & S-54 for the Orchard Street and Hebron Avenue parcels respectively. The development will consist of the creation of 18 single-family residential units with associated site improvements including a new private road, street trees, lighting, utilities, and stormwater management BMP's.

Of the 62.51 Acre tract, approximately 5.80± Acres of the southern portion of the lot is proposed to be disturbed. The proposed site is bounded to the west by Orchard Street and residential land, woods and wetlands to the north, residential lands to the south, and farming lands to the east. For more information, please refer to the plans entitled "Glastonbury Glen ~ Site Plan ~ Glastonbury, CT ~ Lots E-3AA (Orchard Street) & S-54 (Hebron Avenue)" prepared by Design Professionals, Inc. and dated May 29, 2017, as amended.

Pre-Development Site Conditions

The existing surficial characteristics of the site can primarily be classified as woodlands. To accurately assess the existing drainage conditions, small portions of the abutting properties to the east, south, and west, were included in the drainage analysis. Evaluation of the topography in the area demonstrated that runoff from these abutting properties discharge to the subject site. The additional upland areas added residential and farmlands to the watershed study area.

A shallow channel within a wetland system was identified spanning from south-east to north-west across the site. The vast majority of runoff from the watershed is collected here, and then conveyed to and across the north-west corner of the site **(Discharge Point 1)**. The remaining piece of the property directly abutting Orchard Street, sheet-flows to the existing storm drainage system in the road. The storm drain system in Orchard Street conveys collected runoff to the north, where it later joins with the overland flow leaving the site at its north-west corner. The confluence point where the two flows meet is identified on both pre- & post-development condition drainage area maps as **Discharge Point 2** and was the ultimate design point considered in comparing pre- & post-development conditions. Stormwater flows ultimately discharged to the Salmon Brook River. The extent of the woodland, residential, farmland contribution, along with the sites watershed delineations were identified in the Existing Conditions Drainage Map located in **Appendix G**.

Based on Natural Resources Conservation Service (NRCS) Hydrologic Soil Group (HSG) mapping, soils types A, B, C, & D are located on site. See **Appendix C** for The NRCS Soil Map & Data.

An evaluation was performed to quantify the peak rate of stormwater discharge offsite to **design points 1 & 2**. The Natural Resources Conservation Service's TR-55 Manual was followed in predicting the peak rates of runoff and volumes. HydroCAD computer modeling software was utilized.

The peak rates of stormwater runoff discharging to **design points 1 & 2** were determined for the 2-, 10-, 25-, and 100-year storm events. For more information, please refer to the enclosed Pre-Development Drainage HydroCAD Report located in **Appendix A**.

Post-Development Site Conditions

The subject project proposes the construction of 18 single-family residential units with a new private road, street trees, lighting, utilities, and stormwater management BMP's. In the proposed condition, stormwater from the site will be collected, treated, retained, and then discharged toward the existing swale within the wetland system, stretching from south-east to north-west across the site.

The proposed grading for the 18 single-family residential units will maintain the natural conveyance pattern of storm flows, while still promoting positive drainage away from the proposed units. To avoid deep storm trench excavations & limit disturbance to natural underlying soil conditions, a small portion of the proposed private road drive will connect to the existing storm drainage system in Orchard Street. A pipe capacity analysis of the downstream storm conduit sections was conducted to demonstrate that sufficient capacity is available to convey storm flows from the proposed impervious area. The following section **'Storm Sewer Collection System'** describes the analysis results. A profile of the hydraulic grade line in Orchard street is also included in **Appendix E**.

All roof drainage from units 1 through 10 and half of 11, will be discharged to 12 drywell systems. Configurations of four (9 sets) and two (3 sets) of 4' x 4' x 4' concrete gallies will be used as the drywells. The drywells will provide storage for the water quality volume generated from the roofs. Stage storage reports for both drywell configurations are included in **Appendix F**. A water quality basin is proposed as the main component for attenuation of increased peak storm events from all other disturbed areas. Developed areas will be collected and conveyed through a series of underground culverts and catch basins to the proposed water quality basin. See **Appendix B** for the Post-development condition HydroCAD report. Stage storage reports for the water quality pond is included in **Appendix F.** The Proposed Conditions Drainage Map for the site is located in **Appendix G**.

Storm Sewer Collection System

The proposed subsurface stormwater collection and conveyance system was designed to adequately convey proposed runoff under 10-year storm event conditions while still maintaining gutter spreads of less than half a lane width for 5- & 10-yr storms in on-grade and sag conditions respectively. The design of the storm sewers follows the guidelines set forth in the Connecticut Department of Transportation's Drainage Manual. It is estimated that during a 10-year storm event, all proposed subsurface culverts will have sufficient capacity to convey the generated storm runoff.

Review of the impacts to the Orchard Street storm sewer system also showed negligible impacts. The hydraulic grade line showed that the resulting ponding in the existing catchbasin will be well below the grate and 1ft freeboard standard. HydroCAD Storm Sewers computer software was

used for analysis. Results from the onsite storm sewer analysis can be found in **Appendix D** along with results from the existing Orchard Street storm drainage system analysis included in **Appendix E**.

Analysis of Results

The pre-development and post-development conditions were analyzed using HydroCAD consistent with National Resource Conservation Service (NRCS) hydrology methods. Two discharge locations were identified as points of interest for assessing downstream effects. The following table contains the data generated from the HydroCAD software:

Reach		2 year	10 year	25 year	100 year
DP#1 1L - To Stream @ the North West corner	Pre	5.7	17.5	25.0	39.3
	Post	5.5	15.5	21.9	32.3
	Change	*-0.3*	*-2.0*	*-3.2*	*-7.2*
DP#2 – 2L – Total Flow To Orchard Street	Pre	6.1	18.7	26.6	41.8
	Post	6.2	17.1	24.0	35.4
	Change	*0.1*	*-1.6*	*-2.6*	*-6.4*

As seen in the table above, the subject project will result in peak runoff rates in the proposed condition that are less than the peak runoff rates of the existing condition for all design storms.

Water Quality

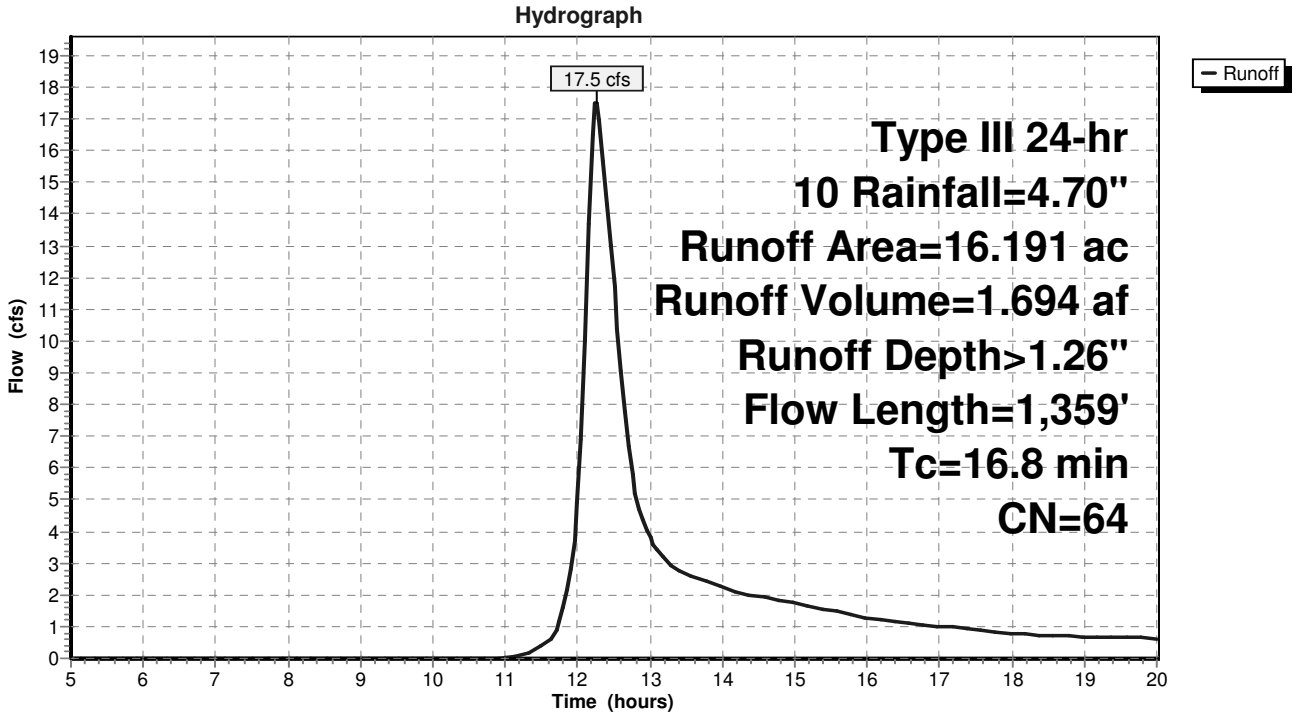
All new catch basins are proposed to have deep sumps and hoods in an effort to contain sediment and floatables. The proposed water quality basin was also sized in accordance with the 2004 Connecticut Stormwater Quality Manual, to provide a ponding volume greater than the water quality volume and a pre-treatment forebay volume greater than 10% of the water quality volume. The proposed drywells also provided additional water quality volume. The underground drywells provide a capture volume exceeding the water quality volume discharging to it. Pond, forebay, and drywell stage storage reports are included in **Appendix F**. Water Quality Volume Calculations are also included in **Appendix F**.

Conclusion

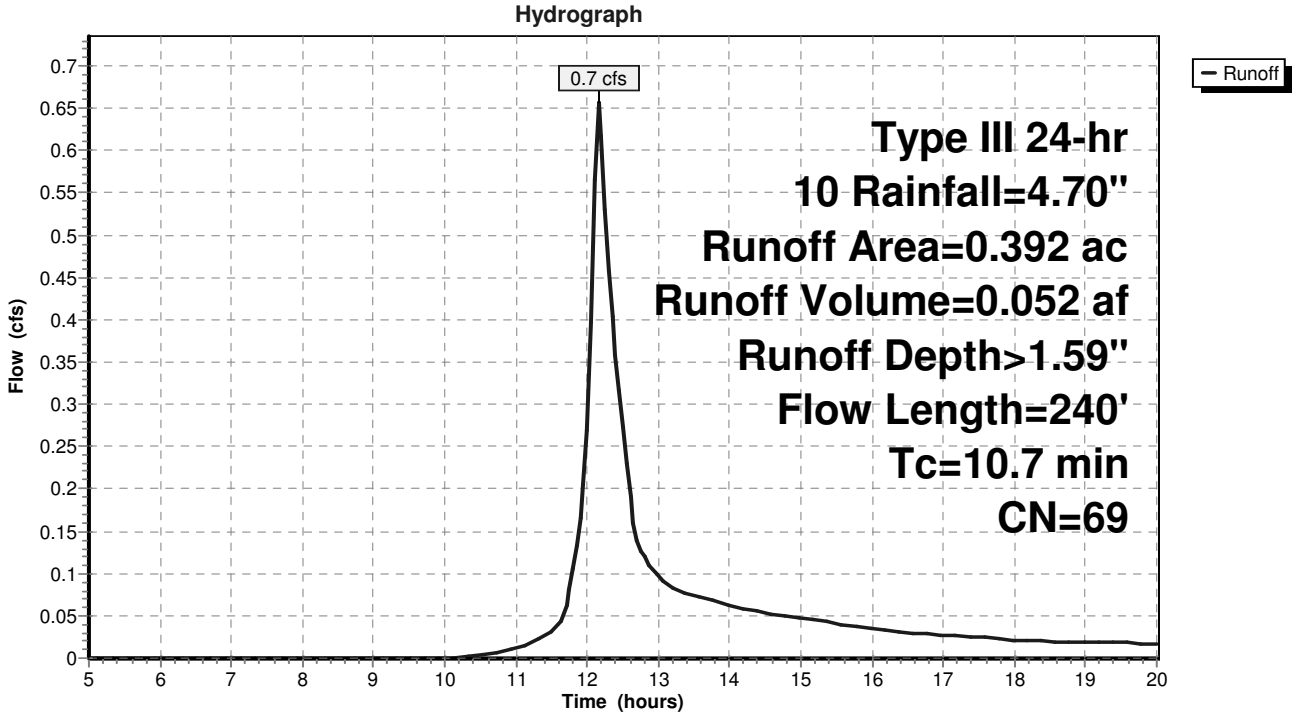
The proposed stormwater management system as discussed herein and shown on the referenced plans is appropriate for the proposed development on the subject site, is consistent with Town and State requirements, and should not pose any detrimental impacts to the environment.

APPENDIX A
Watershed Computations
(Pre-Development Drainage HydroCAD Report)

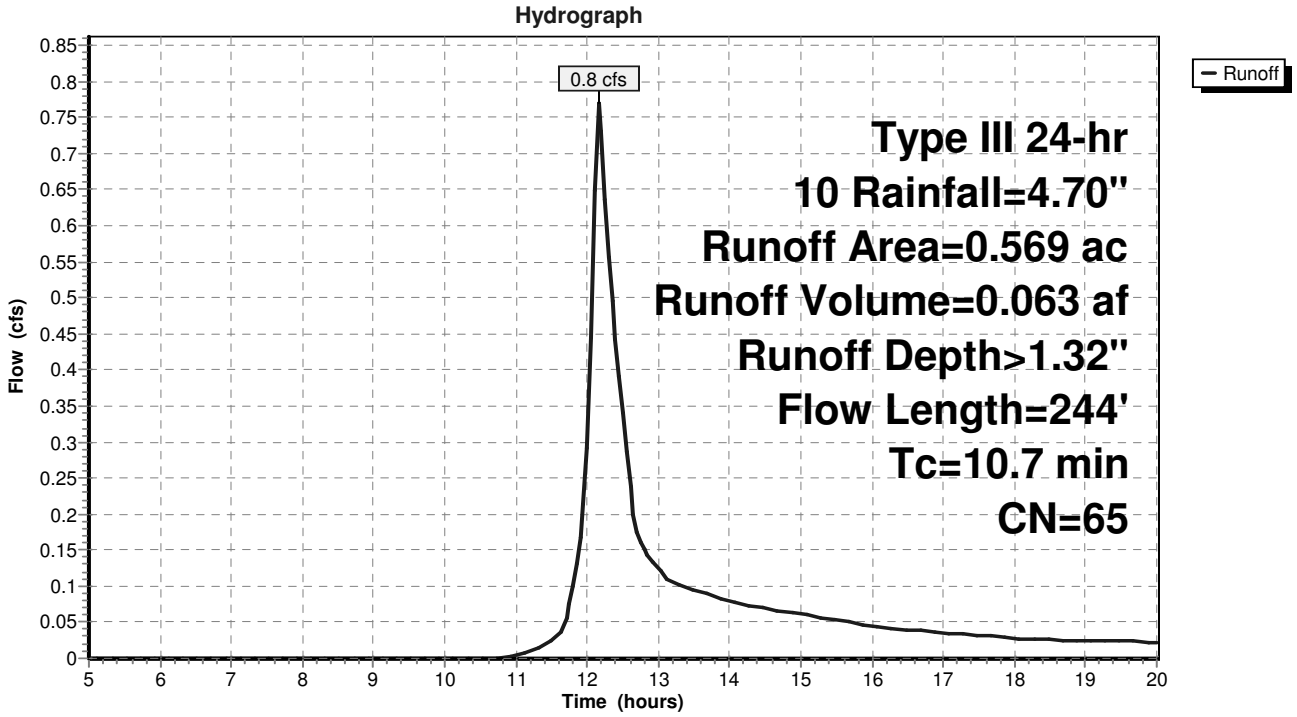
Subcatchment 1S: WATERSHED 1 - TO STREAM @ NW CORNER



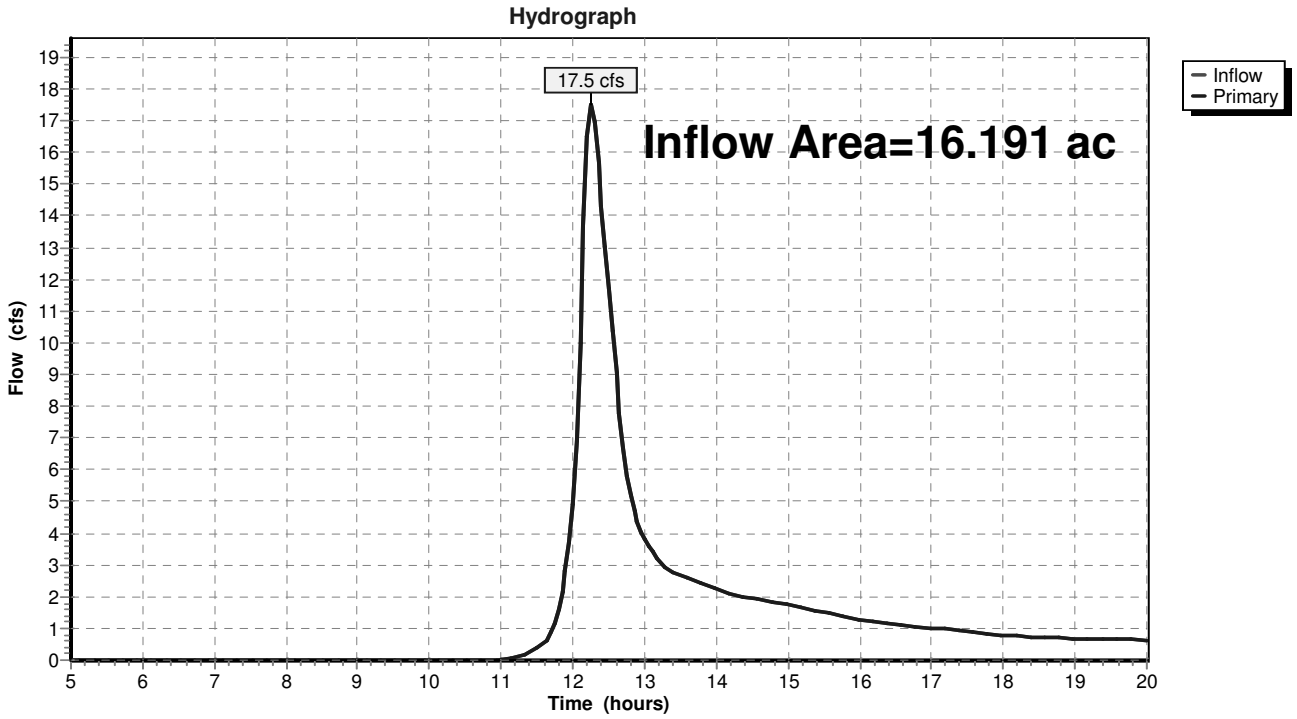
Subcatchment 2S: WATERSHED 2 - TO ORCHARD STREET DRAINAGE SYSTEM



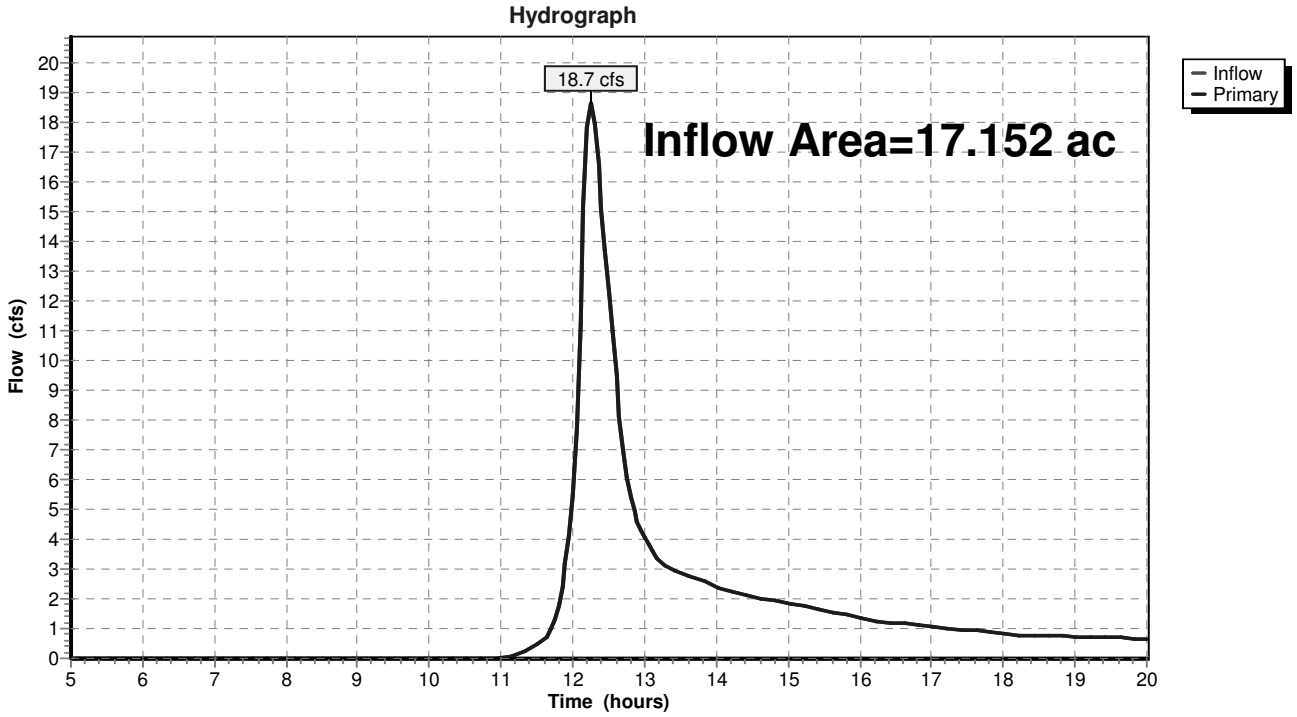
Subcatchment 3S: WATERSHED 3 - TO ORCHARD STREET DRAINAGE SYSTEM



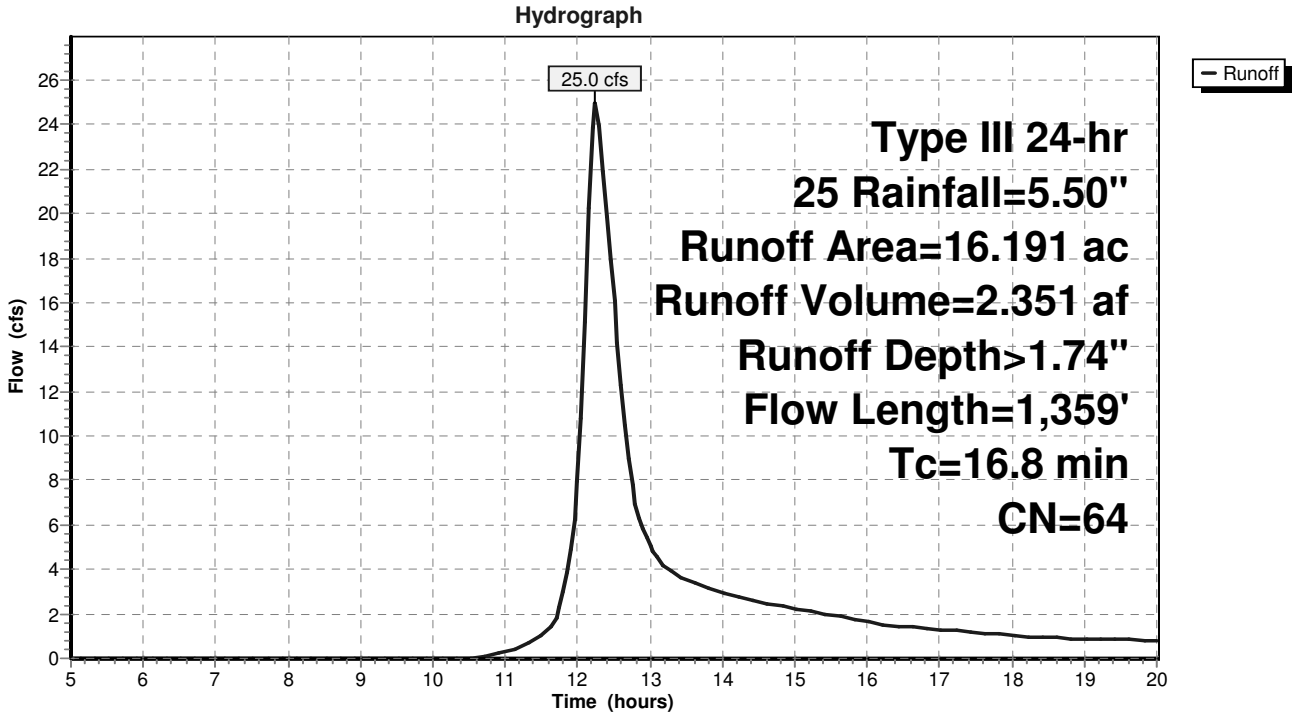
Link 1L: DP#1 - STREAM @ NW CORNER



Link 2L: DP#2 - TO ORCHARD ST STORM DRAIN SYSTEM



Subcatchment 1S: WATERSHED 1 - TO STREAM @ NW CORNER



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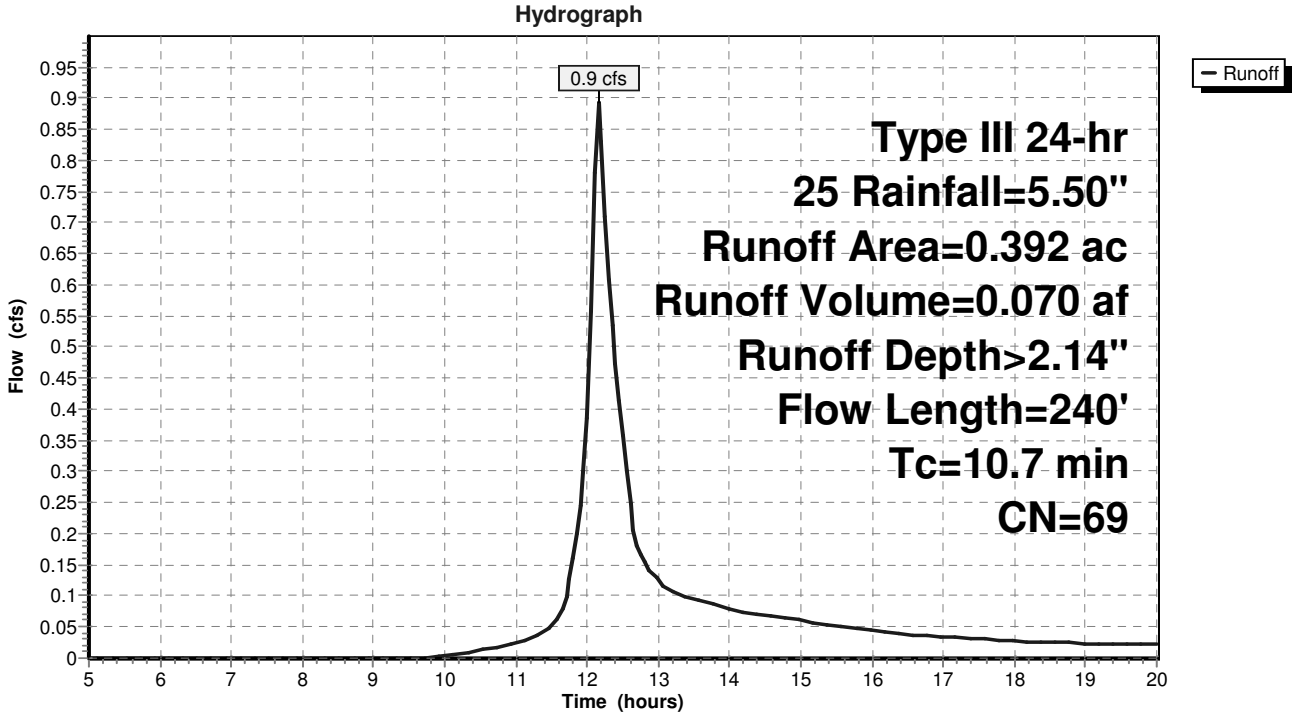

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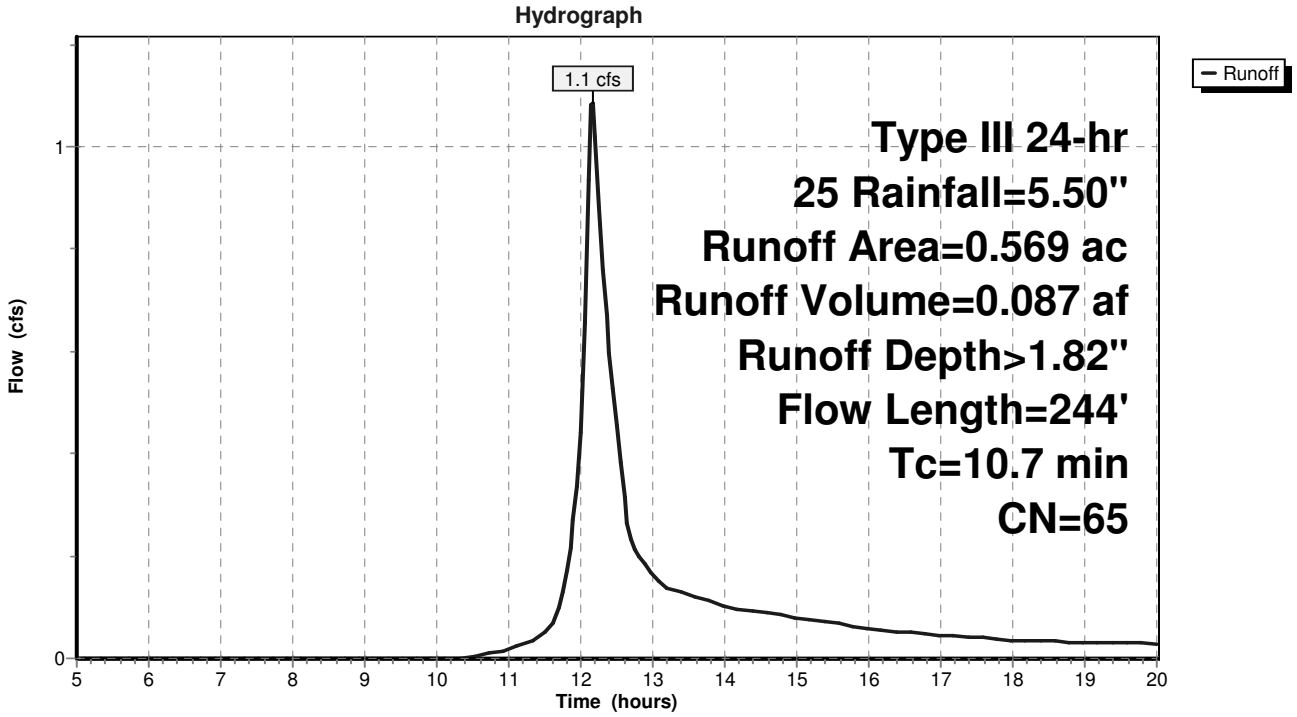

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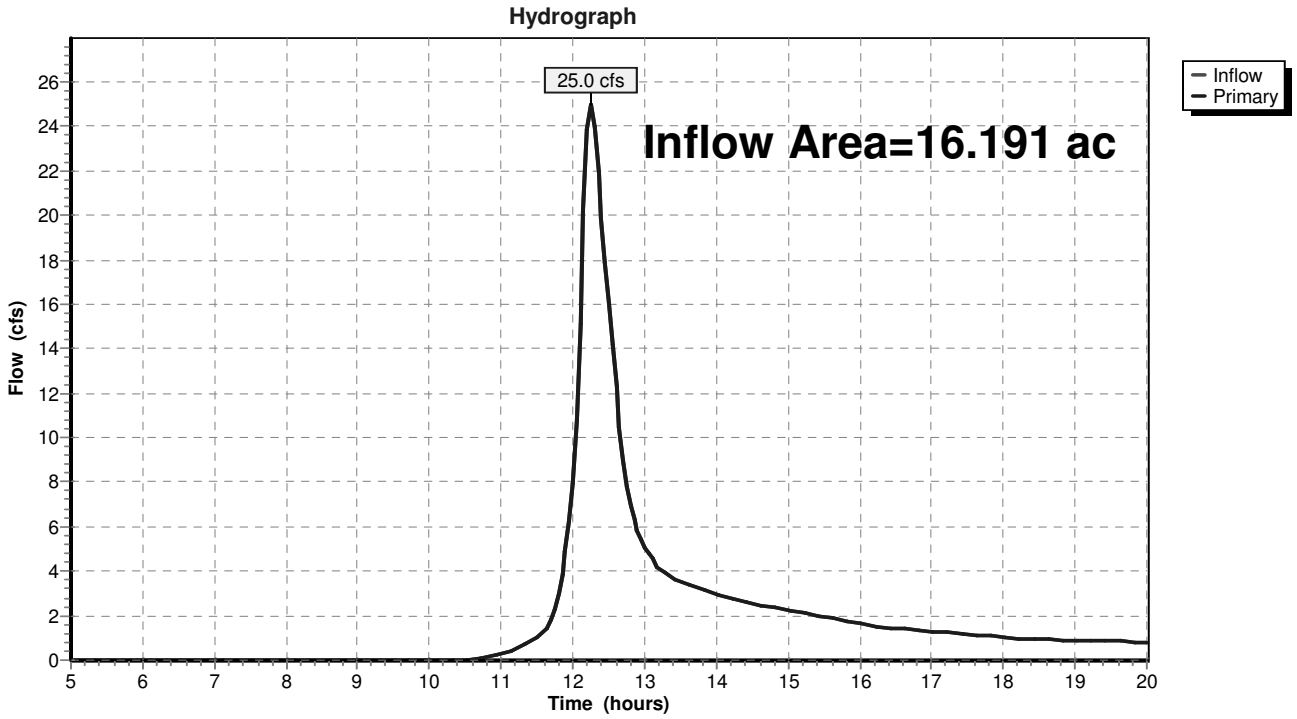

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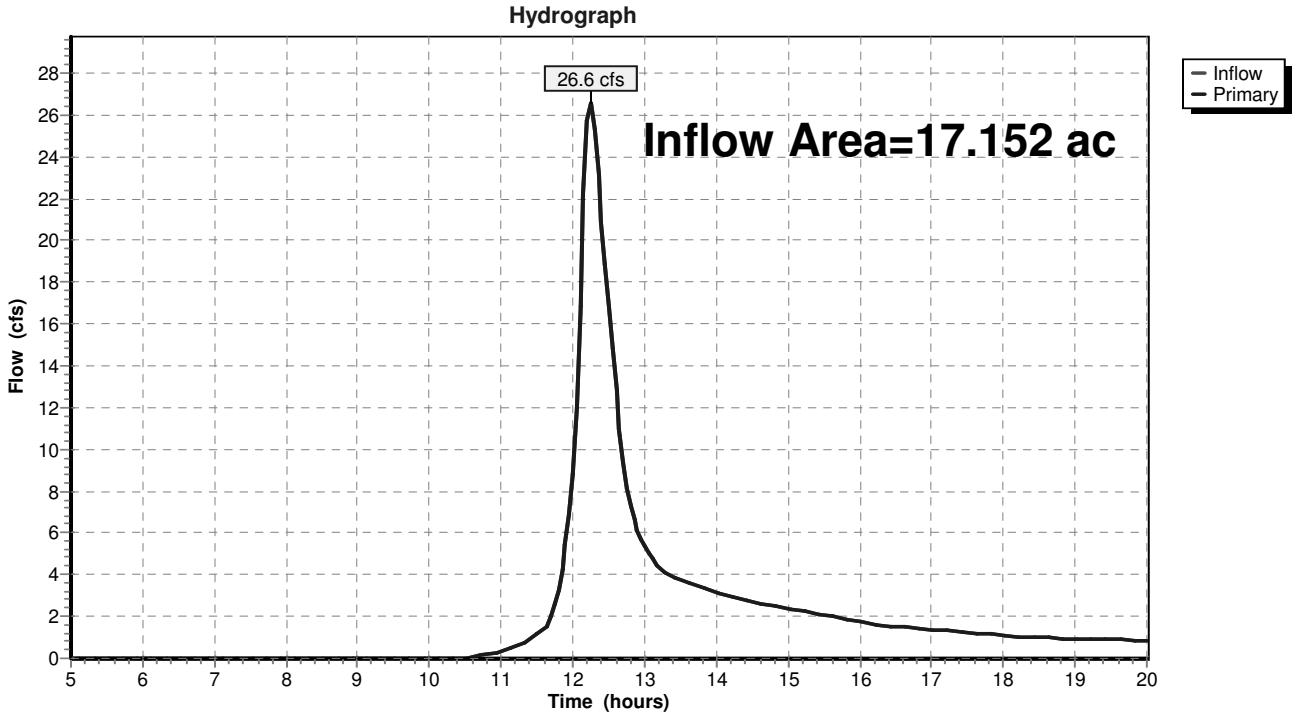

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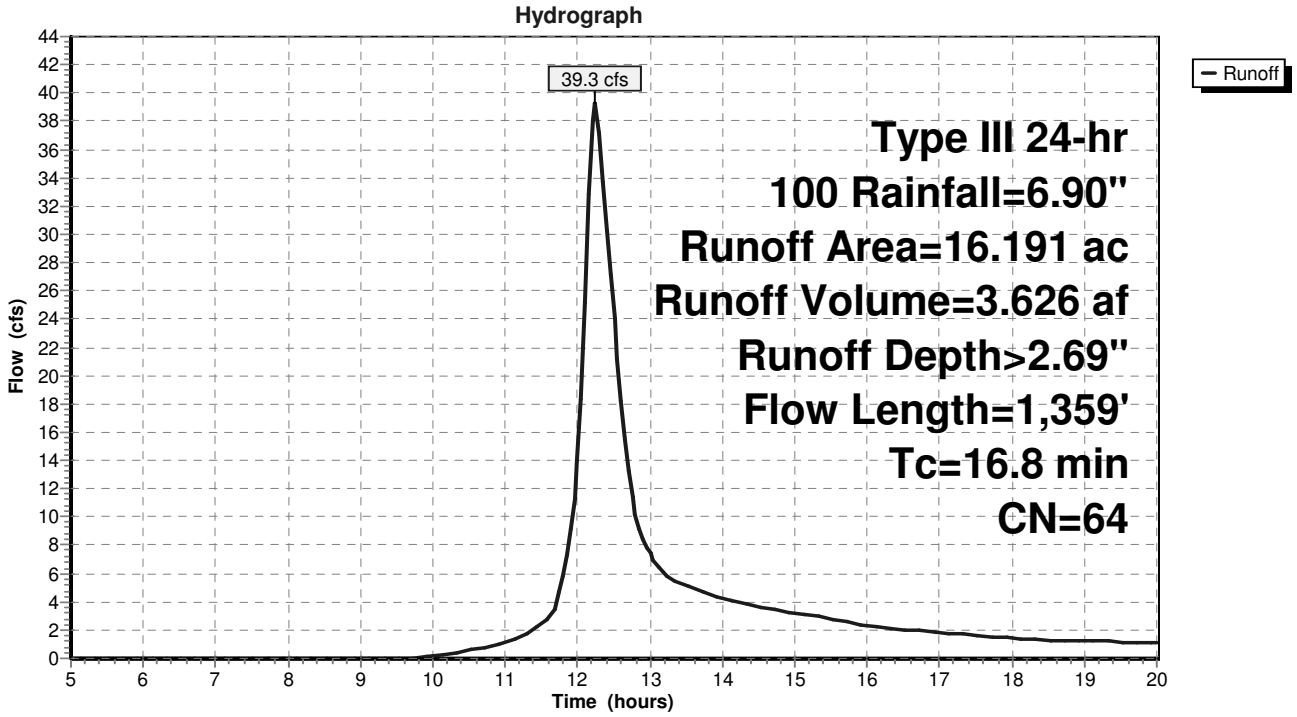

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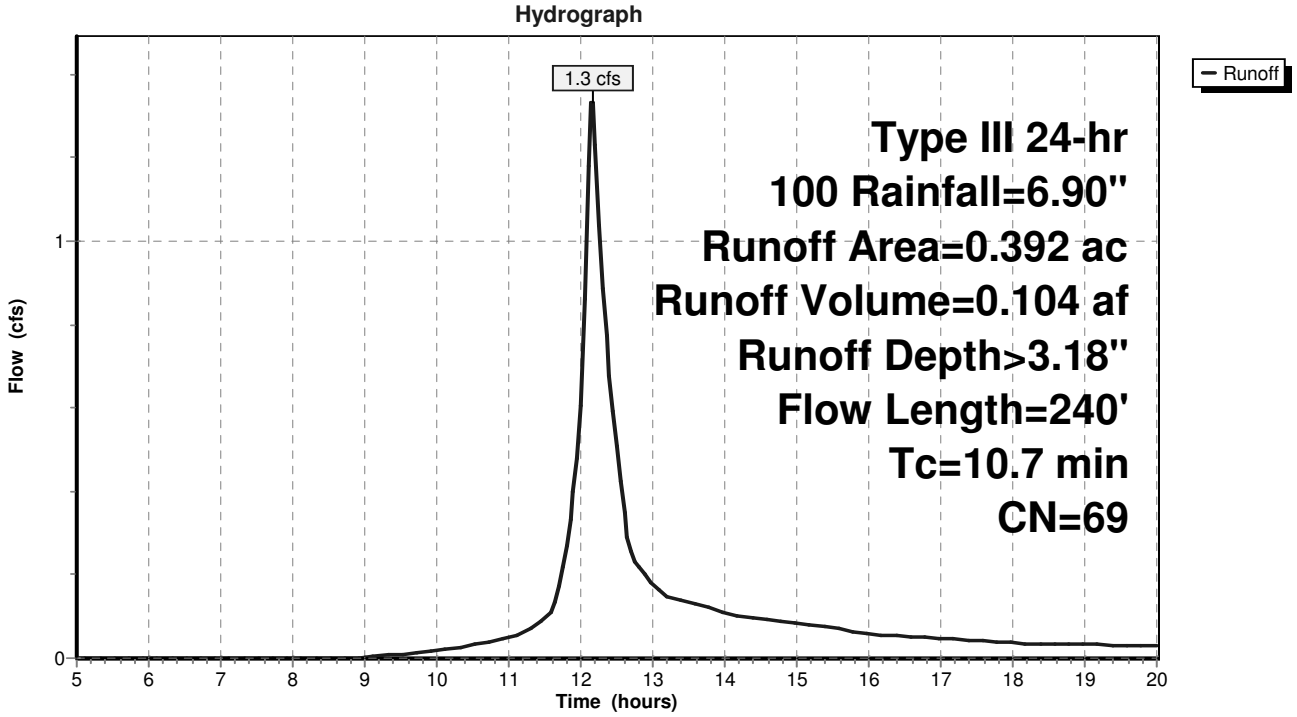
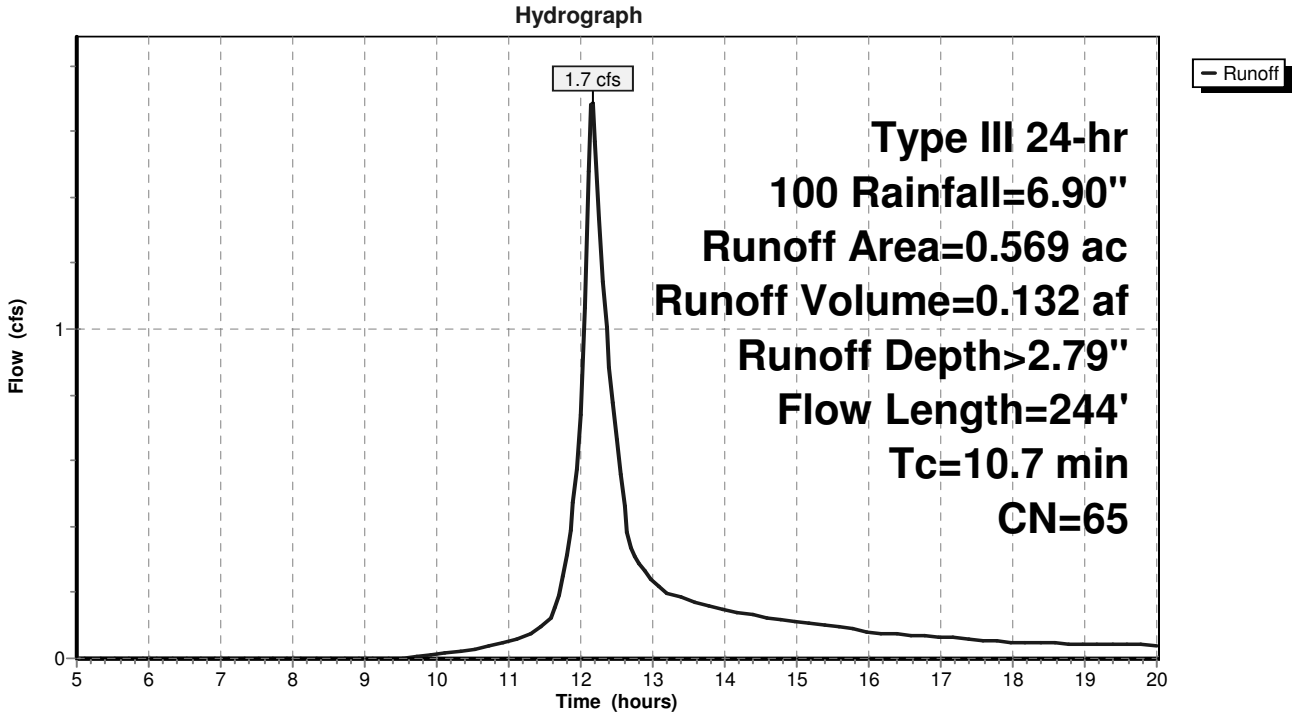
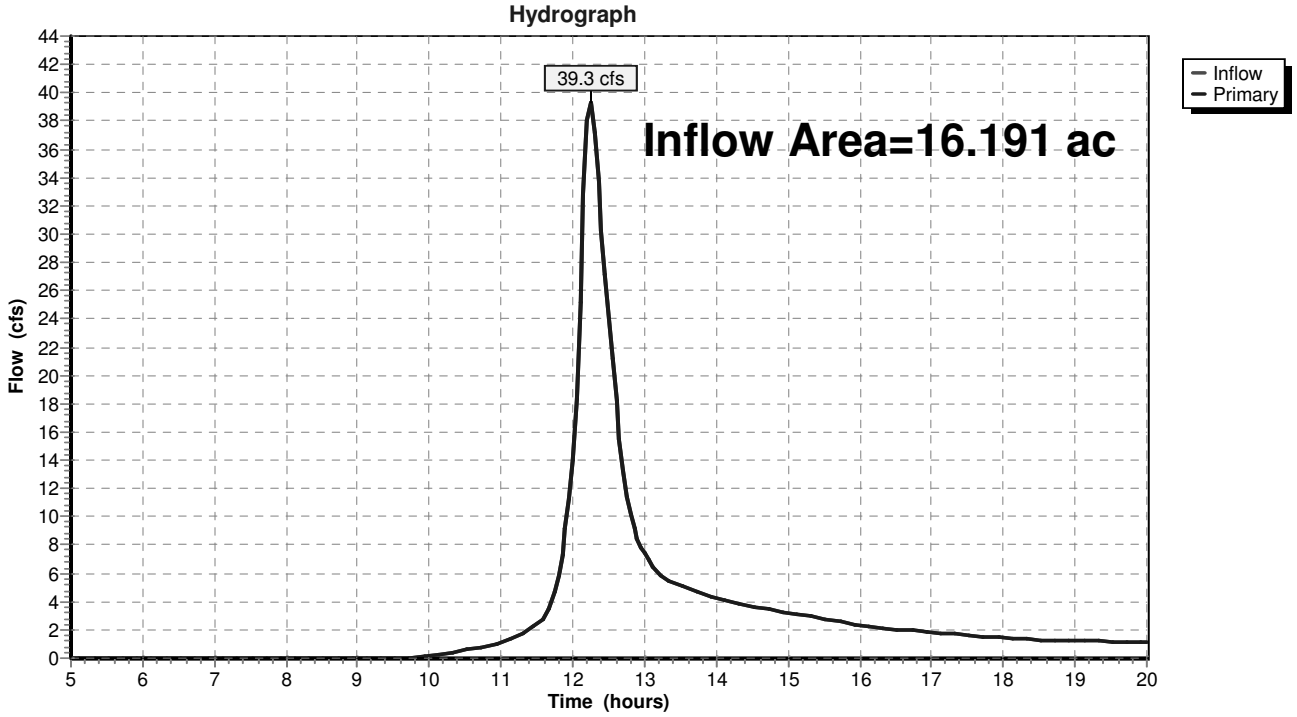


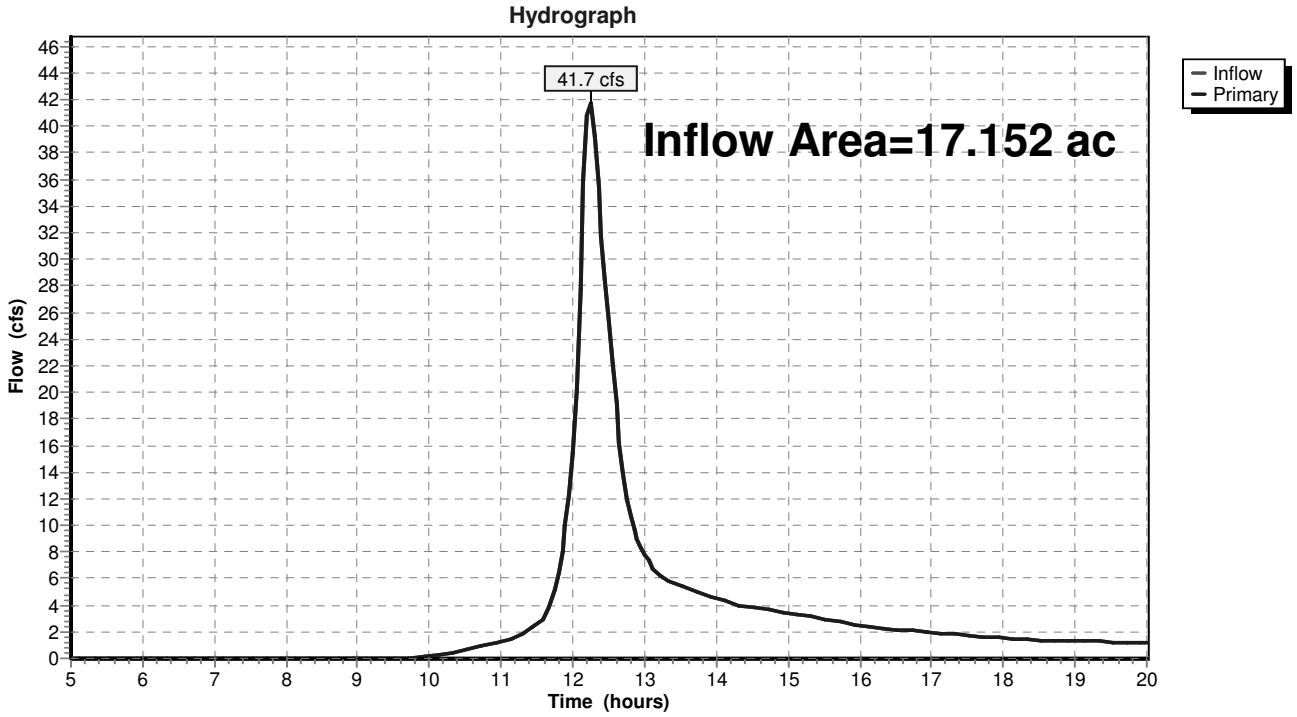
Subcatchment 3S: WATERSHED 3 - TO ORCHARD STREET DRAINAGE SYSTEM

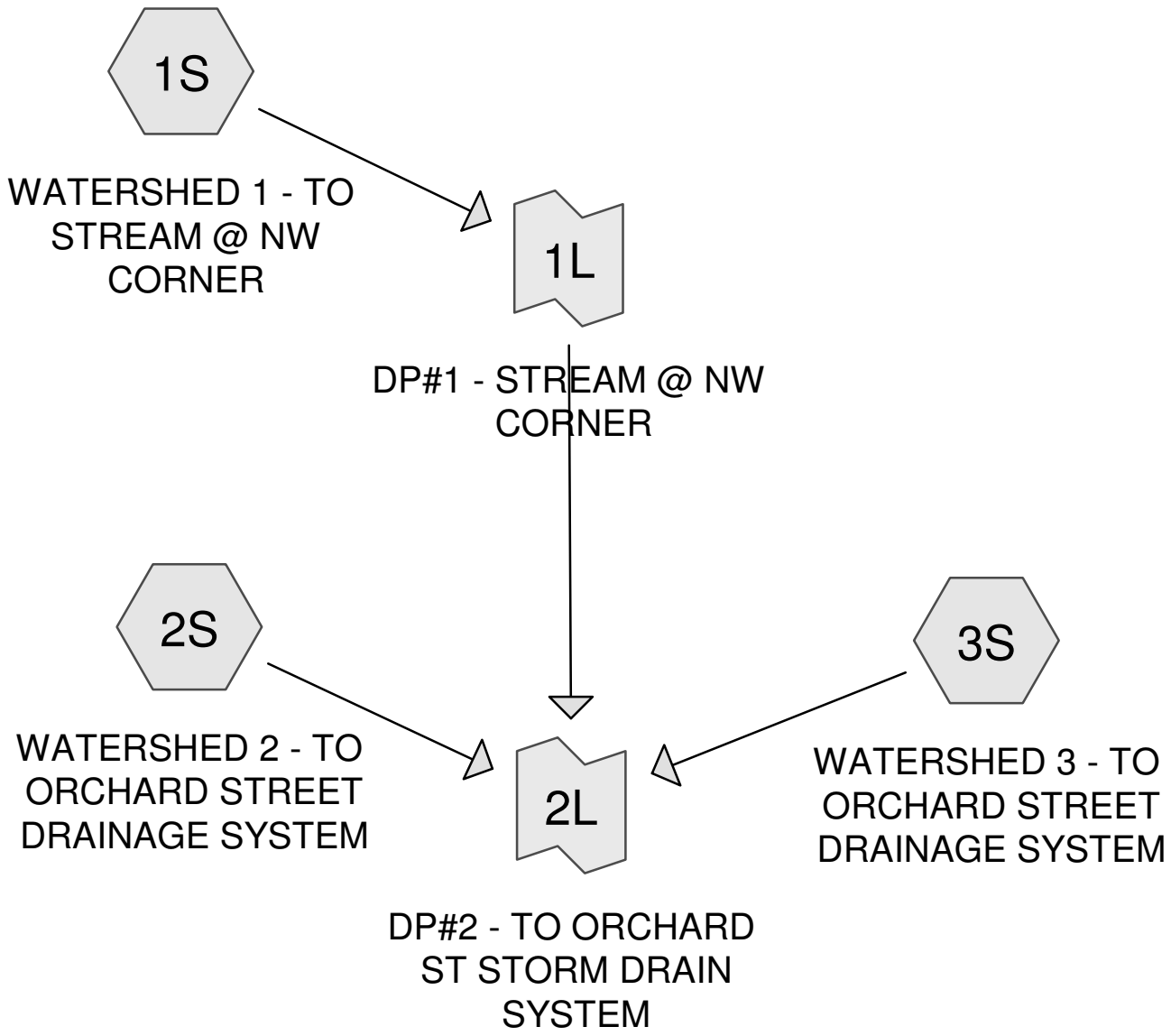


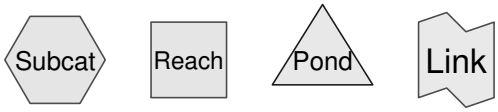
Link 1L: DP#1 - STREAM @ NW CORNER



Link 2L: DP#2 - TO ORCHARD ST STORM DRAIN SYSTEM







Routing Diagram for 3628 - Ex. Conditions-2017-07-12
Prepared by Hewlett-Packard Company, Printed 7/12/2017
HydroCAD® 10.00-16 s/n 09320 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.273	49	50-75% Grass cover, Fair, HSG A (1S)
0.711	69	50-75% Grass cover, Fair, HSG B (1S)
0.363	79	50-75% Grass cover, Fair, HSG C (1S)
0.233	39	>75% Grass cover, Good, HSG A (2S, 3S)
0.228	61	>75% Grass cover, Good, HSG B (2S, 3S)
0.344	74	>75% Grass cover, Good, HSG C (2S, 3S)
0.519	76	Fallow, crop residue, Poor, HSG A (1S)
2.055	90	Fallow, crop residue, Poor, HSG C (1S)
0.274	98	IMPERVIOUS (1S, 2S, 3S)
4.857	36	Woods, Fair, HSG A (1S)
0.201	60	Woods, Fair, HSG B (1S)
5.631	73	Woods, Fair, HSG C (1S)
1.463	79	Woods, Fair, HSG D (1S)
17.152	**64**	**TOTAL AREA**

Summary for Subcatchment 1S: WATERSHED 1 - TO STREAM @ NW CORNER

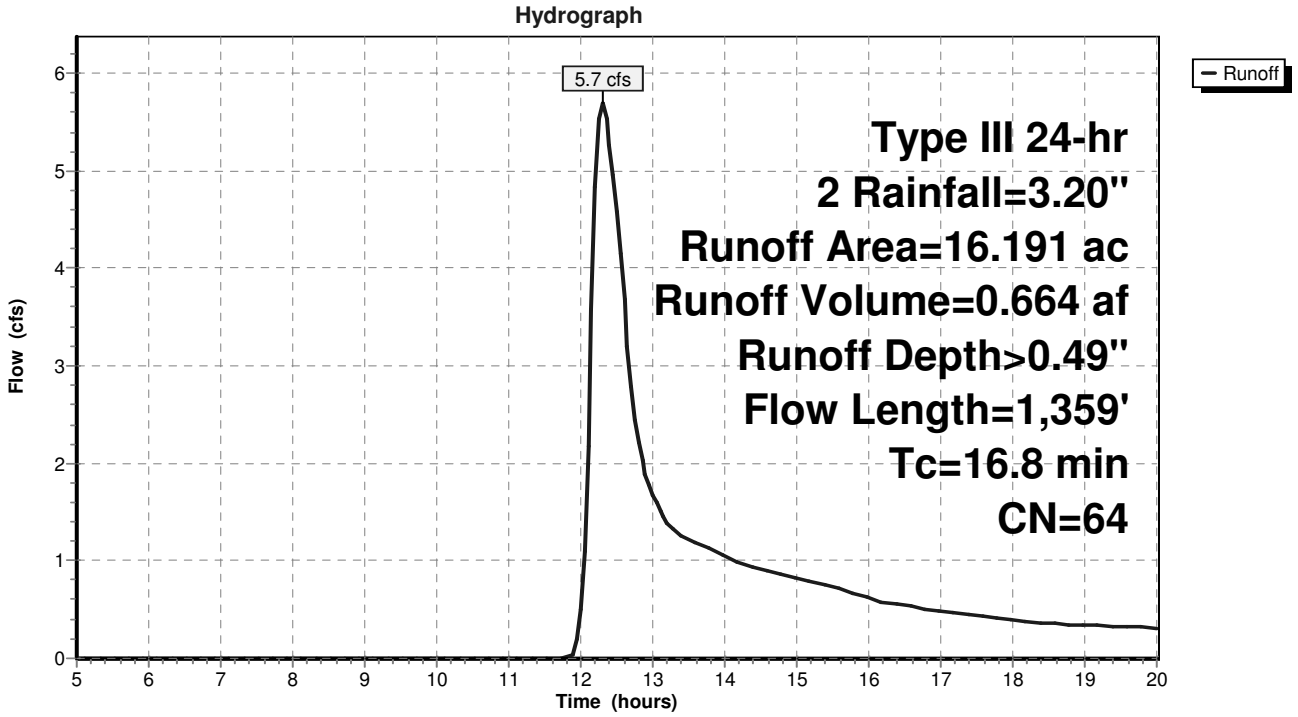
Runoff = 5.7 cfs @ 12.30 hrs, Volume= 0.664 af, Depth> 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (ac)	CN	Description
*	0.118	98	IMPERVIOUS
	4.857	36	Woods, Fair, HSG A
	0.273	49	50-75% Grass cover, Fair, HSG A
	0.519	76	Fallow, crop residue, Poor, HSG A
	0.201	60	Woods, Fair, HSG B
	0.711	69	50-75% Grass cover, Fair, HSG B
	5.631	73	Woods, Fair, HSG C
	0.363	79	50-75% Grass cover, Fair, HSG C
	2.055	90	Fallow, crop residue, Poor, HSG C
	1.463	79	Woods, Fair, HSG D
	16.191	64	Weighted Average
	16.073		99.27% Pervious Area
	0.118		0.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0250	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
7.8	1,259	0.0276	2.67		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
16.8	1,359	Total			

Subcatchment 1S: WATERSHED 1 - TO STREAM @ NW CORNER



Summary for Subcatchment 2S: WATERSHED 2 - TO ORCHARD STREET DRAINAGE SYSTEM

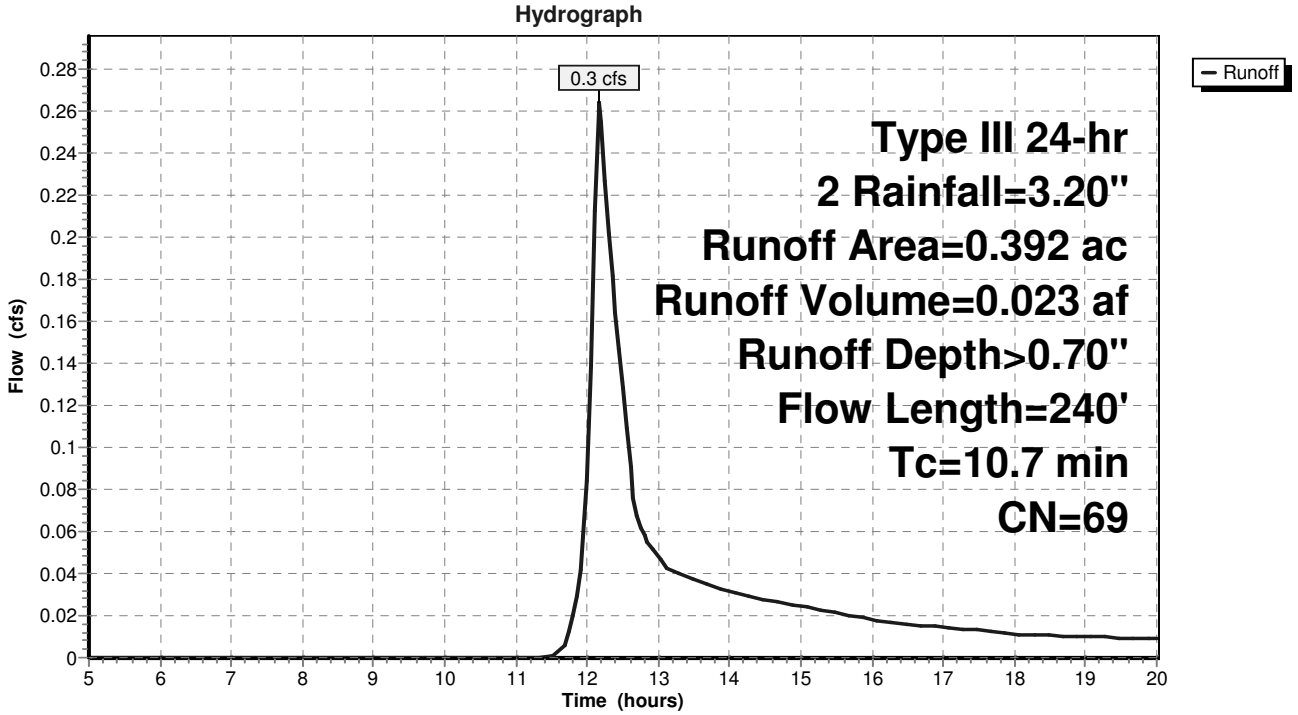
Runoff = 0.3 cfs @ 12.17 hrs, Volume= 0.023 af, Depth> 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (ac)	CN	Description
*	0.126	98	IMPERVIOUS
	0.095	39	>75% Grass cover, Good, HSG A
	0.138	61	>75% Grass cover, Good, HSG B
	0.033	74	>75% Grass cover, Good, HSG C
	0.392	69	Weighted Average
	0.266		67.86% Pervious Area
	0.126		32.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0480	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.4	93	0.0460	4.35		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	47	0.0810	4.58		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.7	240	Total			

Subcatchment 2S: WATERSHED 2 - TO ORCHARD STREET DRAINAGE SYSTEM



Summary for Subcatchment 3S: WATERSHED 3 - TO ORCHARD STREET DRAINAGE SYSTEM

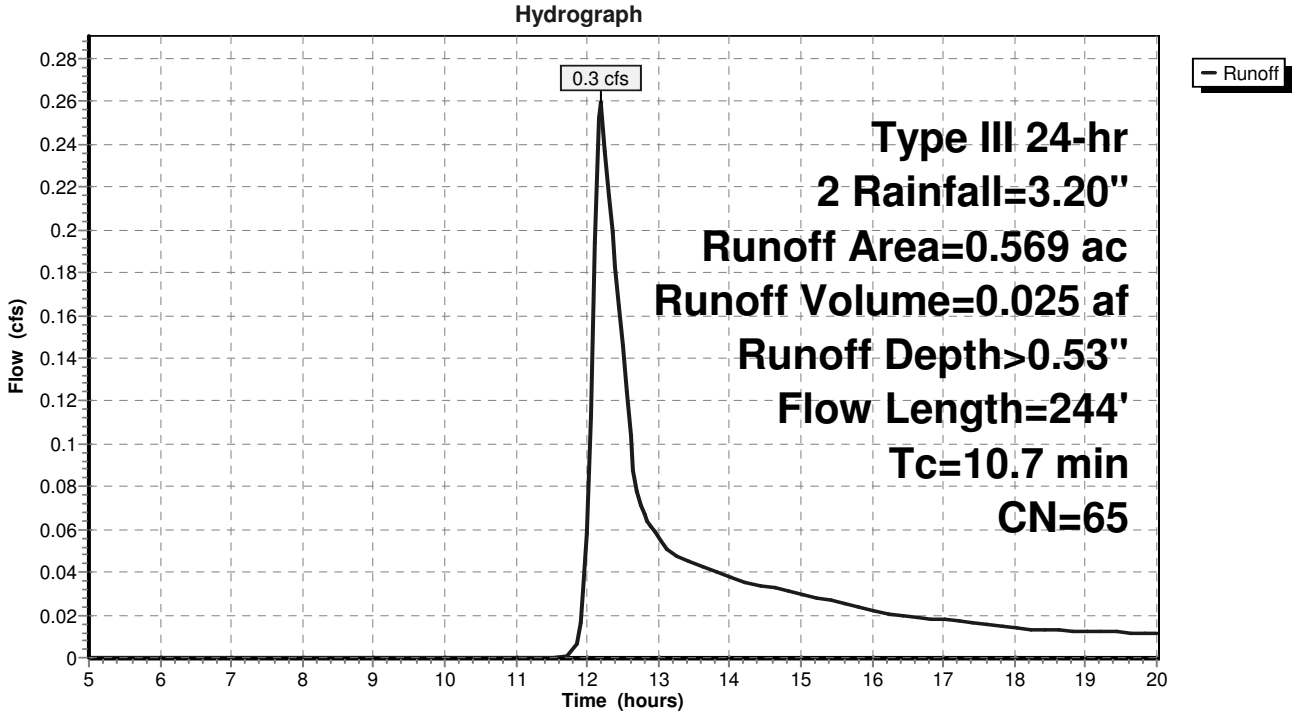
Runoff = 0.3 cfs @ 12.19 hrs, Volume= 0.025 af, Depth> 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (ac)	CN	Description
*	0.030	98	IMPERVIOUS
	0.138	39	>75% Grass cover, Good, HSG A
	0.090	61	>75% Grass cover, Good, HSG B
	0.311	74	>75% Grass cover, Good, HSG C
	0.569	65	Weighted Average
	0.539		94.73% Pervious Area
	0.030		5.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	100	0.0500	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	144	0.0380	3.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.7	244	Total			

Subcatchment 3S: WATERSHED 3 - TO ORCHARD STREET DRAINAGE SYSTEM

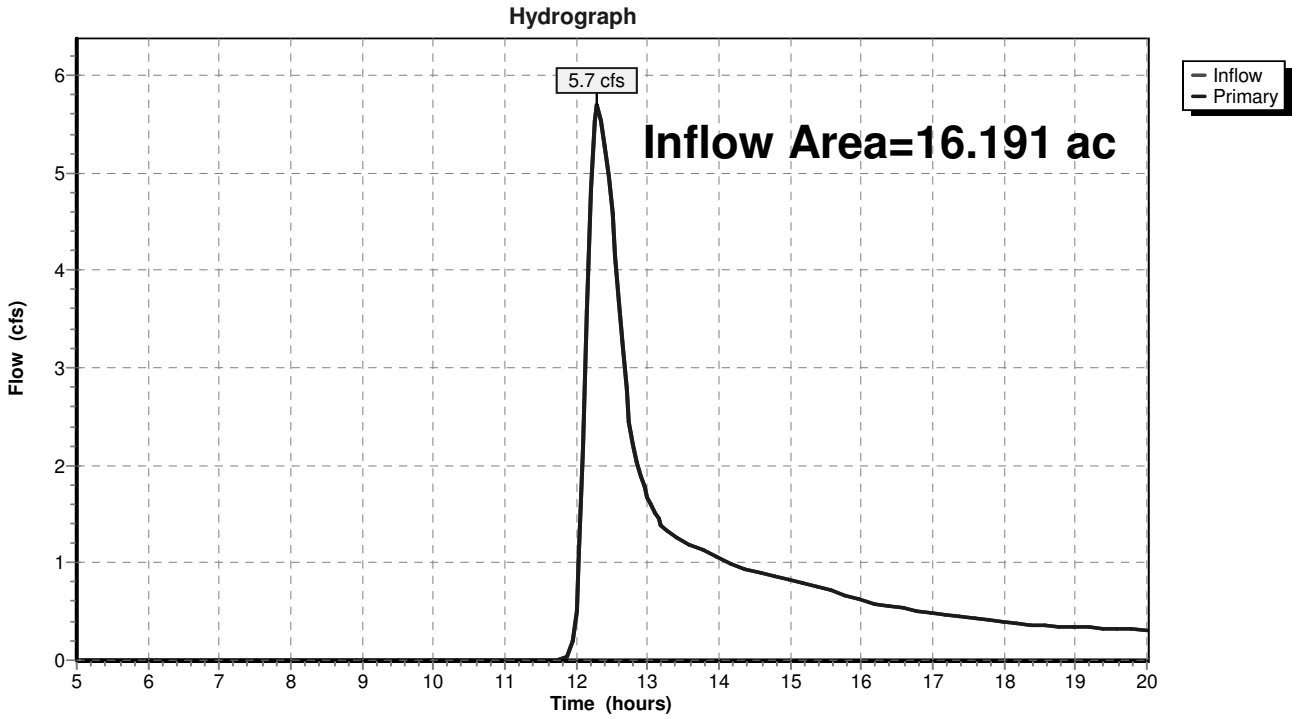


Summary for Link 1L: DP#1 - STREAM @ NW CORNER

Inflow Area = 16.191 ac, 0.73% Impervious, Inflow Depth > 0.49" for 2 event
Inflow = 5.7 cfs @ 12.30 hrs, Volume= 0.664 af
Primary = 5.7 cfs @ 12.30 hrs, Volume= 0.664 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: DP#1 - STREAM @ NW CORNER

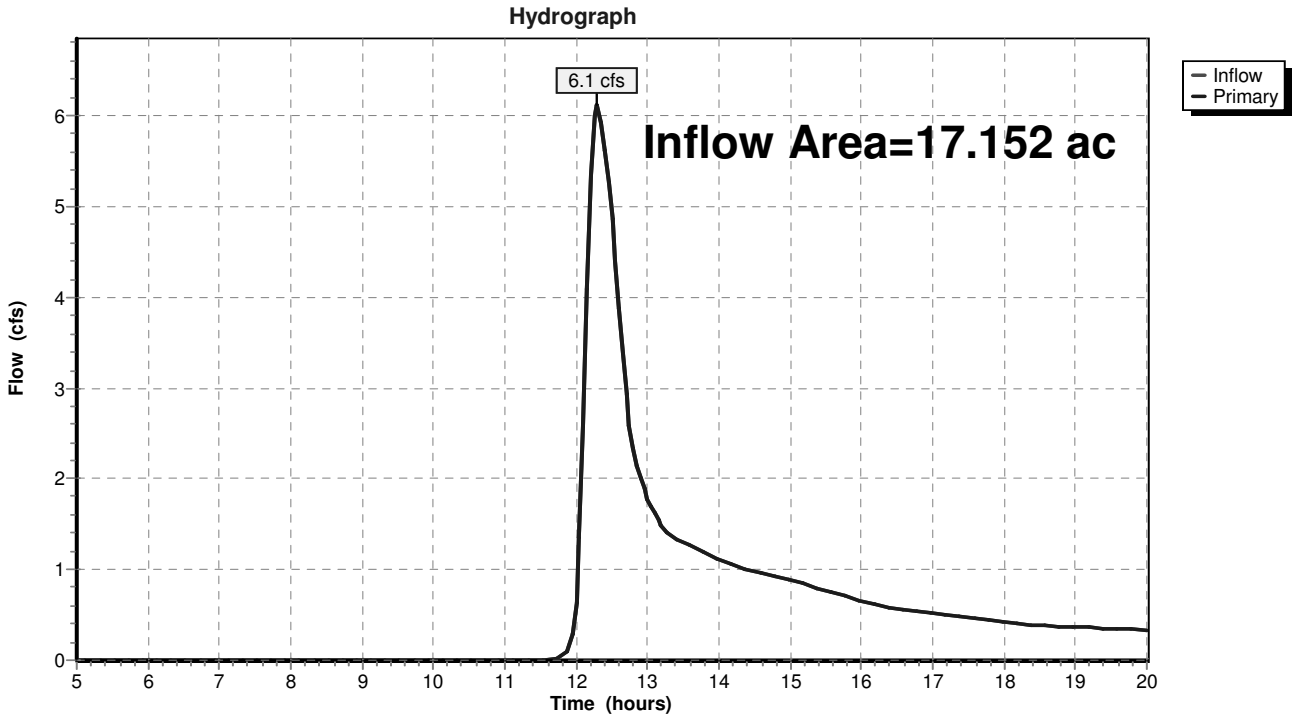


Summary for Link 2L: DP#2 - TO ORCHARD ST STORM DRAIN SYSTEM

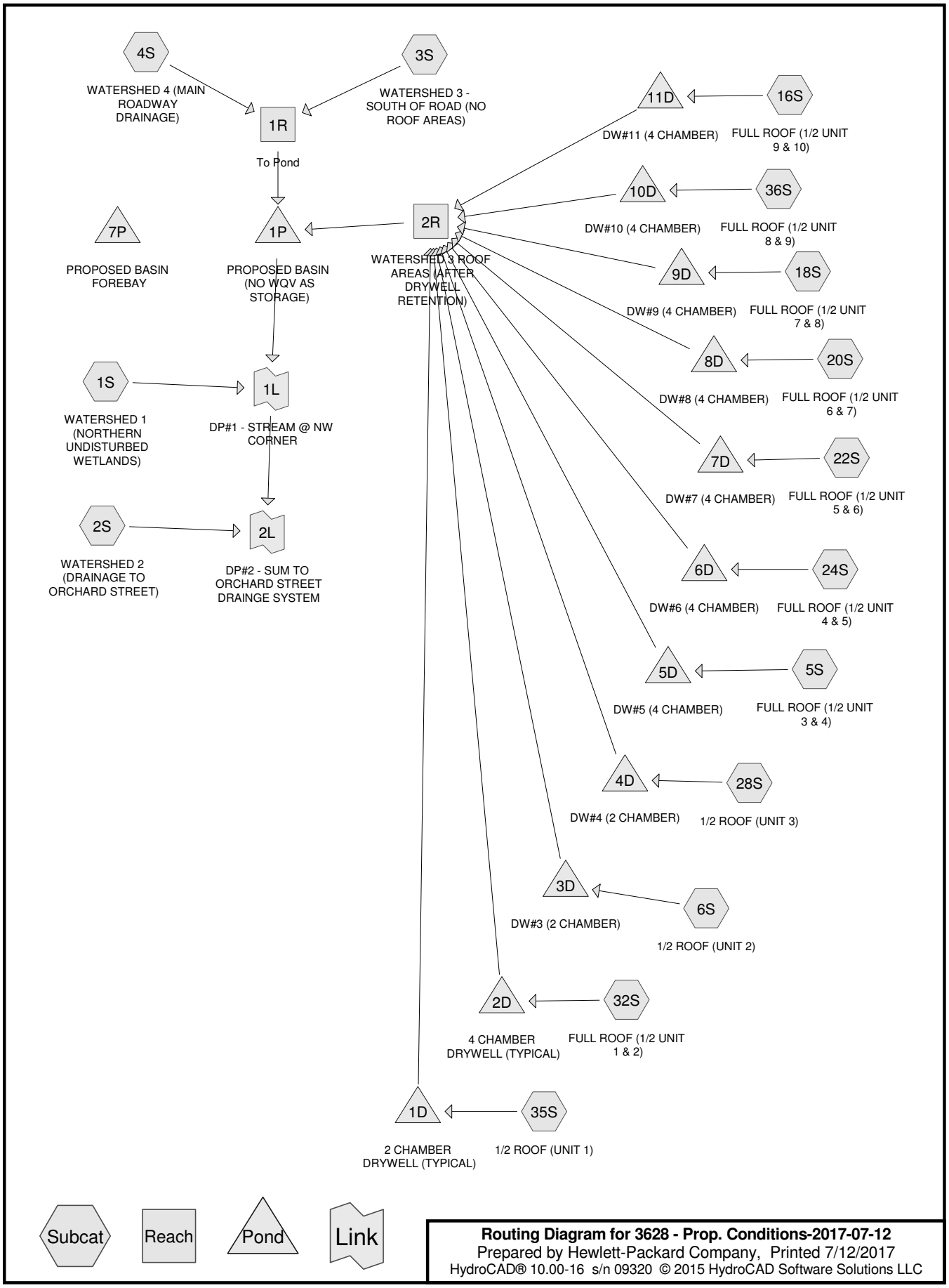
Inflow Area = 17.152 ac, 1.60% Impervious, Inflow Depth > 0.50" for 2 event
Inflow = 6.1 cfs @ 12.29 hrs, Volume= 0.712 af
Primary = 6.1 cfs @ 12.29 hrs, Volume= 0.712 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2L: DP#2 - TO ORCHARD ST STORM DRAIN SYSTEM



APPENDIX B
Watershed Computations
(Post-Development Drainage HydroCAD Report)



Routing Diagram for 3628 - Prop. Conditions-2017-07-12
Prepared by Hewlett-Packard Company, Printed 7/12/2017
HydroCAD® 10.00-16 s/n 09320 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.083	39	>75% Grass cover, Good, HSG A (1S, 2S, 3S, 4S)
1.051	61	>75% Grass cover, Good, HSG B (2S, 3S, 4S)
2.383	74	>75% Grass cover, Good, HSG C (1S, 2S, 3S, 4S)
0.036	80	>75% Grass cover, Good, HSG D (1S)
0.516	76	Fallow, crop residue, Poor, HSG A (1S)
2.073	90	Fallow, crop residue, Poor, HSG C (1S, 3S)
1.602	98	IMPERVIOUS (1S, 2S, 3S, 4S)
0.533	98	IMPERVIOUS (ROOF) (5S, 6S, 16S, 18S, 20S, 22S, 24S, 28S, 32S, 35S, 36S)
2.603	30	Woods, Good, HSG A (1S, 3S)
0.120	55	Woods, Good, HSG B (3S)
2.681	70	Woods, Good, HSG C (1S, 3S, 4S)
1.436	77	Woods, Good, HSG D (1S)
17.117	**67**	**TOTAL AREA**

Summary for Subcatchment 1S: WATERSHED 1 (NORTHERN UNDISTURBED WETLANDS)

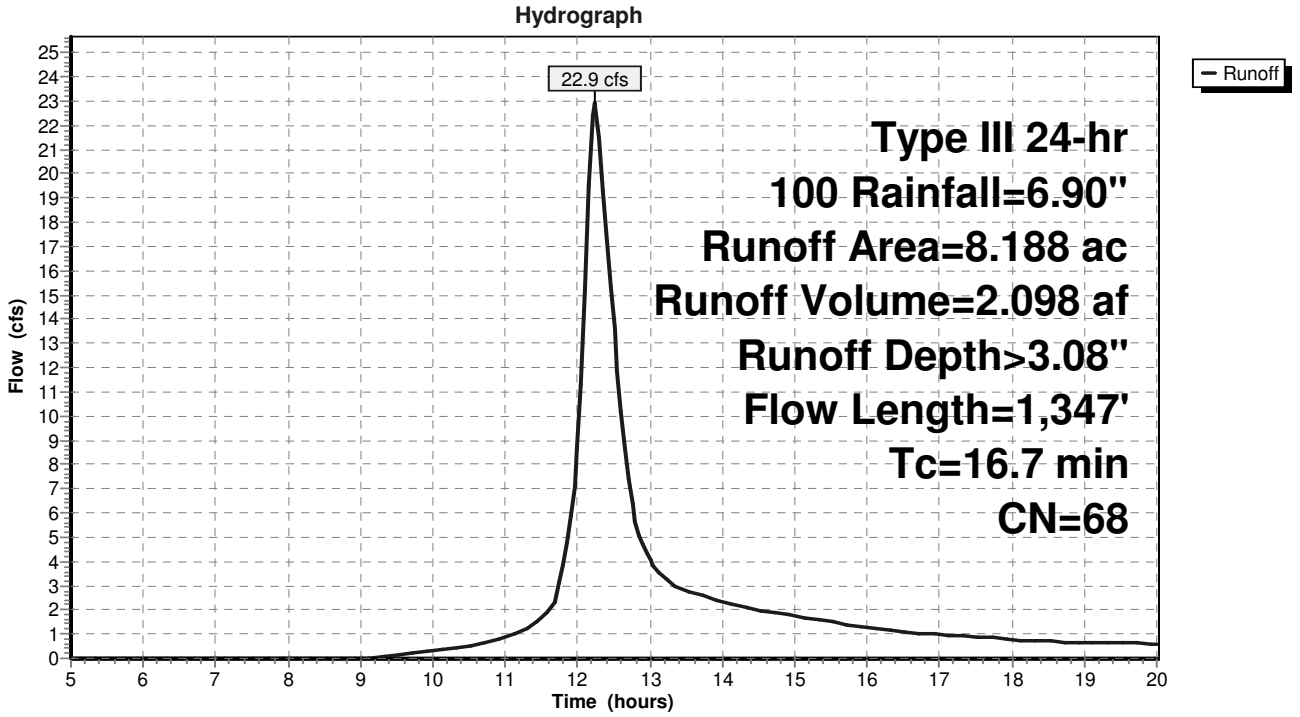
Runoff = 22.9 cfs @ 12.24 hrs, Volume= 2.098 af, Depth> 3.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Rainfall=6.90"

	Area (ac)	CN	Description
*	0.196	98	IMPERVIOUS
	1.503	30	Woods, Good, HSG A
	0.374	39	>75% Grass cover, Good, HSG A
	0.516	76	Fallow, crop residue, Poor, HSG A
	1.933	70	Woods, Good, HSG C
	0.667	74	>75% Grass cover, Good, HSG C
	1.527	90	Fallow, crop residue, Poor, HSG C
	1.436	77	Woods, Good, HSG D
	0.036	80	>75% Grass cover, Good, HSG D
	8.188	68	Weighted Average
	7.992		97.61% Pervious Area
	0.196		2.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0250	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
7.7	1,247	0.0279	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
16.7	1,347	Total			

Subcatchment 1S: WATERSHED 1 (NORTHERN UNDISTURBED WETLANDS)



Summary for Subcatchment 2S: WATERSHED 2 (DRAINAGE TO ORCHARD STREET)

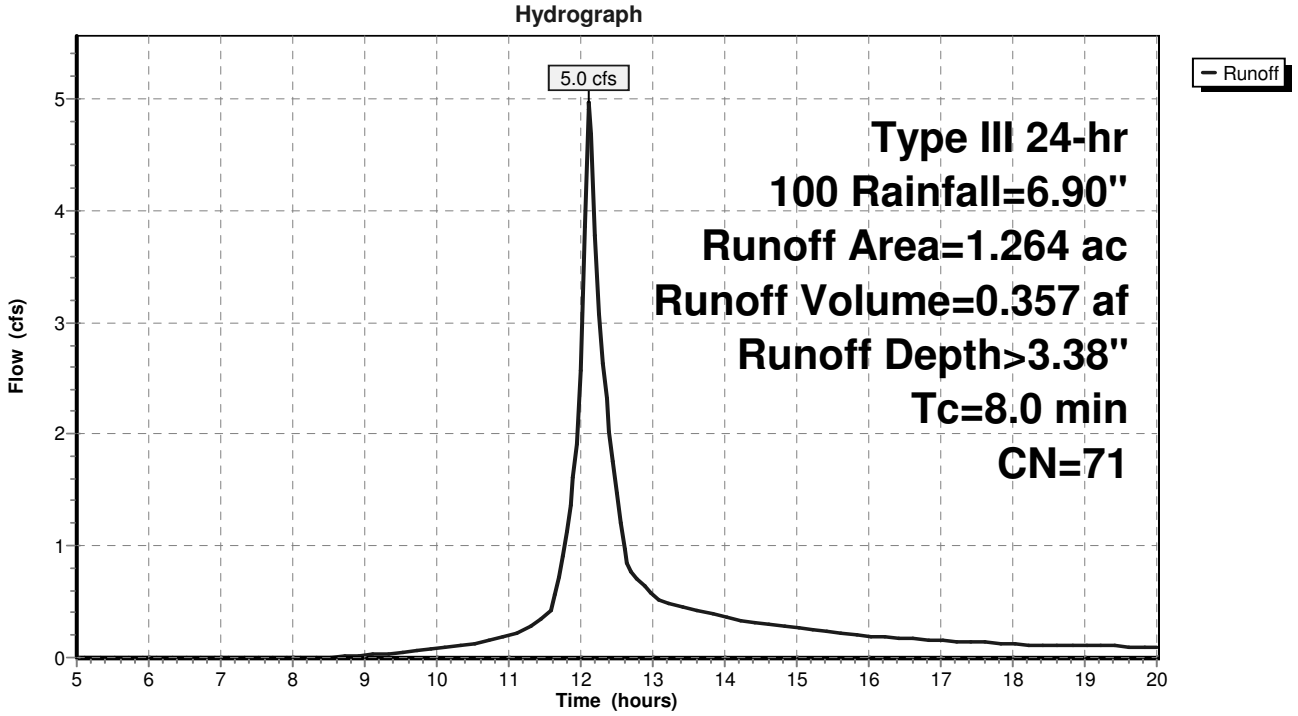
Runoff = 5.0 cfs @ 12.12 hrs, Volume= 0.357 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Rainfall=6.90"

	Area (ac)	CN	Description
*	0.311	98	IMPERVIOUS
	0.171	39	>75% Grass cover, Good, HSG A
	0.375	61	>75% Grass cover, Good, HSG B
	0.407	74	>75% Grass cover, Good, HSG C
	1.264	71	Weighted Average
	0.953		75.40% Pervious Area
	0.311		24.60% Impervious Area

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

Subcatchment 2S: WATERSHED 2 (DRAINAGE TO ORCHARD STREET)



Summary for Subcatchment 3S: WATERSHED 3 - SOUTH OF ROAD (NO ROOF AREAS)

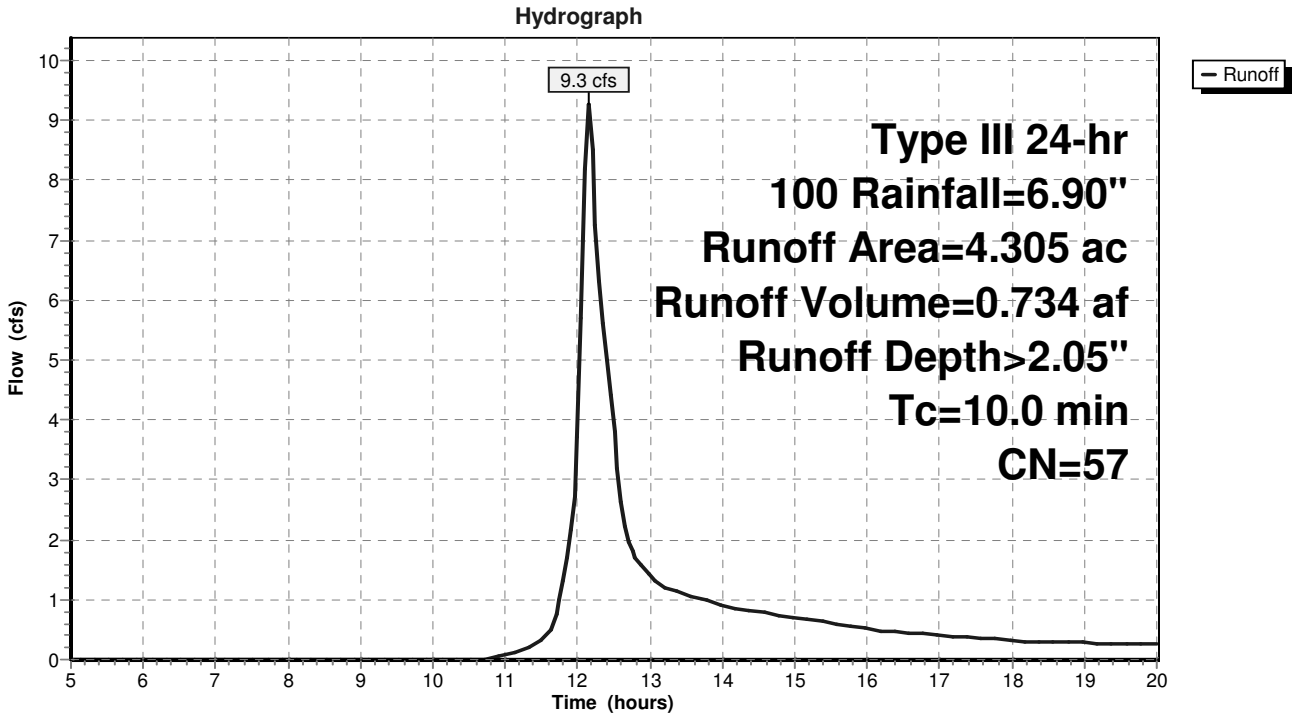
Runoff = 9.3 cfs @ 12.15 hrs, Volume= 0.734 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Rainfall=6.90"

	Area (ac)	CN	Description
*	0.066	98	IMPERVIOUS
	1.100	30	Woods, Good, HSG A
	0.617	39	>75% Grass cover, Good, HSG A
	0.120	55	Woods, Good, HSG B
	0.587	61	>75% Grass cover, Good, HSG B
	0.692	70	Woods, Good, HSG C
	0.577	74	>75% Grass cover, Good, HSG C
	0.546	90	Fallow, crop residue, Poor, HSG C
	4.305	57	Weighted Average
	4.239		98.47% Pervious Area
	0.066		1.53% Impervious Area

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

Subcatchment 3S: WATERSHED 3 - SOUTH OF ROAD (NO ROOF AREAS)



Summary for Subcatchment 4S: WATERSHED 4 (MAIN ROADWAY DRAINAGE)

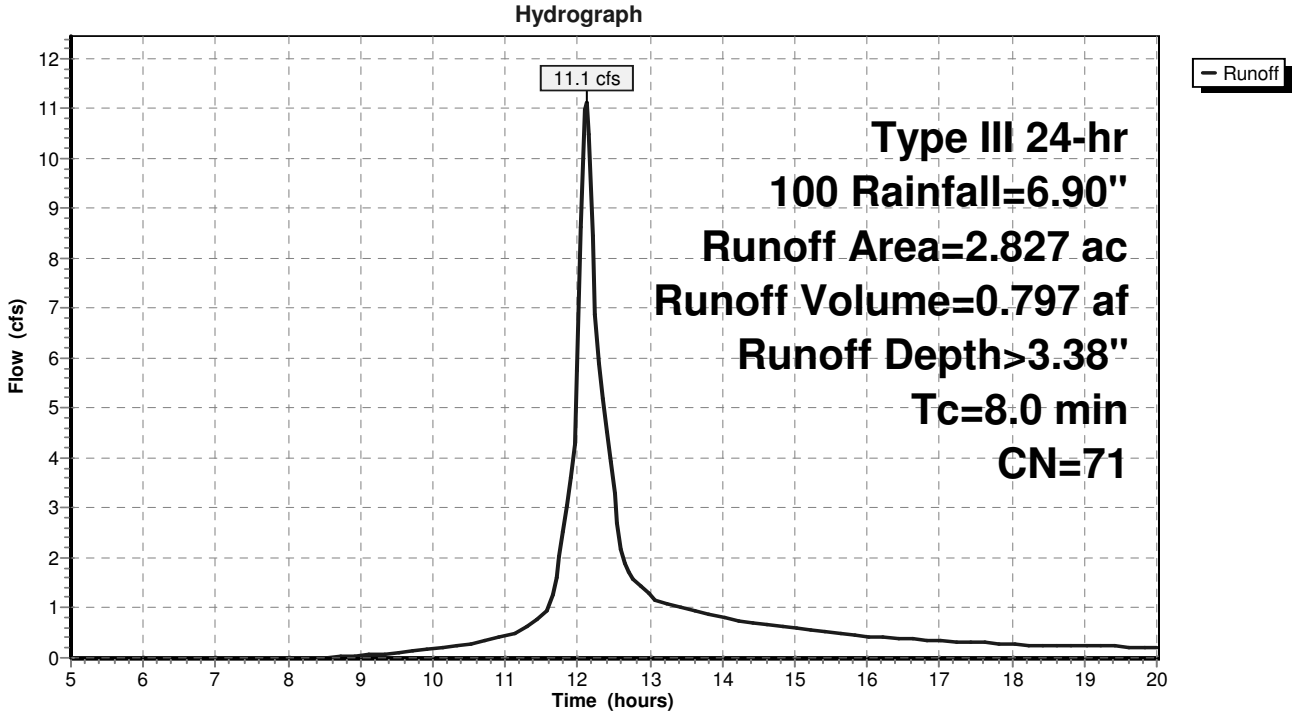
Runoff = 11.1 cfs @ 12.12 hrs, Volume= 0.797 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Rainfall=6.90"

	Area (ac)	CN	Description
*	1.029	98	IMPERVIOUS
	0.921	39	>75% Grass cover, Good, HSG A
	0.089	61	>75% Grass cover, Good, HSG B
	0.056	70	Woods, Good, HSG C
	0.732	74	>75% Grass cover, Good, HSG C
	2.827	71	Weighted Average
	1.798		63.60% Pervious Area
	1.029		36.40% Impervious Area

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

Subcatchment 4S: WATERSHED 4 (MAIN ROADWAY DRAINAGE)

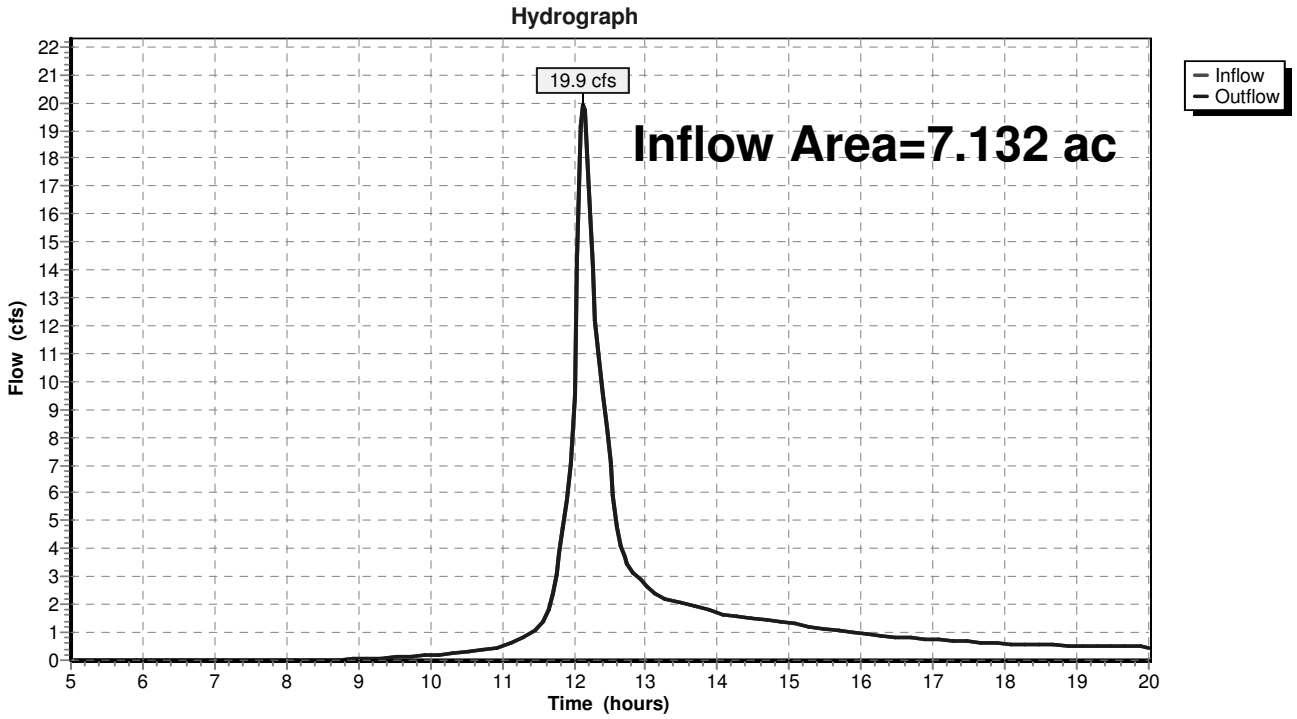


Summary for Reach 1R: To Pond

Inflow Area = 7.132 ac, 15.35% Impervious, Inflow Depth > 2.58" for 100 event
Inflow = 19.9 cfs @ 12.13 hrs, Volume= 1.531 af
Outflow = 19.9 cfs @ 12.13 hrs, Volume= 1.531 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 1R: To Pond

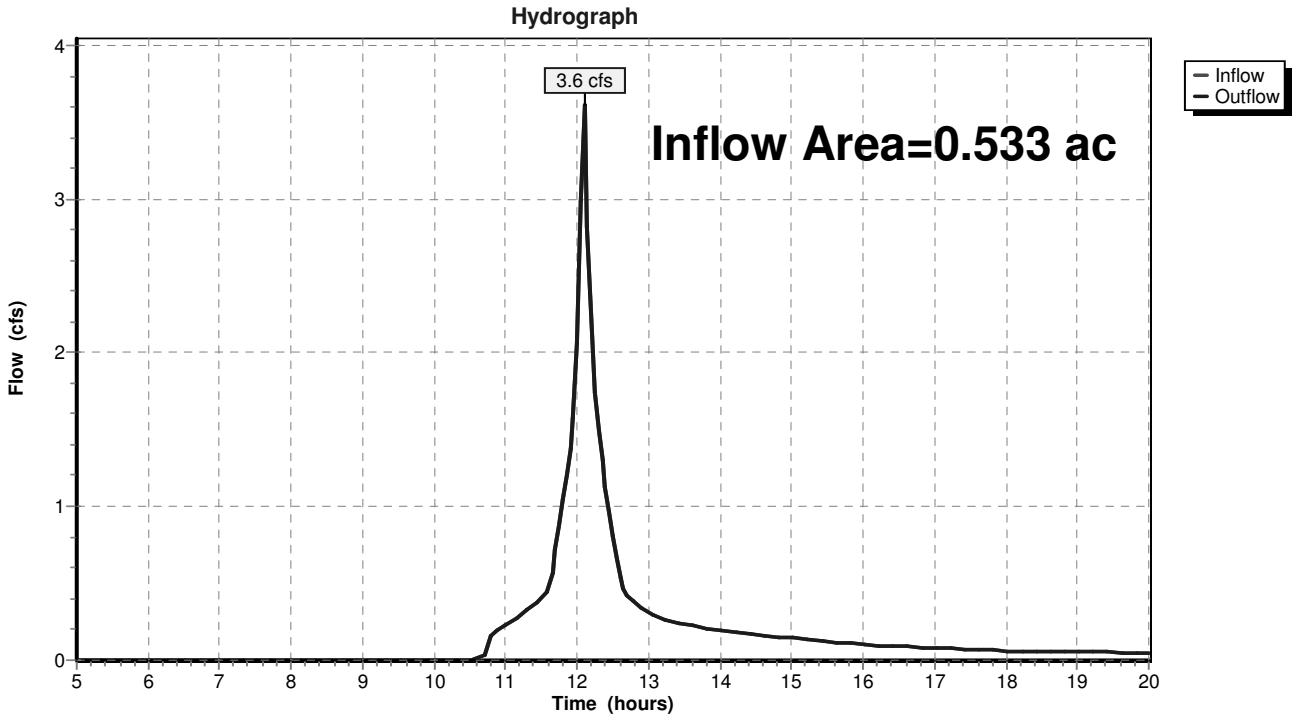


Summary for Reach 2R: WATERSHED 3 ROOF AREAS (AFTER DRYWELL RETENTION)

Inflow Area = 0.533 ac,100.00% Impervious, Inflow Depth > 5.01" for 100 event
Inflow = 3.6 cfs @ 12.10 hrs, Volume= 0.222 af
Outflow = 3.6 cfs @ 12.10 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 2R: WATERSHED 3 ROOF AREAS (AFTER DRYWELL RETENTION)



Summary for Pond 1P: PROPOSED BASIN (NO WQV AS STORAGE)

Inflow Area = 7.665 ac, 21.24% Impervious, Inflow Depth > 2.75" for 100 event
Inflow = 23.4 cfs @ 12.12 hrs, Volume= 1.754 af
Outflow = 10.0 cfs @ 12.43 hrs, Volume= 1.720 af, Atten= 57%, Lag= 18.1 min
Primary = 10.0 cfs @ 12.43 hrs, Volume= 1.720 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 157.90' Surf.Area= 4,007 sf Storage= 3,217 cf
Peak Elev= 160.55' @ 12.43 hrs Surf.Area= 10,124 sf Storage= 23,412 cf (20,195 cf above start)
Flood Elev= 160.60' Surf.Area= 10,206 sf Storage= 23,944 cf (20,727 cf above start)

Plug-Flow detention time= 57.2 min calculated for 1.641 af (94% of inflow)
Center-of-Mass det. time= 28.9 min (833.2 - 804.4)

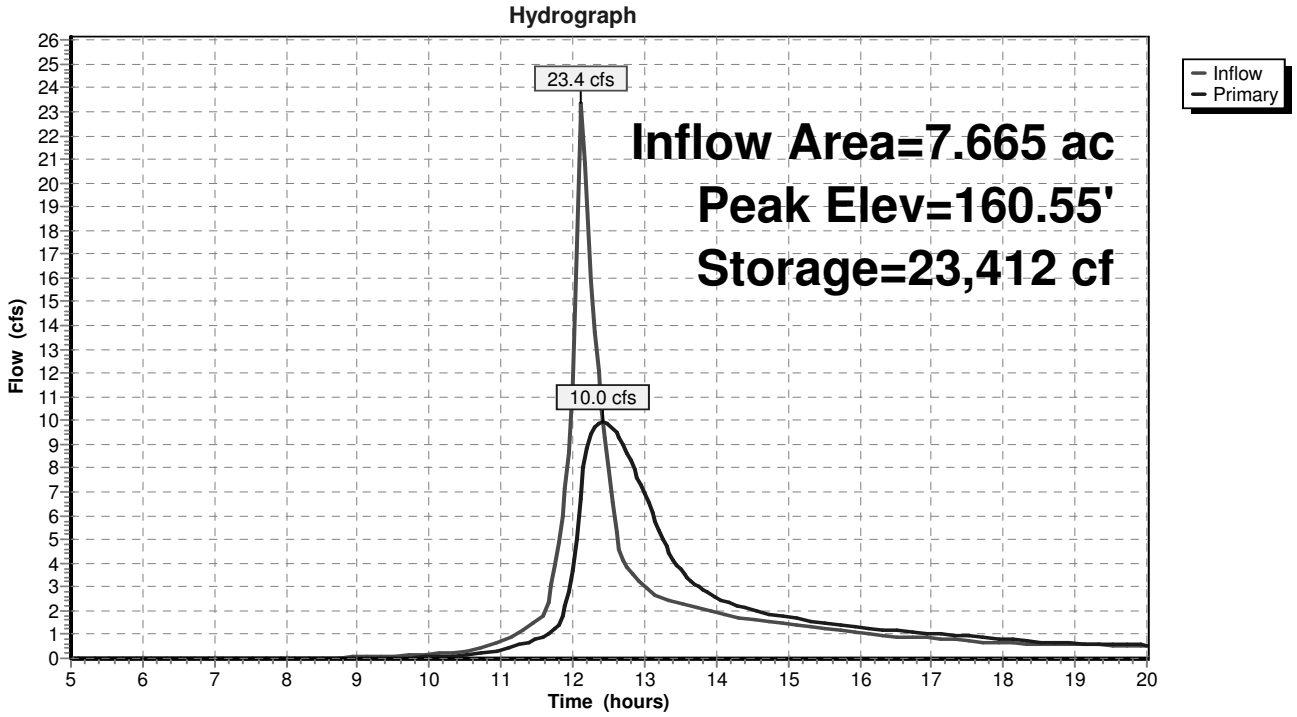
Volume	Invert	Avail.Storage	Storage Description
#1	157.00'	34,949 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.00	3,141	0	0
157.90	4,007	3,217	3,217
158.00	4,107	406	3,622
159.00	7,795	5,951	9,573
160.00	9,264	8,530	18,103
161.00	10,834	10,049	28,152
161.60	11,824	6,797	34,949

Device	Routing	Invert	Outlet Devices
#1	Primary	155.80'	**18.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 155.80' / 155.55' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	157.90'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	158.50'	**15.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=10.0 cfs @ 12.43 hrs HW=160.54' (Free Discharge)
└─**1=Culvert** (Passes 10.0 cfs of 13.4 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.9 cfs @ 7.45 fps)
  └─**3=Orifice/Grate** (Orifice Controls 7.0 cfs @ 5.74 fps)

Pond 1P: PROPOSED BASIN (NO WQV AS STORAGE)

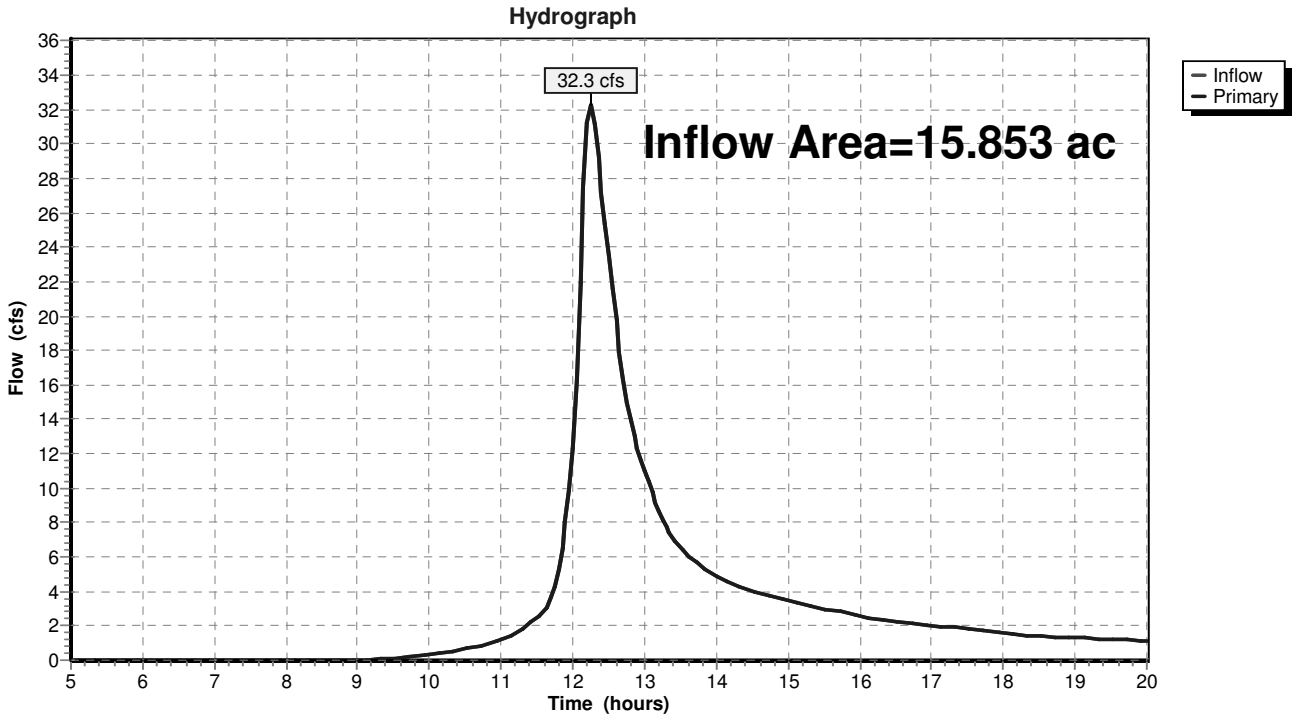


Summary for Link 1L: DP#1 - STREAM @ NW CORNER

Inflow Area = 15.853 ac, 11.51% Impervious, Inflow Depth > 2.89" for 100 event
Inflow = 32.3 cfs @ 12.25 hrs, Volume= 3.819 af
Primary = 32.3 cfs @ 12.25 hrs, Volume= 3.819 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1L: DP#1 - STREAM @ NW CORNER

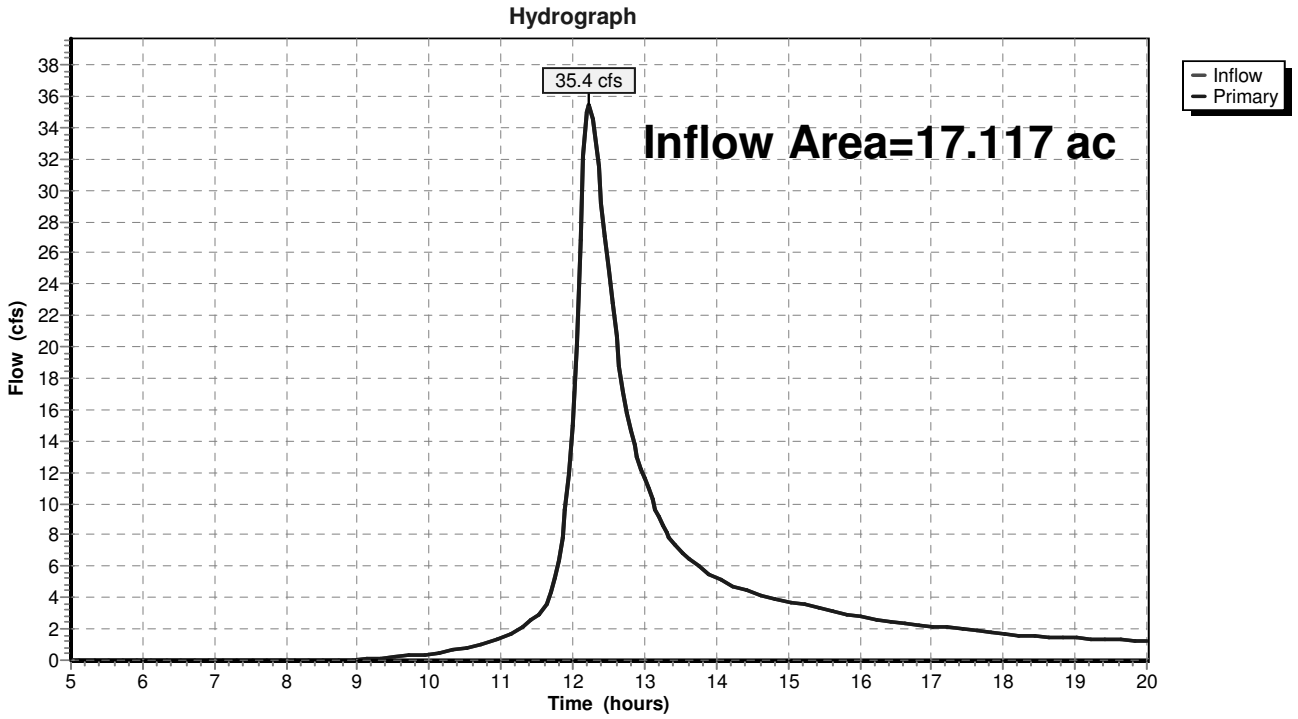


Summary for Link 2L: DP#2 - SUM TO ORCHARD STREET DRAINGE SYSTEM

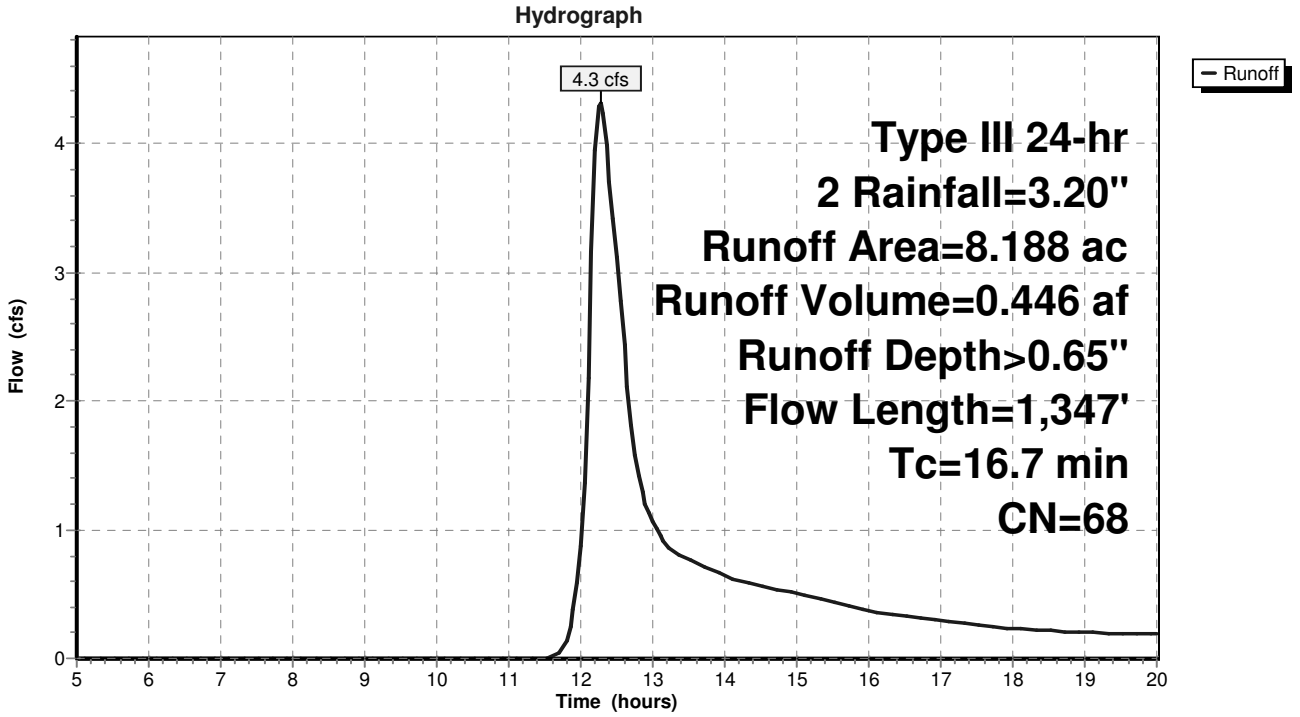
Inflow Area = 17.117 ac, 12.47% Impervious, Inflow Depth > 2.93" for 100 event
Inflow = 35.4 cfs @ 12.23 hrs, Volume= 4.175 af
Primary = 35.4 cfs @ 12.23 hrs, Volume= 4.175 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

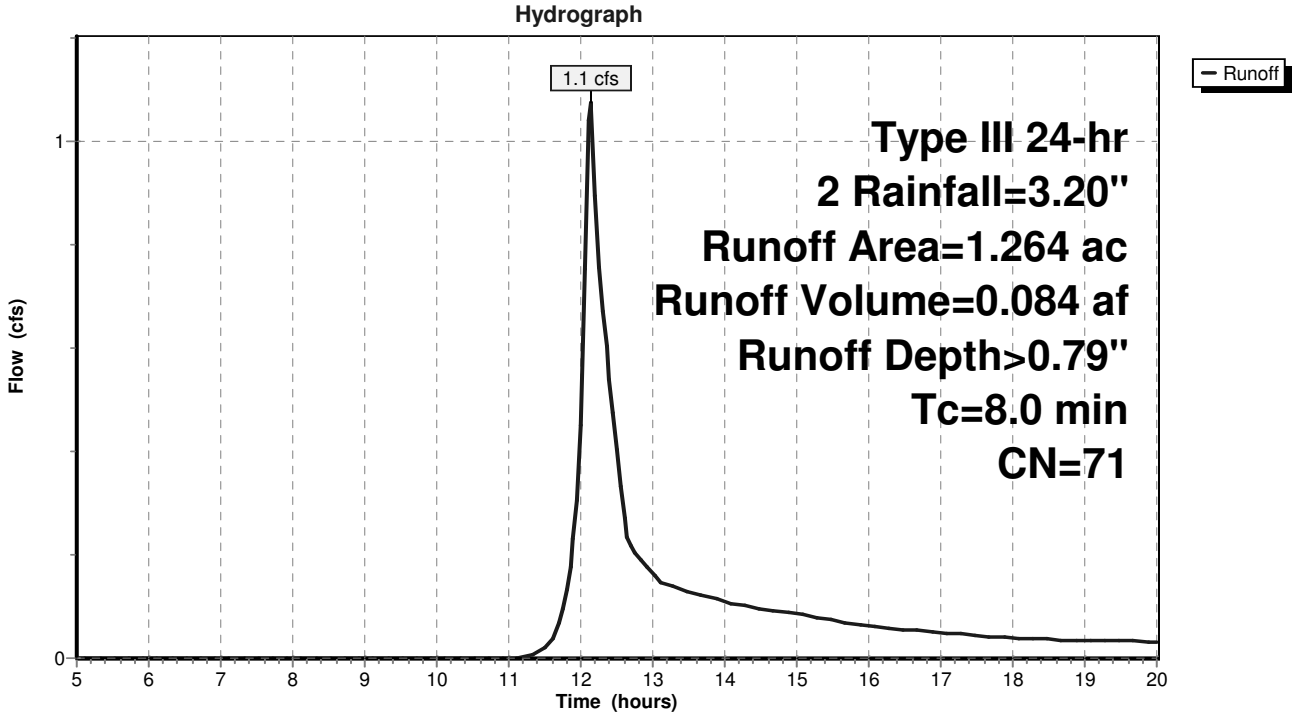
Link 2L: DP#2 - SUM TO ORCHARD STREET DRAINGE SYSTEM



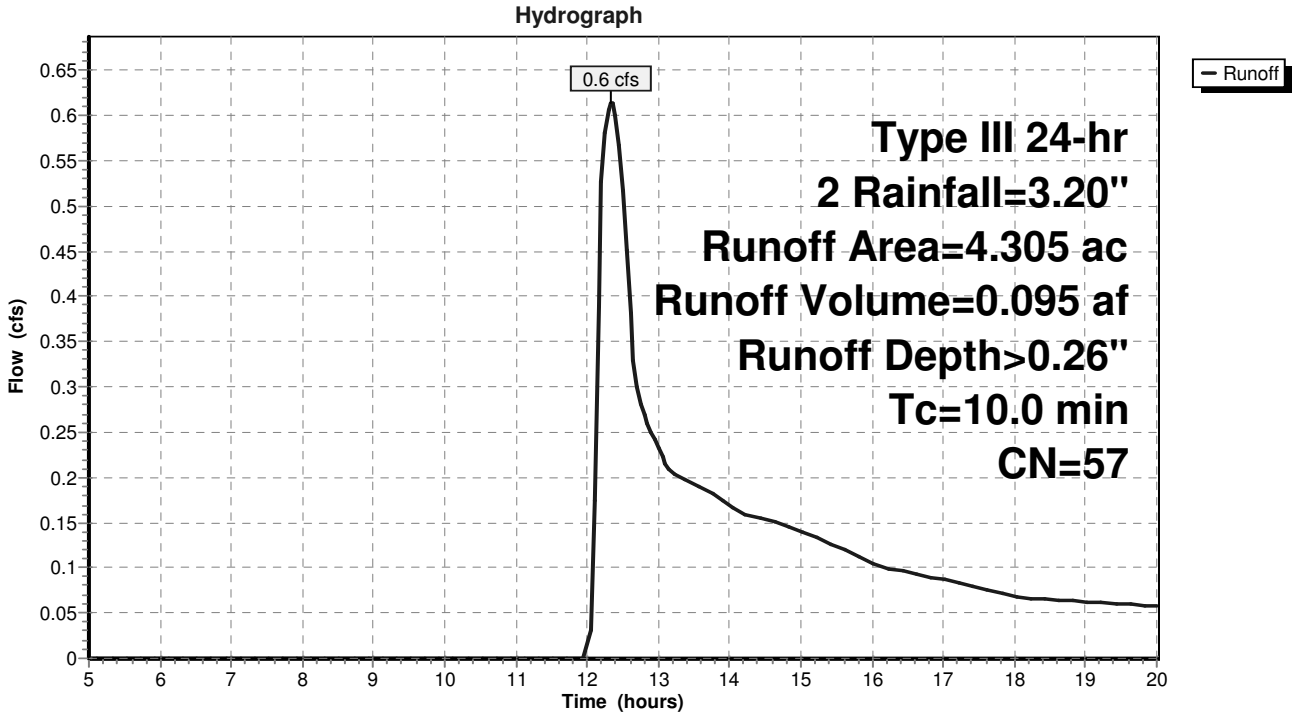
Subcatchment 1S: WATERSHED 1 (NORTHERN UNDISTURBED WETLANDS)



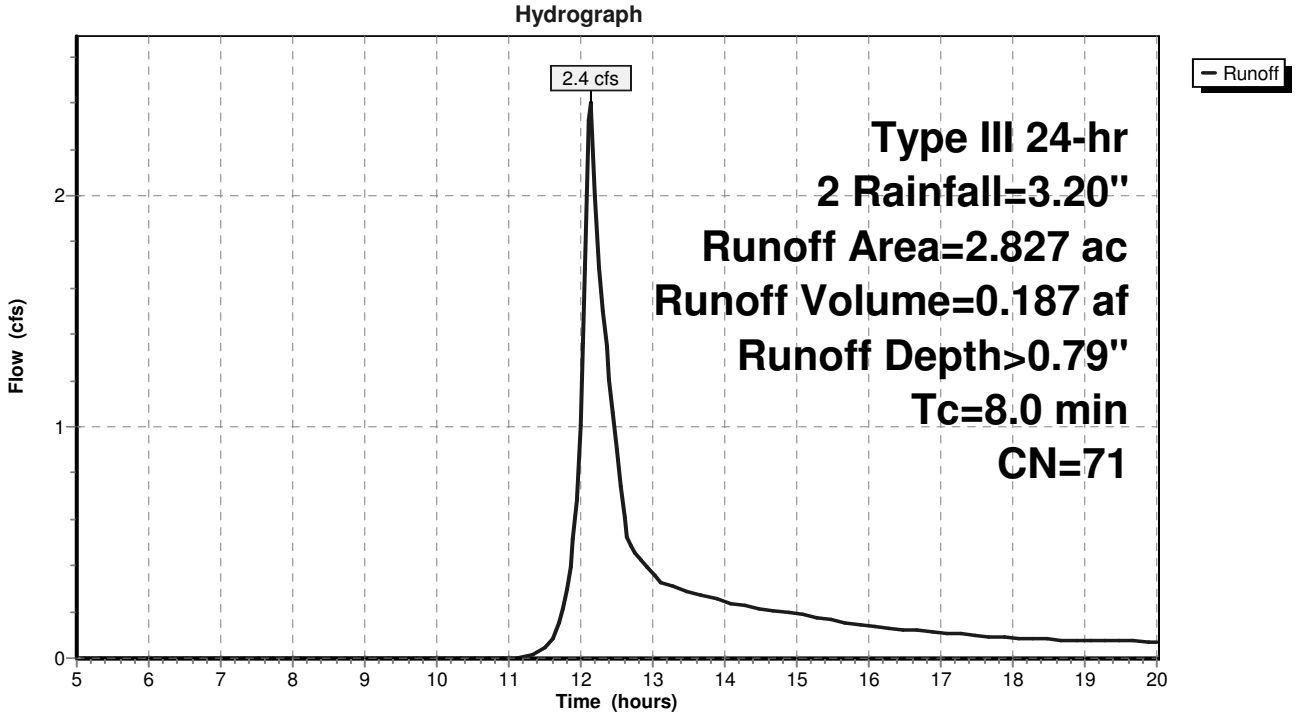
Subcatchment 2S: WATERSHED 2 (DRAINAGE TO ORCHARD STREET)



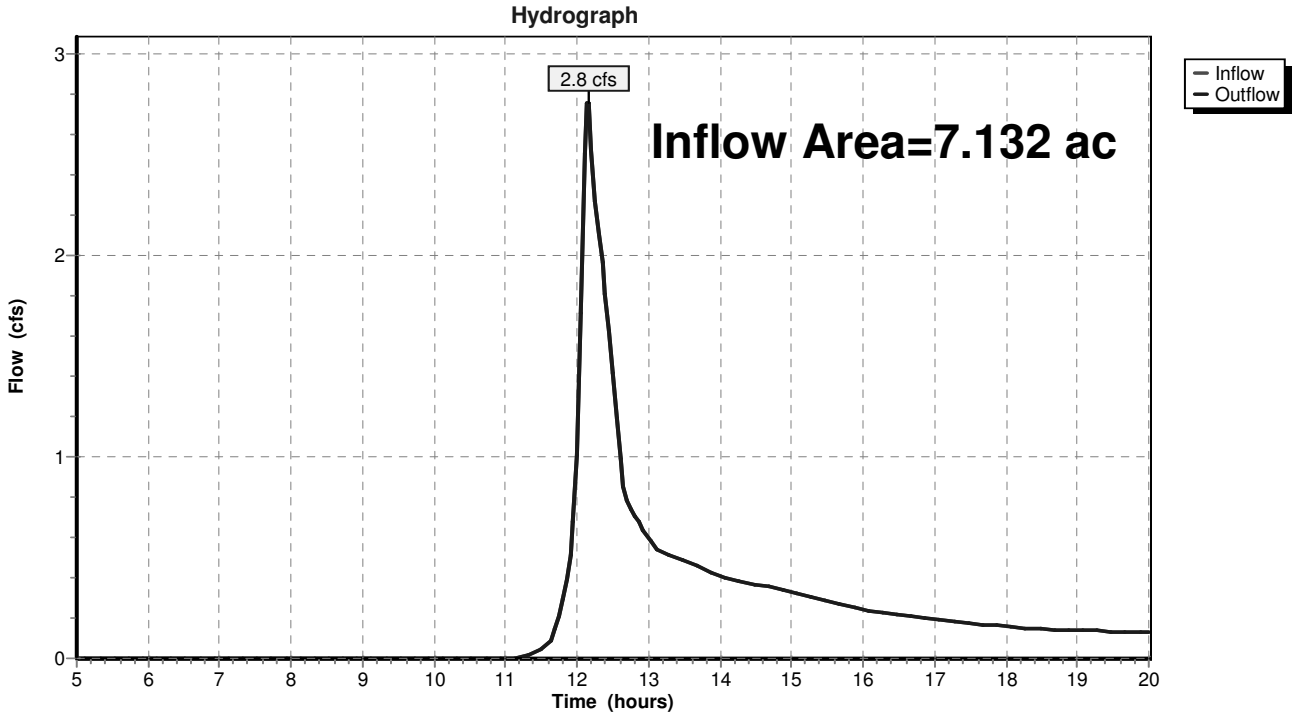
Subcatchment 3S: WATERSHED 3 - SOUTH OF ROAD (NO ROOF AREAS)



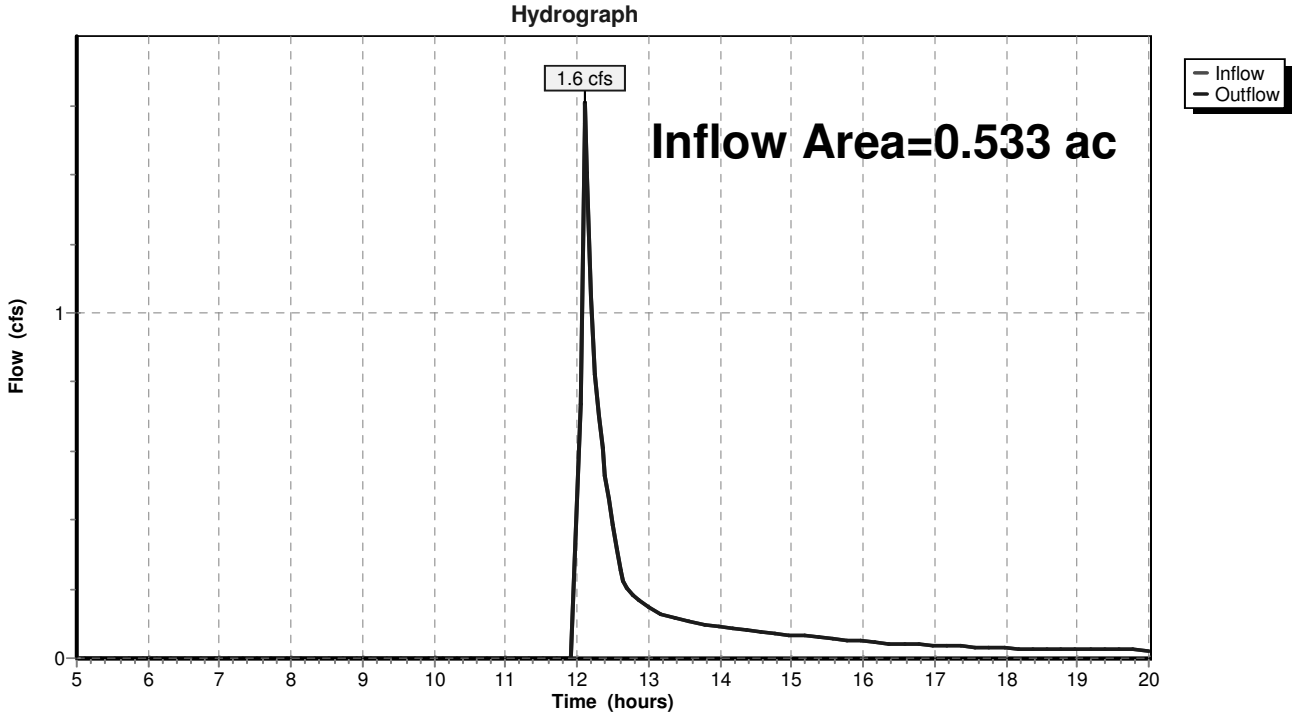
Subcatchment 4S: WATERSHED 4 (MAIN ROADWAY DRAINAGE)



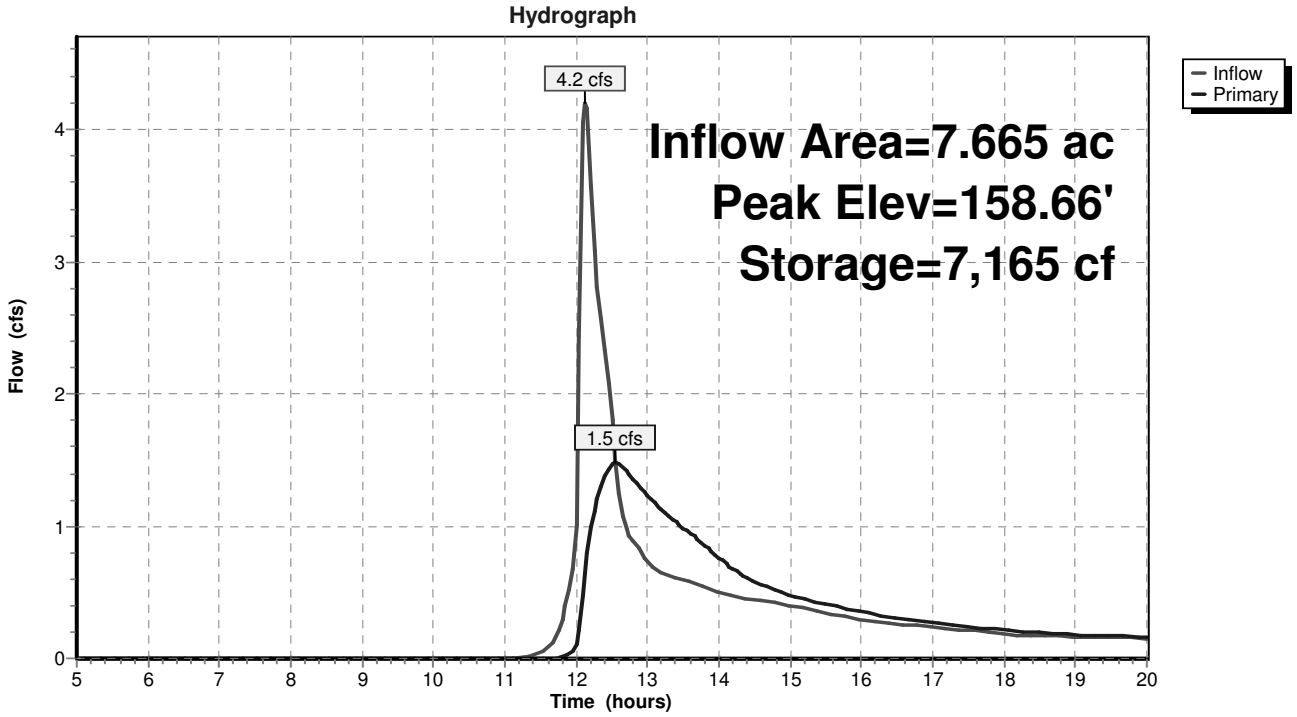
Reach 1R: To Pond



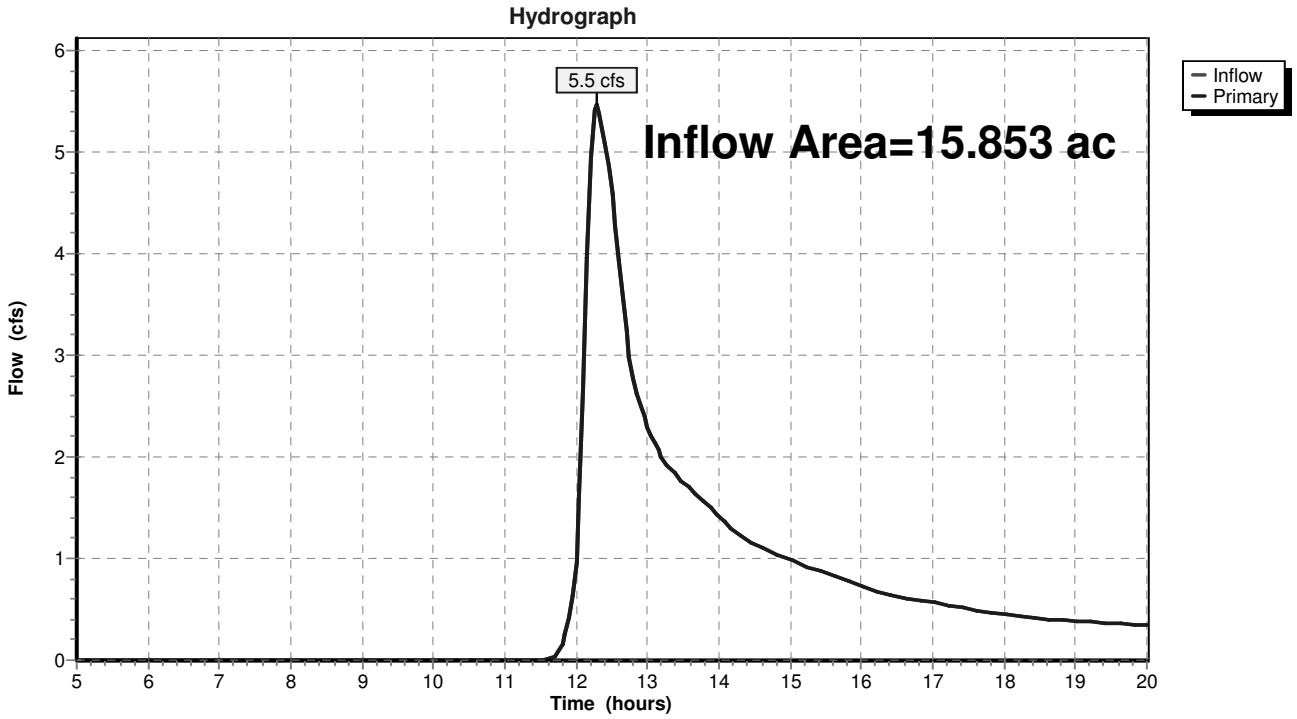
Reach 2R: WATERSHED 3 ROOF AREAS (AFTER DRYWELL RETENTION)



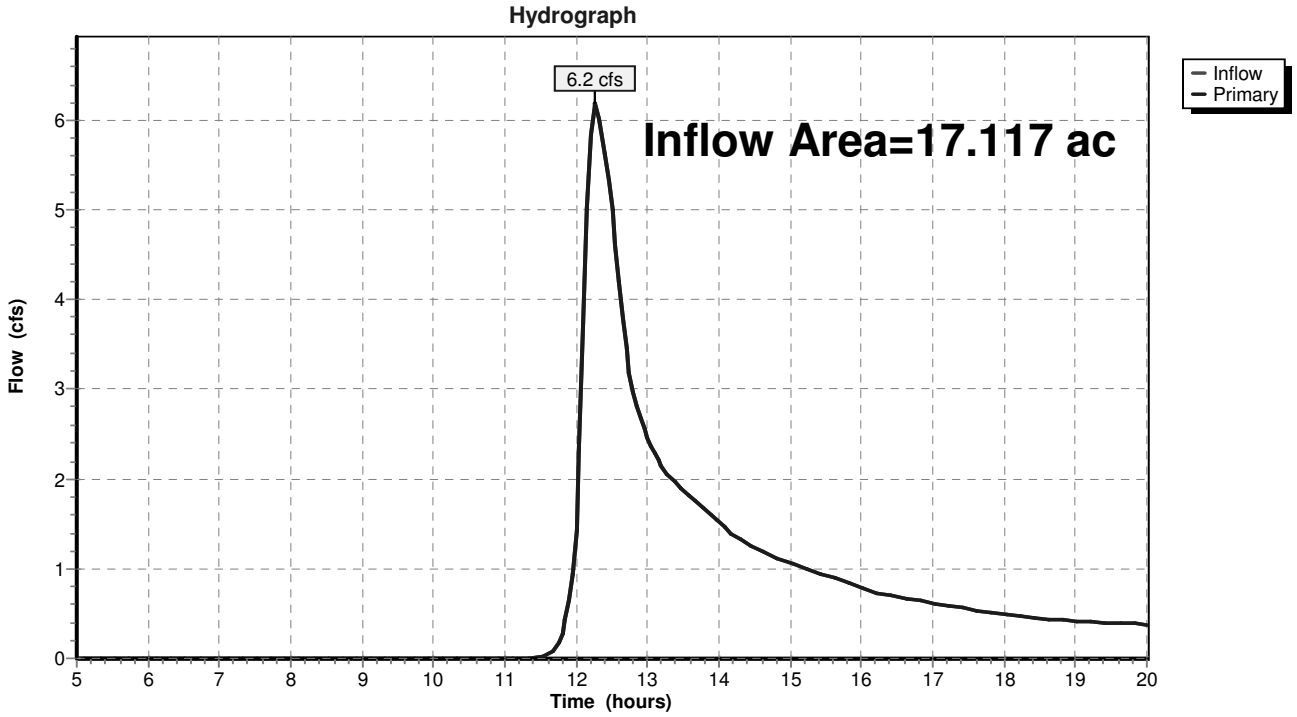
Pond 1P: PROPOSED BASIN (NO WQV AS STORAGE)



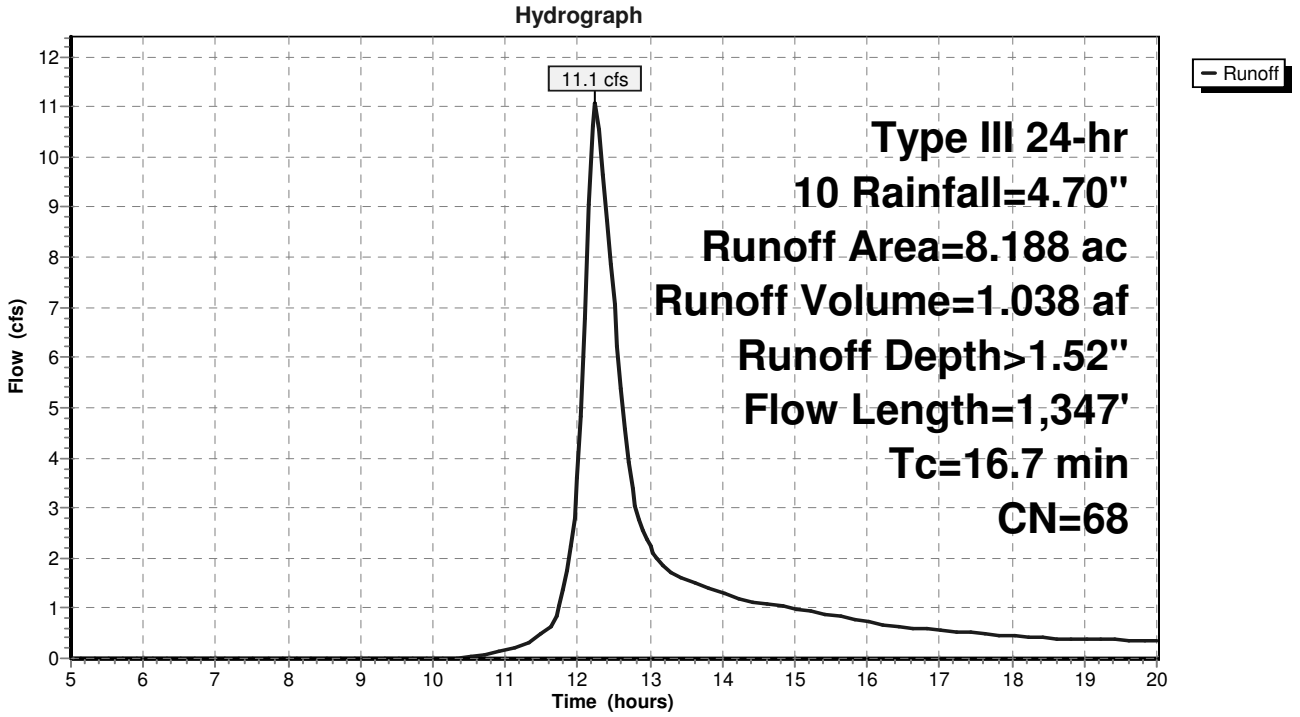
Link 1L: DP#1 - STREAM @ NW CORNER



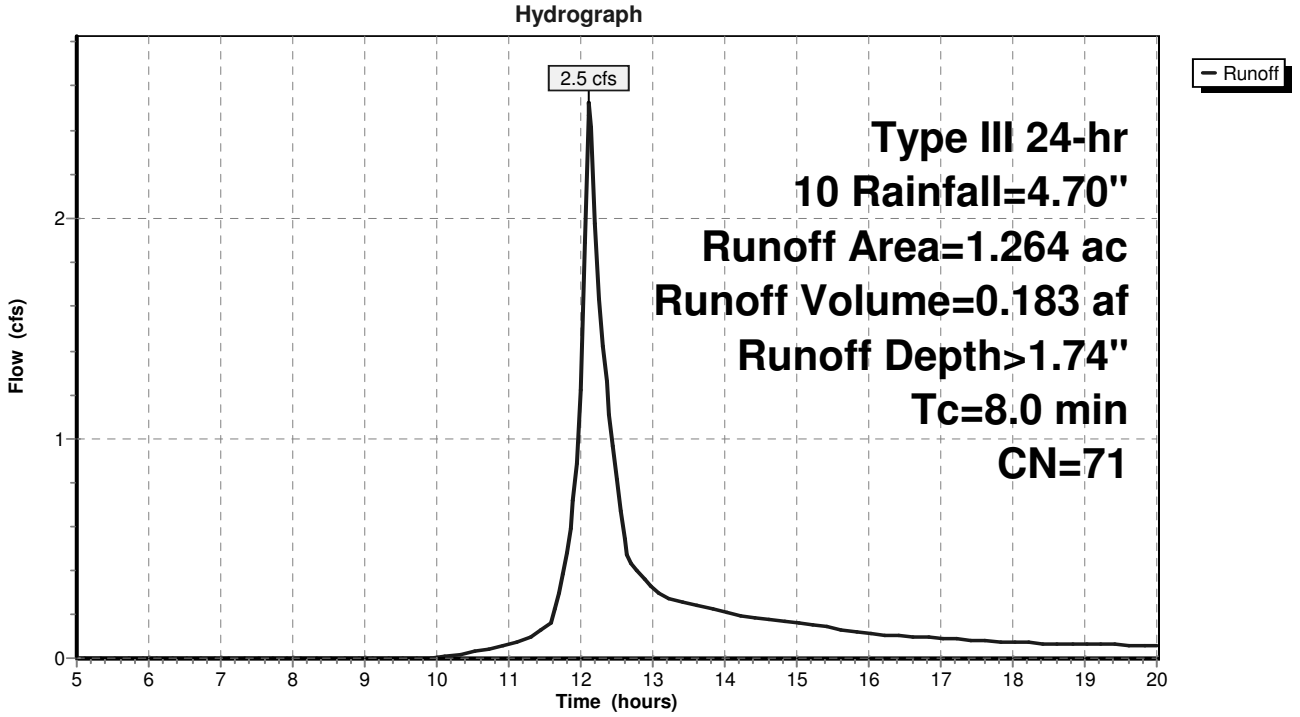
Link 2L: DP#2 - SUM TO ORCHARD STREET DRAINGE SYSTEM



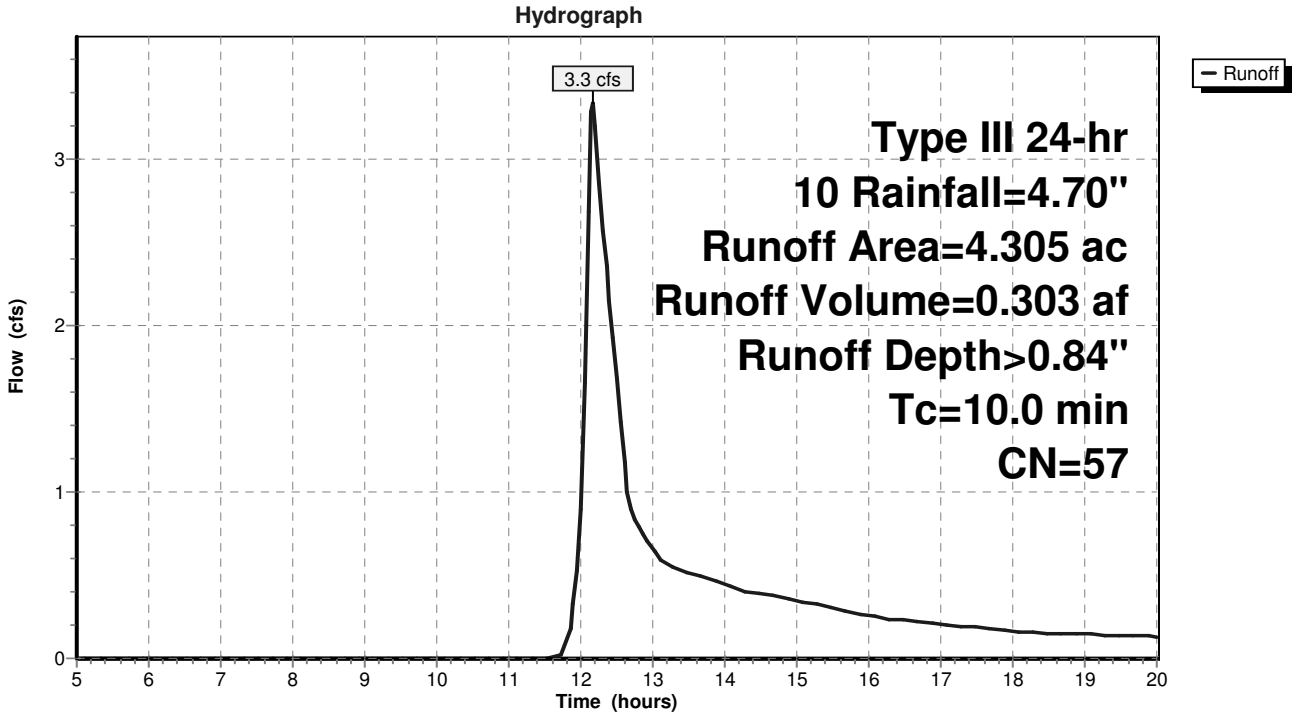
Subcatchment 1S: WATERSHED 1 (NORTHERN UNDISTURBED WETLANDS)



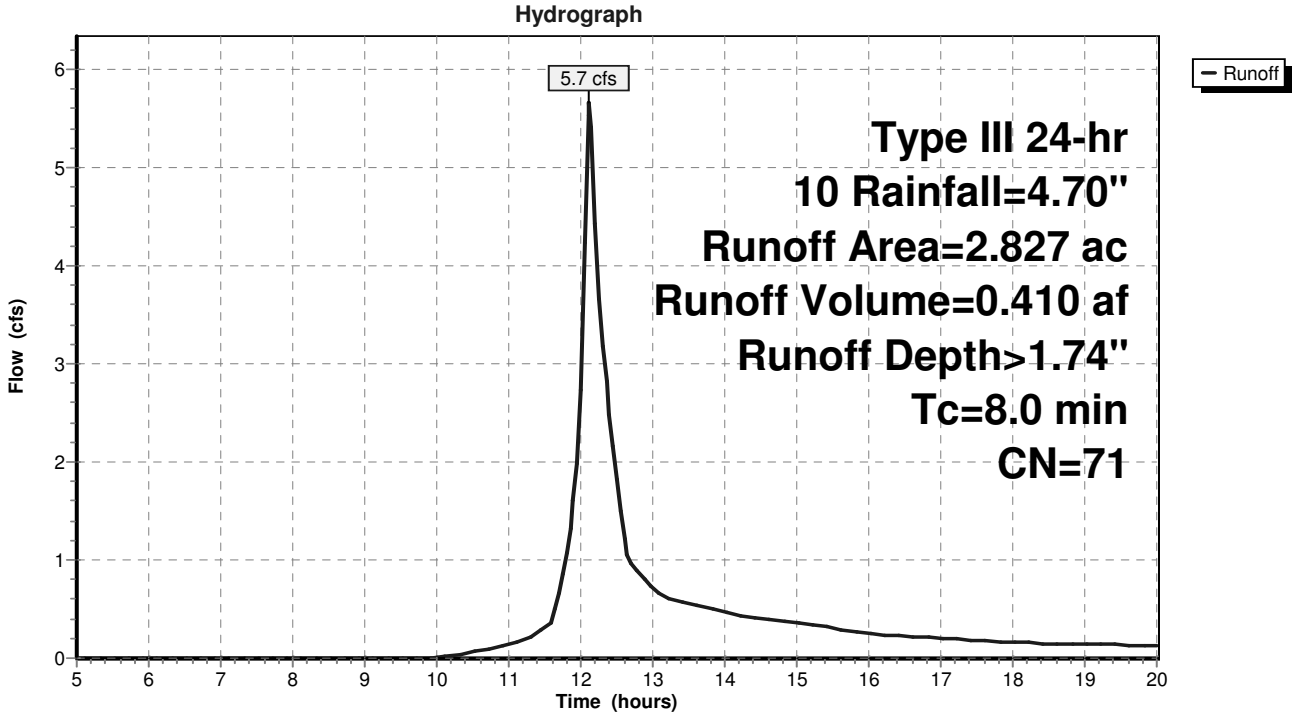
Subcatchment 2S: WATERSHED 2 (DRAINAGE TO ORCHARD STREET)



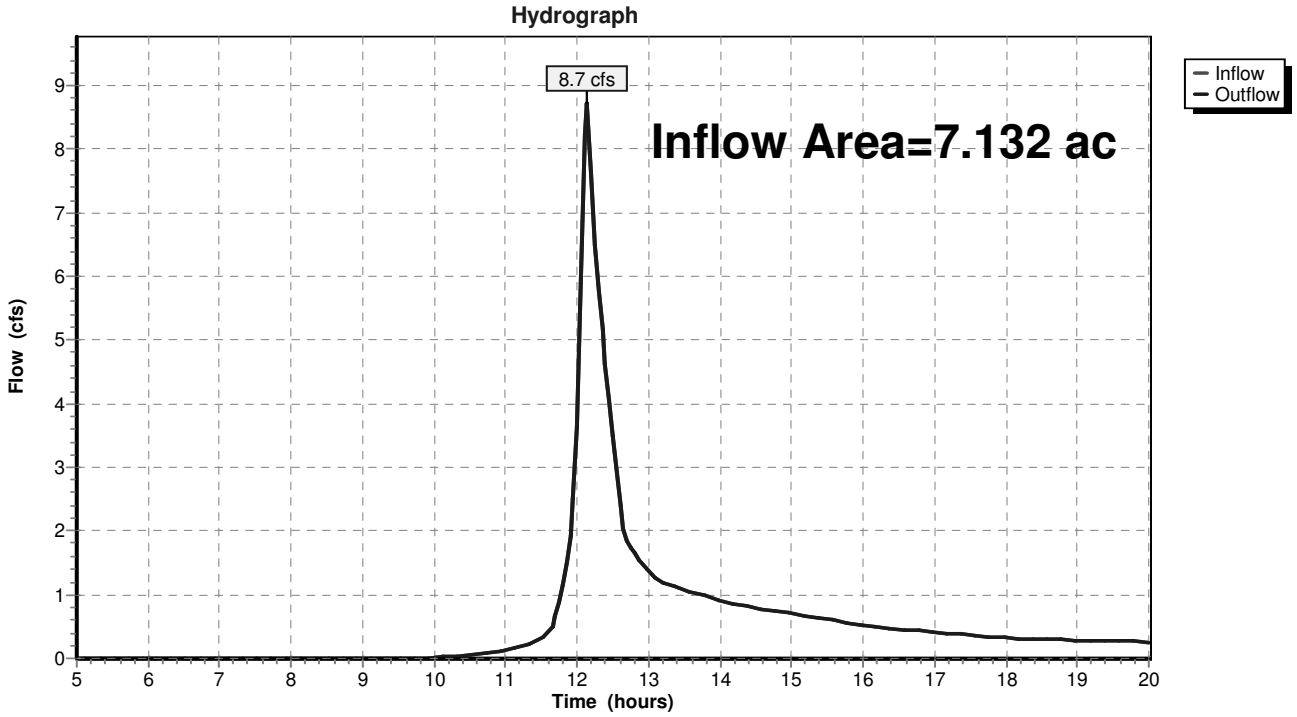
Subcatchment 3S: WATERSHED 3 - SOUTH OF ROAD (NO ROOF AREAS)



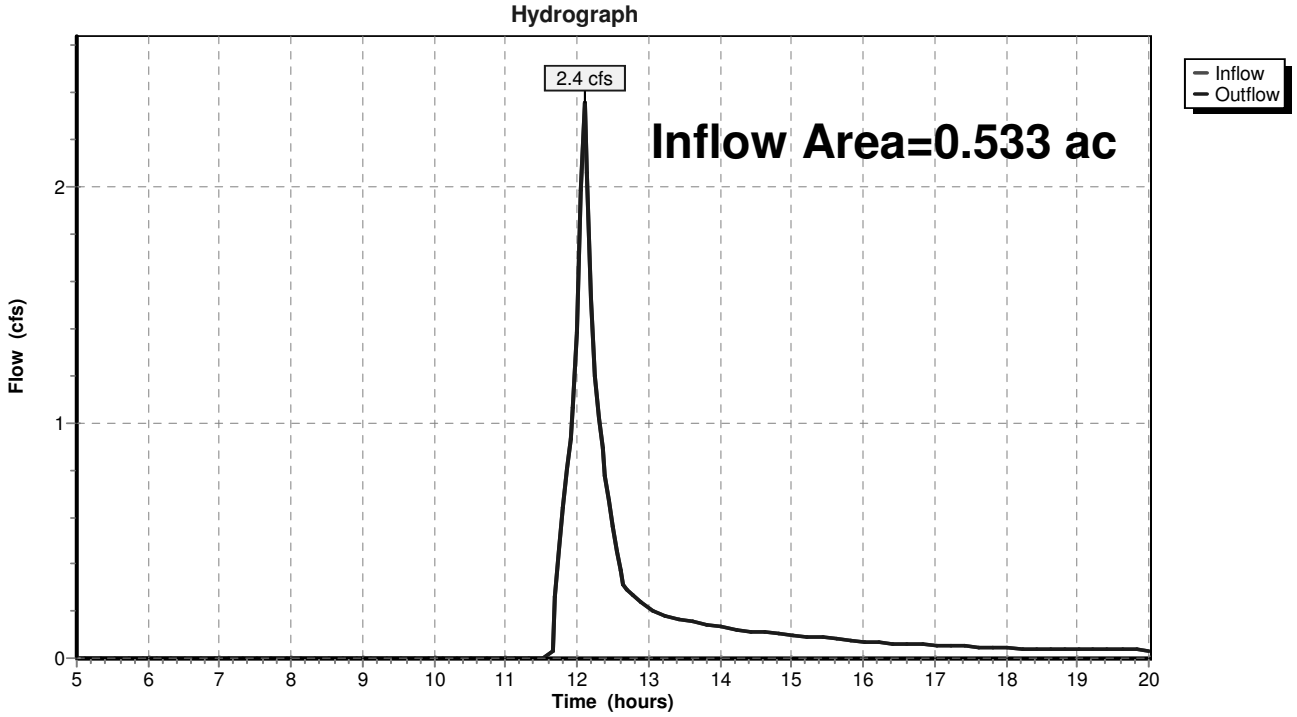
Subcatchment 4S: WATERSHED 4 (MAIN ROADWAY DRAINAGE)



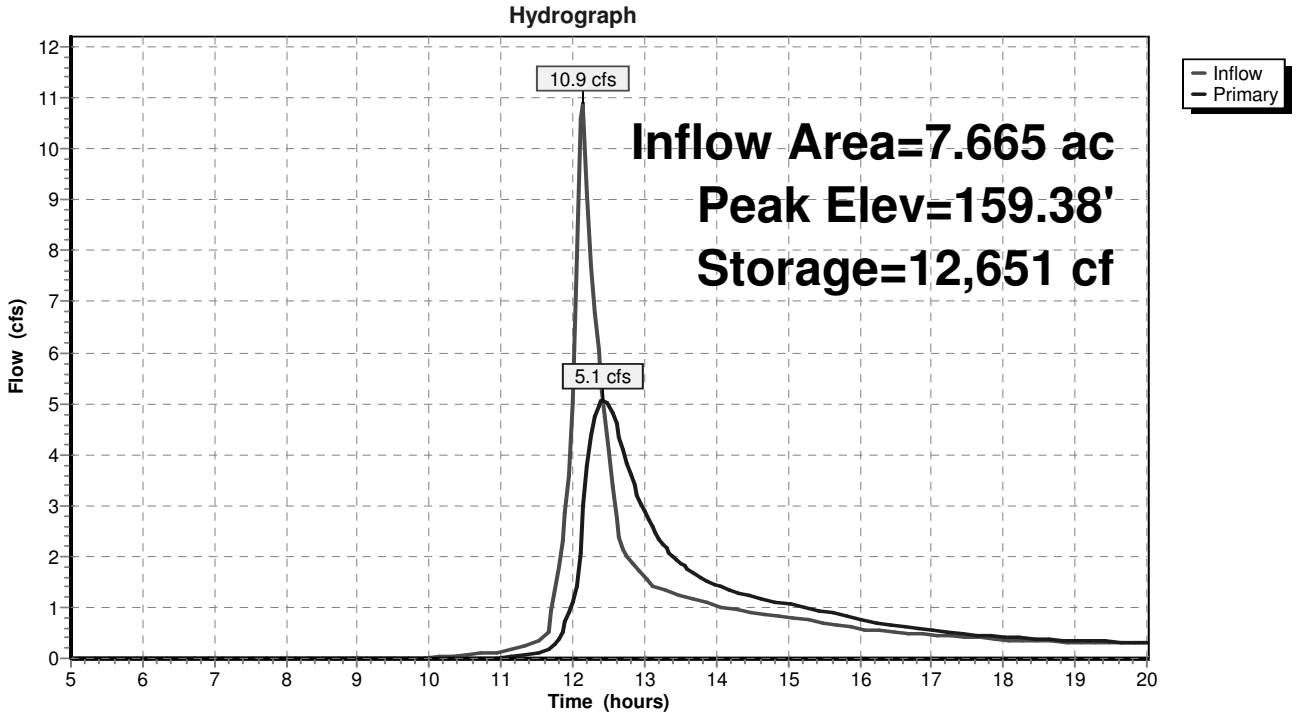
Reach 1R: To Pond



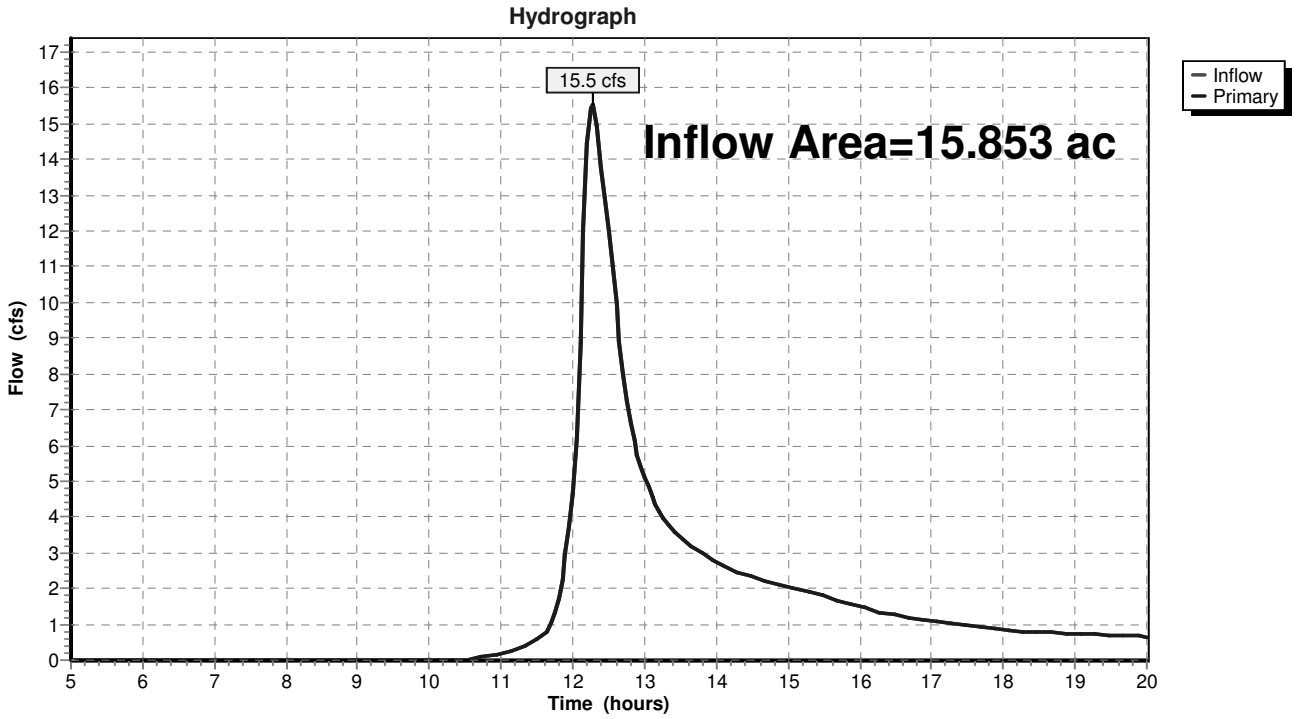
Reach 2R: WATERSHED 3 ROOF AREAS (AFTER DRYWELL RETENTION)



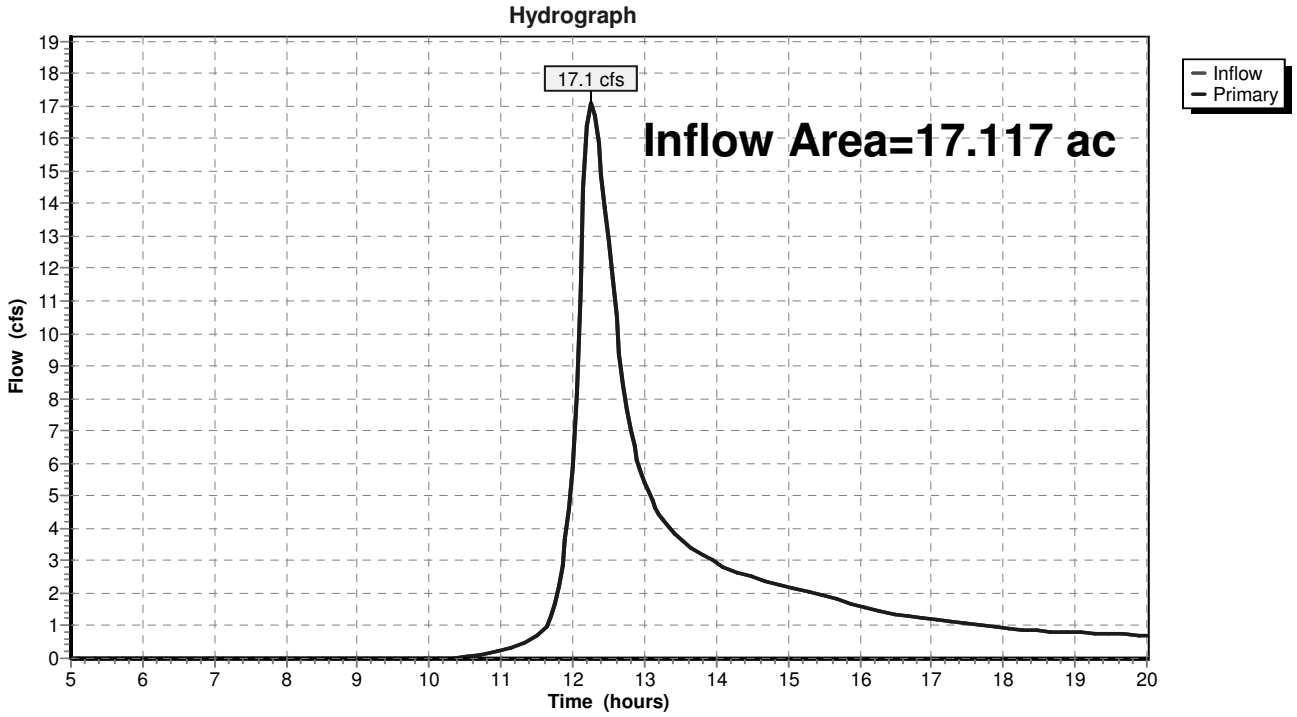
Pond 1P: PROPOSED BASIN (NO WQV AS STORAGE)



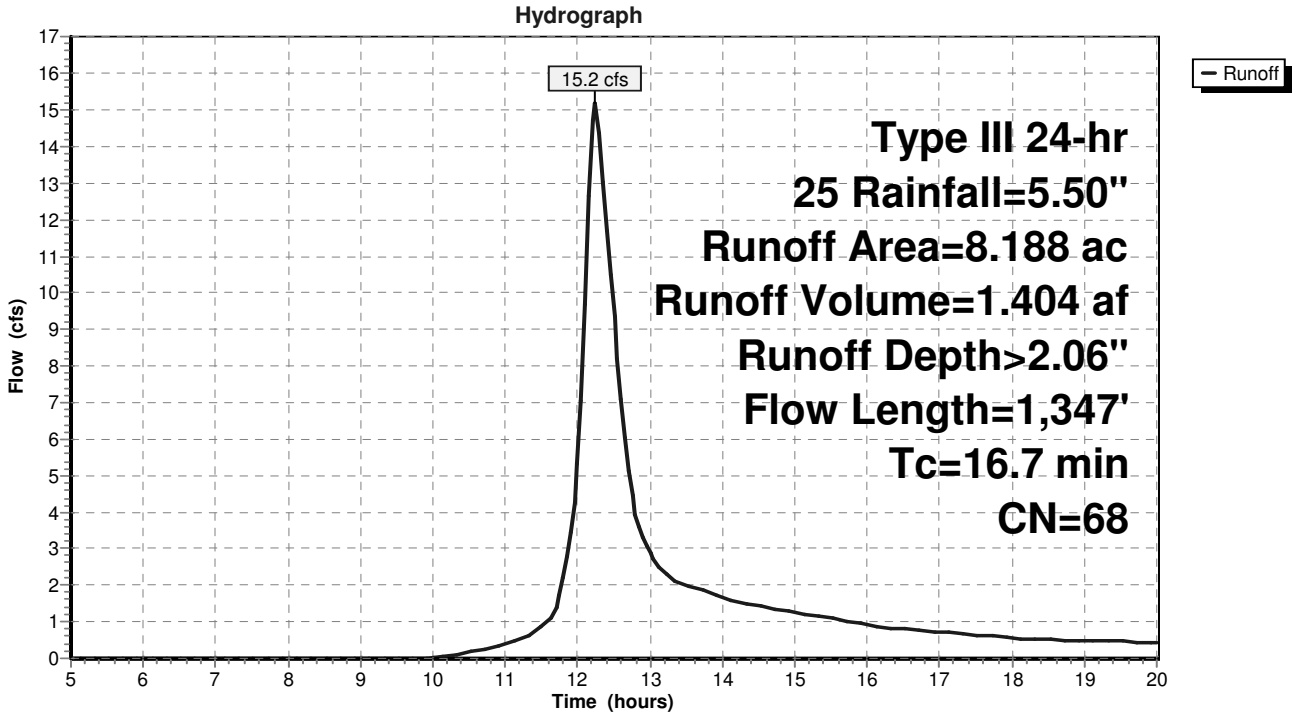
Link 1L: DP#1 - STREAM @ NW CORNER



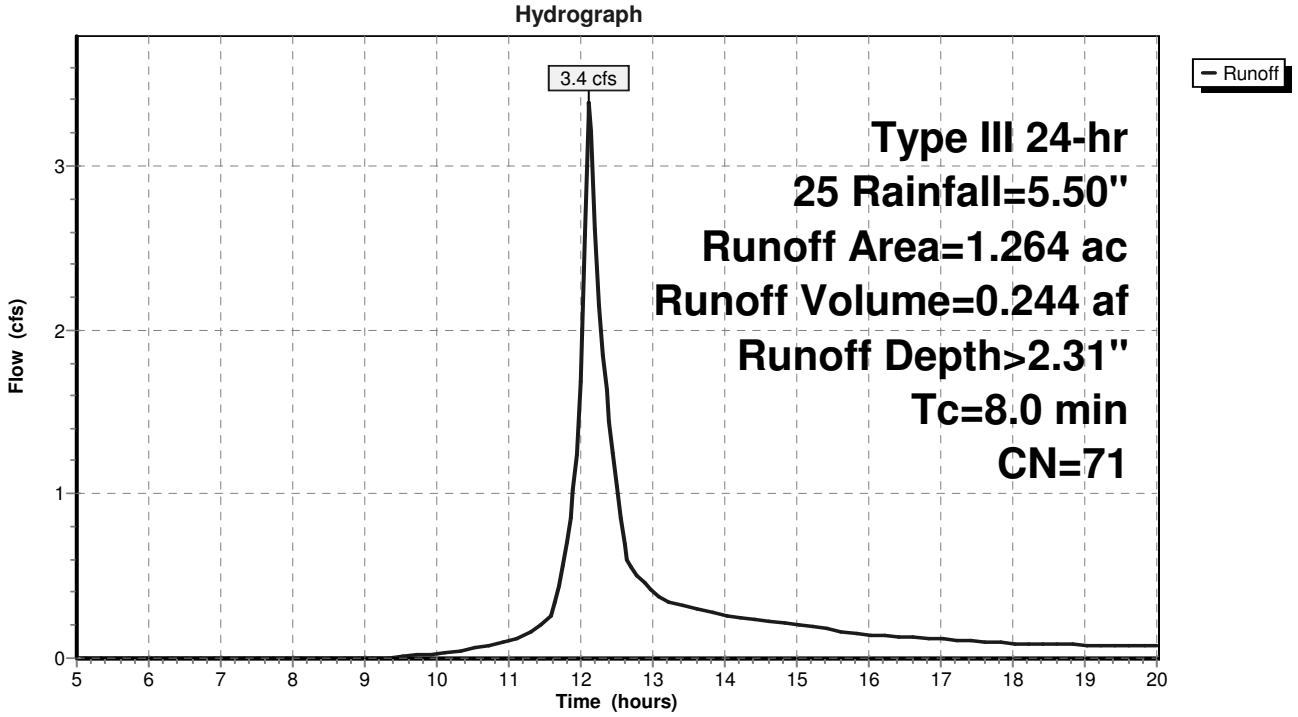
Link 2L: DP#2 - SUM TO ORCHARD STREET DRAINGE SYSTEM



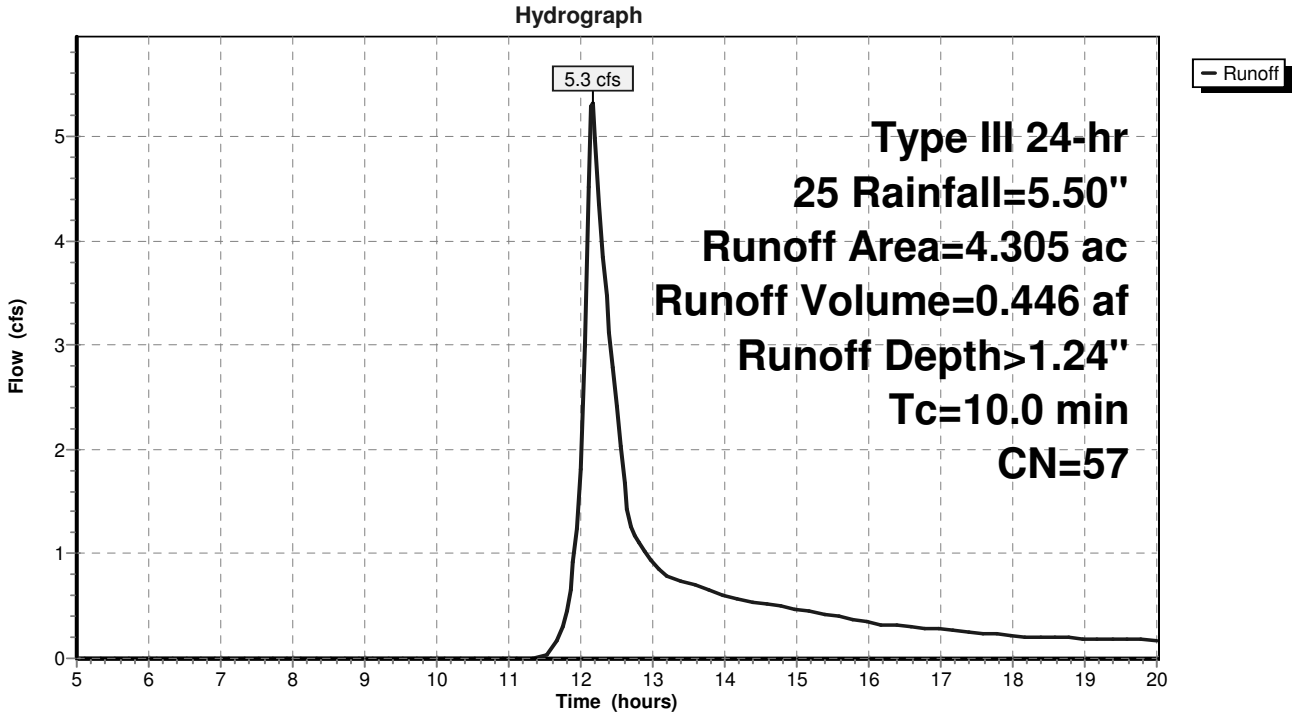
Subcatchment 1S: WATERSHED 1 (NORTHERN UNDISTURBED WETLANDS)



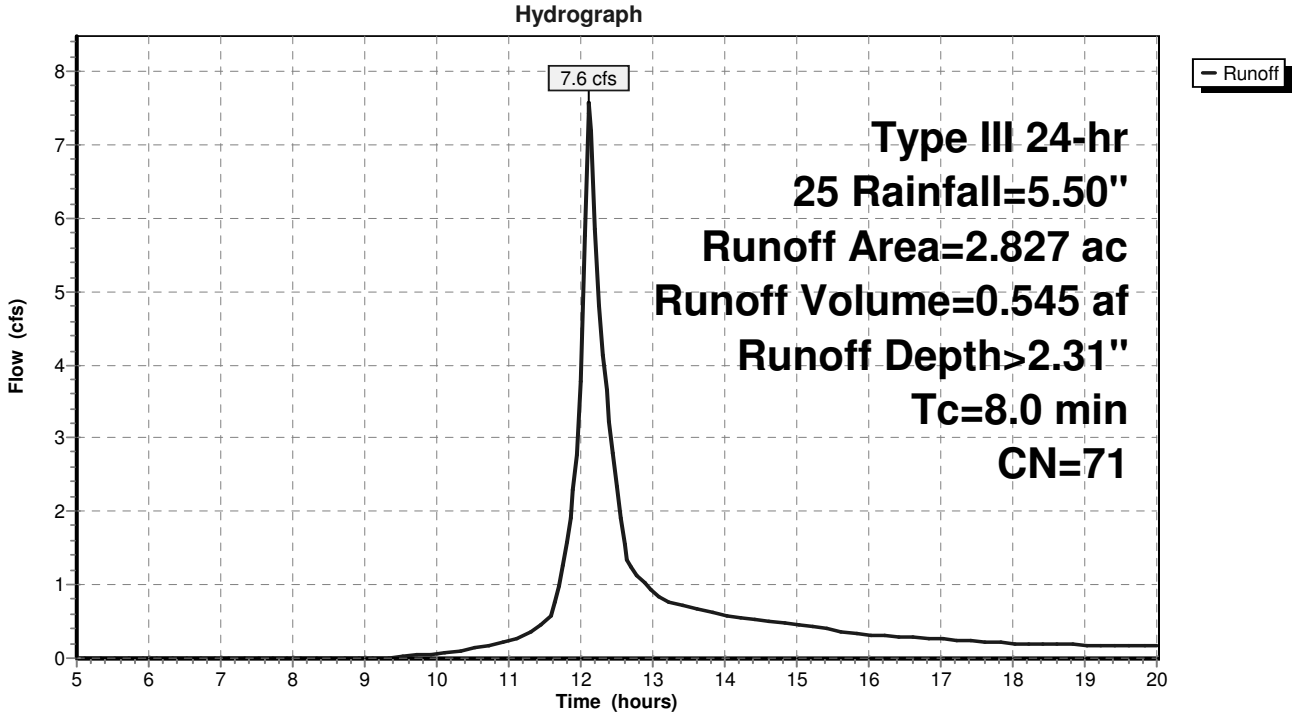
Subcatchment 2S: WATERSHED 2 (DRAINAGE TO ORCHARD STREET)



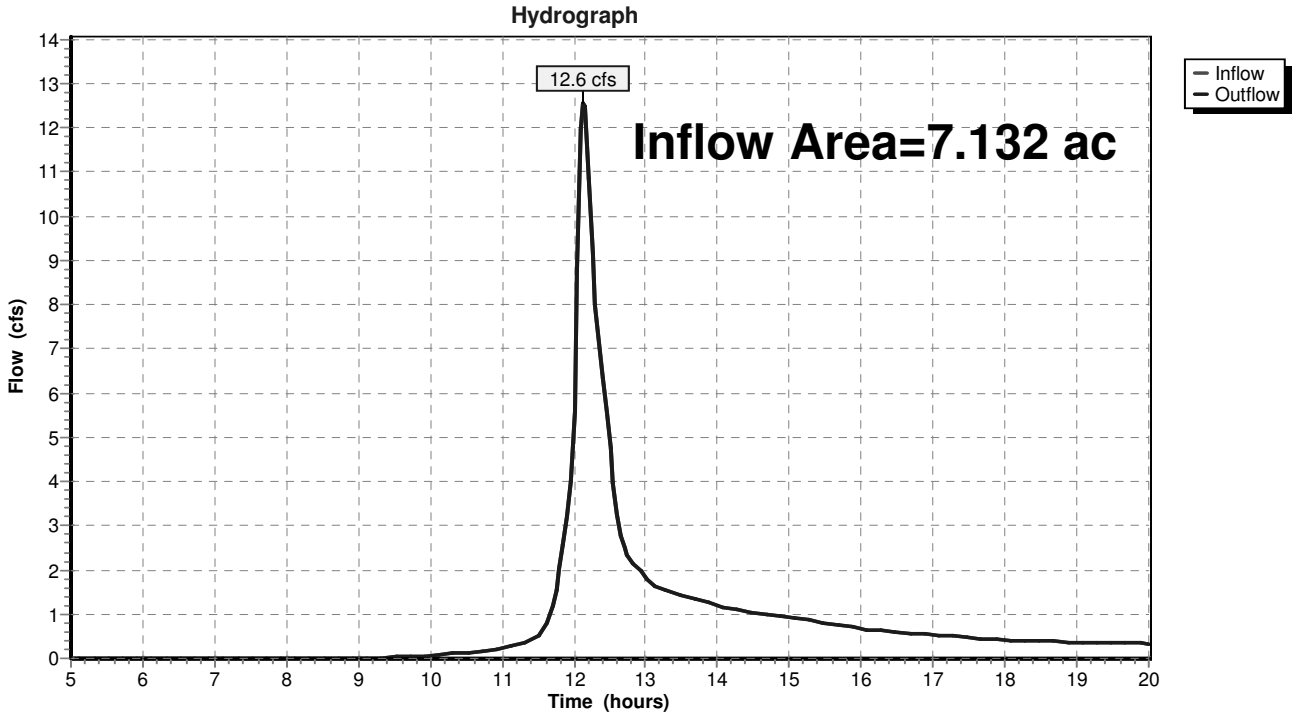
Subcatchment 3S: WATERSHED 3 - SOUTH OF ROAD (NO ROOF AREAS)



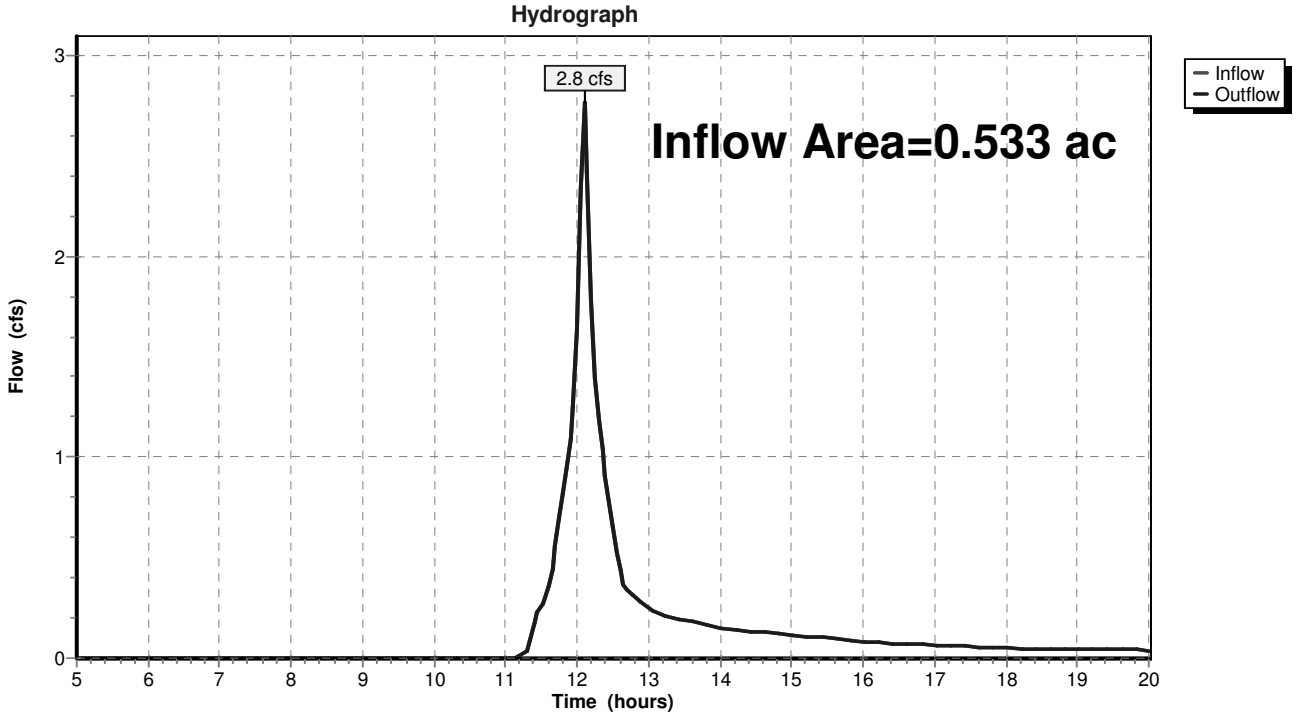
Subcatchment 4S: WATERSHED 4 (MAIN ROADWAY DRAINAGE)



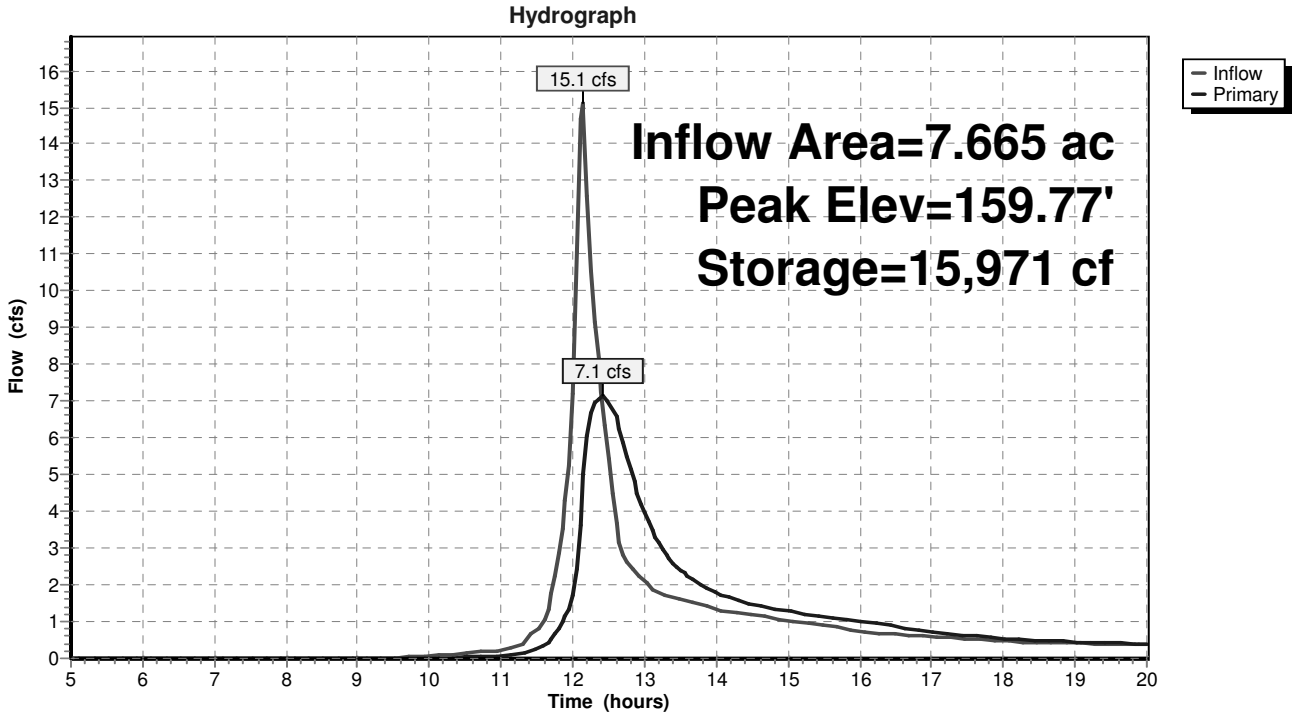
Reach 1R: To Pond



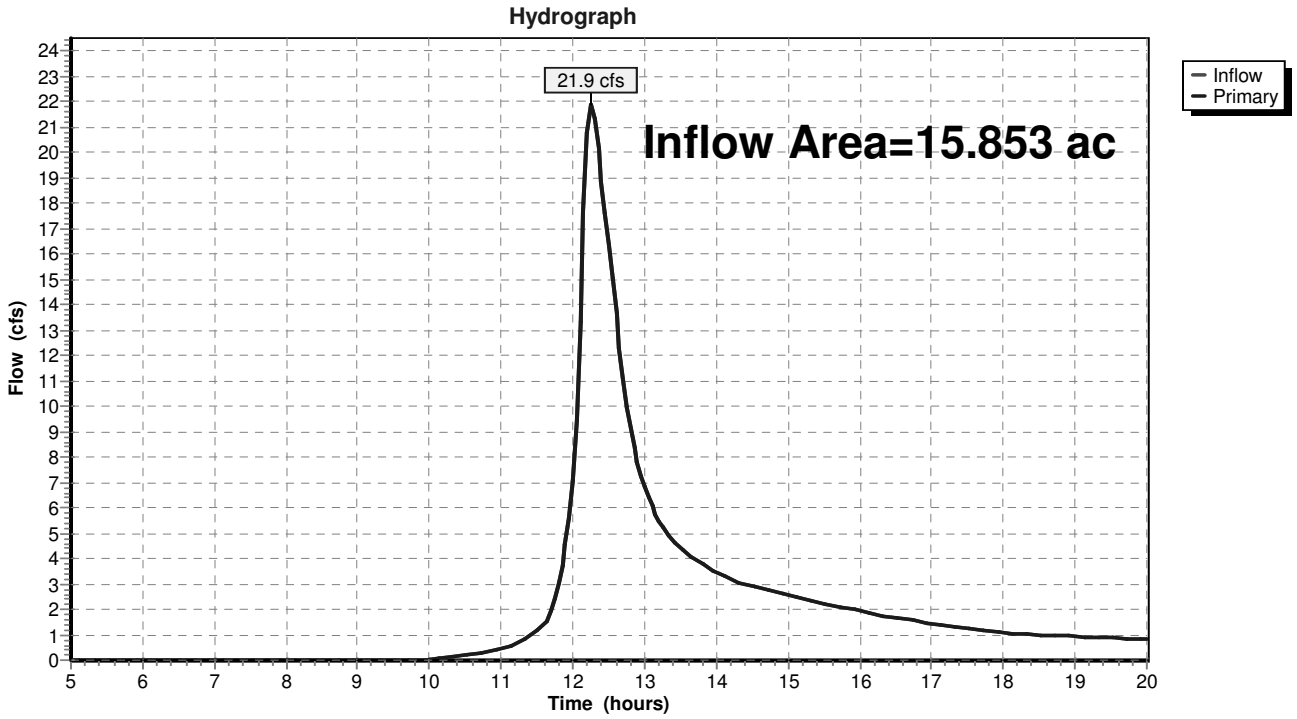
Reach 2R: WATERSHED 3 ROOF AREAS (AFTER DRYWELL RETENTION)



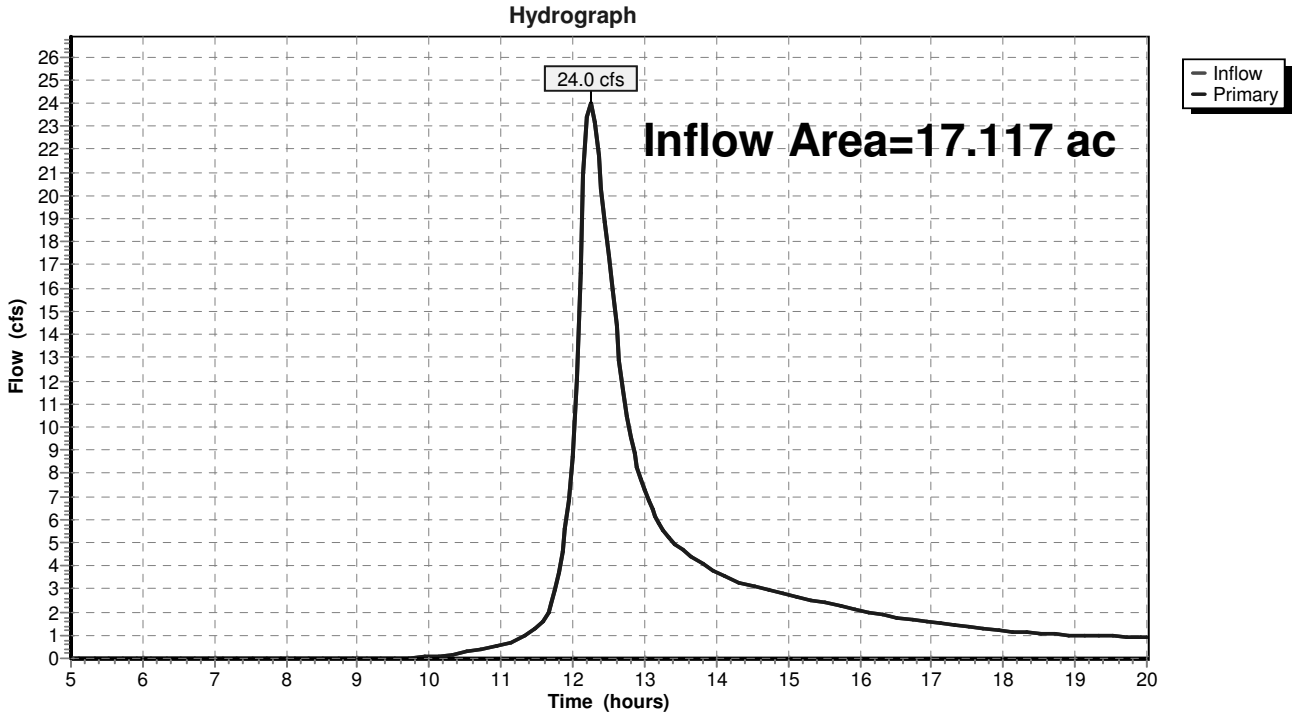
Pond 1P: PROPOSED BASIN (NO WQV AS STORAGE)



Link 1L: DP#1 - STREAM @ NW CORNER



Link 2L: DP#2 - SUM TO ORCHARD STREET DRAINGE SYSTEM



APPENDIX C
NRCS Soil Map & Data

Soil Map—State of Connecticut
(Orchard Street Glastonbury, CT)

Map Scale: 1:3,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 15, Sep 28, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 28, 2011—Apr 18, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

State of Connecticut (CT600)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
12	Raypol silt loam	10.1	23.0%
21A	Ninigret and Tisbury soils, 0 to 5 percent slopes	7.1	16.2%
33A	Hartford sandy loam, 0 to 3 percent slopes	4.3	9.9%
33B	Hartford sandy loam, 3 to 8 percent slopes	4.9	11.2%
37C	Manchester gravelly sandy loam, 3 to 15 percent slopes	1.2	2.7%
87B	Wethersfield loam, 3 to 8 percent slopes	9.1	20.9%
88C	Wethersfield loam, 8 to 15 percent slopes, very stony	4.6	10.6%
306	Udorthents-Urban land complex	2.3	5.4%
Totals for Area of Interest		**43.6**	**100.0%**

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

State of Connecticut

12—Raypol silt loam

Map Unit Setting

National map unit symbol: 9ljx
Elevation: 0 to 1,200 feet

Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Raypol and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Raypol

Setting

Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss

Typical profile

Ap - 0 to 8 inches: silt loam
Bg1 - 8 to 12 inches: very fine sandy loam
Bg2 - 12 to 20 inches: silt loam
Bw1 - 20 to 26 inches: silt loam
Bw2 - 26 to 29 inches: very fine sandy loam
2C1 - 29 to 52 inches: stratified very gravelly coarse sand to loamy fine sand
2C2 - 52 to 65 inches: stratified very gravelly coarse sand to loamy fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Enfield

Percent of map unit: 5 percent

Landform: Outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Haven
Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Ninigret
Percent of map unit: 3 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Scarboro
Percent of map unit: 2 percent
Landform: Depressions, terraces, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Walpole
Percent of map unit: 2 percent
Landform: Depressions on terraces, drainageways on terraces
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Tisbury
Percent of map unit: 2 percent
Landform: Outwash plains, terraces
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Unnamed, loamy substratum
Percent of map unit: 1 percent

21A—Ninigret and Tisbury soils, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2tx07
Elevation: 0 to 1,260 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Ninigret and similar soils: 60 percent
Tisbury and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ninigret

Setting

Landform: Depressions, kames, kame terraces, outwash plains, outwash terraces, drainageways, moraines
Landform position (two-dimensional): Backslope, shoulder, footslope, summit
Landform position (three-dimensional): Side slope, crest, tread, dip, rise
Down-slope shape: Concave, convex, linear
Across-slope shape: Concave, convex
Parent material: Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from gneiss, granite, schist, and/or phyllite

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 16 inches: fine sandy loam
Bw2 - 16 to 26 inches: fine sandy loam
2C - 26 to 65 inches: stratified loamy sand to loamy fine sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 18 to 38 inches to strongly contrasting textural stratification
Natural drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 17 to 39 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Tisbury

Setting

Landform: Deltas, depressions, depressions, outwash plains, outwash terraces, valley trains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-silty eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite, schist, and/or gneiss

Typical profile

Ap - 0 to 8 inches: silt loam
Bw1 - 8 to 18 inches: silt loam
Bw2 - 18 to 26 inches: silt loam
2C - 26 to 65 inches: stratified extremely gravelly sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 24 to 36 inches to strongly contrasting textural stratification
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Eskers, kames, outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Agawam

Percent of map unit: 5 percent
Landform: Kames, kame terraces, outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Backslope, shoulder, footslope, summit
Landform position (three-dimensional): Side slope, crest, tread, riser, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Haven

Percent of map unit: 3 percent
Landform: Kames, kame terraces, outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Shoulder, footslope, backslope, summit
Landform position (three-dimensional): Side slope, crest, tread, riser, rise, dip
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Raypol

Percent of map unit: 2 percent
Landform: Deltas, depressions, depressions, outwash plains, outwash terraces, valley trains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

33A—Hartford sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9lmv
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Hartford and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hartford

Setting

Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits derived from sandstone and/or basalt

Typical profile

Ap - 0 to 8 inches: sandy loam
Bw1 - 8 to 20 inches: sandy loam
Bw2 - 20 to 26 inches: loamy sand
2C - 26 to 65 inches: stratified very gravelly coarse sand to loamy fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Ellington

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Branford

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Penwood

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Convex

Across-slope shape: Linear
Hydric soil rating: No

Manchester

Percent of map unit: 5 percent
Landform: Eskers, kames, outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

33B—Hartford sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9lmw
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Hartford and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hartford

Setting

Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits derived from sandstone and/or basalt

Typical profile

Ap - 0 to 8 inches: sandy loam
Bw1 - 8 to 20 inches: sandy loam
Bw2 - 20 to 26 inches: loamy sand
2C - 26 to 65 inches: stratified very gravelly coarse sand to loamy fine sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Ellington

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Branford

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Penwood

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Manchester

Percent of map unit: 5 percent
Landform: Eskers, kames, outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

37C—Manchester gravelly sandy loam, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9ln6
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Manchester and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manchester

Setting

Landform: Eskers, kames, outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glaciofluvial deposits derived from sandstone and shale and/or basalt

Typical profile

Ap - 0 to 9 inches: gravelly sandy loam
Bw - 9 to 18 inches: gravelly loamy sand
C - 18 to 65 inches: stratified extremely gravelly coarse sand to very gravelly loamy sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Penwood

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Hartford

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Branford

Percent of map unit: 3 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: No

Ellington

Percent of map unit: 3 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Unnamed, nongravelly surface

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, gravelly loamy sand surface

Percent of map unit: 2 percent
Hydric soil rating: No

87B—Wethersfield loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9lrh
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Wethersfield and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wethersfield

Setting

Landform: Drumlins, hills
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from basalt and/or sandstone and shale

Typical profile

Ap - 0 to 3 inches: loam
Bw1 - 3 to 13 inches: loam
Bw2 - 13 to 27 inches: gravelly loam
Cd - 27 to 65 inches: gravelly loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Ludlow
Percent of map unit: 5 percent
Landform: Drumlins, hills
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Cheshire
Percent of map unit: 5 percent
Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Yalesville
Percent of map unit: 5 percent
Landform: Ridges, hills
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Wilbraham
Percent of map unit: 3 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Menlo
Percent of map unit: 2 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

88C—Wethersfield loam, 8 to 15 percent slopes, very stony

Map Unit Setting
National map unit symbol: 9lrm

Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Wethersfield and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wethersfield

Setting

Landform: Drumlins, hills
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from basalt and/or sandstone and shale

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loam
Bw1 - 3 to 13 inches: loam
Bw2 - 13 to 27 inches: gravelly loam
Cd - 27 to 65 inches: gravelly loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Ludlow

Percent of map unit: 5 percent
Landform: Drumlins, hills
Down-slope shape: Concave
Across-slope shape: Linear

Hydric soil rating: No

Cheshire

Percent of map unit: 5 percent
Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Yalesville

Percent of map unit: 5 percent
Landform: Ridges, hills
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Wilbraham

Percent of map unit: 3 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Menlo

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

306—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 9lmg
Elevation: 0 to 2,000 feet
Mean annual precipitation: 43 to 56 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 120 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 50 percent
Urban land: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Drift

Typical profile

A - 0 to 5 inches: loam
C1 - 5 to 21 inches: gravelly loam
C2 - 21 to 80 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 1.98 in/hr)
Depth to water table: About 54 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Urban Land

Typical profile

H - 0 to 6 inches: material

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Unnamed, undisturbed soils

Percent of map unit: 8 percent
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Rock outcrop

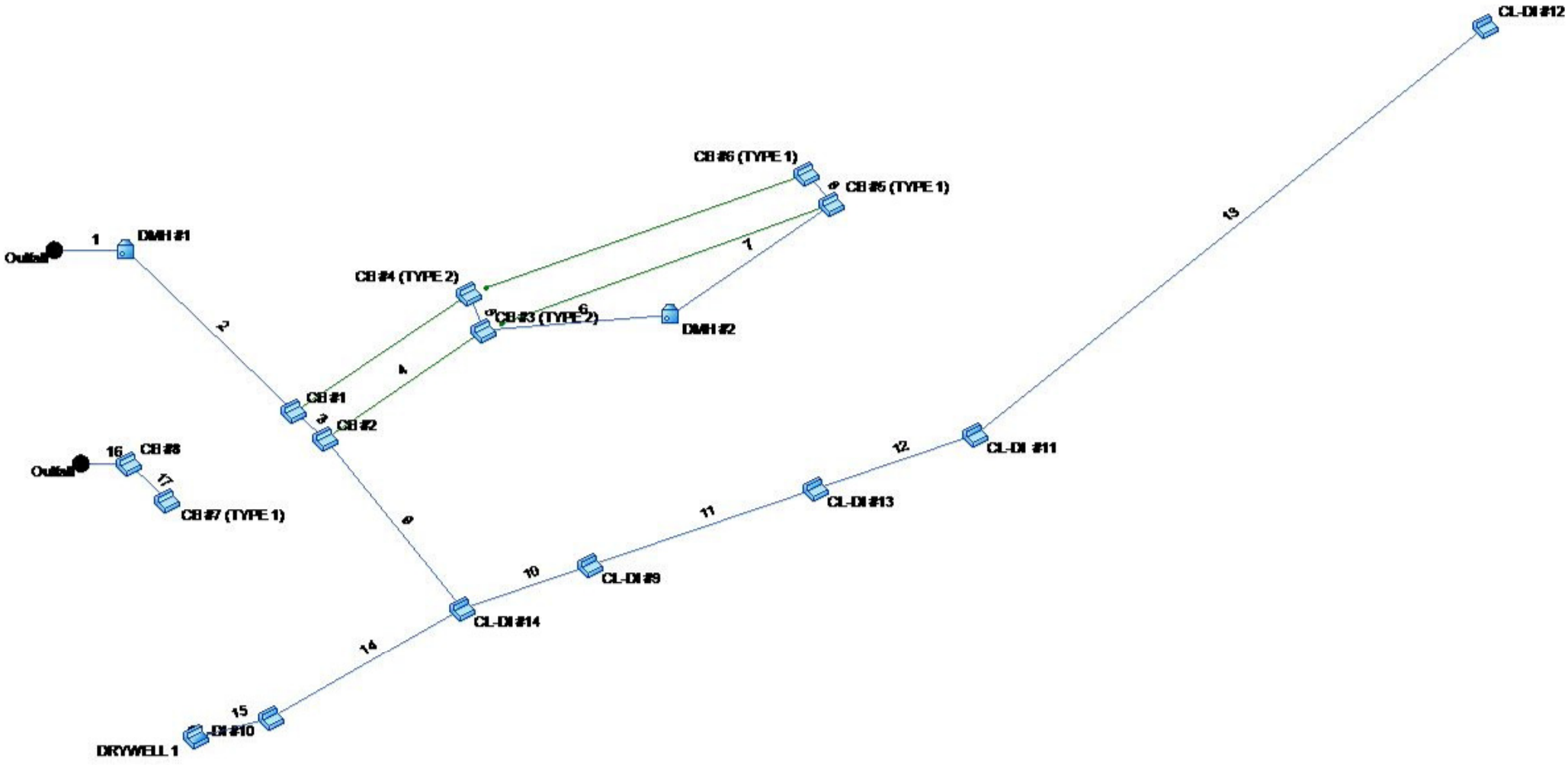
Percent of map unit: 2 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: State of Connecticut
Survey Area Data: Version 15, Sep 28, 2016

APPENDIX D
Onsite Storm Sewer Analysis

HYDRAFLOW STROM SEWERS
3628 - STORM SEWERS
17 LINES
7/12/2017



Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	33.000	0.00	6.99	0.00	0.00	2.70	0.0	12.9	4.3	11.67	17.06	5.38	24	0.48	159.00	159.16	160.40	160.39	0.00	163.50	DMH1 to WQB
2	1	107.000	0.21	6.99	0.55	0.12	2.70	8.0	12.6	4.4	11.79	17.41	5.83	24	0.50	159.16	159.70	160.39	160.93	163.50	164.82	CB1 to DMH1
3	2	19.000	0.42	6.78	0.40	0.17	2.59	8.0	12.6	4.4	11.31	16.86	5.64	24	0.47	159.70	159.79	160.93	161.00	164.82	164.99	CB2 to CB1
4	3	88.000	0.33	1.31	0.50	0.17	0.81	8.0	8.7	5.1	4.09	4.95	3.64	15	0.50	159.79	160.23	161.00	161.23	164.99	163.58	CB3 to CB2
5	4	18.000	0.25	0.25	0.63	0.16	0.16	6.0	6.0	5.7	0.90	2.73	1.14	12	0.50	160.23	160.32	161.67	161.68	163.58	163.58	CB4 to CB3
6	4	86.000	0.00	0.73	0.00	0.00	0.49	0.0	8.3	5.1	2.50	4.73	3.80	12	1.50	160.23	161.52	161.67	162.20	163.58	165.60	DMH2 to CB3
7	6	90.000	0.49	0.73	0.59	0.29	0.49	8.0	8.0	5.2	2.53	4.74	4.46	12	1.51	161.52	162.88	162.20	163.56	165.60	167.03	CB5 to DMH2
8	7	18.000	0.24	0.24	0.82	0.20	0.20	6.0	6.0	5.7	1.12	3.86	2.64	12	1.00	162.88	163.06	163.56	163.51	167.03	167.03	CB6 to CB5
9	3	100.000	0.50	5.05	0.36	0.18	1.61	10.0	12.3	4.4	7.12	11.38	5.08	18	1.00	159.79	160.79	161.00	161.82	164.99	165.00	CL14 to CB2
10	9	62.000	0.86	4.14	0.36	0.31	1.28	10.0	12.1	4.5	5.70	7.00	5.43	15	1.00	160.79	161.41	161.82	162.38	165.00	164.50	CL9 to CL14
11	10	109.000	0.36	3.28	0.36	0.13	0.97	10.0	11.7	4.5	4.39	7.00	4.63	15	1.00	161.41	162.50	162.38	163.35	164.50	166.00	CL13 to CL9
12	11	77.000	1.24	2.92	0.34	0.42	0.84	10.0	11.4	4.6	3.83	3.86	5.45	12	1.00	162.50	163.27	163.35	164.10	166.00	167.09	CL11 to CL13
13	12	300.000	1.68	1.68	0.25	0.42	0.42	10.0	10.0	4.8	2.02	3.86	3.47	12	1.00	163.27	166.27	164.10	166.88	167.09	169.65	CL12 to CL11
14	9	101.000	0.38	0.41	0.32	0.12	0.15	10.0	10.0	4.8	0.71	6.09	2.09	12	2.50	161.16	163.68	161.82	164.03	165.00	167.37	CL10 to CL14
15	14	35.000	0.03	0.03	0.90	0.03	0.03	6.0	6.0	5.7	0.15	1.59	3.65	6	6.86	164.00	166.40	164.11	166.60	167.37	168.50	DW1 to CL10
16	End	22.000	0.13	1.26	0.57	0.07	0.51	8.0	10.1	4.8	2.46	9.41	3.75	12	5.95	160.51	161.82	162.49	162.49	163.51	165.20	P16
17	16	25.000	1.13	1.13	0.39	0.44	0.44	10.0	10.0	4.8	2.12	3.27	2.80	12	0.72	161.82	162.00	162.82	162.88	165.20	165.50	P15

Project File: 3628 - Storm Sewers.stm | Number of lines: 17 | Run Date: 7/12/2017

NOTES:Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	DMH #1	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
2	CB #1	0.60	0.00	0.41	0.19	Comb	4.0	2.31	0.00	2.31	1.35	0.022	11.00	0.031	0.031	0.013	0.11	3.65	0.16	2.58	1.0	5
3	CB #2	0.88	0.00	0.54	0.34	Comb	4.0	2.31	0.00	2.31	1.35	0.022	11.00	0.031	0.031	0.013	0.13	4.19	0.18	3.23	1.0	4
4	CB #3 (TYPE 2)	0.86	0.62	1.48	0.00	Comb	4.0	5.83	3.12	5.83	1.68	Sag	11.00	0.031	0.031	0.013	0.17	5.45	0.25	5.45	1.0	Off
5	CB #4 (TYPE 2)	0.90	0.34	1.24	0.00	Comb	4.0	5.83	9.79	5.83	1.68	Sag	11.00	0.031	0.031	0.013	0.15	4.94	0.24	4.94	1.0	Off
6	DMH #2	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
7	CB #5 (TYPE 1)	1.51	0.00	1.23	0.28	Comb	4.0	2.31	0.00	2.31	2.70	0.025	11.00	0.031	0.031	0.013	0.16	5.00	0.17	2.90	1.0	4
8	CB #6 (TYPE 1)	1.12	0.00	0.97	0.15	Comb	4.0	2.31	0.00	2.31	2.70	0.025	11.00	0.031	0.031	0.013	0.14	4.48	0.15	2.26	1.0	5
9	CL-DI #14	0.86	0.13	1.00	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	11.00	0.031	0.031	0.013	0.18	5.96	0.27	5.96	1.0	Off
10	CL-DI #9	1.49	0.00	1.49	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	11.00	0.031	0.031	0.013	0.23	7.57	0.32	7.57	1.0	Off
11	CL-DI #13	0.62	1.49	2.11	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	11.00	0.031	0.031	0.013	0.29	9.39	0.37	9.39	1.0	Off
12	CL-DI #11	2.03	0.90	1.43	1.49	Grate	0.0	0.00	0.00	2.31	1.35	0.100	11.00	0.031	0.031	0.013	0.15	4.94	0.20	3.87	1.0	11
13	CL-DI #12	2.02	0.00	1.12	0.90	Grate	0.0	0.00	0.00	2.31	1.35	0.100	11.00	0.031	0.031	0.013	0.13	4.32	0.18	3.23	1.0	12
14	CL-DI #10	0.58	0.00	0.45	0.13	Grate	0.0	0.00	0.00	2.31	1.35	0.100	11.00	0.031	0.031	0.013	0.08	2.71	0.13	1.61	1.0	9
15	DRYWELL 1	0.15	0.00	0.15	0.00	Curb	4.0	2.31	0.00	0.00	0.00	Sag	11.00	0.031	0.031	0.013	0.02	0.67	0.10	0.67	1.0	Off
16	CB #8	0.39	0.00	0.29	0.10	Comb	4.0	2.31	0.00	2.31	1.35	0.015	11.00	0.031	0.031	0.013	0.10	3.32	0.15	2.26	1.0	Off
17	CB #7 (TYPE 1)	2.12	0.00	1.53	0.59	Comb	4.0	2.31	0.00	2.31	2.70	0.015	11.00	0.031	0.031	0.013	0.19	6.26	0.20	3.87	1.0	Off

Project File: 3628 - Storm Sewers.stm | Number of lines: 17 | Run Date: 7/12/2017

NOTES: Inlet N-Values = 0.016; Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	DMH #1	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
2	CB #1	0.54	0.00	0.38	0.16	Comb	4.0	2.31	0.00	2.31	1.35	0.022	11.00	0.031	0.031	0.013	0.11	3.52	0.15	2.26	1.0	5
3	CB #2	0.79	0.00	0.50	0.29	Comb	4.0	2.31	0.00	2.31	1.35	0.022	11.00	0.031	0.031	0.013	0.13	4.03	0.17	2.90	1.0	4
4	CB #3 (TYPE 2)	0.78	0.52	1.30	0.00	Comb	4.0	5.83	3.12	5.83	1.68	Sag	11.00	0.031	0.031	0.013	0.16	5.07	0.24	5.07	1.0	Off
5	CB #4 (TYPE 2)	0.82	0.29	1.11	0.00	Comb	4.0	5.83	9.79	5.83	1.68	Sag	11.00	0.031	0.031	0.013	0.14	4.65	0.23	4.65	1.0	Off
6	DMH #2	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
7	CB #5 (TYPE 1)	1.36	0.00	1.13	0.23	Comb	4.0	2.31	0.00	2.31	2.70	0.025	11.00	0.031	0.031	0.013	0.15	4.81	0.16	2.58	1.0	4
8	CB #6 (TYPE 1)	1.02	0.00	0.90	0.12	Comb	4.0	2.31	0.00	2.31	2.70	0.025	11.00	0.031	0.031	0.013	0.13	4.32	0.15	2.26	1.0	5
9	CL-DI #14	0.77	0.10	0.88	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	11.00	0.031	0.031	0.013	0.17	5.53	0.25	5.53	1.0	Off
10	CL-DI #9	1.33	0.00	1.33	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	11.00	0.031	0.031	0.013	0.22	7.08	0.30	7.08	1.0	Off
11	CL-DI #13	0.56	1.26	1.82	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	11.00	0.031	0.031	0.013	0.27	8.57	0.35	8.57	1.0	Off
12	CL-DI #11	1.81	0.78	1.33	1.26	Grate	0.0	0.00	0.00	2.31	1.35	0.100	11.00	0.031	0.031	0.013	0.15	4.74	0.20	3.87	1.0	11
13	CL-DI #12	1.81	0.00	1.03	0.78	Grate	0.0	0.00	0.00	2.31	1.35	0.100	11.00	0.031	0.031	0.013	0.13	4.13	0.18	3.23	1.0	12
14	CL-DI #10	0.52	0.00	0.42	0.10	Grate	0.0	0.00	0.00	2.31	1.35	0.100	11.00	0.031	0.031	0.013	0.08	2.61	0.13	1.61	1.0	9
15	DRYWELL 1	0.14	0.00	0.14	0.00	Curb	4.0	2.31	0.00	0.00	0.00	Sag	11.00	0.031	0.031	0.013	0.02	0.63	0.10	0.63	1.0	Off
16	CB #8	0.35	0.00	0.26	0.08	Comb	4.0	2.31	0.00	2.31	1.35	0.015	11.00	0.031	0.031	0.013	0.10	3.19	0.14	1.94	1.0	Off
17	CB #7 (TYPE 1)	1.90	0.00	1.41	0.49	Comb	4.0	2.31	0.00	2.31	2.70	0.015	11.00	0.031	0.031	0.013	0.19	6.00	0.20	3.87	1.0	Off

Project File: 3628 - Storm Sewers.stm | Number of lines: 17 | Run Date: 7/12/2017

NOTES: Inlet N-Values = 0.016; Intensity = 52.33 / (Inlet time + 9.80) ^ 0.84; Return period = 5 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

APPENDIX E
Orchard Street Capacity Analysis

Storm Sewer Tabulation

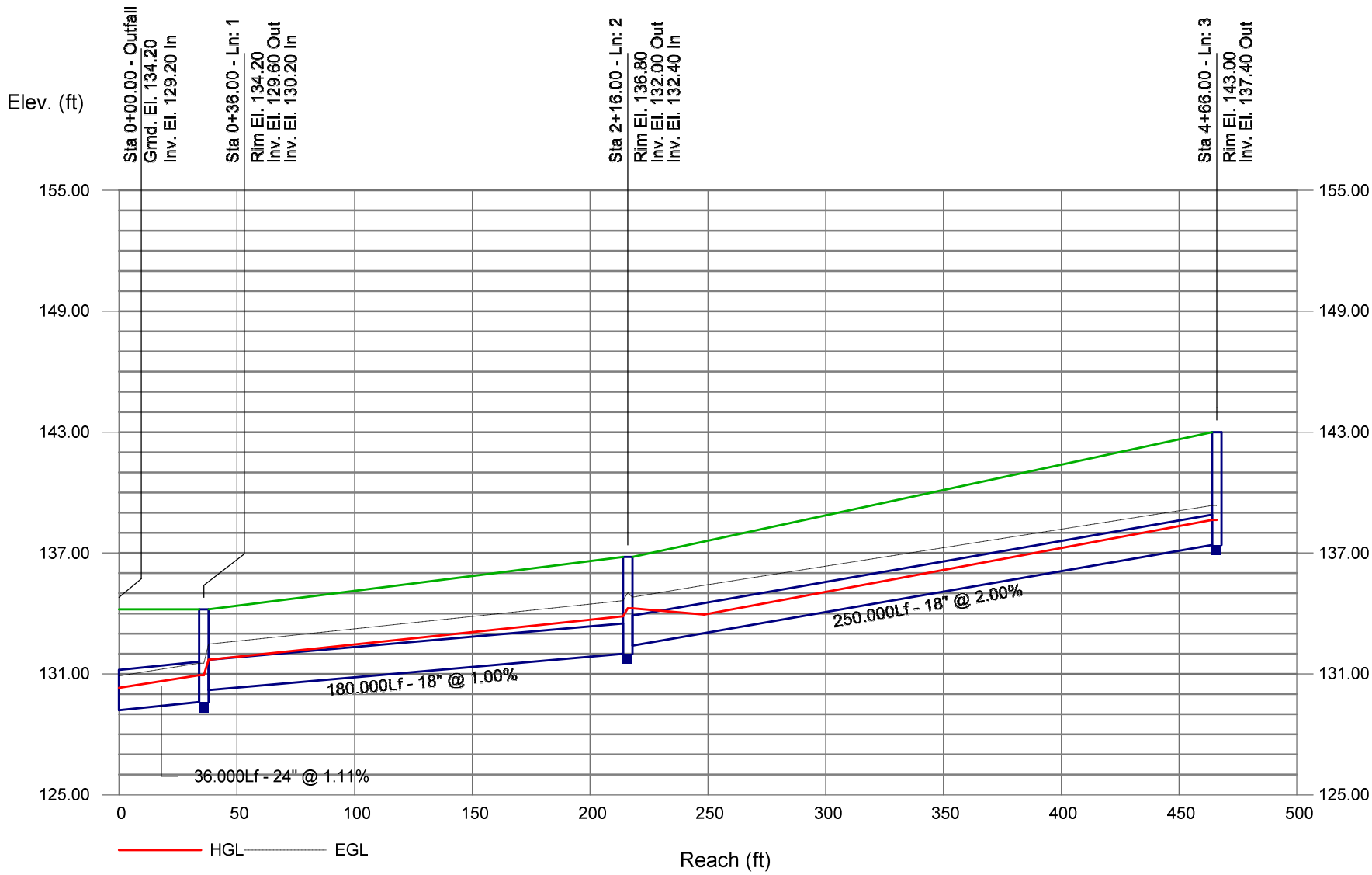
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	36.000	0.55	6.82	0.67	0.37	3.48	10.1	15.7	4.0	13.77	25.83	6.94	24	1.11	129.20	129.60	130.31	130.94	134.20	134.20	CB-1 & 2 TO OUT
2	1	180.000	1.11	6.27	0.47	0.52	3.11	11.4	15.3	4.0	12.47	11.38	7.06	18	1.00	130.20	132.00	131.70	133.86	134.20	136.80	CB-3 & 4 TO CB-
3	2	250.000	1.86	5.16	0.45	0.84	2.59	14.6	14.6	4.1	10.59	16.09	6.37	18	2.00	132.40	137.40	134.25	138.65	136.80	143.00	CB-5 & 6 TO CB-
4	3	273.000	1.08	3.30	0.47	0.51	1.75	11.7	11.7	4.5	7.89	12.12	8.68	15	3.00	138.00	146.19	138.73	147.30	143.00	151.40	CB-7 & 8 TO CB-
5	4	230.000	2.22	2.22	0.56	1.24	1.24	10.0	10.0	4.8	5.97	17.14	5.47	15	6.00	146.19	159.99	147.30	160.98	151.40	164.40	CB-9 & 10 TO CB

3628 - Orchard Street Pipe Cap | Number of lines: 5 | Run Date: 4/4/2017

NOTES:Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: 3628 - Orchards Street Pipe Capacity Analysis.stm



TR55 Tc Worksheet

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. v10.50

Line No. 1

CB-1 & 2 TO OUTFALL

Description

	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 92.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.20		0.00		0.00		
Land slope (%)	= 5.00		0.00		0.00		
Travel Time (min)	**= 9.25**	**+**	**0.00**	**+**	**0.00**	**=**	**9.25**
Shallow Concentrated Flow							
Flow length (ft)	= 132.14		0.00		0.00		
Watercourse slope (%)	= 1.50		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=2.49		0.00		0.00		
Travel Time (min)	**= 0.88**	**+**	**0.00**	**+**	**0.00**	**=**	**0.88**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 10.14 min

TR55 Tc Worksheet

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. v10.50

Line No. 2

CB-3 & 4 TO CB-1 & 2

Description

		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.20		0.00		0.00		
Land slope (%)	=	5.68		0.00		0.00		
Travel Time (min)	**=**	**9.40**	**+**	**0.00**	**+**	**0.00**	**=**	**9.40**
Shallow Concentrated Flow								
Flow length (ft)	=	187.78		208.89		0.00		
Watercourse slope (%)	=	5.10		2.38		0.00		
Surface description	=	UnPaved		Paved		Paved		
Average velocity (ft/s)	=	3.64		3.14		0.00		
Travel Time (min)	**=**	**0.86**	**+**	**1.11**	**+**	**0.00**	**=**	**1.97**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.37 min

TR55 Tc Worksheet

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. v10.50

Line No. 3

CB-5 & 6 TO CB-3 & 4

Description

		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.20		0.00		0.00		
Land slope (%)	=	2.77		0.00		0.00		
Travel Time (min)	**=**	**12.53**	**+**	**0.00**	**+**	**0.00**	**=**	**12.53**
Shallow Concentrated Flow								
Flow length (ft)	=	325.23		38.73		96.28		
Watercourse slope (%)	=	5.00		7.40		3.00		
Surface description	=	UnPaved		Paved		Paved		
Average velocity (ft/s)	=	3.61		5.53		3.52		
Travel Time (min)	**=**	**1.50**	**+**	**0.12**	**+**	**0.46**	**=**	**2.07**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 14.60 min

TR55 Tc Worksheet

Line No. 4

CB-7 & 8 TO CB-5 & 6

Description

		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.20		0.00		0.00		
Land slope (%)	=	4.29		0.00		0.00		
Travel Time (min)	**=**	**10.52**	**+**	**0.00**	**+**	**0.00**	**=**	**10.52**
Shallow Concentrated Flow								
Flow length (ft)	=	150.22		60.15		74.43		
Watercourse slope (%)	=	4.00		7.50		5.10		
Surface description	=	UnPaved		Paved		Paved		
Average velocity (ft/s)	=	3.23		5.57		4.59		
Travel Time (min)	**=**	**0.78**	**+**	**0.18**	**+**	**0.27**	**=**	**1.23**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.74 min

APPENDIX F
Water Quality Calculations

Glen Place Multi-Family Development – DPI Project No.:3628
July 12, 2017

Water Quality Volume Calculations for Drywell Drainage (Units 1 – 10 & ½ of 11)
Per 2004 Connecticut Stormwater Quality Manual, Section 7.4.1:

Water Quality Volume (WQV) = (1")(R)(A)/12, where:

R = unitless volumetric runoff coefficient = 0.05 + 0.009(I), where:
I = percent impervious cover of drainage area = 100.00% (ROOF AREAS)
R = 0.05 + 0.009(I)
R = 0.05 + 0.009(100.00)
R = 0.95

A = drainage area in acres = 0.568 acres

WQV = (1")(R)(A acres)/12 inches per foot
WQV = (1")(0.95)(0.568 acres)/12 inches per foot
WQV = 0.045 acre-feet required = 1960.20 cft

Proposed BMP
Arrangements two and four chambers of 4'x 4'x4' concrete gallies are proposed to retain the required water quality volume for connected roof areas. All outlets are proposed 3.67' (Elev. 100 used as generic bottom elevation for modeling purposes) from the bottom of the chamber trench. The volume provided below the outlet for the two and four chamber arrangements were observed as follows:

- **2 Chambers** – Storage @ Elev. 103.67 = 112 cft
- **4 Chambers** – Storage @ Elev. 103.67 = 225 cft

Total Storage Provided = (8 @ 225 cft) + (3 @ 112 cft) = **2136 cft total storage > 1960.20 cft**
*Water Quality Volume will be retained within drywell w/o discharge .

Water Quality Volume Calculations for Remaining Drainage Area
Per 2004 Connecticut Stormwater Quality Manual, Section 7.4.1:

Water Quality Volume (WQV) = (1")(R)(A)/12, where:
I = percent impervious cover of drainage area = 15.16%
R = 0.05 + 0.009(15.16)
R = 0.186

A = drainage area in acres = 7.222 acres

WQV = (1")(R)(A acres)/12 inches per foot
WQV = (1")(0.186)(7.222 acres)/12 inches per foot
WQV = 0.112 acre-feet required = 4878.72 cft

Proposed BMP
The proposed water quality basin and forebay are proposed to provide 3**,217 cft** & **2,040 cft** of water quality storage respectively. The forebay and basin storage w/ forebay combined, provide greater than 10% and 100% of the total water quality volume for the site respectively.

Summary for Pond 1D: 2 CHAMBER DRYWELL (TYPICAL)

Inflow Area = 0.029 ac,100.00% Impervious, Inflow Depth > 6.15" for 100 event
Inflow = 0.2 cfs @ 12.09 hrs, Volume= 0.015 af
Outflow = 0.2 cfs @ 12.10 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.6 min
Primary = 0.2 cfs @ 12.10 hrs, Volume= 0.012 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 103.98' @ 12.10 hrs Surf.Area= 50 sf Storage= 125 cf

Plug-Flow detention time= 98.9 min calculated for 0.012 af (82% of inflow)
Center-of-Mass det. time= 48.6 min (782.1 - 733.6)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	43 cf	**5.00'W x 10.00'L x 4.50'H Prismatoid** 225 cf Overall - 118 cf Embedded = 107 cf x 40.0% Voids
#2	100.50'	89 cf	**Galley 4x4x4** x 2 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
		132 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	103.67'	**6.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 103.67' / 103.37' S= 0.0150 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.2 cfs @ 12.10 hrs HW=103.98' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.2 cfs @ 1.49 fps)

Summary for Pond 2D: 4 CHAMBER DRYWELL (TYPICAL)

Inflow Area = 0.057 ac,100.00% Impervious, Inflow Depth > 6.15" for 100 event
Inflow = 0.4 cfs @ 12.09 hrs, Volume= 0.029 af
Outflow = 0.4 cfs @ 12.10 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.6 min
Primary = 0.4 cfs @ 12.10 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 104.19' @ 12.10 hrs Surf.Area= 100 sf Storage= 258 cf

Plug-Flow detention time= 101.7 min calculated for 0.024 af (82% of inflow)
Center-of-Mass det. time= 49.8 min (783.4 - 733.6)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	86 cf	**10.00'W x 10.00'L x 4.50'H Prismatoid** 450 cf Overall - 236 cf Embedded = 214 cf x 40.0% Voids
#2	100.50'	177 cf	**Galley 4x4x4** x 4 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 2 Rows of 2 Chambers
		263 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	103.67'	**6.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 103.67' / 102.92' S= 0.0150 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Primary OutFlow Max=0.4 cfs @ 12.10 hrs HW=104.18' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.4 cfs @ 1.95 fps)

Stage-Area-Storage for Pond 1P: PROPOSED BASIN (NO WQV AS STORAGE)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
157.00	3,141	0
157.05	3,189	158
157.10	3,237	319
157.15	3,285	482
157.20	3,333	647
157.25	3,382	815
157.30	3,430	986
157.35	3,478	1,158
157.40	3,526	1,333
157.45	3,574	1,511
157.50	3,622	1,691
157.55	3,670	1,873
157.60	3,718	2,058
157.65	3,766	2,245
157.70	3,815	2,434
157.75	3,863	2,626
157.80	3,911	2,821
157.85	3,959	3,017
157.90	4,007	3,217
157.95	4,057	3,418
158.00	4,107	3,622
158.05	4,291	3,832
158.10	4,476	4,051
158.15	4,660	4,280
158.20	4,845	4,517
158.25	5,029	4,764
158.30	5,213	5,020
158.35	5,398	5,286
158.40	5,582	5,560
158.45	5,767	5,844
158.50	5,951	6,137
158.55	6,135	6,439
158.60	6,320	6,750
158.65	6,504	7,071
158.70	6,689	7,401
158.75	6,873	7,740
158.80	7,057	8,088
158.85	7,242	8,446
158.90	7,426	8,812
158.95	7,611	9,188
159.00	7,795	9,573
159.05	7,868	9,965
159.10	7,942	10,360
159.15	8,015	10,759
159.20	8,089	11,162
159.25	8,162	11,568
159.30	8,236	11,978
159.35	8,309	12,392
159.40	8,383	12,809
159.45	8,456	13,230
159.50	8,530	13,654
159.55	8,603	14,083
159.60	8,676	14,515
159.65	8,750	14,950
159.70	8,823	15,390
159.75	8,897	15,833
159.80	8,970	16,279
159.85	9,044	16,730
159.90	9,117	17,184
159.95	9,191	17,641
160.00	9,264	18,103
160.05	9,343	18,568
160.10	9,421	19,037
160.15	9,500	19,510
160.20	9,578	19,987
160.25	9,657	20,468
160.30	9,735	20,953
160.35	9,813	21,441
160.40	9,892	21,934
160.45	9,970	22,431
160.50	10,049	22,931
160.55	10,128	23,435
160.60	10,206	23,944
160.65	10,285	24,456
160.70	10,363	24,972
160.75	10,442	25,492
160.80	10,520	26,016
160.85	10,598	26,544
160.90	10,677	27,076
160.95	10,755	27,612
161.00	10,834	28,152
161.05	10,917	28,696
161.10	10,999	29,243
161.15	11,082	29,795
161.20	11,164	30,352
161.25	11,247	30,912
161.30	11,329	31,476
161.35	11,411	32,045
161.40	11,494	32,617
161.45	11,576	33,194
161.50	11,659	33,775
161.55	11,742	34,360
161.60	**11,824**	**34,949**

Stage-Area-Storage for Pond 7P: PROPOSED BASIN FOREBAY

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
157.00	963	0
157.05	989	49
157.10	1,015	99
157.15	1,041	150
157.20	1,067	203
157.25	1,093	257
157.30	1,119	312
157.35	1,145	369
157.40	1,171	427
157.45	1,197	486
157.50	1,224	547
157.55	1,250	608
157.60	1,276	672
157.65	1,302	736
157.70	1,328	802
157.75	1,354	869
157.80	1,380	937
157.85	1,406	1,007
157.90	1,432	1,078
157.95	1,458	1,150
158.00	1,484	1,224
158.05	1,514	1,298
158.10	1,544	1,375
158.15	1,573	1,453
158.20	1,603	1,532
158.25	1,633	1,613
158.30	1,663	1,696
158.35	1,693	1,779
158.40	1,722	1,865
158.45	1,752	1,952
158.50	**1,782**	**2,040**
158.55	1,782	2,040
158.60	1,782	2,040
158.65	1,782	2,040
158.70	1,782	2,040
158.75	1,782	2,040
158.80	1,782	2,040
158.85	1,782	2,040
158.90	1,782	2,040
158.95	1,782	2,040
159.00	1,782	2,040
159.05	1,782	2,040
159.10	1,782	2,040
159.15	1,782	2,040
159.20	1,782	2,040
159.25	1,782	2,040
159.30	1,782	2,040

Stage-Area-Storage for Pond 2D: 4 CHAMBER DRYWELL (TYPICAL)

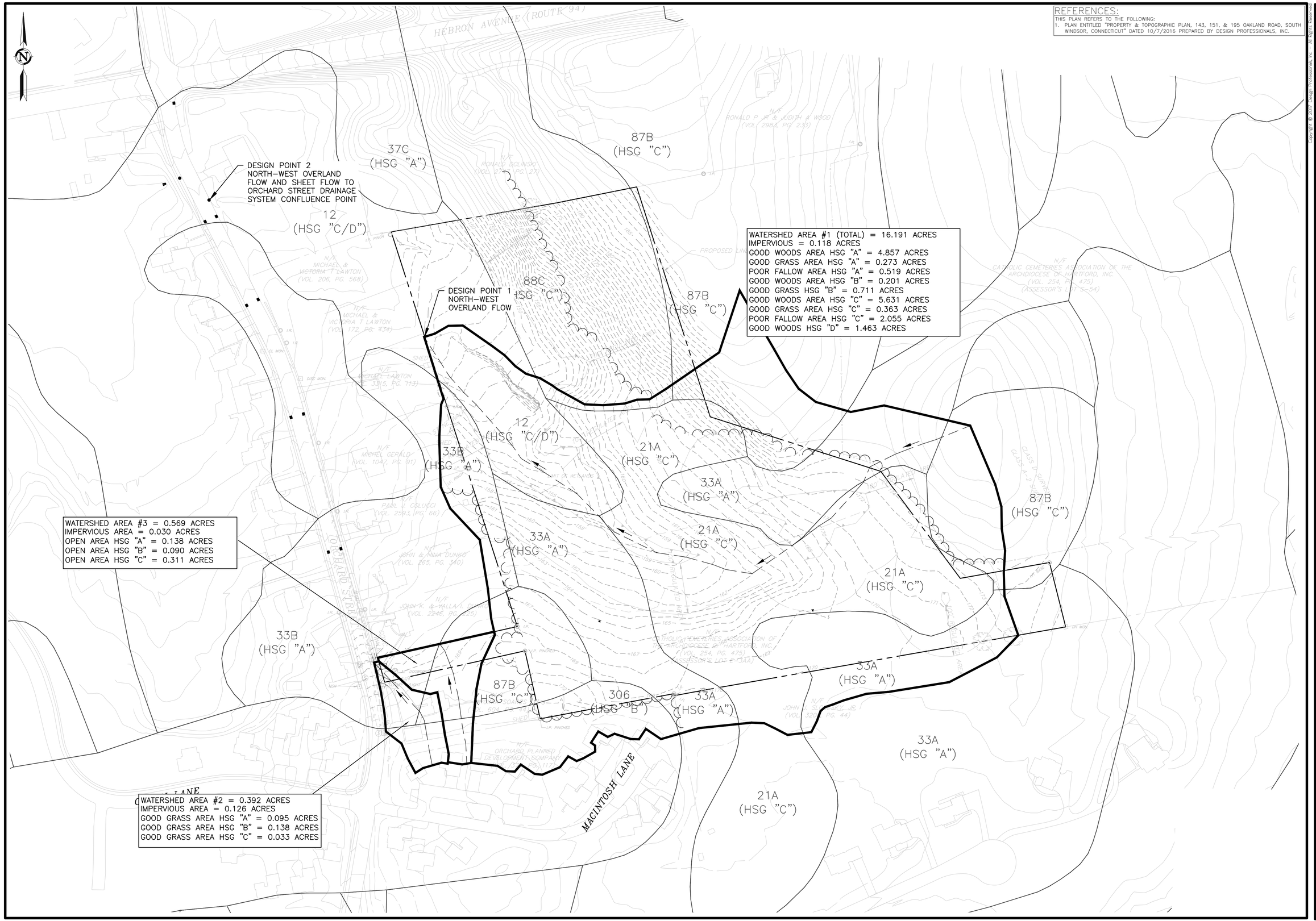
Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
100.00	0	102.60	159
100.05	2	102.65	162
100.10	4	102.70	165
100.15	6	102.75	169
100.20	8	102.80	172
100.25	10	102.85	175
100.30	12	102.90	179
100.35	14	102.95	182
100.40	16	103.00	185
100.45	18	103.05	189
100.50	20	103.10	192
100.55	23	103.15	195
100.60	26	103.20	198
100.65	30	103.25	202
100.70	33	103.30	205
100.75	36	103.35	208
100.80	40	103.40	211
100.85	43	103.45	215
100.90	46	103.50	218
100.95	50	103.55	221
101.00	53	103.60	225
101.05	56	103.65	228
101.10	59	103.70	231
101.15	63	103.75	234
101.20	66	103.80	238
101.25	69	103.85	241
101.30	73	103.90	244
101.35	76	103.95	247
101.40	79	104.00	251
101.45	83	104.05	254
101.50	86	104.10	256
101.55	89	104.15	257
101.60	93	104.20	258
101.65	96	104.25	259
101.70	99	104.30	260
101.75	103	104.35	261
101.80	106	104.40	261
101.85	109	104.45	262
101.90	113	104.50	**263**
101.95	116		
102.00	119		
102.05	123		
102.10	126		
102.15	129		
102.20	132		
102.25	136		
102.30	139		
102.35	142		
102.40	146		
102.45	149		
102.50	152		
102.55	156		

Stage-Area-Storage for Pond 1D: 2 CHAMBER DRYWELL (TYPICAL)

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
100.00	0	102.60	79
100.05	1	102.65	81
100.10	2	102.70	83
100.15	3	102.75	84
100.20	4	102.80	86
100.25	5	102.85	88
100.30	6	102.90	89
100.35	7	102.95	91
100.40	8	103.00	93
100.45	9	103.05	94
100.50	10	103.10	96
100.55	12	103.15	98
100.60	13	103.20	99
100.65	15	103.25	101
100.70	16	103.30	102
100.75	18	103.35	104
100.80	20	103.40	106
100.85	21	103.45	107
100.90	23	103.50	109
100.95	25	103.55	111
101.00	26	103.60	112
101.05	28	103.65	114
101.10	30	103.70	116
101.15	31	103.75	117
101.20	33	103.80	119
101.25	35	103.85	120
101.30	36	103.90	122
101.35	38	103.95	124
101.40	40	104.00	125
101.45	41	104.05	127
101.50	43	104.10	128
101.55	45	104.15	129
101.60	46	104.20	129
101.65	48	104.25	129
101.70	50	104.30	130
101.75	51	104.35	130
101.80	53	104.40	131
101.85	55	104.45	131
101.90	56	104.50	**132**
101.95	58		
102.00	60		
102.05	61		
102.10	63		
102.15	65		
102.20	66		
102.25	68		
102.30	70		
102.35	71		
102.40	73		
102.45	74		
102.50	76		
102.55	78		

APPENDIX G
Drainage Area Maps

REFERENCES:
THIS PLAN REFERS TO THE FOLLOWING:
1. PLAN ENTITLED "PROPERTY & TOPOGRAPHIC PLAN, 143, 151, & 195 OAKLAND ROAD, SOUTH WINDSOR, CONNECTICUT" DATED 10/7/2016 PREPARED BY DESIGN PROFESSIONALS, INC.



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Prepared for:
ROBERT URSO
128-3 ARTHUR DRIVE
SOUTH WINDSOR, CT 06074

PROJECT NO.	3628
DATE	5-23-2017
DESIGN BY:	GRD
DRAWN BY:	
CHK. BY:	JAB
APPROVED BY:	JAB

ORCHARD STREET
LOT E-3AA ORCHARD STREET
LOT S-54 HEBRON AVENUE
GLASTONBURY, CONNECTICUT
SITE PLAN

REVISIONS

NO.	DATE	REV. FOR IWWC SUBMISSION	BY
1	7/12/17		

EXISTING CONDITION DRAINAGE MAP

SCALE: 0 40' 80' 160'
1" = 80'

SHEET
C-DR1
SHEET 1 OF 3

File: C:\jobs\3628\Stormwater\2017-07-12\3628 – Drainage Plan-2017-07-12.dwg Layout: 01 C-DR1 Plotted: 7/12/2017 10:41 AM Last Saved: 7/12/2017 10:39 AM Last Saved By: daniel.jameson

REFERENCES:
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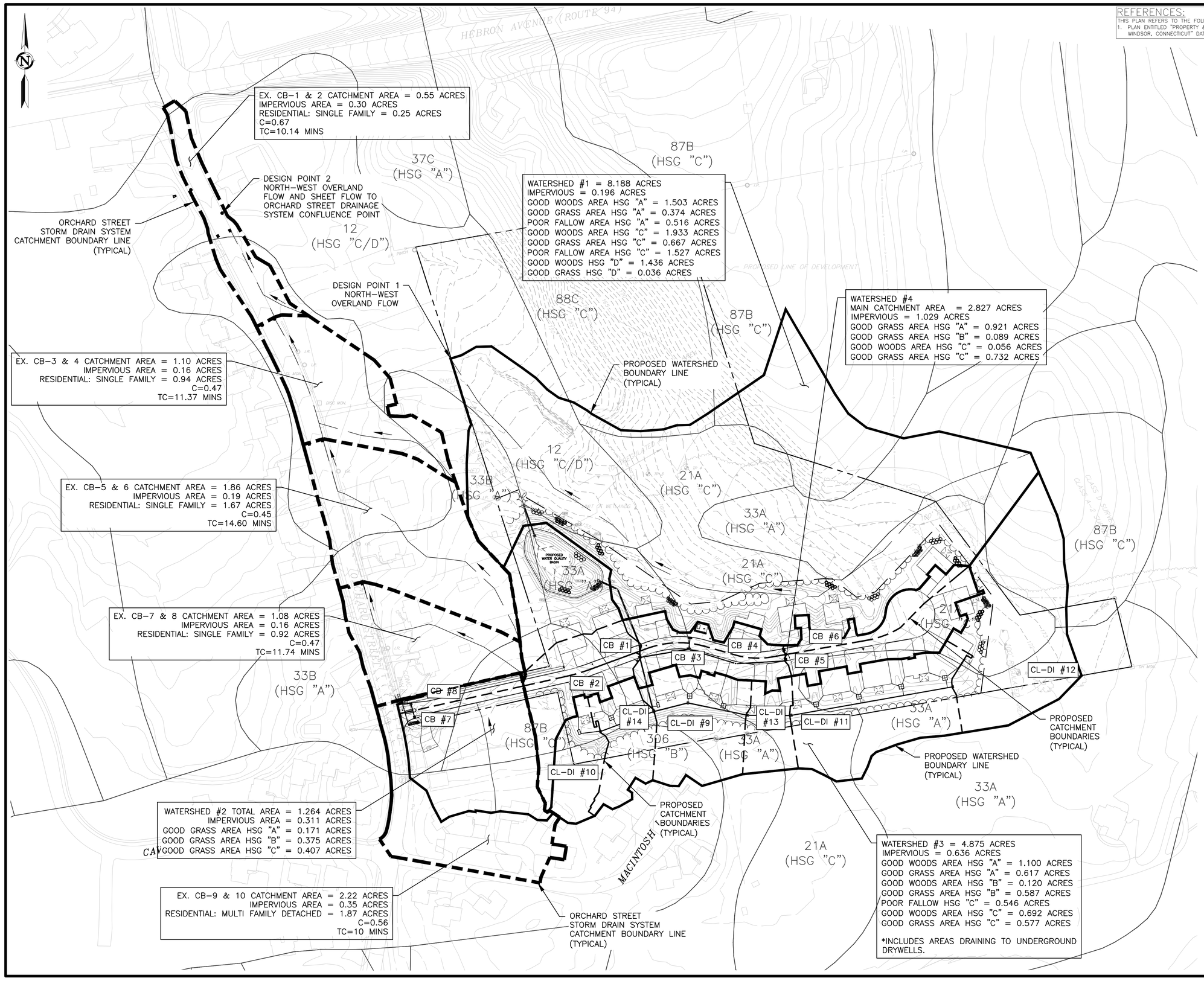

CATCHMENT DRAINAGE AREAS

BASIN	DETAILS
CB#1	TOTAL AREA = 0.212 ACRES GRASS: 0.115 ACRES IMPERVIOUS 0.097 ACRES C=0.55 Tc= 8 MINUTES
CB#2	TOTAL AREA = 0.418 ACRES GRASS: 0.322 ACRES IMPERVIOUS 0.096 ACRES C=0.40 Tc= 8 MINUTES
CB#3	TOTAL AREA = 0.330 ACRES GRASS: 0.205 ACRES IMPERVIOUS 0.125 ACRES C=0.50 Tc= 8 MINUTES
CB#4	TOTAL AREA = 0.245 ACRES GRASS: 0.102 ACRES IMPERVIOUS 0.143 ACRES C=0.63 Tc= 6 MINUTES
CB#5	TOTAL AREA = 0.489 ACRES GRASS HSG A: 0.232 ACRES IMPERVIOUS: 0.257 ACRES C= 0.59 Tc= 8 MINUTES
CB#6	TOTAL AREA = 0.240 ACRES GRASS HSG A: 0.031 ACRES IMPERVIOUS: 0.209 ACRES C= 0.82 Tc= 6 MINUTES
CB#7	TOTAL AREA = 1.131 ACRES GRASS HSG A: 0.889 ACRES IMPERVIOUS: 0.242 ACRES C= 0.39 Tc= 8 MINUTES
CB#8	TOTAL AREA = 0.134 ACRES GRASS HSG A: 0.069 ACRES IMPERVIOUS: 0.065 ACRES C= 0.57 Tc= 8 MINUTES
CL-DI #9	TOTAL AREA = 0.856 ACRES WOODS: 0.217 ACRES GRASS: 0.479 ACRES IMPERVIOUS: 0.160 ACRES C= 0.36 Tc= 10 MINUTES
CL-DI #14	TOTAL AREA = 0.497 ACRES WOODS: 0.126 ACRES GRASS: 0.278 ACRES IMPERVIOUS: 0.093 ACRES C= 0.36 Tc= 10 MINUTES
CL-DI #13	TOTAL AREA = 0.360 ACRES WOODS: 0.091 ACRES GRASS: 0.202 ACRES IMPERVIOUS: 0.067 ACRES C= 0.36 Tc= 10 MINUTES
CL-DI #10	TOTAL AREA = 0.381 ACRES WOODS: 0.020 ACRES GRASS: 0.316 ACRES IMPERVIOUS: 0.045 ACRES C= 0.32 Tc= 8 MINUTES
CL-DI #11	TOTAL AREA = 1.238 ACRES WOODS: 0.596 ACRES GRASS: 0.428 ACRES IMPERVIOUS: 0.214 ACRES C= 0.34 Tc= 10 MINUTES
CL-DI #12	TOTAL AREA = 1.676 ACRES WOODS: 0.843 ACRES GRASS/MEADOW: 0.776 ACRES IMPERVIOUS: 0.057 ACRES C= 0.25 Tc= 10 MINUTES

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Prepared for:
ROBERT URSO
128-3 ARTHUR DRIVE
SOUTH WINDSOR, CT 06074

PROJECT NO. 3628
DATE: 5-22-2017
DESIGN BY: ----
DRAWN BY: ----
CHK. BY: JAB
APP. BY: JAB

ORCHARD STREET
LOT E-3AA ORCHARD STREET
LOT S-54 HEBRON AVENUE
GLASTONBURY, CONNECTICUT
SITE PLAN

REVISIONS

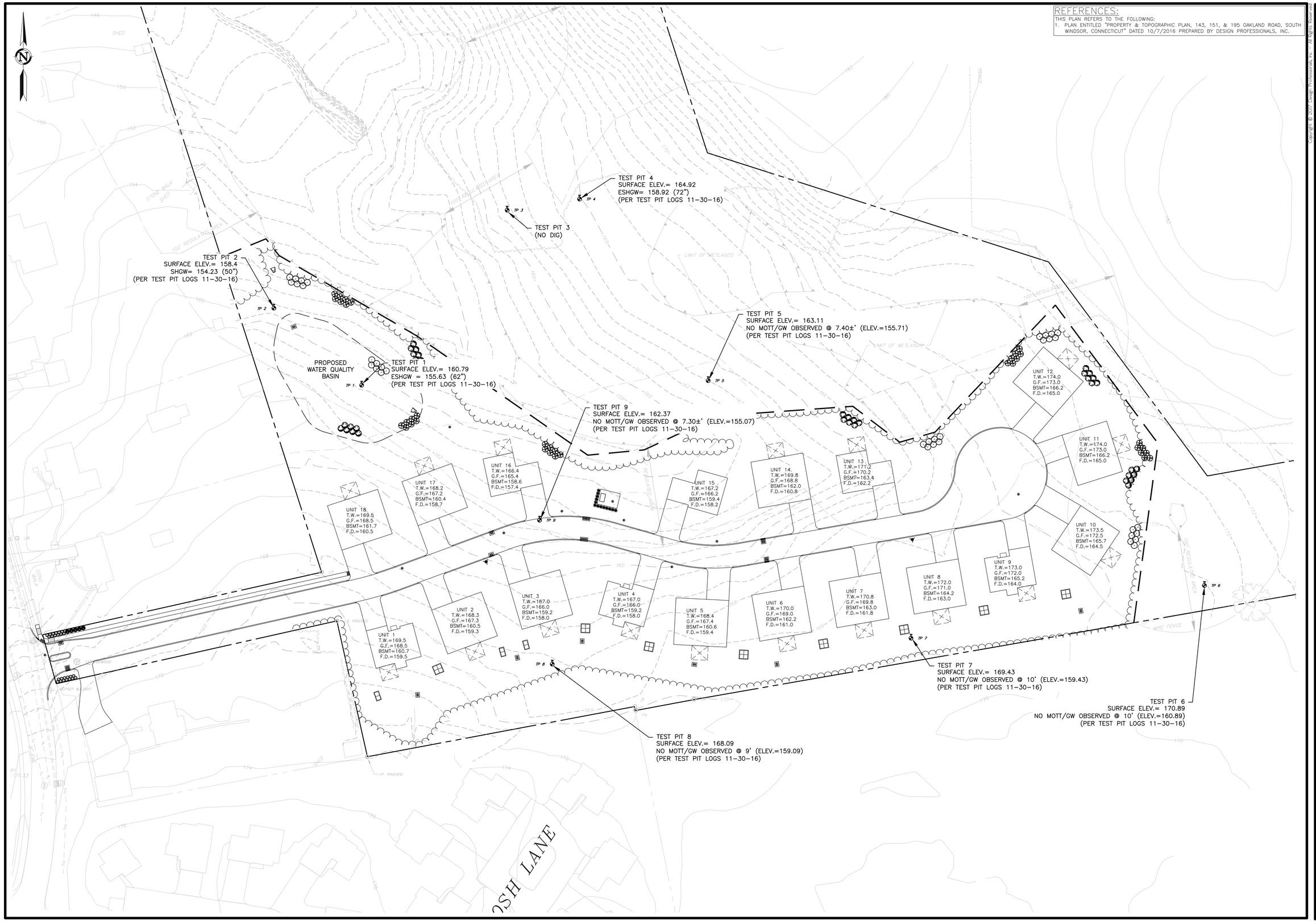
NO.	DATE	REV. FOR IWWC SUBMISSION	BY
1	7/12/17		

PROPOSED CONDITION DRAINAGE MAP

SCALE: 1" = 80' (0 40 80' 160')

SHEET
C-DR2
SHEET 2 OF 3

File: C:\jobs\3628\Stormwater\2017-07-12\3628 - Drainage Plan-2017-07-12.dwg Layout: 02 C-DR2 Plotted: 7/12/2017 1:35 AM Last Saved: 7/12/2017 10:51 AM Last Saved By: daniel.jameson



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Prepared for:
ROBERT URSO
128-3 ARTHUR DRIVE
SOUTH WINDSOR, CT 06074

PROJECT NO.	3628
DATE	7-12-2017
SCALE	1"=40'
DRAWN BY	
CHK'D BY	JAB

ORCHARD STREET
LOT E-3AA ORCHARD STREET
LOT S-54 HEBRON AVENUE
GLASTONBURY, CONNECTICUT
SITE PLAN

REVISIONS

NO.	DATE		BY
1	7/12/17	REV. FOR IWWC SUBMISSION	

TEST PIT EXHIBIT

SCALE: 1" = 40'
0 20' 40' 80'

SHEET
C-TP1
SHEET 3 OF 3

File: C:\jobs\3628\Stormwater\2017-07-12\3628 - Drainage Plan-2017-07-12.dwg Layout: 03 C-TP1 Plotted: 7/12/2017 10:41 AM Last Saved: 7/12/2017 10:39 AM Last Saved By: daniel.jameson

~~Recommend~~:

11.30.16 BOB URSO 11.30.16
ORCHARD ST.
SOIL TESTS

TP#1

0-17 F.S.L TOPSOIL
A-Horiz 17-24 FSL ~~SILT LOAM~~ - LOOSE FRIABLE
24-36 COMPACT/DENSE SILT LOAM
SOME ROOTS
36-52 COMPACT MED. SAND
52-70 COARSE SAND + SOME COBBLES
70-88 FINE SANDS FRIABLE
62" SOME ROOTS / END

≈36" LOW CHROMA (3 or 4) SIGNS OF PERCHED TABLE:
ESHGW 62"

TP#2

0-10" FSL TOP SOIL
10-31 VFSL TRACE SILT
31"-53 DENSE SANDY LOAM
w/ MOTTLING @ 50"
53'-82 de composed SHALE / SHIST
- ROOT ZONE LIMIT 52"
ESHGW @ 50"

TM
11-30-16

TP#3 NOT DUG

2 of 3
11.30.16

TP#4

0-8" ~~*~~ S.L TOP SOIL
8"-38 Compact (somewhat)
VFSL.
38"-62" SILT LOAM
62"-92 MED. COARSE SAND
72" END OF ROOT ZONE.
72" MOTTLING ALSO

TP#5
0"-11" VFSL - TRACE SILT.
SL TOP SOIL
11"-24 VFSL
24"-44" FINE MED SANDY LOAM
44" → LOW CHROMA MOTTLING - SHGW
44"-89" SILT LOAM
60" ROOT ZONE END

TM
11-30-16

11.30.16

TP#9

0-14"	FSL. trace silt
14-25"	FSL- Sub soil
25"-42"	Compact Fin Sandy loam trace silt
42"-82	~~Fine~~ Silty loam/Dense 72-Gas Root zone
82-88	Coarse Sand

Root Top shallow infiltration around here

→ TP#8 Sandy - ~~[illegible]~~ Deep.

TM
11-30-16

GLASTONBURY FOR 3628
BOBBY 11-30-16

TH #10 TP. NEAR TRAV 4 8' DEEP
→ LOOSE + GRAVELY SAND LITTLE FINES
→ STABLE TRENCH
→ NO EVIDENCE OF G.W OR MOT.
→ NO LEDGE

TH #11 TP NEAR TRAV 16 (20' NORTH)
→ TOP 3'-4' MEDIUM DENSE SANDY GRAVEL W/ FINES
→ 4.5' HARD PAN (VERY DENSE BREAK AGLE)
→ NO MOTT / G.W

TP 6 (10' OFFSET WEST)
→ MEDIUM DENSE GRAVELY SAND W/ FINES 3-5'
→ LOSE SANDY GRAVEL LITTLE ↓ FINES 10' DEEP
→ NO MOTT / G.W
→ STABLE TRENCH

TH #7 TP-7 (10' OFFSET EAST)

3'-4' → LOSE SAND GRAVEL

5'-6' → GRAVELY ~~MED~~ SAND

↓ DENSE (BREAKABLE)

10' DEEP

→ NO MOTT / G.W.

→ STABLE TRENCH

TH #8 TP-8

1-2' MEDIUM SAND W/ LITTLE FINES

2-5' GRAVELY SAND SLIGHT DENSE

5'-9' SANDY GRAVEL LOSE

→ NO MOTT / G.W.

→ STABLE TRENCH

ORCHARD STREET GLASTONBURY

GROUNDWATER READINGS						
STAND PIPE #	**1**	**EX. GROUND ELEVATION**	**160.8**			
HEIGHT OF STAND PIPE	3.4	**FT**				
TO BOTTOM OF STAND PIPE	9.55	**FT**				
ELEV TOP OF PIPE	**164.2**					
DATE	**TOP STAND PIPE TO GW (FT)**	**GROUND WATER ELEV**	**NOTES**			
2/8/2017	9.55	154.65	NO GW OBSERVED			
2/16/2017	9.55	154.65	NO GW OBSERVED			
2/23/2017	9.55	154.65	NO GW OBSERVED			
3/1/2017	9.55	154.65	NO GW OBSERVED			
3/8/2017	9.55	154.65	NO GW OBSERVED			
3/13/2017	9.55	154.65	NO GW OBSERVED			
3/20/2017	9.55	154.65	NO GW OBSERVED			
3/28/2017	9.55	154.65	NO GW OBSERVED			
4/5/2017	8.8	155.4	WATER			
4/11/2017	8.2	156	WATER			
4/18/2017	8.6	155.6	WATER			
5/2/2017	8.7	155.5	WATER			
5/9/2017	8.7	155.5	WATER			

ORCHARD STREET GLASTONBURY

GROUNDWATER READINGS						
STAND PIPE #	**2**	**EX. GROUND ELEVATION**	**158.4**			
HEIGHT OF STAND PIPE	3.1	**FT**				
TO BOTTOM OF STAND PIPE	9.7	**FT**				
ELEV TOP OF PIPE	**161.5**					
DATE	**TOP STAND PIPE TO GW (FT)**	**GROUND WATER ELEV**	**NOTES**			
2/8/2017	9.6	151.9	GW OBSERVED			
2/16/2017	9.6	151.9	GW OBSERVED			
2/23/2017	9	152.5	GW OBSERVED			
3/1/2017	7.9	153.6	GW OBSERVED			
3/8/2017	8.2	153.3	GW OBSERVED			
3/13/2017	8.6	152.9	GW OBSERVED			
3/20/2017	8.2	153.3	GW OBSERVED			
3/28/2017	6.7	154.8	GW OBSERVED			
4/5/2017	5.6	155.9	GW OBSERVED			
4/11/2017	5	156.5	GW OBSERVED			
4/18/2017	6.3	155.2	GW OBSERVED			
5/2/2017	6.3	155.2	GW OBSERVED			
5/9/2017	6.3	155.2	GW OBSERVED			

ORCHARD STREET GLASTONBURY

GROUNDWATER READINGS						
STAND PIPE #	**4**	**EX. GROUND ELEVATION**	**164.9**			
HEIGHT OF STAND PIPE	2.9	**FT**				
TO BOTTOM OF STAND PIPE	9.8	**FT**				
ELEV TOP OF PIPE	**167.8**					
DATE	**TOP STAND PIPE TO GW (FT)**	**GROUND WATER ELEV**	**NOTES**			
2/8/2017	9.8	158	NO GW OBSERVED			
2/16/2017	9.8	158	NO GW OBSERVED			
2/23/2017	9.8	158	NO GW OBSERVED			
3/1/2017	9.8	158	NO GW OBSERVED			
3/8/2017	9.4	158.4	GW OBSERVED			
3/13/2017	9.3	158.5	GW OBSERVED			
3/20/2017	9.3	158.5	GW OBSERVED			
3/28/2017	8.3	159.5	GW OBSERVED			
4/5/2017	6	161.8	GW OBSERVED			
4/11/2017	5	162.8	GW OBSERVED			
4/18/2017	5.2	162.6	GW OBSERVED			
4/25/2017	5.6	162.2	GW OBSERVED			
5/2/2017	5.6	162.2	GW OBSERVED			
5/9/2017	5.1	162.7	GW OBSERVED			

ORCHARD STREET GLASTONBURY

GROUNDWATER READINGS						
STAND PIPE #	**9**	**EX. GROUND ELEVATION**	**162.4**			
HEIGHT OF STAND PIPE	1.5	**FT**				
TO BOTTOM OF STAND PIPE	8.2	**FT**				
ELEV TOP OF PIPE	**163.9**					
DATE	**TOP STAND PIPE TO GW (FT)**	**GROUND WATER ELEV**	**NOTES**			
2/8/2017	8.2	155.7	NO GW OBSERVED			
2/16/2017	8.2	155.7	NO GW OBSERVED			
2/23/2017	8.2	155.7	NO GW OBSERVED			
3/1/2017	8.2	155.7	NO GW OBSERVED			
3/8/2017	8.2	155.7	NO GW OBSERVED			
3/13/2017	8.2	155.7	NO GW OBSERVED			
3/20/2017	8.2	155.7	NO GW OBSERVED			
3/28/2017	7.3	156.6	GW OBSERVED			
4/5/2017	7.9	156	GW OBSERVED			
4/11/2017	8.2	155.7	NO GW OBSERVED			
4/18/2017	8.2	155.7	NO GW OBSERVED			
4/25/2017	8.2	155.7	NO GW OBSERVED			
5/2/2017	8.2	155.7	NO GW OBSERVED			
5/9/2017	8.2	155.7	NO GW OBSERVED			

MATERIALS TESTING, INC.

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42 BOSTON POST ROAD • WILLIMANTIC, CONNECTICUT 06226 • (860) 423-1972

DATE: 01-13-17

REPORT: M-1000

CLIENT: Design Professionals, Inc.
PO Box 1167
South Windsor, CT 06074
Attn: Mr. James A. Bernardino, P.E.

PROJECT: Glastonbury Project

SUBJECT: **PERMEABILITY OF GRAVEL MATERIALS (Falling Head)**

Listed below are the results of laboratory run permeability tests performed on soil samples delivered to our facility on 1/10/17.

Sample Location	Recompacted Percentage	Average Permeability Ft/Day (4 Runs)
Onsite Test Pit #1	85%	0.23 ft/day
Onsite Test Pit #3	85%	9.33 ft/day
Onsite Test Pit #9	85%	21.34 ft/day

Attached to this report are the results of the modified proctors (ASTM D-1557) used to determine recompacted percentages at 85%.

Materials Testing, Inc., Inspector
Richard C. Kearns

William J. Soucy

STATE OF CONNECTICUT
M. S. RAVI SHARMA
No. 28322
LICENSED
PROFESSIONAL ENGINEER

1/18/17

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www.materialstestinginc.com

CLIENT: Design Professionals, Inc.
PO Box 1167
South Windsor, CT 06074
Attn: Mr. James A. Bernardino, P.E.

DATE: January 11, 2017

REPORT # M-1001

PROJECT: Glastonbury Project

SUBJECT: Modified Proctor Analysis, ASTM D-1557-C

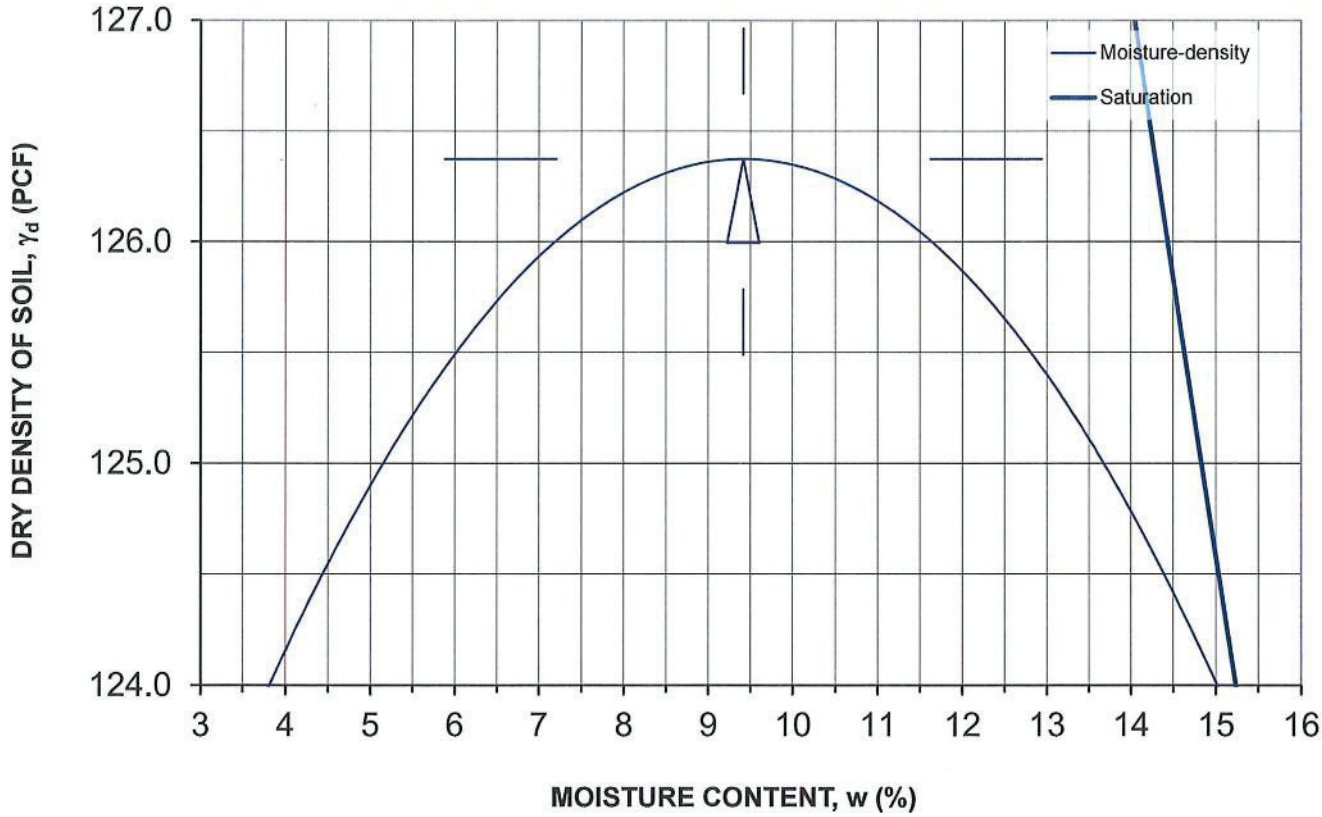
MATERIAL: Sandy Gravel

SOURCE: Onsite Test Pit #1

SAMPLED BY: Client and delivered to MTI

RECEIVED: January 10, 2017

MAXIMUM DRY DENSITY: 126.4 PCF @ 9.4% 15% Plus 3/4"



Materials Testing, Inc.

William J. Soucy

STATE OF CONNECTICUT
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CLIENT: Design Professionals, Inc.
PO Box 1167
South Windsor, CT 06074
Attn: Mr. James A. Bernardino, P.E.

DATE: January 11, 2017

REPORT # M-1002

PROJECT: Glastonbury Project

SUBJECT: Modified Proctor Analysis, ASTM D-1557-C

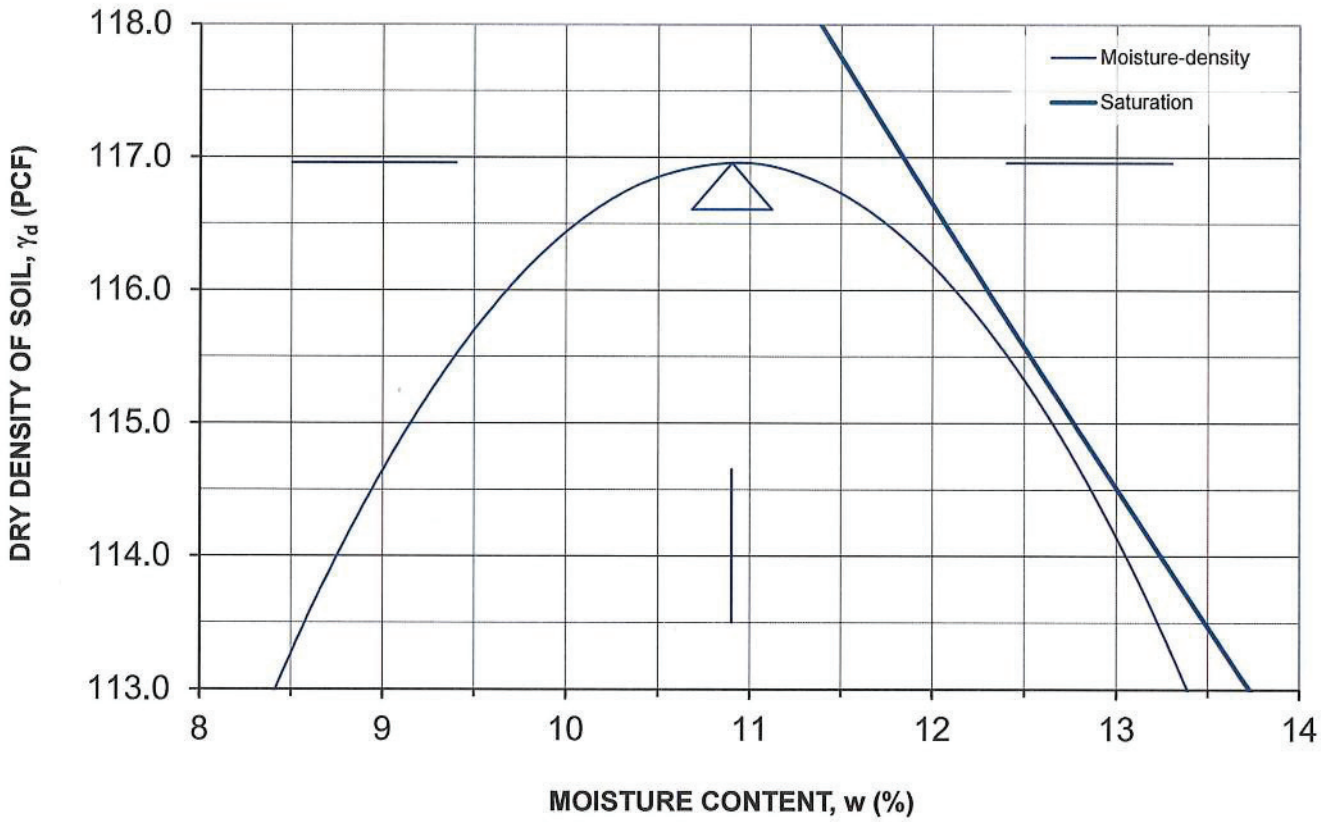
MATERIAL: Sandy Gravel

SOURCE: Onsite Test Pit #3

SAMPLED BY: Client and delivered to MTI

RECEIVED: January 10, 2017

MAXIMUM DRY DENSITY: 117.0 PCF @ 10.9% 2% Plus 3/4"



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STATE OF CONNECTICUT
M. S. RAVI SHARMA
No. 28322
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www.materialstestinginc.com

CLIENT: Design Professionals, Inc.
PO Box 1167
South Windsor, CT 06074
Attn: Mr. James A. Bernardino, P.E.

DATE: January 11, 2017

REPORT # M-1003

PROJECT: Glastonbury Project

SUBJECT: Modified Proctor Analysis, ASTM D-1557-C

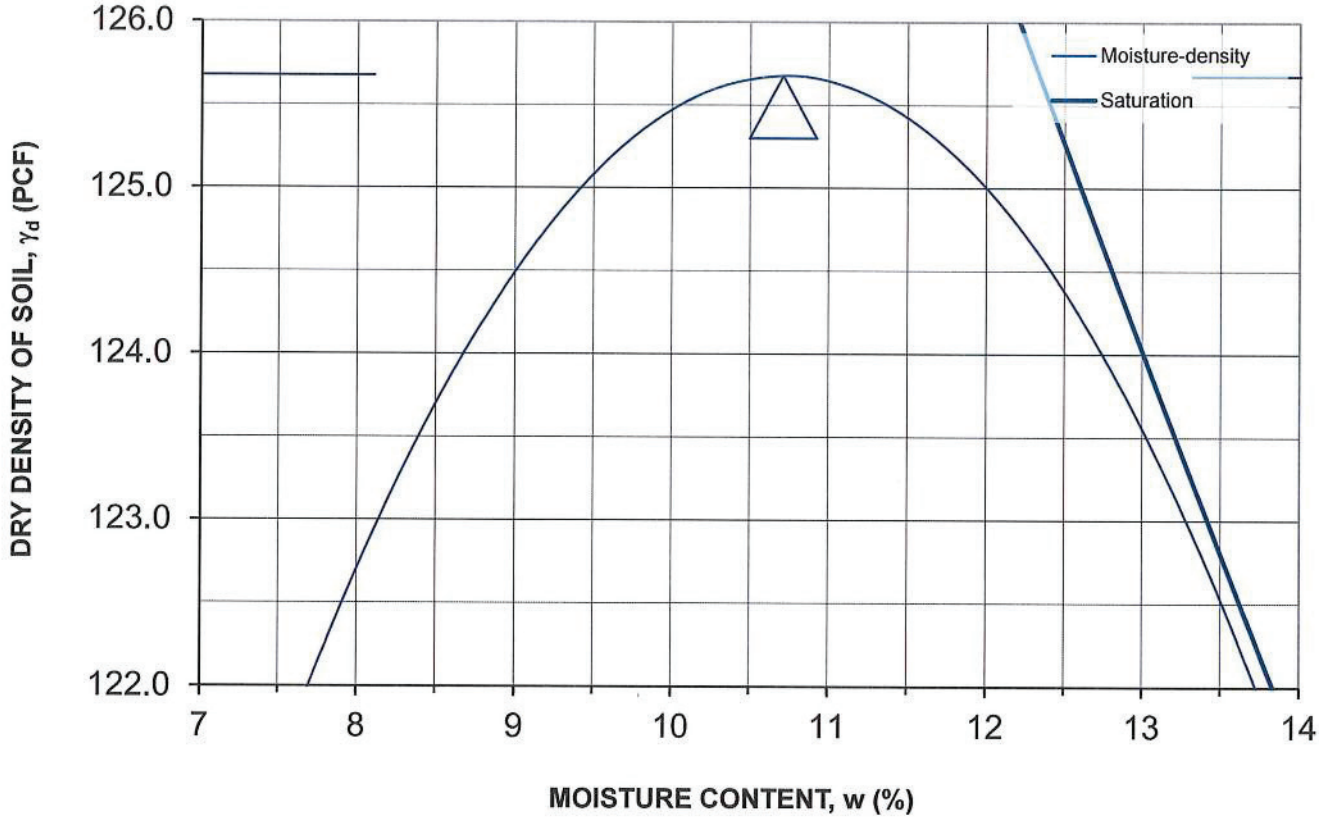
MATERIAL: Sandy Gravel

SOURCE: Onsite Test Pit #9

SAMPLED BY: Client and delivered to MTI

RECEIVED: January 10, 2017

MAXIMUM DRY DENSITY: 125.7 PCF @ 10.7% 1% Plus 3/4"



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William J. Soucy

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No. 28322
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1/18/17

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APPENDIX H
Outlet Protection Calculation Sheets

Glastonbury Glen Multi-Family Development – DPI Project No.:3628
9/18/2017

CONNDOT Rip-Rap Apron Design Calcs (Type A)

Type A - No Tailwater Condition
Type B - High Tailwater Condition
Type C - Discharge to Well Defined Channel

Inside Culvert Diameter (FT)	**1.5**
Design Flow (CFS) - 25 YR STORM	**7.1**
Design Velocity (FPS) - 25 YR STORM	**4.64**
Tail Water (height above invert - FT)	0
Required Length (FT)	**12.06**
Required Width 1 (UPSTREAM - FT)	**4.50**
Required Width 2 (DOWNSTREAM - FT)	**12.94**

*Minimum apron width should be at least three times the culvert diameter

Allowable Rip-Rap

Velocity (FPS)	Rip Rap Specification
0-8	Modified
8-10	Intermediate
10-14	Standard

Type A Riprap Apron (Minimum Tailwater Condition) **TW < 0.5 R_p**

$$L_a = \frac{3.26(Q-0.142)}{S_P^{1.5}} + 3.05 \qquad \left(L_a = \frac{1.80(Q-5)}{S_P^{1.5}} + 10 \right) \quad (11.31)$$

Type A Riprap Apron (Minimum Tailwater Condition)

$W_1 = 3S_p$ (min.)

$W_2 = 3S_p + 0.7L_a$ for TW < 0.5 R_p (11.33)

Pipe (25YR STORM) Velocity Calcs

Reference : Engineers Edge, Solotions By Design
http://www.engineersedge.com/fluid_flow

Inputs

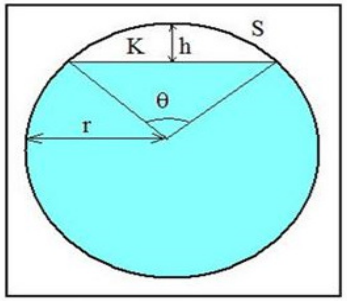
Pipe Diameter, **D** =	18	in
Depth of flow, **y** =	14.55	in

(must have y ≥ D/2)

Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, **S** =	0.0056	ft/ft

Calculations

n/n_{full} =	1.0958333
Partially Full Manning roughness, **n** =	0.014



r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

V = Q/A

Calculations

Pipe Diameter, **D** =	1.5	ft
Pipe Radius, **r** =	0.75	ft
Circ. Segment Height, **h** =	0.287	ft
Central Angle, **q** =	1.81	radians
Cross-Sect. Area, **A** =	1.53	ft^2
Wetted Perimeter, **P** =	3.4	ft
Hydraulic Radius, **R** =	0.46	ft
Discharge, **Q** =	7.10	cfs
Ave. Velocity, **V** =	4.64	ft/sec
pipe % full [(A/A_{full})*100%] =	86.6%	

Glastonbury Glen Multi-Family Development – DPI Project No.:3628

9/18/2017

CONNDOT Preformed Scour Pad Design Calcs (Type 1)

Inside Culvert Diameter (FT)	**2**
Design Flow (CFS) - 25YR STORM	**12.6**
Tail Water (height above invert - FT)	0.2
*TW = 0.1 Inside Diameter	
Rip-Rap d50 requirements (FT)	**0.46**
*Max Stone sized: d50 x 1.5	
Rip Rap Specification	d50 Range (FT)
Modified	0-0.42
Intermediate	0.42-0.67
Standard	0.67-1.25
Special Design	1.25+

Storm Drainage Systems 11.13-5

Empirical Preformed Scour Hole Equations:

Type 1: Scour Hole Depression = one-half pipe rise, m (ft)

$$d_{50} = (0.0276\, R_p^2 / TW)\,(Q/R_p^{2.5})^{1.333} \qquad \left(d_{50} = (0.0125 R_p^2/TW)\,(Q/R_p^{2.5})^{1.333} \right) \qquad \textbf{(11.35)}$$

Type 2: Scour Hole Depression = full pipe rise, m (ft)

$$d_{50} = (0.0181\, R_p^2 / TW)\,(Q/R_p^{2.5})^{1.333} \qquad \left(d_{50} = (0.0082 R_p^2/TW)\,(Q/R_p^{2.5})^{1.333} \right) \qquad \textbf{(11.36)}$$

d_{50} = median stone size required, m (ft)

* Deminstions Based on Town of Glastonbury Detail (see plan sheet C-D2)

Operation and Maintenance Plan

Glastonbury Glen

Lot E-3AA Orchard Street &
Lot S-54 Hebron Avenue
Glastonbury, CT

Prepared for:

Horseshoe Lane Associates, LLC
18-3 Arthur Drive
South Windsor, CT

Prepared by:

Design Professionals, Inc.
21 Jeffrey Drive
South Windsor, CT

September 18, 2017

STORM DRAINAGE SYSTEM MAINTENANCE AND OPERATIONS

Responsible Party: Glastonbury Glen Homeowners Association:

The following maintenance shall be required to ensure efficient operation of the storm drainage system detention basin and/or underground basins. The maintenance schedule is intended to be a guide. An inspection of all storm drainage components is required following large storm events (0.5 inches or greater) that could cause the deposition of excess debris.

Pipe outlet locations:

Pipe outlets shall be inspected annually and cleaned of silt and/or debris. riprap shall be re-shaped and replenished as required.

Catchbasins:

Catchbasins shall be inspected annually and sumps cleaned when depth of material reaches twelve inches.

Water Quality Basins and Sediment Forebays:

WQB's and forebays shall be inspected biannually. All large woody, non-landscape growth that may affect the flow of water or the stability of the basin shall be removed. Riprap shall be re-arranged and added to as required. Any erosion or other problems that may affect the proper operation of the basin shall be repaired promptly. Accumulated sediment shall be removed.

SITE MAINTENANCE AND OPERATIONS

Pavement Sweeping:

Pavement areas shall be swept at least twice per year. Once in the spring shortly after the end of the snow season, and in the fall after the leaves have fallen.

Snow Removal:

Snow Removal will be the responsibility of the home owner's association. All roadways and driveways will be plowed onto roadway shoulders. Walkways will be shoveled or snow thrown onto roadway shoulders and/or lawn areas. Roadway shoulders and site lawn areas are to be used for snow storage in such a manner as to not impede site access,

roadway sight lines or cause damage to buildings and/or landscaping. In no instance shall snow be stored or placed within the projects detention basin or any onsite wetland or impede the access to the onsite sewer pump station. At such time that snow can no longer be reasonably stored onsite, it shall be removed from the property and disposed of in accordance with local, state and federal regulations.

MEADOW MAINTENANCE

First Growing Season:

- Whenever canopy (overall vegetation) reaches a height of 18”- trim the meadow to a height of 8” (Note: A lawn mower is not recommended as the mower height will be too low and native seedlings will be killed). This will reduce competition by fast-growing weeds for sunlight, water and nutrients needed by slow-growing perennial natives. Mowing should cease by mid-September.
- For seedings of annual wildflower mixes or annual & perennial wildflower mixes, problem weeds should be hand pulled.
- Problem weeds should be hand pulled or spot sprayed with approved herbicides (such as Roundup® or Rodeo®).

Second Growing Season:

- Prior to new spring growth reaching a height of 2” (e.g., shortly after forsythia or redbud blooms), trim any material standing from the previous year close to the ground (approximately 2”). This will allow the soil to warm more quickly, which will stimulate the emergence and growth of native seedlings and reduce the likelihood of the meadow being invaded by shrubs.
- Problem weeds should be hand pulled or spot sprayed with an approved herbicide.

On-going Maintenance:

- Native Meadow shall be bush-hogged between November 1 and March 1 at least every other year, but not more than once per year.
- Access to the meadow for maintenance purposes shall be along the path designated on the approved site plans.

Special Circumstances:

If you notice a heavy infestation of ragweed or foxtail in the second growing season, trim the meadow to a height of 8”. Trimming should cease by mid-September.

WATER QUALITY SEED MIX MAINTENANCE

First Growing Season:

Whenever canopy (overall vegetation) reaches a height of 18”-24”, use a brush hog mower or string trimmer to trim the meadow to a height of 8” (Note: A lawn mower is not recommended as the mower height will be too low and native seedlings will be killed). This will reduce competition by fast-growing weeds for sunlight, water and nutrients needed by slow-growing perennial natives. If bioengineering or containerized woody materials are used on the site, mowing should be above the new growth of these materials. Mowing should cease by mid-September.

- Problem weeds should be hand pulled or spot sprayed with an approved herbicide (such as Rodeo®).

Second Growing Season:

- Prior to new spring growth reaching a height of 2” (e.g., shortly after forsythia or redbud blooms), trim any material standing from the previous year close to the ground (approximately 2”). This will allow the soil to warm more quickly, which will stimulate the emergence and growth of native seedlings. It will also reduce the likelihood of the meadow being invaded by shrubs.

- If bioengineering or containerized woody materials were used on the site or seed of shrubs/trees were part of the mix, the site should not be trimmed after the establishment year.

- Problem weeds should be hand pulled or spot-sprayed.

Special Circumstances:

If you notice a heavy infestation of ragweed or foxtail in the second growing season, trim the meadow to a height of 8”. If bioengineering or containerized woody materials were used, trimming should be above or around new growth of the plants. Trimming should cease after mid-September.

General Maintenance:

In addition to structural maintenance, siltation needs to be removed as needed. Close mowing or extensive chemical use is not conducive to water quality improvement and wildlife habitat.

SANITARY SEWER MAINTENANCE

Sanitary Sewer Line and manhole Inspection Schedule: Sanitary manholes shall be inspected once every two years for any blockage within the structure. Should blockage be observed, corrective measures shall be taken to remove the blockage (ie manual removal, jetting) to assure unobstructed flow.

Pump Station: At a minimum, the Pump Station shall be inspected monthly to report any blockage/debris, loose and/or parts and repair as necessary. Components shall be inspected and replaced/repaired if necessary per the manufactures recommendation.

Back up Emergency Generator: Back up emergency generator shall be tested monthly to assure standby power is available. Ongoing and routine maintenance shall be performed per the manufactures recommendations of the provided unit.

Consulting
Engineers and
Scientists

Draft Environmental Impact Statement Report

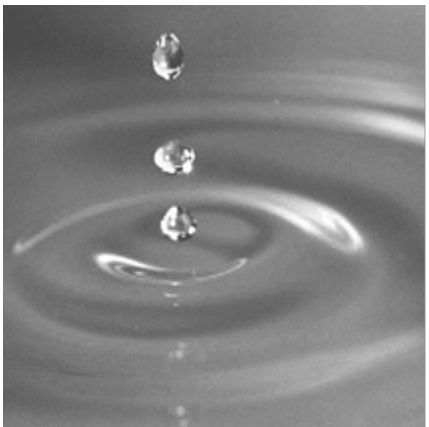
Glastonbury Glen

Glastonbury, Connecticut

Prepared For:
Horseshoe Lane Associates, LLC
18-3 Arthur Drive
South Windsor, CT 06704

Prepared by:
GEI Consultants, Inc., P.C.
455 Winding Brook Drive
Glastonbury, CT 06033
860-368-5300

July 2017
Project # 1702010



Frederick W. Johnson, LEP
Sr. Vice President/Principal

John Gondek
Ecotoxicologist

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1. Introduction

On behalf of Horseshoe Lane Associates, LLC, GEI Consultants, Inc. (GEI) has prepared this Environmental Impact Statement report for the proposed development, Glastonbury Glen, located on Lot E-3AA Orchard Street and a portion of Lot S-54 Hebron Avenue in Glastonbury, Connecticut (subject property or site). This report will be submitted as a component of the application to the Town of Glastonbury Conservation Commission/Inland Wetlands and Watercourses Commission. Other reports prepared by Design Professional, Inc. (DPI) and GEI as part of this application are referenced herein but are not included as appendices to this report. The reader is therefore directed to review the full application package for these references.

2. Site Description

2.1 Proposed Development Description

As described in the Site Plan prepared by DPI, the Applicant, Horseshoe Lane Associates, LLC is under agreement with the property owner, Catholic Cemeteries Association of the Archdiocese of Hartford, Inc, to acquire lot E-3AA and a portion of lot S-54 for the Orchard Street and Hebron Avenue parcels, respectively, consisting of 15.5 acres to be used for the proposed development.

The development includes the construction of 18 single-family homes, a private road, water and sewer connections, and construction of a detention basin for stormwater management. A total of 5.8 acres of this parcel would be disturbed, while the remaining 9.45 acres will be placed as a conservation easement. Approximately 100,000 square feet (2.296 acres) of this disturbance will be within the 100-foot upland review area extending from the wetlands on site. A detailed description and maps of the proposed development are provided within the Site Plans developed by DPI.

2.2 Physical Setting

The parcel proposed for development consists of forested uplands and wetlands, and recently cleared uplands. The subject property is surrounded by residential homes to the west and south, active farmland to the east, and by State Route 94 to the north. The elevation of the property is lower than its adjacent neighbors and gradually descends to its lowest point at its northern border from the higher ground in the south.

3. Natural Resources

As part of the Wetlands Functions & Values Report prepared by GEI, two site surveys were performed, in April and May 2017, to assess the plant and wildlife community throughout the site. A list of the flora and fauna observed on site and a comprehensive description of the wetlands are included within the Wetlands Functions & Values Report prepared by GEI. Two additional site visits were made in June and July 2017, and the findings from those surveys are presented herein.

3.1 Geology and Water Resources

The site includes hydric and nonhydric soil and is primarily underlain by Hartford sandy loam (33), Wethersfield Loam (87B), Ninigret and Tisbury soils – fine sands and sandy loams (21A), and Raypol-Silt Loam (12) soils, based on mapping from Natural Resources Conservation Service (NRCS). The bedrock in this region is classified as Jp - Portland Arkose: reddish-brown arkose (brownstone). As provided in the Drainage Report prepared by DPI, these soil descriptions were found to be consistent with results of soil testing performed on site.

The largest of the wetland complexes on site contains a functioning ephemeral stream with a defined bank and substrate which flows north to the terminus of the property. The nearest surface waterbodies include Salmon Brook to the north, across State Route 94, and an unnamed tributary to Hubbard Brook to the south; both streams are Class A surface waterbodies. The groundwater in this location is classified as GA.

3.2 Flora and Fauna

The palustrine-forested wetlands are comprised of three complexes; two smaller wetlands to the northeast, and one larger complex along of the western boundary of the site. In total, wetlands account for 3.26 of the 15.5 acres of the property. The two smaller wetlands in the eastern half of the property that are isolated from the larger complex, and are likely fed by runoff water from the adjacent properties, while the larger complex is likely supplied by groundwater, in addition to the surface runoff. No Critical Habitats were identified on, or in the vicinity, of the site.

The wetlands included a mix of facultative upland, facultative wet, and obligate species, separated by transitional wooded uplands. Native plant species were found to be more abundant within the largest wetland complex, dominated by skunk cabbage (*Symplocarpus foetidus*) and northern spicebush (*Lindera benzoin*) along the open floodplain of the perennial stream. While invasives species, such as Asiatic bittersweet (*Celastrus orbiculatus*) and burningbush (*Euonymus alatu*), were found throughout the property, they were more concentrated along the southern portion of the parcel within the footprint of the proposed development.

The wetlands on site primarily function as an active wildlife corridor within a developing watershed, providing foraging and breeding habitat for wildlife within an otherwise suburban area. The wetlands and uplands support a number of bird species, such as American crow (*Corvus brachyrhynchos*), black-capped chickadee (*Poecile atricapillus*), northern flicker (*Colaptes auratus*), and gray catbird (*Dumetella carolinensis*). The species identified on site are generalists and were expected for this type of habitat. These species are able to utilize a variety of habitats and are tolerant of human disturbance and habitat fragmentation. In addition to the avifauna, numerous game trails, white-tailed deer (*Odocoileus virginianus)*, eastern chipmunk *(Tamias striatus*), and eastern gray squirrel (*Sciurus carolinensis*) were also observed on site. These mammals, too, are typical of suburban habitat and are tolerant of human disturbance. During the site visits conducted by GEI, no reptiles or adult amphibians were observed on the property.

The small perennial stream is unlikely to support a large benthic invertebrate community. A limited effort was conducted during the April and May site visits to document the presence of benthic invertebrates (e.g., overturning rocks), however, none were observed. A single adult crane fly (*Tipulidae*) was observed within the wetlands around the stream, but otherwise, the stream did not appear to support the breeding and development of semi-aquatic insects typically associated with benthic invertebrates. The perennial stream, therefore, does not provide foraging habitat for wetland specialist birds, such as waders, which depend upon benthic invertebrates for a large portion of their diet.

A 2.5-acre portion of the uplands, adjacent to the active farmland along the northeastern corner of the property, has been cleared or has historically been used for logging. This area includes an early successional plant community, and numerous fallen trees, stumps, and other plant debris are scattered throughout this area. In its current state, this area provides limited value to wildlife, and is vulnerable to pioneering invasive species.

3.3 Vernal Pool

During the April and May site visits, a small pocket wetland located near the southeastern corner of the property was found to contain wood frog tadpoles (*Rana sylvatica*). This area may function as a vernal pool and provides a unique habitat for amphibians occurring on the property. No other vernal pool obligate species (e.g., fairy shrimp) were observed during these two site visits.

GEI returned to the vernal pool on June 23, 2017 and it was found to have dried up. While vernal pools are generally seasonal, they must retain water long enough to support the breeding *and* development of vernal pool obligate species. Given that wood frogs typically take two to four months to develop and disperse from a vernal pool, the vernal pool on site may retain water close to the minimum amount of time needed to support the development of wood frogs. As such, the small size of this vernal pool and the fact it is in unlikely to remain active during the full amphibian breeding season, suggests this pool may provide limited function and value.

3.4 Threatened and Endangered Species

In addition to the functions and values assessment, the site was also evaluated by GEI for the presence of three state-listed species identified in the preliminary Connecticut Department of Energy & Environmental Protection (CT DEEP) Natural Diversity Data Base review (NDDB; NDDB Preliminary Assessment No.: 201703283 April 18, 2017) for the property. These included one plant, Climbing fern (*Lygodium palmatum*), and two vertebrate species, American brook lamprey (*Lethenteron appendix*), and eastern box turtle (*Terrapene carolina carolina*). However, only the climbing fern and box turtle would potentially occur on site as there is no available habitat for the lamprey.

During the original surveys by GEI, climbing fern was not observed on site. It is our understanding that a known population of this listed species occurs near the site, to the south. On July 11, 2017, GEI performed an additional targeted search for this species, focusing efforts along the southern and eastern borders of the property and within the footprint of the proposed developed. Climbing fern was, again, not observed on site.

Eastern box turtle was not observed during the any of the GEI surveys. The wooded wetlands and forested uplands may however provide suitable habitat for the turtle, and thus, should be considered as potentially occurring on site.

4. Impacts and Mitigation

It is our understanding that DPI has incorporated a number of modification into the proposed development (since the original design) to minimize impacts to onsite and offsite resources, based upon discussion with GEI and the Town of Glastonbury. The following subsections describe the activities and/or resources that may occur on site, and proposed actions to be taken to mitigate impacts from the development of this property.

4.1 Construction Activities

All construction activities will be conducted outside of the wetlands, and thus, no direct disturbances are expected to this resource. The wetlands may still be impacted by stormwater runoff, sedimentation, and modifications to groundwater levels and flow. These impacts may occur during clearing and grading, excavation, stockpiling, sewer connection, and construction activities.

To mitigate and/or eliminate these effects, a comprehensive Stormwater Management Plan and Erosion and Sediment Control Plan, submitted as part of the Site Plans by DPI, were developed. Measures to be implemented during construction include,

- Construction of temporary sediment traps and stone check dams;
- Silting fencing around the perimeter;
- Stone construction exit from the site;
- Catch basin inlet filter protection;
- Construction of diversion swales;
- Construction and fill materials will be processed or clean virgin materials sourced from local areas;
- No vehicles or heavy machinery are to be parked in the wetlands.

4.2 Stormwater Management

To mitigate potential long-term impacts post-construction, a comprehensive stormwater collection, conveyance, and treatment system, including construction of a stormwater retention basin, has been proposed. In total, 1.896 acres (12.2 percent) of impervious area will exist on site following construction.

As described in the Site Plan, the stormwater management plan includes roof top infiltration practices, deep sump catch basins, a sediment forebay, and extended detention basin that will provide mitigation for the runoff generated from the proposed development. The operation and maintenance of this system is included within the Site Plan as well. Overall, the system should provide adequate protection of the wetlands, based on the results of the drainage analysis and report which demonstrate the development's consistency with local and state regulations. No long-term impacts are anticipated to infiltration and groundwater recharge, and connection to the public utilities (sewer and water) are not anticipated to result in dewatering of the wetlands.

The proposed detention basin, under normal operating conditions and maintenance, will mitigate impacts to water quality and maintain the existing functions and values of the receiving wetlands. The design of the basin should also include native water-tolerant plant species to further aide in the removal of nutrients, sediments, and to improve the overall habitat available on site.

4.3 Habitat Protection and Enhancement

It is our understanding that originally, 11.56 acres of land were to be purchased for the planned development. Subsequently, a total of 15.532 acres are ultimately to be purchased, with no additional units added from the original design, resulting in an additional 3.972 acres for conservation. The open space on site will be protected as a conservation easement totaling 9.45 acres, or approximately 61 percent of the subject property.

Based on discussion with the Town of Glastonbury, adjustments were also made to the design of the curvature of the private road to provide a greater area between the wetlands and proposed development.

The footprint of the proposed development is located in an upland portion of the site (i.e., the southern boundary) where invasive species are presently abundant. Clearing of this area for construction presents an opportunity to remove and eliminate a portion of the invasive species on site. Similarly, the small amount solid household waste that is present in this portion of the site will be removed during clearing activities. Overall, the proposed development may improve the current viewscapes of the wetlands and reduce the spread of invasive species throughout the subject property.

The fauna documented utilizing the site were typical of suburban environments and are generally tolerate of human disturbance. While there may be short-term impacts to wildlife on site, such as from noise-related disturbances, these species are expected to continue to use the site post-construction.

Because this is to be a Planned Area Development, administrative controls can be put into place that would limit the impact of the development on the surrounding uplands and wetlands. Measures that can be incorporated into the management plan for the property include,

- The use of organic, slow-release fertilizers to minimize excess nutrients from running off into the wetlands;
- A landscape architecture plan that will include high-value native plantings which would provide food and habitat for wildlife and limit the introduction of invasive species;
- Minimizing the construction of permeant obstructions to wildlife, such as fencing.

4.4 Cleared/logged Area

The 2.5 acres of cleared area to the northeast presents an opportunity to enhance existing habitat on site and provide a greater diversity of habitats available to wildlife. A figure showing the planned enhancements of this area is included in the Site Plan developed by DPI, and includes,

- Removal of existing vegetation, including elimination of existing invasive species throughout this area;
- On 2 acres of the cleared area, reseeding with native wildflower-meadow mix. This area will be mowed once a year and maintained as a meadow;
- On the remaining 0.5 acres, large downed trees and stumps are to remain to provide wildlife habitat. The area will be reseeded with a native woodland mix and allowed to revert to woodland.

4.5 Vernal Pool

Special consideration was given to preserving the ongoing limited function and value of the vernal pool in the final design plan. The plan includes an undeveloped corridor connecting the vernal pool to the wetlands on site, as well as to the larger upland areas on- and off site. Wood frogs utilize forested uplands for wintering grounds, migrate to vernal pools to spawn in the early spring, and spend the summer months in forested wetlands. Given the complex habitat requirements, the wildlife corridor proposed would maintain connectivity to all of these habitats, and allow for the continued use of the site by wood frogs for all stages of their life.

Additionally, modifications were made to the site design to maximize clearance around the vernal pool. This maintains the existing canopy cover surrounding the vernal pool, providing protection to wood frogs on their breeding ground.

4.6 Eastern Box Turtles

While no box turtles were observed on site, steps should still be taken to minimize any impact to turtles which may utilize the site. Such steps include,

- Installation of silt fencing around the perimeter of the work area prior to construction;
- Time-of-year restrictions on installing sediment and erosion control materials from late August through September and from March through mid-May. This would limit disturbance to amphibians and reptiles when they are migrating to/from breeding sites;
- Periodic monitoring of silt fencing to check for turtles. If any turtles are observed, they should be removed from the fencing and returned to immediately outside the fenced area and positioned in the same direction they were walking;
- Onsite training for construction workers regarding the potential presence of box turtles and training into their identification;
- No vehicles or heavy machinery should be parked in the wetlands;
- Removal of silt fencing after work is completed and soils are stable so that reptile and amphibian movement between uplands and wetlands is not restricted.
- Silt fencing should be placed around stockpiled soil to prevent turtles from attempting to nest in them.

5. Conclusion

The Glastonbury Glen development includes the construction of 18 single-family residences on an approximately 15.5-acre parcel. Of this area, 61 percent, or 9.45 acres will be protected as a conservation easement. The forested uplands and wetlands provide habitat for wildlife species tolerant of human disturbance and no long-term impacts are anticipated to these resources. The design of this development incorporates a number of measures to minimize impacts to the surrounding uplands and wetlands and includes multiple means to enhance the current habitat on site. The stormwater management system proposed will maintain the water quality of the wetlands and protect their existing function and values, while the landscape design of the development will eliminate invasive species and include native plants, proving food and habitat for wildlife.

GEI Consultants

Consulting Engineers and Scientists

May 25, 2017
Project# 1702010

VIA EMAIL: bob.a.urso@gmail.com

Bob Urso
Horseshoe Lane Associates, LLC
18-3 Arthur Drive
South Windsor, CT 06704

Re: Wetlands Function & Value Assessment for Proposed Orchard Street Development

Dear Mr. Urso:

GEI Consultants, Inc. (GEI) conducted several field surveys during the April and May 2017 and a review of the wetlands located on Lot E-3AA Orchard Street and Lot S-54 Hebron Avenue in Glastonbury, Connecticut (Figure 1). The objectives of the survey were to document the flora and fauna on site and to evaluate the wetlands for the purposes of completing a Wetlands Function & Value Assessment (USACE 1999). This also included evaluation of a potential vernal pool that had already been identified on site.

On April 24, 2017, two GEI scientists conducted a field survey of the site and walked the wetlands previously delineated by John Ianni of Highlands Soils LLC. During this time, a search was performed for three (3) Connecticut State-listed threatened, endangered or special concern species (i.e., one plant and two vertebrate species) listed in a Connecticut Department of Energy & Environmental Protection (CT DEEP) Natural Diversity Data Base review (NDDB; NDDB Preliminary Assessment No.: 201703283 April 18, 2017; Attachment A). Prior to the field visit, GEI conducted a desktop review of the listed species and their habitat requirements (Table 1).

Table 1: Listed species identified in CTDEEP's preliminary NDDB review for the site

Scientific Name	Common Name	State Status	Preferred Habitat[1]	Potential Available Habitat
Vascular Plant				
Lygodium palmatum	Climbing fern	SC	Wetlands and forest edges	Yes
Vertebrate Animal				
Lethenteron appendix	American brook lamprey	E	Cold water, unrestricted streams	No
Terrapene carolina carolina	Eastern box turtle	SC	Various upland habitats and open woodlands, but also seen along field, stream or wetland edges.	Yes

E = Endangered, SC = Special Concern
[1]References for preferred habitat conditions listed at the end of this memo.

GEI Consultants, Inc.
455 Winding Brook Drive, Suite 201, Glastonbury, CT 06033
860.368.5300 fax: 860.368.5307

A follow-up field survey was performed on May 9, 2017, to reassess the wetlands during more active growing conditions. The potential vernal pool was also rechecked and evaluated.

Findings

Flora

The subject property is a forested community ranging from upland to wetland surrounded by residential homes to the west and south, active farmland to the east, and by state route 94 to the north. The elevation of the property is lower than its adjacent neighbors and gradually descends to its lowest point at its northern border from the higher ground in the south. A list of flora observed during the two sites visits is included in Table 2.

The southern half of the property is characterized by its surrounding upland tree species of red oak (Quercus rubra), black oak (*Quercus velutina*), and black cherry (*Prunus serotina*), and its understory of invasive species, upland vegetation, and tree seedlings including Asiatic bittersweet (*Celastrus orbiculatus*), burningbush (*Euonymus alatu*), multiflora rose (*Rosa multiflora*), Tartarian honeysuckle (*Lonicera tatarica*), Pennsylvania sedge (*Carex pensylvanica*), and blue violet (*Viola sororia*). There are two smaller wetlands in the southern half of the property that are isolated from the larger complex, and are likely fed by runoff water from the adjacent properties. Here the forest species shift to a more wetland tolerant mix dominated by red maple (*Acer rubrum*), white and pin oak (*Quercus alba, Q. palustris*), and American beech (*Fagus grandifolia*). The transitional area includes facultative species like littleleaf buttercup (*Ranunculus arborvitus*) and jack in the pulpit (*Arisaema triphyllum*), while the herbaceous layer in the wetland contained jewelweed (*Impatiens capensis*), smooth goldenrod (*Solidago gigantea*), and skunk cabbage (*Symplocarpus foetidus*).

As the property descends to the north, similar upland woods define the buffer between developed adjacent land and the wetland in the middle. This larger wetland begins as a narrow facultative-to-wetland plant community which opens into a wider floodplain of saturated wetland as water flows north. At its center, this wetland complex contains a functioning ephemeral stream with a defined bank and substrate which continues north to the terminus of the property. The plant community improves in quality in the north as the invasive species are almost exclusively found in the upland areas, while the diversity of native wetland species increases within the wetland. The community in the wetland is dominated by facultative wet and obligate species including tussock sedge (*Carex stricta*), common rush (*Juncus effusus*), sensitive fern (*Onoclea sensibilis*), and skunk cabbage. Red and silver maple (*A. rubrum, A. saccharinum*) and white and pin oak make up the canopy, while northern spicebush (*Lindera benzoin*) dominates the scrub shrub layer. In some areas of the wetland, the skunk cabbage and spicebush together made up 80 percent of the total cover. As these higher quality species are dominant in this area, it is likely that groundwater is also supplying this wetland complex, in addition to the surface runoff.

There are also isolated populations of common landscaping ground covers such as pachysandra (*Pachysandra terminalis*) at the wetland's edge, likely a result of yard waste dumping. Additionally, evidence of dumping of solid waste (e.g., tires, household waste) was commonly observed along portions of the wetlands which border the residential properties.

While the wooded wetland and forest edges may provide suitable habitat for climbing fern, this species was not observed during the site surveys.

Fauna

The small perennial stream on the subject property does not provide suitable habitat for the American brook lamprey. The other listed species, eastern box turtle, may utilize the wooded wetlands and forested uplands, however, none were observed on site during GEI's field survey.

Wildlife observed on the subject property are provided in Table 3. During the survey, several white-tailed deer (*Odocoileus virginianus)* were observed along with evidence of higher trophic level mammals potentially utilizing the property (e.g., a large bone with apparent teeth scrapings). This suggests that the greenspace supports an active wildlife corridor. Numerous bird species were heard and observed during the survey, suggesting the property provides suitable breeding habitat for a variety of birds. Several woodpecker species were also noted to be displaying territorial behavior (e.g., drumming), providing further evidence of breeding habitat use. The frequent standing deadwood throughout the site provides potential breeding spots for cavity nesters as well as foraging opportunities for a variety of animals.

The surveys were performed mid-morning to afternoon, so other species, particularly amphibians and reptiles, may have been hidden from view.

Vernal Pool

An isolated wetland pocket was identified in the southern half of the property relatively close to the edge of the farm field. It is our understanding that amphibian eggs masses were observed in this area during the initial wetland delineation effort by John Ianni. GEI revisited this area to confirm the presence/absence of these masses and to document the development of any amphibians or other vernal pool obligate species.

This wetland was a small pool of standing water with no apparent submerged vegetation at time of survey. The vegetation immediately surrounding the pool was a mix of Facultative upland to Facultative wet species including flowering dogwood (*Cornus florida*), ironwood (*Carpinus caroliniana*), black oak, multiflora rose, northern spicebush, Virginia wildrye (*Elymus virginicus*), and an unidentified sedge (*Carex sp*.).

This area does appear to have the potential to function as a vernal pool. In our initial survey in April, GEI observed tadpoles throughout this wetland (see photolog; Attachment B). But given their early developmental stage, GEI was not able to identify the species of frog at the time. Dip netting was also performed along the edges and deeper portions of the pool, and in addition to tadpoles, mosquito larvae and water mites were recovered. No additional vernal pool obligate species (e.g., fairy shrimp) were observed during this field survey.

During the field survey in May, the pool was found to still be retaining water and tadpoles remained abundant. These tadpoles were identified as wood frogs (*Rana sylvatica*), a vernal pool obligate species. Based on the depth of the pool (greater than 1foot), it is likely this depression would remain inundated long enough to support the full development of

amphibians. Given that this pool supports both the breeding and, likely, the development of a vernal pool obligate species, this area would classify as a vernal pool.

In April, GEI also observed along the northeastern border of the property several pockets retaining water at the base of fallen trees. These depressions may also serve as potential breeding sites for amphibians. However, no egg masses, amphibians, or other vernal pool obligate species were observed within these pockets. And given their shallow depth (i.e., less than 1 foot), these pockets are unlikely to stay inundated for the duration of the season. These pockets were rechecked in May and found to have dried out.

Wetlands Function and Value

The 1999 US Army Corps of Engineers (USACE) "Highway Methodology Workbook Supplement –Wetlands Functions and Values" was utilized to render a descriptive evaluation of the dominant wetlands on site. The USACE approach lists eight (8) functions and five (5) values under their Section 404 wetland permit to describe the wetland resources of a proposed project. This methodology characterizes wetland functions and values based on a series of standardized questions, and derives a qualitative evaluation utilizing a combined desktop analysis and field analysis approach. GEI's scientists completed a Wetland Function – Value Evaluation Form for the subject property included in the Attachment C. The qualifiers, as defined in USACE workbook (1999), are also provided.

Based on this evaluation process, GEI determined that the on-site wetlands were suitable for 11 of the 13 USASCE functions and values; however, only 7 of these were considered principle functions and values (Attachment C). Overall the wetland provides groundwater recharge/discharge, flood protection, sediment retention, nutrient removal, and wildlife habitat. The wetlands on site primarily function as an active wildlife corridor within a developing watershed, providing foraging and breeding habitat for wildlife within an otherwise suburban area. Additionally, the vernal pool on site provides a unique habitat for wetlands species. This greenspace, however, provides limited value for recreational and educational opportunities given its small size. The perennial stream does provide some vistas, and the viewscape in this area could be enhanced by removal of the solid waste present. Implementation of invasive species control and habitat restoration could similarly improve the visual aesthetic throughout the wetlands.

Conclusions

Wetlands on the subject property range in function and value. The system as a whole functions as a detention basin that provides important functions for groundwater recharge/discharge, flood protection, sediment and nutrient removal. While invasives species were present primarily in the vine and shrub stratum, high quality native species were found in abundance along the perennial stream. Additionally, the pocket wetland previously identified on site was found to contain wood frog tadpoles and is likely to function as a vernal pool.

The proposed site plan prepared by Design Professionals Inc. shows the residential development bordering the wetlands along the southern portion of the property (Figure 2). A number of the proposed units are located within the 100-foot regulatory wetland buffer, including within the buffer around the vernal pool. plans also include regrading the

development to a higher elevation adjacent to the southern boundary of the wetlands, and construction of a stormwater retention pond.

Potential impacts of the development on the wetlands and vernal pool include:

- Filling from grading and clearing activities and from erosion within the 100 foot wetland buffer;
- Introduction of excess nutrients from lawn fertilizers via run off;
- Loss of native vegetation and introduction of invasive species;
- Potential changes in groundwater discharge/recharge resulting from regrading activities and installation of dry wells and basement drainage systems;
- Restriction of wildlife access to the site;
- Potential loss of available habitat within the wetlands buffer and within the immediate vicinity of the vernal pool; and
- Restriction of access to the vernal pool by amphibians which may migrate to the pool from the surround wetlands/uplands complex.

These possible impacts should be discussed with the Town of Glastonbury and alternatives to mitigate these effects should be considered and incorporated into the final site design.

Limitations

This letter report was prepared for the exclusive use of Horseshoe Lane Associates, LLC. GEI's site evaluation was based on information provided to us at the time of this report and may require modification if there are any changes in the nature or scope of the proposed development. GEI's professional services for this study have been performed in accordance with generally accepted ecological practices. No warranty, expressed or implied, is made. The recommendations in this report are based in part on data obtained from limited observations made on the subject property. Observations of other living organisms, and functions and values may differ during other seasons and times.

Sincerely,

GEI CONSULTANTS, INC.

Frederick W. Johnson, LEP
Sr. Vice President/Principal

John Gondek
Ecotoxicologist

Enclosures

JG/ah H:\WPROC\Project\Urso\Orchard Street\Functions & Values\GEI Orchard Street Wetlands Report 25May17.docx

References

United States Army Corps of Engineers, New England District. 1999. The Highway Methodology Workbook Supplement. Wetland Functions and Values, A Descriptive Approach. NAEEP- 360-1-30a.

http://www.ct-botanical-society.org/Plants/view/1878

http://www.ct.gov/deep/cwp/view.asp?a=2723&q=416520&deepNav_GID=1655

http://www.mass.gov/eea/docs/dfg/nhesp/species-and-conservation/nhfacts/lampetra-appendix.pdf

TABLES

Table 2. Plants Identified on Site
Wetlands Function & Value Assessment for Proposed Orchard Street Development
Horshoe Lane Associates, LLC
May 2017

Scientific Name	Common Name	Wetland Rating
Trees		
*Acer Platanoides**	Norway Maple	UPL
Acer rubrum	Red Maple	~FAC
Acer saccharinum	Silver Maple	FACW
*Alianthus altissima**	Tree of Heaven	UPL
Carpinus caroliniana	Ironwood	~FAC
Carya ovata	Shagbark Hickory	FACU
Cornus florida	Flowering Dogwood	~FACU
*Elaeagnus umbellata**	Autumn Olive	
Fagus grandifolia	American Beech	FACU
Fraxinus pennsylvanica	Green Ash	FACW
Liriodendron tulipifera	Tuliptree	FACU
Nyssa sylvatica	Black Gum	FAC
Pinus strobus	Eastern White Pine	FACU
Populus deltoides	Eastern Cottonwood	FAC
Prunus serotina	Black Cherry	~FACU
Quercus alba	White Oak	FACU
Quercus palustris	Pin Oak	FACW
Quercus rubra	Northern Red Oak	~FACU
Quercus velutina	Black Oak	
Salix sepulcralis	Weeping Willow	FACW
Ulmus americana	American Elm	FACW
Shrubs		
Amelanchier arborea	Smooth Shadbush	FACU
*Euonymus alatus**	Burningbush	
Hamamelis virginiana	Witch Hazel	~FACU
Lindera benzoin	Northern spicebush	~FACW
*Lonicera tartarica**	Tatarian honeysuckle	~FACU
*Rosa multiflora**	Multiflora Rose	~FACU
Vines		
*Celastrus orbiculatus**	Asiatic Bittersweet	UPL
Parthenocissus Quinquefolia	Virginia Creeper	FACU
Toxicodendron radicans	Poison Ivy	FAC
Vitis Riparia	Riverbank grape	FAC
Herbaceous		
*Aliaria petiolata**	Garlic Mustard	FACU
Anenome quinquefolia	Wood Anenome	FACU
Arisaema triphyllum	Jack in the Pulpit	FAC
Barbarea vulgaris	Garden Yellowrocket	FAC
*Berberis thunbergii**	Japanese Barberry	FACU
Cardamine pensylvanica	Pennsylvania Bittercress	FACW
Equisetum arvense	Horsetail	FAC
Erythronium americanum	Yellow Trout Lily	
Fragaria virginiana	Virginia Strawberry	FACU
Galium asprellum	Rough Bedstraw	OBL
Galium trifidum	Threepetal Bedstraw	FACW
Impatiens Capensis	Jewelweed	FACW

Table 2. Plants Identified on Site
Wetlands Function & Value Assessment for Proposed Orchard Street Development
Horshoe Lane Associates, LLC
May 2017

Scientific Name	Common Name	Wetland Rating
Lycopodium obscurum	Rare Clunmoss	FACU
Lysimachia nummuleria	Creeping Jenny	FACW
Maianthemum canadense	Canada Mayflower	FACU
Onoclea sensibilis	Sensitive Fern	FACW
Osmunda cinnamomea	Cinnamin Fern	FACW
Pachysandra terminalis	Pachysandra	
Polygonum virginianum	Jumpseed	~FAC
Potentilla simplex	Common Cinquefoil	FACU
Ranunculus arborvitus	Littleleaf Buttercup	FAC
Rubus allegheniensis	Allegheny Blackberry	FACU
Rumex crispus	Curly Dock	FAC
Solidago altissima	Tall Goldenrod	FACU
Solidago gigantea	Smooth Goldenrod	FACW
Symphyotrichum puniceum	Purplestem Aster	OBL
Symplocarpus foetidus	Skunk Cabbage	OBL
Vinca minor	Common Periwinkle	
Viola sororia	Blue Violet	FAC
Grasses, Rushes, Sedges		
Carex lacustris	Hairy Sedge	OBL
Carex pensylvanica	Pennsylvania Sedge	~
Carex sp	Sedge	
Carex stricta	Tussock Sedge	OBL
Cyperus strigosus	Strawcolored flatsedge	FACW
Dichanthelium clandestinum	Deer tongue	FACW
Elymus virginicus	Virginia Wildrye	~FACW
Juncus effusus	Common Rush	OBL
Juncus sp	Rush	
Poa annua	Common Bluegrass	FACU
Poa palustris	Fowl Bluegrass	FACW

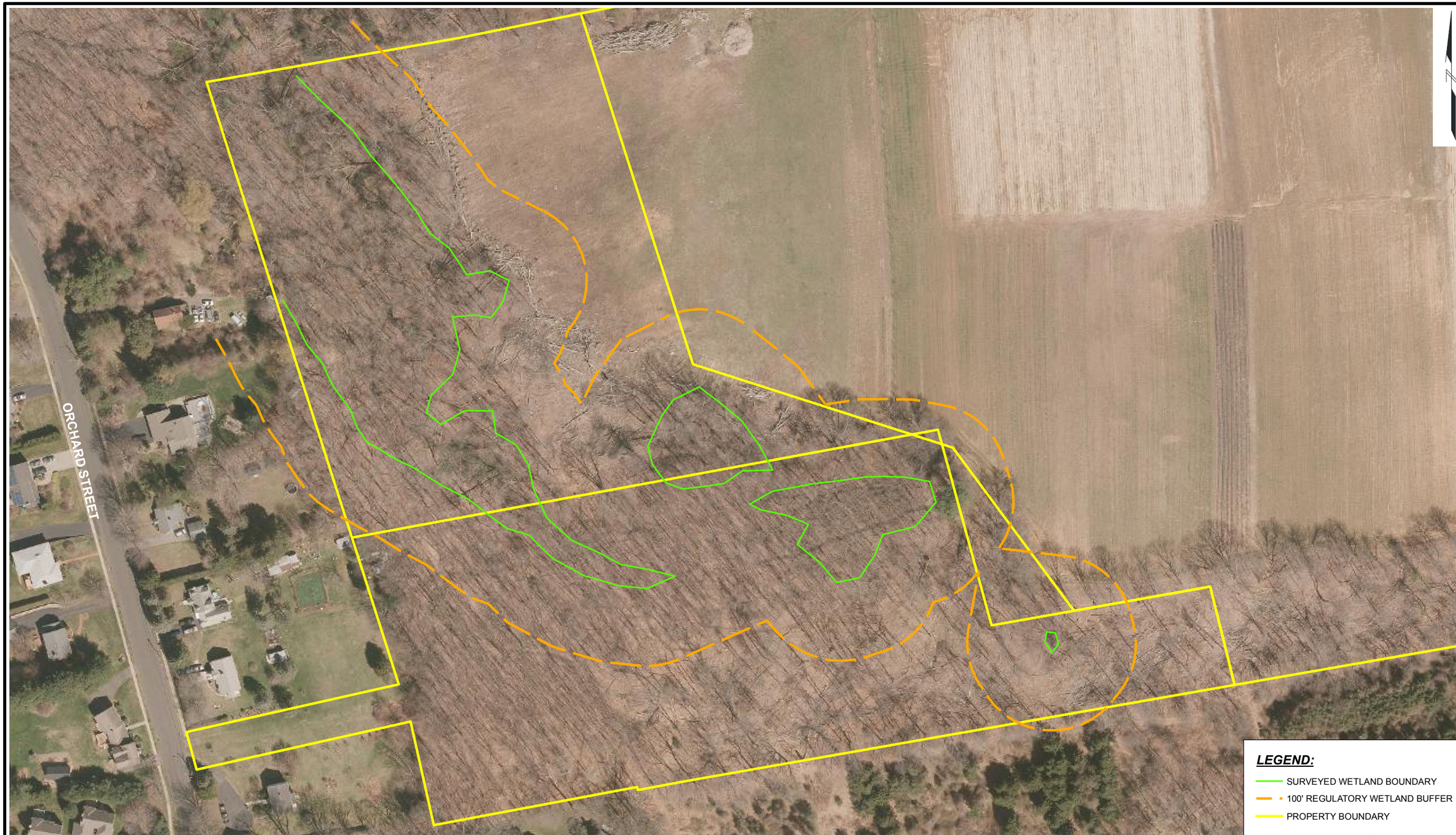
Notes:
* Invasive Species
~Found in Vernal Pool

UPL = Upland or unlisted species;
FACU = Usually occur in non-wetlands but occasionally found in wetlands (1–33%)
FAC = Facultative plants with a similar likelihood of occurring in both wetlands and non-wetlands (probability of occurring in wetlands - 33%-67%);
FACW = Facultative Wet Plants that usually occur in wetlands (>67% to 99%); and
OBL = Obligate Plants that almost always occur in wetlands (>99%)

Table 3. Wildlife Identified on Site
Wetlands Function & Value Assessment for Proposed Orchard Street Development
Horshoe Lane Associates, LLC
May 2017

Scientific Name	Common Name	(O) Observed or (C) Call/song
Birds		
Cyanocitta cristata	Blue Jay	O
Turdus migratorius	American Robin	O
Baeolophus bicolor	Tufted Titmouse	O
Poecile atricapillus	Black-capped Chickadee	C
Corvus brachyrhynchos	American Crow	C
Passer domesticus	House Sparrow	C
Melospiza melodia	Song Sparrow	C
Spizella passerina	Chipping Sparrow	C
Melospiza georgiana	Swamp Sparrow	C
Haemorhous mexicanus	House Finch	C
Troglodytes aedon	House Wren	C
Thryothorus ludovicianus	Carolina Wren	C
Zenaida macroura	Mourning Dove	C
Colaptes auratus	Northern Flicker	O
Picoides pubescens	Downy Woodpecker	C
Melanerpes carolinus	Red-bellied Woodpecker	C
Quiscalus quiscula	Common Grackle	O
Cardinalis cardinalis	Northern Cardinal	C
Sitta carolinensis	White-breasted Nuthatch	C
Dumetella carolinensis	Gray Catbird	O
Sialia sialis	Eastern Bluebird	O
Buteo lineatus	Red-shouldered Hawk	O
Mammals		
Odocoileus virginianus	White-tailed Deer	O
Sciurus carolinensis	Eastern Gray Squirrel	O
Tamias striatus	Eastern Chipmunk	O
Amphibians		
Rana sylvatica	Wood Frog	O

FIGURES



SOURCE:
1. SURVEY PROVIDED BY DESIGN PROFESSIONALS, INC.
2. 2016 AERIAL PHOTOGRAPH ACCESSED FROM CT ENVIRONMENTAL CONDITIONS ONLINE (CT ECO).

0 120 240

SCALE: 1" = 120'

Wetlands Function and Values Assessment
Proposed Orchard Street Development
Glastonbury, Connecticut

Horseshoe Lane Associates, LLC
South Windsor, Connecticut

GEI Consultants

Project 1702010

AERIAL SITE PLAN WITH WETLAND BOUNDARIES

May 2017

Fig. 1

J:\Projects\1702010_OrchardSt\Site Plan.mxd

SOURCE: PLAN PROVIDED BY DESIGN PROFESSIONALS INC.

NOT TO SCALE

Wetlands Function & Value Assessment
Proposed Orchard Street Development
Glastonbury, Connecticut

Robert Urso
South Windsor, Connecticut

GEI Consultants

Project 1702010

PROPOSED PLAN

May 2017

Fig. 2

I:\Standard\Sheet Templates\PowerPoint\11x17h.ppt

ATTACHMENT A
Connecticut Department of Energy & Environmental Protection
Natural Diversity Data Base Preliminary Assessment

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep Affirmative Action/Equal Opportunity Employer

April 18, 2017

Dane LaBonte
Design Professionals, Inc.
21 Jeffrey Drive
South Windsor, CT 06074
dlabonte@dpinc.co

Project: Preliminary assessment of the Orchard Street Subdivision, undeveloped land south of Hebron Avenue and East of Orchard Street in Glastonbury
NDDB Preliminary Assessment No.: 201703283

Dear Mr. LaBonte,

I have reviewed Natural Diversity Database maps and files regarding the area delineated on the map provided for a preliminary assessment of the proposed Orchard Street Subdivision in Glastonbury, Connecticut.

According to our records there are known extant populations of State Listed Species that occur within or close to the boundaries of this project. I have attached a list of species known from this area. Please be advised that this is a preliminary review and not a final determination. A more detailed review will be necessary to move forward with any environmental permit applications submitted to DEEP for the proposed project. **This preliminary assessment letter cannot be used or submitted with permit applications at DEEP**. This letter is valid for one year.

To prevent impacts to State-listed species, field surveys of the site should be performed by a qualified biologist with the appropriate scientific collecting permits at a time when these target species are identifiable. A report summarizing the results of such surveys should include:

1. Survey date(s) and duration
2. Site descriptions and photographs
3. List of component vascular plant and animal species within the survey area (including scientific binomials)
4. Data regarding population numbers and/or area occupied by State-listed species
5. Detailed maps of the area surveyed including the survey route and locations of State listed species
6. Statement/résumé indicating the biologist's qualifications

The site surveys report should be sent to our CT DEEP-NDDB Program (deep.nddbrequest@ct.gov) for further review by our program biologists along with an updated request for another NDDB review. Incomplete reports may not be accepted.

If you do not intend to do site surveys to determine the presence or absence of state-listed species, then you should presume species are present and let us know how you will protect the state-listed species from being impacted by this project. You may submit these best management practices or protection plans with your new request for an NDDB review. After reviewing your new NDDB request form and the

documents describing how you will protect this species from project impacts we will make a final determination and provide you with a letter from our program to use with DEEP-Permits.

Natural Diversity Database information includes all information regarding critical biological resources available to us at the time of the request. This information is a compilation of data collected over the years by the Department of Energy and Environmental Protection's Natural History Survey, cooperating units of DEEP, landowners, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the NDDB should not be substitutes for onsite surveys necessary for a thorough environmental impact assessment. The result of this review does not preclude the possibility that listed species may be encountered on site and that additional action may be necessary to remain in compliance with certain state permits.

Please contact me if you have further questions at (860) 424-3378, or karen.zyko@ct.gov . Thank you for consulting the Natural Diversity Data Base.

Sincerely,

Karen Zyko
Environmental Analyst

Species List for NDDB Request

Scientific Name	Common Name	State Status
Vertebrate Animal		
Lethenteron appendix	American brook lamprey	E
Terrapene carolina carolina	Eastern box turtle	SC
Vascular Plant		
Lygodium palmatum	Climbing fern	SC

E = State Endangered, T = State Threatened, SC = State Special Concern
FE = Federally Endangered, FT = Federally Threatened

ATTACHMENT B
Supplemental Photo Documentation
Photos taken May 9, 2017

Photo 1: Vernal pool located near the southeast boundary of the site

Photo 2: Wood frog (*Rana sylvatica*) tadpoles recovered from the vernal pool

Photo 3: Discolored leaves and standing water within the larger of the two wetlands along the northeastern border of the property

Photo 4: Transitional area of upland to wetland-tolerant plant species

Photo 5: Skunk cabbage (*Symplocarpus foetidus*) dominated floodplain along the ephemeral stream. Evidence of solid waste dumping (e.g., tires).

Photo 6: Defined bank and sandy substrate of the ephemeral stream

ATTACHMENT C
Wetlands Functions and Values Assessment

Wetland Function-Value Evaluation Form

Total area of wetland 3.25 acres Human made? No Is wetland part of a wildlife corridor? Yes or a "habitat island"? No

Adjacent land use Residential, crop field Distance to nearest roadway or other development 15'

Dominant wetland systems present Palustrine – Forested Wetlands Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? Yes If not, where does the wetland lie in the drainage basin?

How many tributaries contribute to the wetland? 1 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D.

Latitude 41.715147 Longitude -72.569143

Prepared by: JG Date 5/9/17

Wetland Impact:
Type Buffer zone reduction Area

Evaluation based on:
Office X Field X
Corps manual wetland delineation completed? Y N X

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	Y	2, 4, 8, 10, 13	Y	Perennial stream in western portion of wetlands likely the result of groundwater discharge
Floodflow Alteration	Y	2, 4, 5, 6, 7, 11, 13, 14, 15	Y	Wetlands occupy a relatively flat forested area within a suburban watershed. Outflow constricted by culvert. Provides stormwater retention.
Fish and Shellfish Habitat	N	-	N	Insufficient water in perennial stream to support fish and shellfish populations
Sediment/Toxicant Retention	Y	1, 2, 3, 4, 9, 10, 11	Y	Stream sinuosity and deep organic deposits suggest sediment retention
Nutrient Removal	Y	3, 4, 6, 7, 13, 14	Y	Active farmland upgradient of wetlands. Water/sediment retention in wetlands may reduce nutrients
Production Export	Y	1, 2, 4, 5, 12	N	Limited transport expected by wildlife. Low flows in channelized portion.
Sediment/Shoreline Stabilization	Y	1, 2, 3, 4, 6, 7, 9	N	Portion of the wetland has channelized flow with a distinct bank; low flow velocities.
Wildlife Habitat	Y	3, 4, 5, 8, 17, 18, 19, 20, 21	Y	Wetlands provide valuable wildlife corridor in a developing watershed. Potential vernal pool present on site.
Recreation	Y	4, 5, 12	N	Small creek diameter and low flow limit recreation opportunities
Educational/Scientific Value	Y	5	N	Limited educational value due to size wetlands
Uniqueness/Heritage	Y	2, 7, 17, 19	Y	Limited value but provides undeveloped greenspace in developing watershed
Visual Quality/Aesthetics	Y	8, 9, 11, 12	Y	Borderline quality. Viewshed limited by invasives shrubs in portions of wetlands, presence of dumping and logging/clearing activity adjacent to site.
ES Endangered Species Habitat	N	-	N	No documented site use by threatened or endangered species
Other				

* Refer to backup list of numbered considerations.

Appendix A

Wetland evaluation supporting documentation; Reproducible forms.

Below is an example list of considerations that was used for a New Hampshire highway project. Considerations are flexible, based on best professional judgment and interdisciplinary team consensus. This example provides a comprehensive base, however, and may only need slight modifications for use in other projects.

GROUNDWATER RECHARGE/DISCHARGE— This function considers the potential for a wetland to serve as a groundwater recharge and/or discharge area. It refers to the fundamental interaction between wetlands and aquifers, regardless of the size or importance of either.

CONSIDERATIONS/QUALIFIERS

1. Public or private wells occur downstream of the wetland.
2. Potential exists for public or private wells downstream of the wetland.
3. Wetland is underlain by stratified drift.
4. Gravel or sandy soils present in or adjacent to the wetland.
5. Fragipan does not occur in the wetland.
6. Fragipan, impervious soils, or bedrock does occur in the wetland.
7. Wetland is associated with a perennial or intermittent watercourse.
8. Signs of groundwater recharge are present or piezometer data demonstrates recharge.
9. Wetland is associated with a watercourse but lacks a defined outlet or contains a constricted outlet.
10. Wetland contains only an outlet, no inlet.
11. Groundwater quality of stratified drift aquifer within or downstream of wetland meets drinking water standards.
12. Quality of water associated with the wetland is high.
13. Signs of groundwater discharge are present (e.g., springs).
14. Water temperature suggests it is a discharge site.
15. Wetland shows signs of variable water levels.
16. Piezometer data demonstrates discharge.
17. Other

FLOODFLOW ALTERATION (Storage & Desynchronization) — This function considers the effectiveness of the wetland in reducing flood damage by water retention for prolonged periods following precipitation events and the gradual release of floodwaters. It adds to the stability of the wetland ecological system or its buffering characteristics and provides social or economic value relative to erosion and/or flood prone areas.

CONSIDERATIONS/QUALIFIERS

1. Area of this wetland is large relative to its watershed.
2. Wetland occurs in the upper portions of its watershed.
3. Effective flood storage is small or non-existent upslope of or above the wetland.
4. Wetland watershed contains a high percent of impervious surfaces.
5. Wetland contains hydric soils which are able to absorb and detain water.
6. Wetland exists in a relatively flat area that has flood storage potential.
7. Wetland has an intermittent outlet, ponded water, or signs are present of variable water level.
8. During flood events, this wetland can retain higher volumes of water than under normal or average rainfall conditions.
9. Wetland receives and retains overland or sheet flow runoff from surrounding uplands.
10. In the event of a large storm, this wetland may receive and detain excessive flood water from a nearby watercourse.
11. Valuable properties, structures, or resources are located in or near the floodplain downstream from the wetland.
12. The watershed has a history of economic loss due to flooding.
13. This wetland is associated with one or more watercourses.
14. This wetland watercourse is sinuous or diffuse.
15. This wetland outlet is constricted.
16. Channel flow velocity is affected by this wetland.
17. Land uses downstream are protected by this wetland.
18. This wetland contains a high density of vegetation.
19. Other

FISH AND SHELLFISH HABITAT (FRESHWATER) — This function considers the effectiveness of seasonal or permanent watercourses associated with the wetland in question for fish and shellfish habitat.

CONSIDERATIONS/QUALIFIERS

1. Forest land dominant in the watershed above this wetland.
2. Abundance of cover objects present.

STOP HERE IF THIS WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE

3. Size of this wetland is able to support large fish/shellfish populations.
4. Wetland is part of a larger, contiguous watercourse.
5. Wetland has sufficient size and depth in open water areas so as not to freeze solid and retain some open water during winter.
6. Stream width (bank to bank) is more than 50 feet.
7. Quality of the watercourse associated with this wetland is able to support healthy fish/shellfish populations.
8. Streamside vegetation provides shade for the watercourse.
9. Spawning areas are present (submerged vegetation or gravel beds).
10. Food is available to fish/shellfish populations within this wetland.
11. Barrier(s) to anadromous fish (such as dams, including beaver dams, waterfalls, road crossing) are absent from the stream reach associated with this wetland.
12. Evidence of fish is present.
13. Wetland is stocked with fish.
14. The watercourse is persistent.
15. Man-made streams are absent.
16. Water velocities are not too excessive for fish usage.
17. Defined stream channel is present.
18. Other

Although the above example refers to freshwater wetlands, it can also be adapted for marine ecosystems. The following is an example provided by the National Marine Fisheries Service (NMFS) of an adaptation for the fish and shellfish function.

FISH AND SHELLFISH HABITAT (MARINE) — This function considers the effectiveness of wetlands, embayments, tidal flats, vegetated shallows, and other environments in supporting marine resources such as fish, shellfish, marine mammals, and sea turtles.

CONSIDERATIONS/QUALIFIERS

1. Special aquatic sites (tidal marsh, mud flats, eelgrass beds) are present.
2. Suitable spawning habitat is present at the site or in the area.
3. Commercially or recreationally important species are present or suitable habitat exists.
4. The wetland/waterway supports prey for higher trophic level marine organisms.
5. The waterway provides migratory habitat for anadromous fish.
6. Essential fish habitat, as defined by the 1996 amendments to the Magnuson-Stevens Fishery & Conservation Act, is present (consultation with NMFS may be necessary).
7. Other

SEDIMENT/TOXICANT/PATHOGEN RETENTION — This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants, or pathogens in runoff water from surrounding uplands or upstream eroding wetland areas.

CONSIDERATIONS/QUALIFIERS

1. Potential sources of excess sediment are in the watershed above the wetland.
2. Potential or known sources of toxicants are in the watershed above the wetland.
3. Opportunity for sediment trapping by slow moving water or deepwater habitat are present in this wetland.
4. Fine grained mineral or organic soils are present.
5. Long duration water retention time is present in this wetland.
6. Public or private water sources occur downstream.
7. The wetland edge is broad and intermittently aerobic.
8. The wetland is known to have existed for more than 50 years.
9. Drainage ditches have not been constructed in the wetland.

STOP HERE IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE.

10. Wetland is associated with an intermittent or perennial stream or a lake.
11. Channelized flows have visible velocity decreases in the wetland.
12. Effective floodwater storage in wetland is occurring. Areas of impounded open water are present.
13. No indicators of erosive forces are present. No high water velocities are present.
14. Diffuse water flows are present in the wetland.
15. Wetland has a high degree of water and vegetation interspersion.
16. Dense vegetation provides opportunity for sediment trapping and/or signs of sediment accumulation by dense vegetation is present.
17. Other

NUTRIENT REMOVAL/RETENTION/TRANSFORMATION — This function considers the effectiveness of the wetland as a trap for nutrients in runoff water from surrounding uplands or contiguous wetlands and the ability of the wetland to process these nutrients into other forms or trophic levels. One aspect of this function is to prevent ill effects of nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries.

CONSIDERATIONS/QUALIFIERS

1. Wetland is large relative to the size of its watershed.
2. Deep water or open water habitat exists.
3. Overall potential for sediment trapping exists in the wetland.

4. Potential sources of excess nutrients are present in the watershed above the wetland.
5. Wetland saturated for most of the season. Ponded water is present in the wetland.
6. Deep organic/sediment deposits are present.
7. Slowly drained fine grained mineral or organic soils are present.
8. Dense vegetation is present.
9. Emergent vegetation and/or dense woody stems are dominant.
10. Opportunity for nutrient attenuation exists.
11. Vegetation diversity/abundance sufficient to utilize nutrients.

STOP HERE IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE.

12. Waterflow through this wetland is diffuse.
13. Water retention/detention time in this wetland is increased by constricted outlet or thick vegetation.
14. Water moves slowly through this wetland.
15. Other

PRODUCTION EXPORT (Nutrient) — This function evaluates the effectiveness of the wetland to produce food or usable products for humans or other living organisms.

CONSIDERATIONS/QUALIFIERS

1. Wildlife food sources grow within this wetland.
2. Detritus development is present within this wetland
3. Economically or commercially used products found in this wetland.
4. Evidence of wildlife use found within this wetland.
5. Higher trophic level consumers are utilizing this wetland.
6. Fish or shellfish develop or occur in this wetland.
7. High vegetation density is present.
8. Wetland exhibits high degree of plant community structure/species diversity.
9. High aquatic vegetative diversity/abundance is present.
10. Nutrients exported in wetland watercourses (permanent outlet present).
11. “Flushing” of relatively large amounts of organic plant material occurs from this wetland.
12. Wetland contains flowering plants that are used by nectar-gathering insects.
13. Indications of export are present.
14. High production levels occurring, however, no visible signs of export (assumes export is attenuated).
15. Other

SEDIMENT/SHORELINE STABILIZATION — This function considers the effectiveness of a wetland to stabilize streambanks and shorelines against erosion.

CONSIDERATIONS/QUALIFIERS

1. Indications of erosion or siltation are present.
2. Topographical gradient is present in wetland.
3. Potential sediment sources are present up-slope.
4. Potential sediment sources are present upstream.
5. No distinct shoreline or bank is evident between the waterbody and the wetland or upland.
6. A distinct step between the open waterbody or stream and the adjacent land exists (i.e., sharp bank) with dense roots throughout.
7. Wide wetland (>10’) borders watercourse, lake, or pond.
8. High flow velocities in the wetland.
9. The watershed is of sufficient size to produce channelized flow.
10. Open water fetch is present.
11. Boating activity is present.
12. Dense vegetation is bordering watercourse, lake, or pond.
13. High percentage of energy-absorbing emergents and/or shrubs border a watercourse, lake, or pond.
14. Vegetation is comprised of large trees and shrubs that withstand major flood events or erosive incidents and stabilize the shoreline on a large scale (feet).
15. Vegetation is comprised of a dense resilient herbaceous layer that stabilizes sediments and the shoreline on a small scale (inches) during minor flood events or potentially erosive events.
16. Other

WILDLIFE HABITAT — This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and/or migrating species must be considered. Species lists of observed and potential animals should be included in the wetland assessment report.[1]

CONSIDERATIONS/QUALIFIERS

1. Wetland is not degraded by human activity.
2. Water quality of the watercourse, pond, or lake associated with this wetland meets or exceeds Class A or B standards.
3. Wetland is not fragmented by development.
4. Upland surrounding this wetland is undeveloped.
5. More than 40% of this wetland edge is bordered by upland wildlife habitat (e.g., brushland, woodland, active farmland, or idle land) at least 500 feet in width.
6. Wetland is contiguous with other wetland systems connected by a watercourse or lake.
7. Wildlife overland access to other wetlands is present.
8. Wildlife food sources are within this wetland or are nearby.
9. Wetland exhibits a high degree of interspersion of vegetation classes and/or open water.
10. Two or more islands or inclusions of upland within the wetland are present.
11. Dominant wetland class includes deep or shallow marsh or wooded swamp.
12. More than three acres of shallow permanent open water (less than 6.6 feet deep), including streams in or adjacent to wetland, are present.
13. Density of the wetland vegetation is high.
14. Wetland exhibits a high degree of plant species diversity.
15. Wetland exhibits a high degree of diversity in plant community structure (e.g., tree/shrub/vine/grasses/mosses)
16. Plant/animal indicator species are present. (List species for project)
17. Animal signs observed (tracks, scats, nesting areas, etc.)
18. Seasonal uses vary for wildlife and wetland appears to support varied population diversity/abundance during different seasons.
19. Wetland contains or has potential to contain a high population of insects.
20. Wetland contains or has potential to contain large amphibian populations.
21. Wetland has a high avian utilization or its potential.
22. Indications of less disturbance-tolerant species are present.
23. Signs of wildlife habitat enhancement are present (birdhouses, nesting boxes, food sources, etc.).
24. Other

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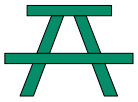
[1]In March 1995, a rapid wildlife habitat assessment method was completed by a University of Massachusetts research team with funding and oversight provided by the New England Transportation Consortium. The method is called WEThings (wetland habitat indicators for non-game species). It produces a list of potential wetland-dependent mammal, reptile, and amphibian species that may be present in the wetland. The output is based on observable habitat characteristics documented on the field data form. This method may be used to generate the wildlife species list recommended as backup information to the wetland evaluation form and to augment the considerations. Use of this method should first be coordinated with the Corps project manager. A computer program is also available to expedite this process.

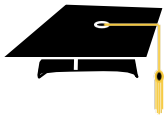
RECREATION (Consumptive and Non-Consumptive) — This value considers the suitability of the wetland and associated watercourses to provide recreational opportunities such as hiking, canoeing, boating, fishing, hunting, and other active or passive recreational activities. Consumptive opportunities consume or diminish the plants, animals, or other resources that are intrinsic to the wetland. Non-consumptive opportunities do not consume or diminish these resources of the wetland.



CONSIDERATIONS/QUALIFIERS

1. Wetland is part of a recreation area, park, forest, or refuge.
2. Fishing is available within or from the wetland.
3. Hunting is permitted in the wetland.
4. Hiking occurs or has potential to occur within the wetland.
5. Wetland is a valuable wildlife habitat.
6. The watercourse, pond, or lake associated with the wetland is unpolluted.
7. High visual/aesthetic quality of this potential recreation site.
8. Access to water is available at this potential recreation site for boating, canoeing, or fishing.
9. The watercourse associated with this wetland is wide and deep enough to accommodate canoeing and/or non-powered boating.
10. Off-road public parking available at the potential recreation site.
11. Accessibility and travel ease is present at this site.
12. The wetland is within a short drive or safe walk from highly populated public and private areas.
13. Other

EDUCATIONAL/SCIENTIFIC VALUE — This value considers the suitability of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research.



CONSIDERATIONS/QUALIFIERS

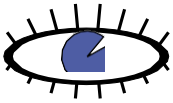
1. Wetland contains or is known to contain threatened, rare, or endangered species.
2. Little or no disturbance is occurring in this wetland.
3. Potential educational site contains a diversity of wetland classes which are accessible or potentially accessible.
4. Potential educational site is undisturbed and natural.
5. Wetland is considered to be a valuable wildlife habitat.
6. Wetland is located within a nature preserve or wildlife management area.
7. Signs of wildlife habitat enhancement present (bird houses, nesting boxes, food sources, etc.).
8. Off-road parking at potential educational site suitable for school bus access in or near wetland.
9. Potential educational site is within safe walking distance or a short drive to schools.
10. Potential educational site is within safe walking distance to other plant communities.
11. Direct access to perennial stream at potential educational site is available.
12. Direct access to pond or lake at potential educational site is available.
13. No known safety hazards exist within the potential educational site.
14. Public access to the potential educational site is controlled.
15. Handicap accessibility is available.
16. Site is currently used for educational or scientific purposes.
17. Other

UNIQUENESS/HERITAGE — This value considers the effectiveness of the wetland or its associated waterbodies to provide certain special values. These may include archaeological sites, critical habitat for endangered species, its overall health and appearance, its role in the ecological system of the area, its relative importance as a typical wetland class for this geographic location. These functions are clearly valuable wetland attributes relative to aspects of public health, recreation, and habitat diversity.

CONSIDERATIONS/QUALIFIERS

1. Upland surrounding wetland is primarily urban.
2. Upland surrounding wetland is developing rapidly.
3. More than 3 acres of shallow permanent open water (less than 6.6 feet deep), including streams, occur in wetlands.
4. Three or more wetland classes are present.
5. Deep and/or shallow marsh or wooded swamp dominate.
6. High degree of interspersion of vegetation and/or open water occur in this wetland.
7. Well-vegetated stream corridor (15 feet on each side of the stream) occurs in this wetland.
8. Potential educational site is within a short drive or a safe walk from schools.
9. Off-road parking at potential educational site is suitable for school buses.
10. No known safety hazards exist within this potential educational site.
11. Direct access to perennial stream or lake exists at potential educational site.
12. Two or more wetland classes are visible from primary viewing locations.
13. Low-growing wetlands (marshes, scrub-shrub, bogs, open water) are visible from primary viewing locations.
14. Half an acre of open water or 200 feet of stream is visible from the primary viewing locations.
15. Large area of wetland is dominated by flowering plants or plants that turn vibrant colors in different seasons.
16. General appearance of the wetland visible from primary viewing locations is unpolluted and/or undisturbed.
17. Overall view of the wetland is available from the surrounding upland.
18. Quality of the water associated with the wetland is high.
19. Opportunities for wildlife observations are available.
20. Historical buildings are found within the wetland.
21. Presence of pond or pond site and remains of a dam occur within the wetland.
22. Wetland is within 50 yards of the nearest perennial watercourse.
23. Visible stone or earthen foundations, berms, dams, standing structures, or associated features occur within the wetland.
24. Wetland contains critical habitat for a state- or federally-listed threatened or endangered species.
25. Wetland is known to be a study site for scientific research.
26. Wetland is a natural landmark or recognized by the state natural heritage inventory authority as an exemplary natural community.
27. Wetland has local significance because it serves several functional values.
28. Wetland has local significance because it has biological, geological, or other features that are locally rare or unique.
29. Wetland is known to contain an important archaeological site.
30. Wetland is hydrologically connected to a state or federally designated scenic river.
31. Wetland is located in an area experiencing a high wetland loss rate.
32. Other

VISUAL QUALITY/AESTHETICS — This value considers the visual and aesthetic quality or usefulness of the wetland.



CONSIDERATIONS/QUALIFIERS

1. Multiple wetland classes are visible from primary viewing locations.
2. Emergent marsh and/or open water are visible from primary viewing locations.
3. A diversity of vegetative species is visible from primary viewing locations.
4. Wetland is dominated by flowering plants or plants that turn vibrant colors in different seasons.
5. Land use surrounding the wetland is undeveloped as seen from primary viewing locations.
6. Visible surrounding land use form contrasts with wetland.
7. Wetland views absent of trash, debris, and signs of disturbance.
8. Wetland is considered to be a valuable wildlife habitat.
9. Wetland is easily accessed.
10. Low noise level at primary viewing locations.
11. Unpleasant odors absent at primary viewing locations.
12. Relatively unobstructed sight line exists through wetland.
13. Other

ENDANGERED SPECIES HABITAT — This value considers the suitability of the wetland to support threatened or endangered species.

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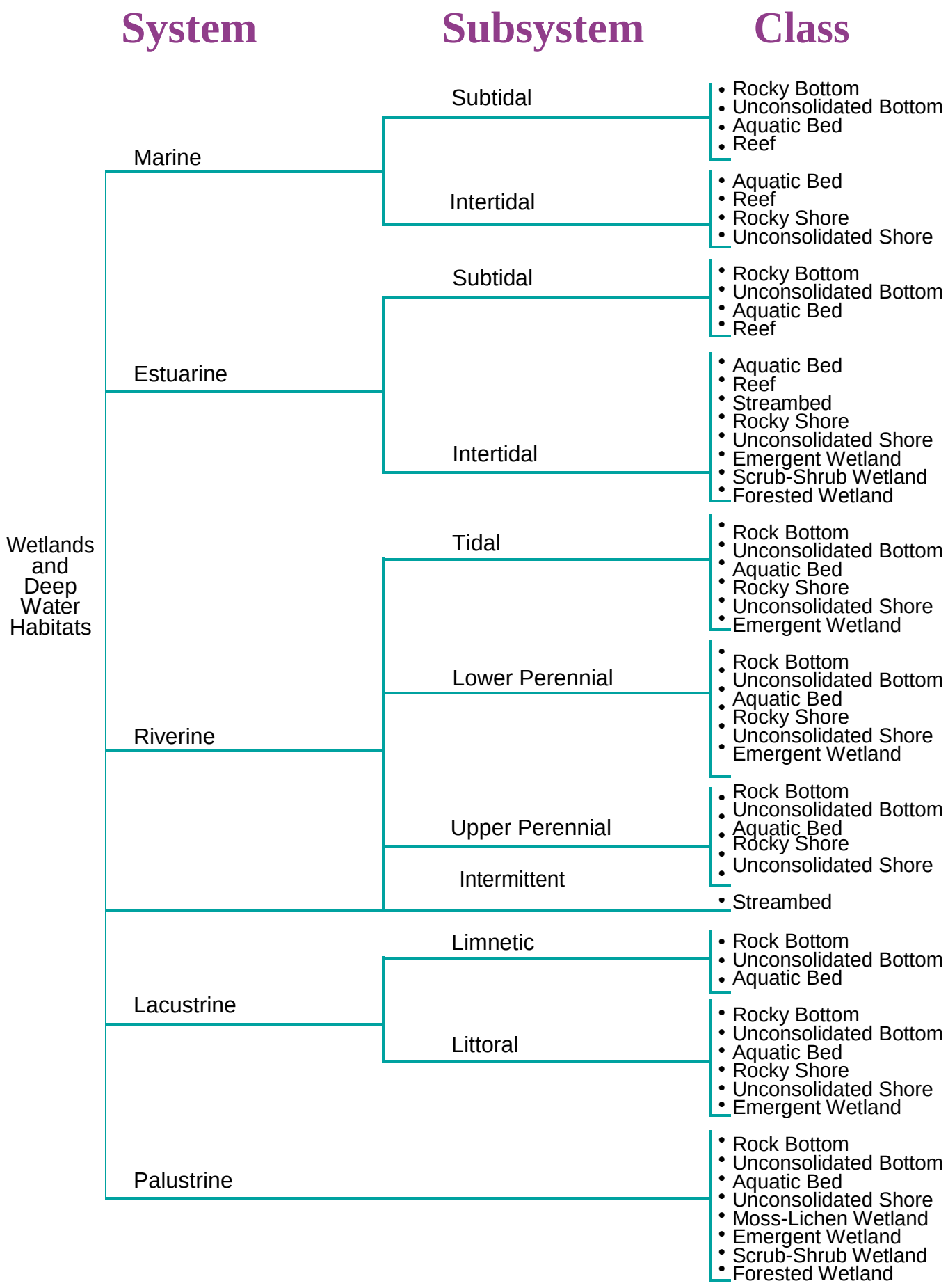
CONSIDERATIONS/QUALIFIERS

1. Wetland contains or is known to contain threatened or endangered species.
2. Wetland contains critical habitat for a state or federally listed threatened or endangered species.


System
Subsystem
Class
Wetlands and Deep Water Habitats
Marine
Subtidal
Rocky Bottom
Unconsolidated Bottom
Aquatic Bed
Reef
Intertidal
Aquatic Bed
Reef
Rocky Shore
Unconsolidated Shore
Estuarine
Subtidal
Rocky Bottom
Unconsolidated Bottom
Aquatic Bed
Reef
Intertidal
Aquatic Bed
Reef
Streambed
Rocky Shore
Unconsolidated Shore
Emergent Wetland
Scrub-Shrub Wetland
Forested Wetland
Riverine
Tidal
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Rocky Shore
Unconsolidated Shore
Emergent Wetland
Lower Perennial
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Rocky Shore
Unconsolidated Shore
Emergent Wetland
Upper Perennial
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Rocky Shore
Unconsolidated Shore
Intermittent
Streambed
Lacustrine
Limnetic
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Littoral
Rocky Bottom
Unconsolidated Bottom
Aquatic Bed
Rocky Shore
Unconsolidated Shore
Emergent Wetland
Palustrine
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Unconsolidated Shore
Moss-Lichen Wetland
Emergent Wetland
Scrub-Shrub Wetland
Forested Wetland