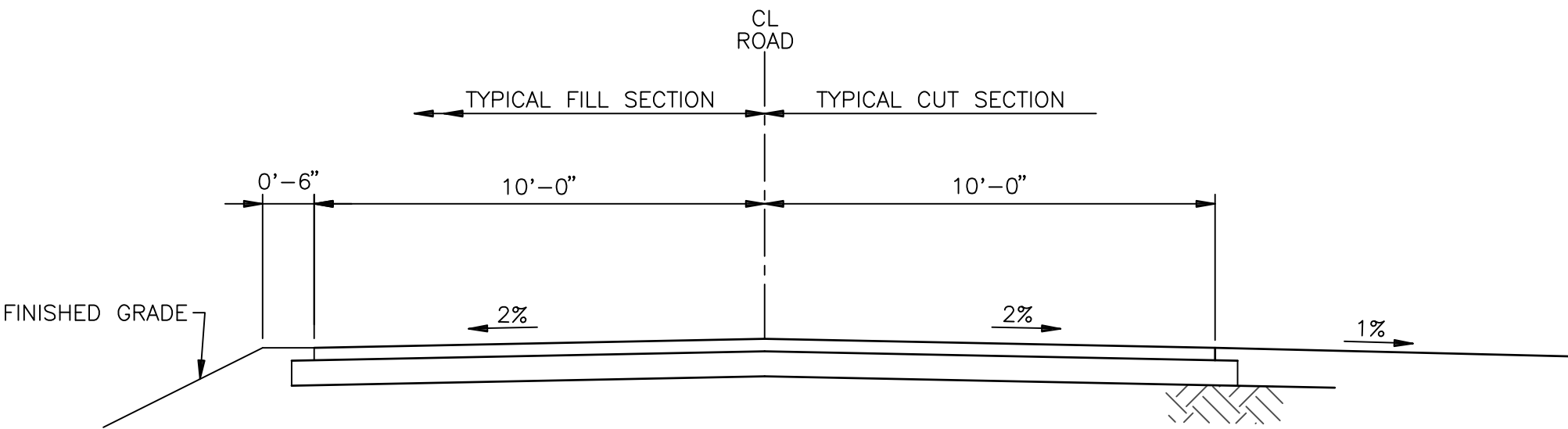
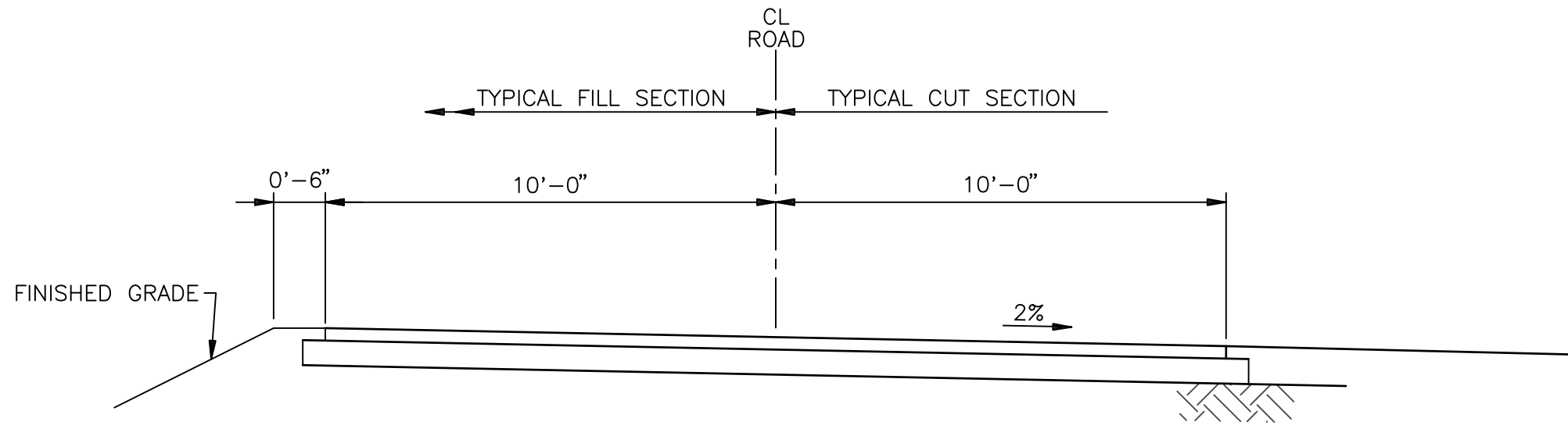


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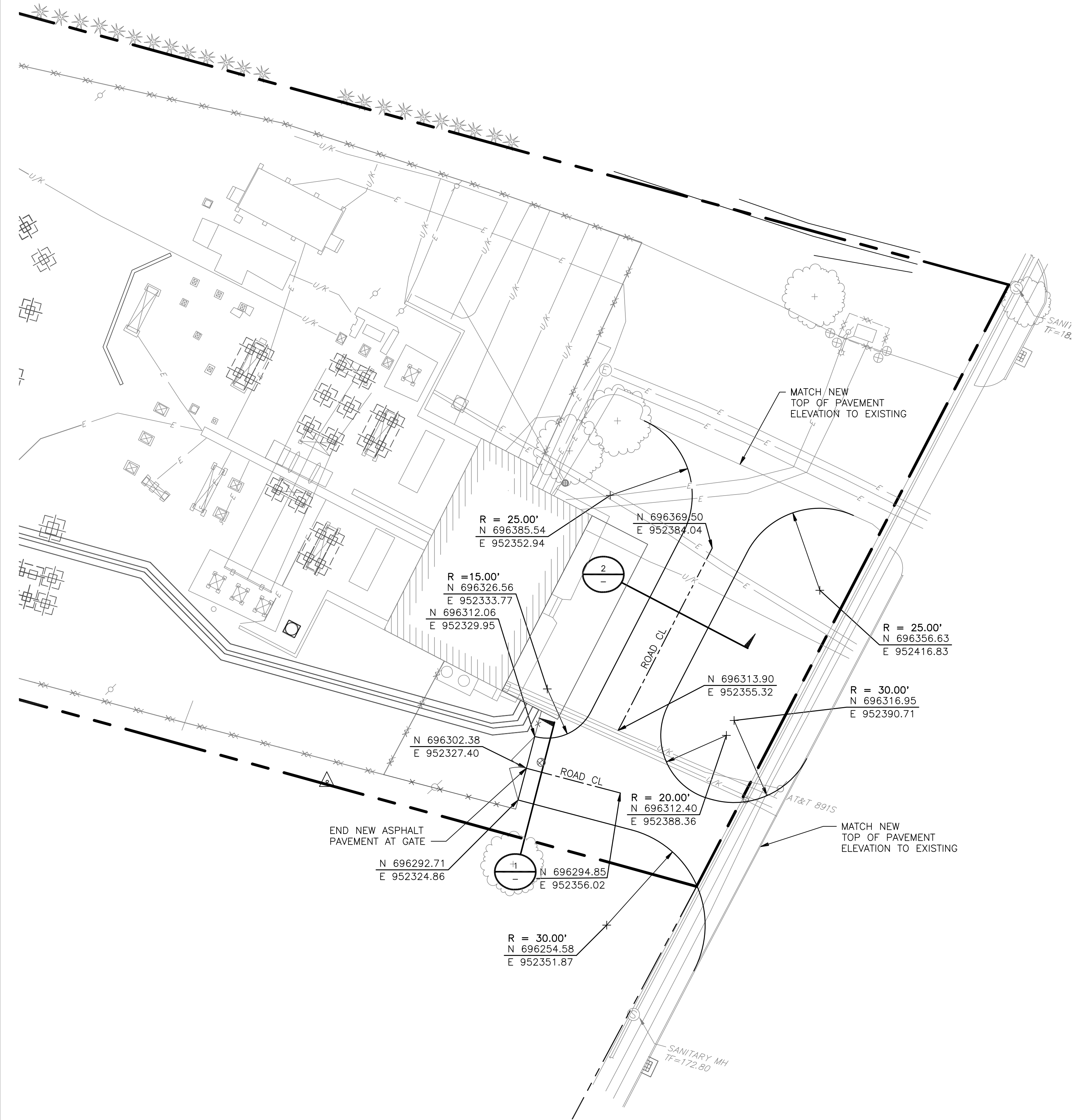
1. SEE DWG 15238-417 FOR GENERAL NOTES AND LEGEND.
2. REFER TO UI DWG "SUBSTATION ACCESS DRIVE STANDARD PAVEMENT SECTION DETAILS" REVISION 1 FOR ASPHALT PAVEMENT CROSS SECTION AND FOR TYPICAL PAVEMENT SECTIONS.



SECTION 1
TYPICAL ASPHALT SURFACE ROAD SECTION
NO SCALE
SEE NOTE 2



SECTION 2
TYPICAL ASPHALT SURFACE ROAD SECTION
NO SCALE
SEE NOTE 2

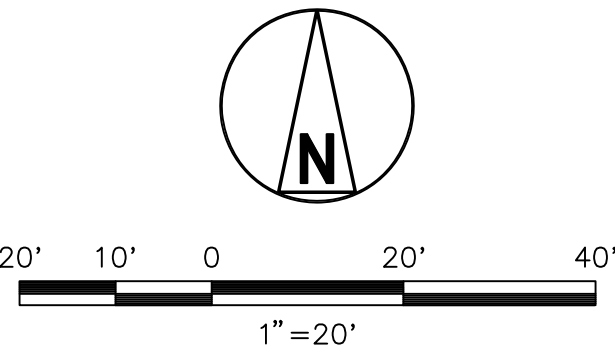


NOT TO BE USED FOR CONSTRUCTION

REFERENCE DRAWINGS

GRADING AND DRAINAGE PLAN	15238-417 & 417J
EROSION CONTROL PLAN & DETAILS	15238-417A & 417B
SURFACING AND FENCING PLAN	15238-417C
ROADS AND PARKING PLAN	15238-417D
FUSS AND O'NEILL SURVEY	15238-417E

BLACK & VEATCH Building a world of difference®									
DESIGNER	SMR	DRAWN	JRH						
CHECKED	-	DATE	-						
PROJECT # 180592									
NO	DATE	REVISION			DRN	CHKD	DES	SUPR.	
E	11/05/2015	ISSUED FOR SWPCP PERMITTING-PROJECT 180592-CAP BANK AND REACTOR			RRH	-	SMR	MAV	
D	10/28/2015	ISSUED FOR SWPCP PERMITTING-PROJECT 180592-CAP BANK AND REACTOR			JDL	-	SMR	MAV	
C	10/26/2015	ISSUED FOR PERMITTING - PROJECT 180592 - CAP BANK AND REACTOR			JDL	-	SMR	MAV	
B	07/09/2015	ISSUED FOR BID - PROJECT 180592 - CAP BANK AND REACTOR			MEM	-	JJD	MAV	
A	08/09/2013	ISSUED FOR UI 30% REVIEW			JRH	-	SMR	-	



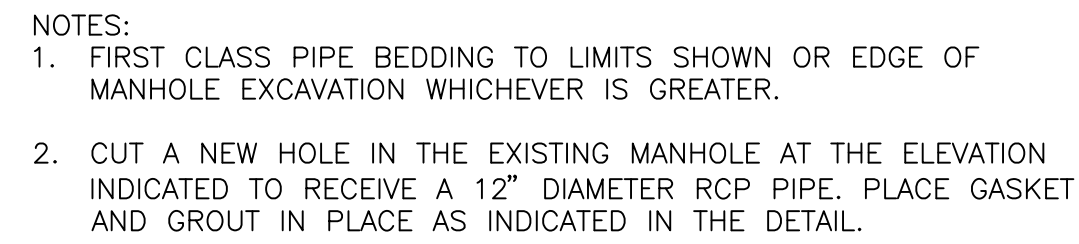
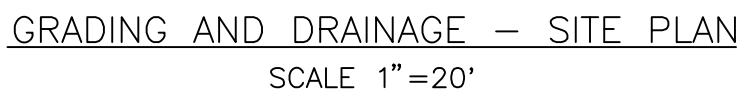
No	Date	Revision	By	Chkd.	Engr.	Supv.



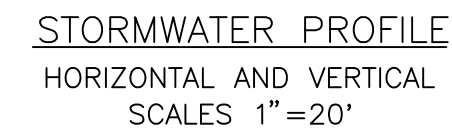
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Chkd.	-	Design Engr.	SMR	Design Supv.	-

ROADS AND PARKING - SITE
PLAN
MIX AVENUE SUBSTATION

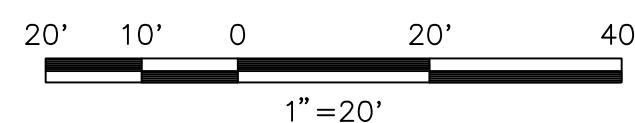
CAD FILE NAME	SEQUENCE No.	DRAWING NUMBER
-	-	15238-417D



TYPICAL WALL PENETRATION DETAIL
NO SCALE



PROPOSED EASEMENT



CAD FILE NAME	SEQUENCE No.	DRAWING NUMBER
—	—	15238-417J

15238-417 & 417J
15238-417A & 417B
15238-417C
15238-417D
15238-417E

STORMWATER PRE-POST VERIFICATION



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CALCULATION RECORD

Client Name United Illuminating Company Page 1 of 8

Project Name Mix Avenue Substation Project No. 180592

Calculation Title Stormwater Pre-Post Verification

Calculation No./File No. 51.1210.001

Verification Method: ☐ Check and Review ☐ Alternate Calculations

Objective: To develop Pre and Post development stormwater discharge rates, confirm detention vault sizing, and to determine trench drain and culvert pipe sizing.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

Refer to Page ____ of this calculation for additional assumptions.

This Section Used for Software-Generated Calculations

Program Name/Number Bentley® PondPack® Version V8i
Bentley® FlowMaster® V8i

Standard B&V Application Used? ☒ Yes ☐ No

If no, list approved deviation permit number below and attach approved deviation permit.

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	D. Fenyell	12/17/2015	Jerry Dyck	12/17/2015	STEPHEN M REITZ	01/05/16
	<i>[Signature]</i>	12/17/2015	<i>[Signature]</i>	12-17-15	<i>[Signature]</i>	01-05-16

CONFIDENTIAL AND PROPRIETARY BUSINESS INFORMATION OF B&V.

P-GN-100G (Referenced by Energy-Std-2-03880-00140) Effective 15/DEC/11



Client United Illuminating Company
Project Mix Avenue Substation **Unit** _____
Project No. 180592 **File No.** 51.1210.001
Title Stormwater Pre-Post Verification

Computed By D. Fennell
Date December 17, 2015
Verified By _____
Date _____
Page Page 2 of 8

TABLE OF CONTENTS

	Page No.
1.0 Objective	3
2.0 References	3
3.0 Design Basis	3
4.0 Definition of Units & Constants	3
5.0 Analysis	4
6.0 Conclusions	8

Attachments

Attachment A- Pre-development Drainage Area Map	A1-A2
Attachment B – Soils Report	B1-B23
Attachment C- Post-development Drainage Area Map	C1 – C2
Attachment D- Storm Trap Drawings	D1 – D6
Attachment E –Bentley PondPack Report	E1 – E201
Attachment F –Rainfall Depth In Inches	F1 – F2
Attachment G –Section 6.9 CONN-DOT Drainage Manual	G1 – G7
Attachment H –NOAA Report, Intensity In Inches/Hour	H1-H2
Attachment I –Flow Master Reports	I1-I8
Attachment J –Storm Trap Elevation-Volume Data	J1-J2



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Project Mix Avenue Substation Unit
Project No. 180592 File No. 51.1210.001
Title Stormwater Pre-Post Verification

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Date
Page Page 3 of 8

1.0 Objective

To develop Pre and Post development stormwater discharge rates, confirm detention vault sizing, and to determine trench drain and culvert pipe sizing.

2.0 References

1. Zoning Regulations, Town of Hamden, CT (August, 2010)
2. 2004 Connecticut Stormwater Quality Manual, Connecticut Department of Environmental Protection.
3. Urban Hydrology for Small Watersheds, US Department of Agriculture, Soil Conservation Service, Technical Release 55, 1986.
4. Rainfall Intensity in Inches per Hour for Hamden, CT (Lat:43.3722, Lon:-72.9238), NOAA – Hydrometeorological Design Studies Center, Rainfall Frequency Information (Attachment H).
5. CS-CIVIL SITE-3, Grading and Drainage Procedure.
6. Energy-Gid-3-03112-03216-Revision 2, Guide for Culverts.
7. Custom Soil Resource Report for State of Connecticut, USDA Natural Resources Conservation Service (Attachment B).
8. Section 6.9 "Rational Method" of the Drainage Manual, Connecticut Department of Transportation, 2000. (Attachment G)
9. Drawing 15238-417, Grading and Drainage – Site Plan.
10. Storm Trap Elevation-Volume Data (Attachment J).

3.0 Design Basis

1. The design storms evaluated for Pre-development and Post-development runoff rates shall be the 2-year, 10-year, 25-year, 50-year, and 100-year storms with a 24-hour duration -Type III Distribution (Ref. 1, Section 520.11.3) as computed with TR-55 (Ref. 3).
2. Rainfall depth for the design storms as shown in Chapter 7 of the 2004 DEEP Stormwater Manual (Ref. 2).
3. The design storm for conveyance (trench drains and culverts) shall be the 25-year storm (Ref. 5).

4.0 Definition of Units & Constants

' = feet
"=inches
AC = acre
FT = feet
SF = square feet
SI= square inches
EL = Elevation
CF= Cubic Feet
CFS = cubic feet per second



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Project Mix Avenue Substation Unit
Project No. 180592 File No. 51.1210.001
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Date
Page Page 4 of 8

5.0 Analysis

Existing Site

The Subject Site is located west of Mix Avenue in Hamden, CT. The site is developed for use as an electrical substation with a paved driveway, a control house, and electrical substation equipment. All substation areas inside the fence are surfaced with open graded substation rock unless noted otherwise.

The site is generally rectangular with the longer dimension running east-west and the shorter dimension north-south. Existing drainage is from the western, northern, and eastern boundaries inward to the center of the site and then south to a catch basin on adjoining property. A map of the pre-development drainage area is provided in Attachment A.

Soils

Per the Soils Survey for Hamden, CT by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), the soils at the Subject Site consist primarily of Watchaug fine sandy loam, Cheshire fine sandy loam, and Urban land. The characteristics of these soils as defined by the USDA – NRCS are as follows:

These soils range from moderately well drained to well drained with no ponding or flooding. The Hydrologic Soil Group of these soils ranges from B to C in the classified areas and D in the unclassified areas. For pre-development runoff analysis, soils in undeveloped areas (woods) are assigned a rating of B. All developed areas are assigned a rating of C/D. For post-development runoff analysis all areas are assigned a rating of C/D. A copy the Soils Survey is provided in Attachment B.

Proposed Improvements

The existing substation is being expanded. On the eastern side of the site, an addition is proposed at the control house along with new asphalt paving. On the western side of the site extensive grading will create a larger yard area for the substation. Surfacing for the expanded yard area will match the existing open graded substation rock.

A map of the post-development drainage areas is provided in Attachment C.

Drainage Design Narrative

Existing drainage patterns at the site will be maintained to the extent possible. The central portion of the site shall continue to drain by overland flow to the catch basin on adjoining property.

To attenuate the increase in runoff from improved areas on the eastern and western portions of the site, an underground detention chamber is proposed. Vendor information for the preliminary design of the vault is provided in Attachment D.

A new trench drain is proposed to capture runoff from the expanded yard area on the western side of the project. A new culvert and catch basin will collect runoff from the control house addition and the new pavement.

Pre-development and Post-development stormwater runoff rates were evaluated in the 2-year, 10-year, 25-year, 50-year, and 100-year storms with a 24-hour duration -Type III Distribution (Ref. 1, Section 520.11.3) as computed with TR-55 (Ref. 3). Reservoir routing calculations were computed/modeled using the Bentley® PondPack® software. Routing results are provided in Attachment E.

5.1 Hydrograph Input Data

Drainage basin characteristics were developed from multiple sources, including an existing conditions survey, topographic survey, Google Earth aerial imagery, and the proposed grading plan (Ref. 9). The drainage basins were delineated and measured in AutoCAD. Existing and proposed surfacing was evaluated and Curve Numbers assigned in accordance with TR-55 (Ref. 2). Grass and substation surfacing were assigned a curve number of 80 for group C/D soils. The flow path length and slope was also delineated and measured in AutoCAD for use in determining time of concentration. A summary of the drainage basin characteristics input into Bentley® PondPack® software can be found on the PRE and POST development drainage area maps (Attachments A and C).

5.2 Pre-Development Runoff Rates

Pre-development stormwater runoff rates were evaluated in the 2-year, 10-year, 25-year, 50-year, and 100-year storms with a 24-hour duration -Type III Distribution (Ref. 1, Section 520.11.3) as computed with TR-55 (Ref. 3). Reservoir routing calculations were computed/modeled using the Bentley® PondPack® software. Precipitation depths for each design storm were found in the 2004 Connecticut Stormwater Manual (Ref. 3, Attachment F). Routing results are provided in Attachment E. The following is a summary of the results:

	Design Storm				
	2	10	25	50	100
Rainfall Depth (in)	3.3	5.0	5.6	6.4	7.1
Peak Flow (cfs)	2.00	4.52	5.49	6.81	7.98

5.3 Post-Development Runoff Rates

Four discreet drainage basins were developed for analyzing post-development runoff rates. Three of the areas convey runoff to the proposed underground detention chamber and are designated by their conveyance measure (trench, pipe, or catch basin). The underground detention basin will discharge directly to the catch basin on adjoining property by a new 12" RCP or CHDPE culvert.

The balance of the post-developed area will follow existing drainage patterns and drain by overland flow to the existing catch basin, bypassing the detention chamber.

Post-development stormwater runoff rates were evaluated in the 2-year, 10-year, 25-year, 50-year, and 100-year storms with a 24-hour duration -Type III Distribution (Ref. 1, Section 520.11.3) as computed with TR-55 (Ref. 3). Reservoir routing calculations were computed/modeled using the Bentley® PondPack® software. Precipitation depths for each design storm were found in the 2004 Connecticut Stormwater Manual (Ref. 3, Attachment F). Elevation-volume data for the proposed detention chamber as dimensioned on the drawings included in Attachment D was provided by the manufacturer (Ref. 10, Attachment J). Routing results are provided in Attachment E. The following is a summary of the results:

	Design Storm				
	2	10	25	50	100
Rainfall Depth (in)	3.3	5.0	5.6	6.4	7.1
Peak Flow Out Detention (cfs)	0.44	1.67	1.96	2.06	2.59
Peak Flow Bypass (cfs)	1.40	2.62	3.07	3.66	4.18
Peak Flow Total (cfs)	1.78	4.28	5.02	5.72	6.76

5.4 Conveyance

The design storm for conveyance (trench drains and culverts) shall be the 25-year storm (Ref. 5). In the developed condition the collected drainage area is conveyed to the detention chamber via trench drain and circular pipe. Runoff from the control house addition and the new asphalt driveway is conveyed via a circular pipe. Peak discharge to these conveyance structures shall be computed by the Rational Method as illustrated in Conn-DOT drainage manual (Ref. 8, Attachment G). Bentley FlowMaster software is utilized to compute the capacity of the trench and pipes.

5.4.1 Drainage Basin Data

Drainage basin characteristics were developed as described in Section 5.1 above. Existing and proposed surfacing were evaluated and Rational runoff coefficients assigned in accordance with Tables 6-3 and 6-4 (Ref. 8, Attachment G) and a frequency factor of 1.1 was applied in accordance with Table 6-2 (Ref. 8, Attachment G). The flow path length and slope were also delineated and measured in AutoCAD for use in determining time of concentration. Post-development drainage area maps are included in Attachment C.

5.4.2 Composite Runoff Coefficient

Composite runoff coefficients (Cc) are determined by computing the weighted average of the surface areas measured in AutoCAD. Surface areas were measured as follows:

	DESCRIPTION	"C" VALUE (REF.1, TABLE T-4)	FREQUENCY FACTOR (REF.1, TABLE T-5)	ADJUSTED "C" VALUE	AREA	CiAi
TRENCH/TRENCH-PIPE						
	GRASS	0.21	1.1	0.23	0.50	0.12
	SUB-ROCK	0.19	1.1	0.21	0.75	0.16
TOTALS:					1.25	0.27
PIPE						
	GRASS	0.21	1.1	0.23	0.07	0.02
	IMPERVIOUS	0.95	1.1	1.00	0.10	0.10
TOTALS:					0.17	0.12

$$Cc = \sum CiAi/A$$

Trench: $Cc = 0.27/1.25 = 0.21$

Pipe: $Cc = 0.12/0.17 = 0.71$

5.4.3 Time of Concentration

Time of concentration for the trench drain is taken from the Bentley® PondPack® modeling results (Attachment E). The time of concentration for the pipe is less than 5 minutes so 5 minutes is used for calculation purposes.

Tc (Trench) = 20 minutes

Tc (Pipe) = 5 minutes (minimum)

5.4.4 Intensity

With the calculated time of concentration, storm intensity can be found in the NOAA IDF table (Ref. 4, Attachment H),. The intensity for each drainage basin was determined to be:

Trench → 4.56 in/hr

Pipe → 9.16 in/hr

5.4.5 Peak Discharge

The Rational method calculates peak discharge as:

$Q = CIA$ where: Q = peak discharge (CFS)
 C – runoff coefficient
 I = Intensity (in/hr)
 A = drainage area

Trench

$Q = CIA = 0.21 * 4.56 \text{ in/hr} * 1.25 \text{ AC} = 1.20 \text{ CFS}$

Pipe

$Q = CIA = 0.71 * 9.16 \text{ in/hr} * 0.17 \text{ AC} = 0.1.11 \text{ CFS}$

5.4.6 Trench Drain Capacity

FlowMaster software is utilized to design the trench drain. Capacity calculations are performed for a 10" wide trench with a minimum depth of 12". The trench drain is modeled as a rectangular trench with software inputs as follows:

FlowMaster Model Input Data					
	Solve For	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Bottom Width (ft)
TRENCH	Discharge	0.012	0.0030	1.00	0.83

Flow Master results are summarized in the following table:

Flow Master Model Output Data						
	Discharge (cfs)	Flow Area (sf)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Top Width (ft)	Velocity (ft/s)
TRENCH	2.48	0.83	4.71	2.83	0.83	2.99

The calculated capacity is greater than the required capacity calculated in 5.4.5. Flow Master output reports are included in Attachment I.

5.4.7 Pipe Capacity

FlowMaster software is also utilized to design the pipes downstream of the trench drain, at the road crossing north of the detention chamber, and the discharge pipe from the chamber to the outlet catch basin. Capacity calculations are performed starting with a minimum 12" pipe size. Flow Master software inputs are as follows:

FlowMaster Model Input Data					
Culvert	Solve For	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Diameter (ft)
Trench	Full Flow Capacity	0.012	0.0083	1.00	1.00
Culvert	Full Flow Capacity	0.012	0.0200	1.00	1.00
Chamber Discharge	Full Flow Capacity	0.012	0.0100	1.00	1.00

Flow Master results are summarized in the following table:

Flow Master Model Output Data						
Culvert	Discharge (cfs)	Flow Area (sf)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Percent Full (%)	Velocity (ft/s)
Trench	3.52	0.79	3.14	0.25	100	4.48
Culvert	5.46	0.79	3.14	0.25	100	6.95
Chamber Discharge	3.86	0.79	3.14	0.25	100	4.91

The calculated capacity is greater than the required capacity calculated in 5.4.5. Flow Master output reports are included in Attachment I.

6.0 Conclusions

Pre-development stormwater runoff rates are less than post-development stormwater runoff rates in the 2-year, 10-year, 25-year, 50-year, and 100-year storms with a 24-hour duration -Type III Distribution as computed with TR-55. These results confirm the proposed detention volume is adequate.

	Design Storm				
	2	10	25	50	100
Peak Flow Pre (cfs)	2.00	4.52	5.49	6.81	7.98
Peak Flow Post (cfs)	1.78	4.28	5.02	5.72	6.76

The provided capacity of the trench drain and conveyance pipes is greater than required:

	Capacity Provided (cfs)	Capacity Required (cfs)
Trench	2.48	1.20
Trench Pipe	3.52	0.82
Culvert	5.46	1.11
Chamber Discharge	3.86	2.59



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Project Mix Avenue Substation

Project No. 180592 **File No.** 51.1210.001

Title Stormwater Pre-Post Verification

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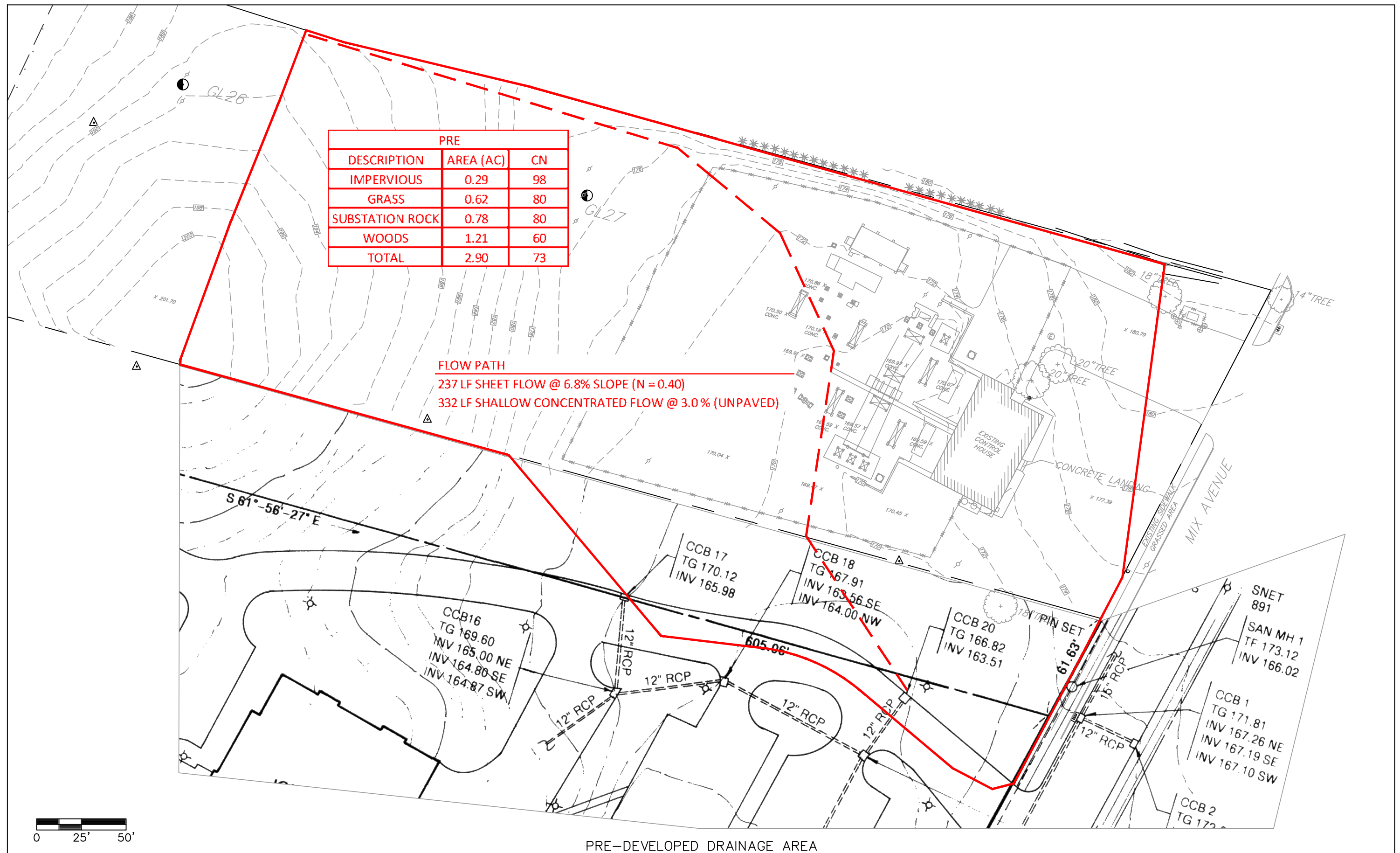
Date December 16, 2015

Verified By _____

Date _____

Page Page A1 of A2

Attachment A
Pre-developed Drainage Area Maps





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Page Page B1 of B23

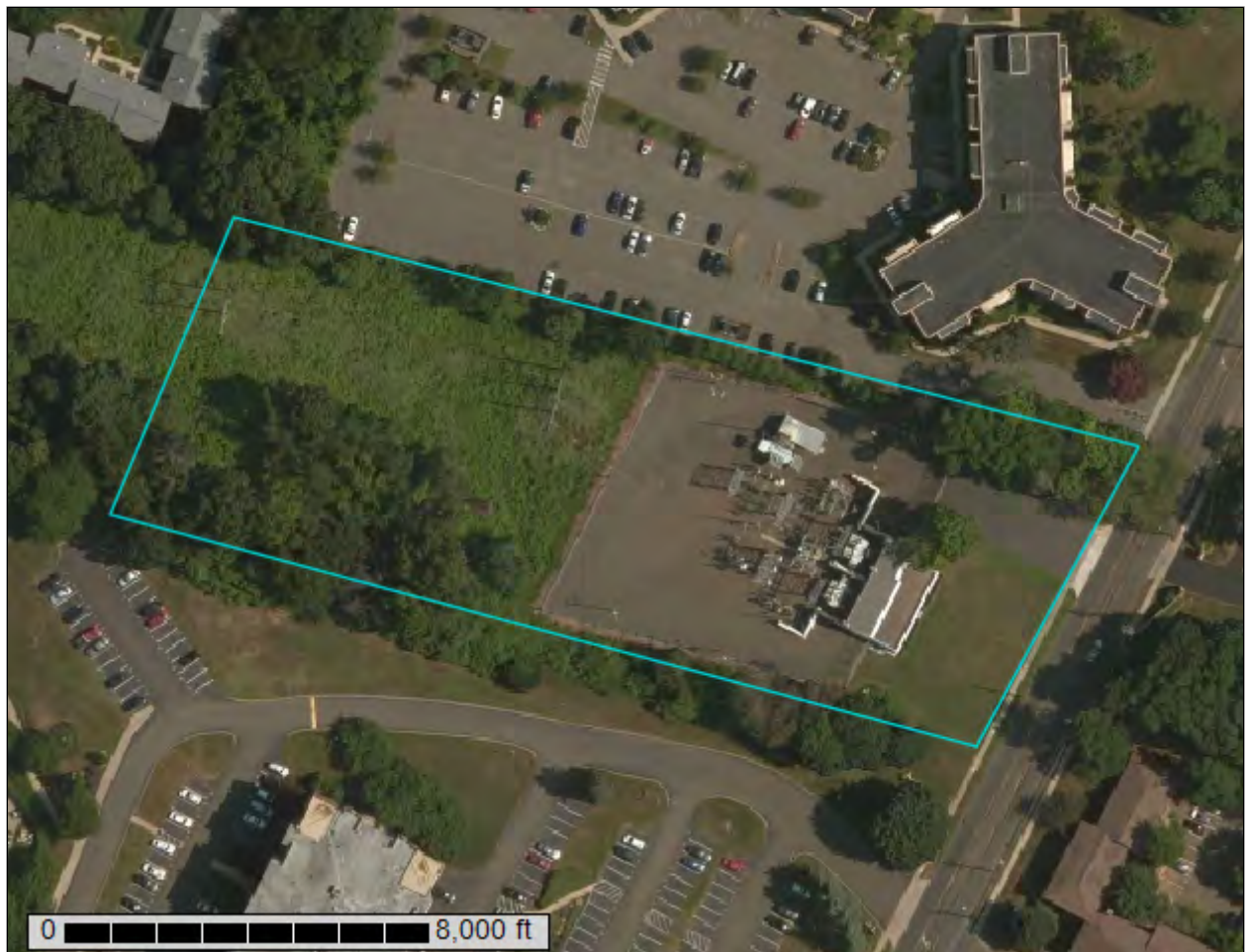
Attachment B Soils Report



A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for State of Connecticut

Mix Avenue, Hamden CT



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Preface	2
How Soil Surveys Are Made	5
Soil Map	7
Soil Map.....	8
Legend.....	9
Map Unit Legend.....	10
Map Unit Descriptions.....	10
State of Connecticut.....	12
55B—Watchaug fine sandy loam, 3 to 8 percent slopes.....	12
64C—Cheshire fine sandy loam, 8 to 15 percent slopes, very stony.....	13
307—Urban land.....	15
Soil Information for All Uses	16
Soil Properties and Qualities.....	16
Soil Qualities and Features.....	16
Hydrologic Soil Group (Mix Avenue, Hamden CT).....	16
References	21

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

Custom Soil Resource Report

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

180592.51.1210.001
Attachment B
Page B9



Custom Soil Resource Report

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: <http://websoilsurvey.nrcs.usda.gov>
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 14, Sep 22, 2015

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

Date(s) aerial images were photographed: Jun 27, 2014—Jul 22, 2014

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.

Custom Soil Resource Report

Map Unit Legend

State of Connecticut (CT600)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
55B	Watchaug fine sandy loam, 3 to 8 percent slopes	0.8	25.7%
64C	Cheshire fine sandy loam, 8 to 15 percent slopes, very stony	1.7	53.2%
307	Urban land	0.7	21.1%
Totals for Area of Interest		3.1	100.0%

Map Unit Descriptions

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, 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

Custom Soil Resource Report

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*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one 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.

Custom Soil Resource Report

State of Connecticut

55B—Watchaug fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9lpb
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 52 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

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

Description of Watchaug

Setting

Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Coarse-loamy melt-out till derived from basalt and/or sandstone and shale

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 18 inches: fine sandy loam
Bw2 - 18 to 24 inches: fine sandy loam
C - 24 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Medium
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 18 to 30 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): 2w
Hydrologic Soil Group: C

Minor Components

Cheshire

Percent of map unit: 5 percent
Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Linear

Custom Soil Resource Report

Wilbraham

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave

Ludlow

Percent of map unit: 3 percent
Landform: Drumlins, hills
Down-slope shape: Concave
Across-slope shape: Linear

Unnamed, stony surface

Percent of map unit: 3 percent

Menlo

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

Unnamed, silt loam surface

Percent of map unit: 2 percent

64C—Cheshire fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 9lq0
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

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

Description of Cheshire

Setting

Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy melt-out till derived from basalt and/or sandstone and shale

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 16 inches: fine sandy loam

Custom Soil Resource Report

Bw2 - 16 to 26 inches: fine sandy loam
C - 26 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.57 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: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B

Minor Components

Wilbraham

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave

Wethersfield

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

Yalesville

Percent of map unit: 5 percent
Landform: Hills, ridges
Down-slope shape: Convex
Across-slope shape: Linear

Watchaug

Percent of map unit: 3 percent
Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Concave

Menlo

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

Custom Soil Resource Report

307—Urban land

Map Unit Setting

National map unit symbol: 9lmh

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

Urban land: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

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

Minor Components

Udorthents, wet substratum

Percent of map unit: 10 percent

Down-slope shape: Convex

Across-slope shape: Linear

Unnamed, undisturbed soils

Percent of map unit: 10 percent

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (Mix Avenue, Hamden CT)

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

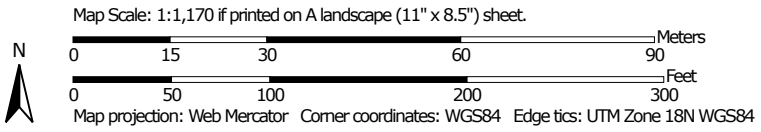
Custom Soil Resource Report

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group (Mix Avenue, Hamden CT)



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

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: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

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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 14, Sep 22, 2015

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

Date(s) aerial images were photographed: Jun 27, 2014—Jul 22, 2014

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.

Custom Soil Resource Report

Table—Hydrologic Soil Group (Mix Avenue, Hamden CT)

Hydrologic Soil Group— Summary by Map Unit — State of Connecticut (CT600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
55B	Watchaug fine sandy loam, 3 to 8 percent slopes	C	0.8	25.7%
64C	Cheshire fine sandy loam, 8 to 15 percent slopes, very stony	B	1.7	53.2%
307	Urban land	D	0.7	21.1%
Totals for Area of Interest			3.1	100.0%

Rating Options—Hydrologic Soil Group (Mix Avenue, Hamden CT)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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BLACK & VEATCH

Client United Illuminating Company

Project Mix Avenue Substation

Project No. 180592 **File No.** 51.1210.001

Title Stormwater Pre-Post Verification

Computed By D. Fennell

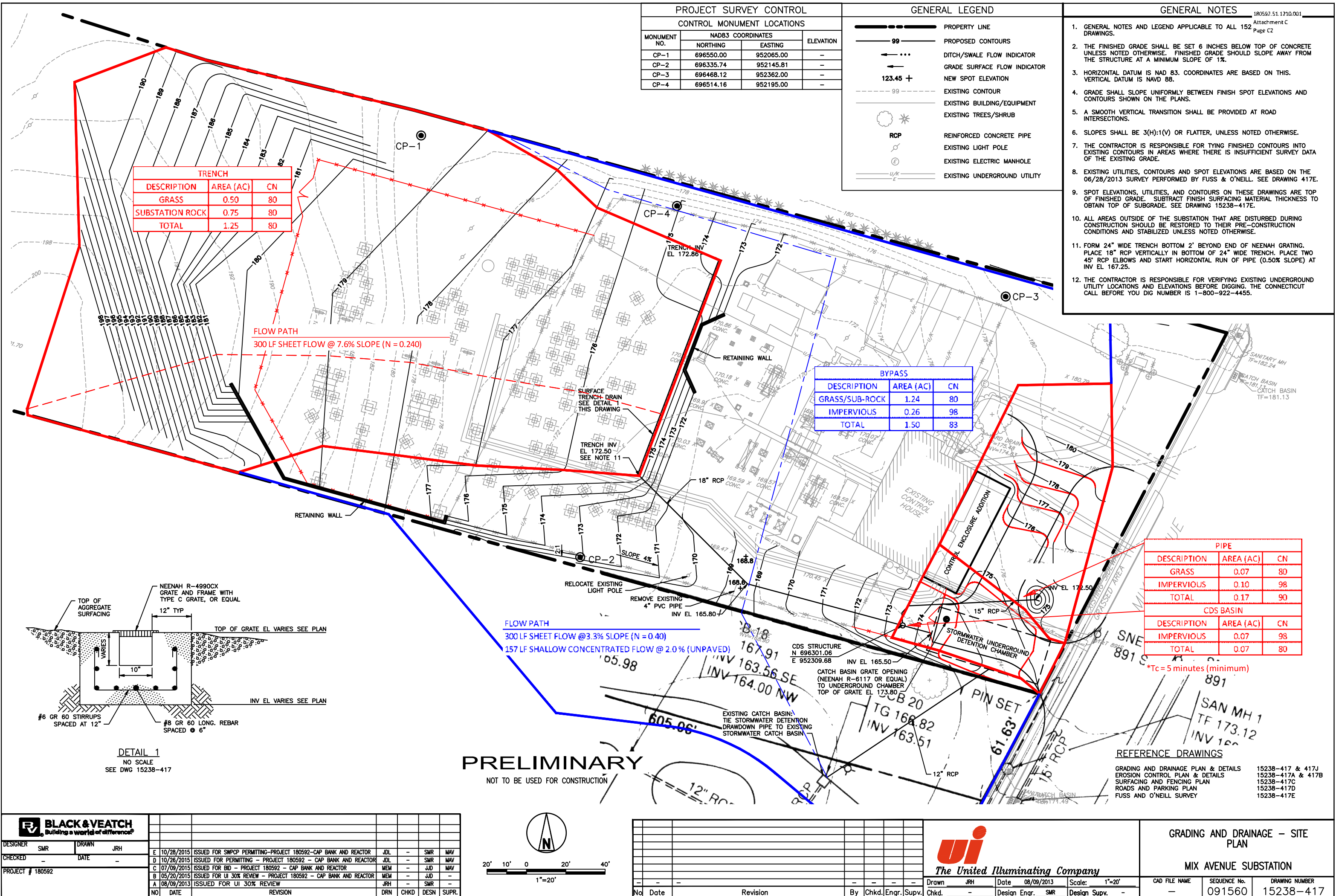
Date December 16, 2015

Verified By

Date

Page Page C1 of C2

Attachment C
Post-development Drainage Area Map



PROJECT SURVEY CONTROL			
CONTROL MONUMENT LOCATIONS			
MONUMENT NO.	NAD83 COORDINATES		ELEVATION
	NORTHING	EASTING	
CP-1	696550.00	952065.00	-
CP-2	696335.74	952145.81	-
CP-3	696468.12	952362.00	-
CP-4	696514.16	952195.00	-

GENERAL LEGEND	
	PROPERTY LINE
	PROPOSED CONTOURS
	DITCH/SWALE FLOW INDICATOR
	GRADE SURFACE FLOW INDICATOR
	NEW SPOT ELEVATION
	EXISTING CONTOUR
	EXISTING BUILDING/EQUIPMENT
	EXISTING TREES/SHRUB
	RCP
	REINFORCED CONCRETE PIPE
	EXISTING LIGHT POLE
	EXISTING ELECTRIC MANHOLE
	EXISTING UNDERGROUND UTILITY

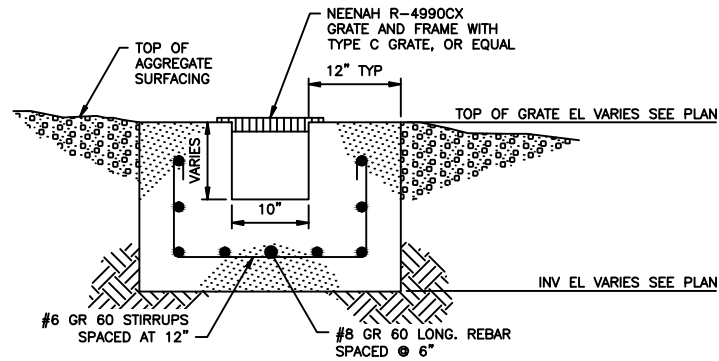
- | GENERAL NOTES | |
|---|-------------------------|
| 180592.51.1210.001 | Attachment C
Page C2 |
| 1. GENERAL NOTES AND LEGEND APPLICABLE TO ALL 152 DRAWINGS. | |
| 2. THE FINISHED GRADE SHALL BE SET 6 INCHES BELOW TOP OF CONCRETE UNLESS NOTED OTHERWISE. FINISHED GRADE SHOULD SLOPE AWAY FROM THE STRUCTURE AT A MINIMUM SLOPE OF 1%. | |
| 3. HORIZONTAL DATUM IS NAD 83. COORDINATES ARE BASED ON THIS. VERTICAL DATUM IS NAVD 88. | |
| 4. GRADE SHALL SLOPE UNIFORMLY BETWEEN FINISH SPOT ELEVATIONS AND CONTOURS SHOWN ON THE PLANS. | |
| 5. A SMOOTH VERTICAL TRANSITION SHALL BE PROVIDED AT ROAD INTERSECTIONS. | |
| 6. SLOPES SHALL BE 3(H):1(V) OR FLATTER, UNLESS NOTED OTHERWISE. | |
| 7. THE CONTRACTOR IS RESPONSIBLE FOR TYING FINISHED CONTOURS INTO EXISTING CONTOURS IN AREAS WHERE THERE IS INSUFFICIENT SURVEY DATA OF THE EXISTING GRADE. | |
| 8. EXISTING UTILITIES, CONTOURS AND SPOT ELEVATIONS ARE BASED ON THE 06/28/2013 SURVEY PERFORMED BY FUSS & O'NEILL. SEE DRAWING 417E. | |
| 9. SPOT ELEVATIONS, UTILITIES, AND CONTOURS ON THESE DRAWINGS ARE TOP OF FINISHED GRADE. SUBTRACT FINISH SURFACING MATERIAL THICKNESS TO OBTAIN TOP OF SUBGRADE. SEE DRAWING 15238-417E. | |
| 10. ALL AREAS OUTSIDE OF THE SUBSTATION THAT ARE DISTURBED DURING CONSTRUCTION SHOULD BE RESTORED TO THEIR PRE-CONSTRUCTION CONDITIONS AND STABILIZED UNLESS NOTED OTHERWISE. | |
| 11. FORM 24" WIDE TRENCH BOTTOM 2' BEYOND END OF NEENAH GRATING. PLACE 18" RCP VERTICALLY IN BOTTOM OF 24" WIDE TRENCH. PLACE TWO 45" RCP ELBOWS AND START HORIZONTAL RUN OF PIPE (0.50% SLOPE) AT INV EL 167.25. | |
| 12. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING EXISTING UNDERGROUND UTILITY LOCATIONS AND ELEVATIONS BEFORE DIGGING. THE CONNECTICUT CALL BEFORE YOU DIG NUMBER IS 1-800-922-4455. | |

TRENCH		
DESCRIPTION	AREA (AC)	CN
GRASS	0.50	80
SUBSTATION ROCK	0.75	80
TOTAL	1.25	80

BYPASS		
DESCRIPTION	AREA (AC)	CN
GRASS/SUB-ROCK	1.24	80
IMPERVIOUS	0.26	98
TOTAL	1.50	83

PIPE		
DESCRIPTION	AREA (AC)	CN
GRASS	0.07	80
IMPERVIOUS	0.10	98
TOTAL	0.17	90

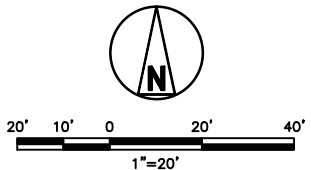
CDS BASIN		
DESCRIPTION	AREA (AC)	CN
IMPERVIOUS	0.07	98
TOTAL	0.07	80



PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

*Tc = 5 minutes (minimum)

BLACK & VEATCH		Building a world of difference	
DESIGNER	SMR	DRAWN	JRH
CHECKED	-	DATE	-
PROJECT # 180592			
NO DATE REVISION			
DRN CHKD DESN SUPR.			
E 10/28/2015 ISSUED FOR SWPCP PERMITTING-PROJECT 180592-CAP BANK AND REACTOR JDL - SMR MAV			
D 10/26/2015 ISSUED FOR PERMITTING - PROJECT 180592 - CAP BANK AND REACTOR JDL - SMR MAV			
C 07/09/2015 ISSUED FOR BID - PROJECT 180592 - CAP BANK AND REACTOR MEM - JJD MAV			
B 05/20/2015 ISSUED FOR UI 30% REVIEW - PROJECT 180592 - CAP BANK AND REACTOR MEM - JJD -			
A 08/09/2013 ISSUED FOR UI 30% REVIEW JRH - SMR -			



No	Date	Revision	By	Chkd.	Engr.	Supv.

ui
The United Illuminating Company

Drawn	JRH	Date	08/09/2013	Scale:	1"=20'
Design Engr.	SMR	Design Supv.	-		

GRADING AND DRAINAGE - SITE PLAN		
MIX AVENUE SUBSTATION		
CAD FILE NAME	SEQUENCE No.	DRAWING NUMBER
-	091560	15238-417



BLACK & VEATCH

Client United Illuminating Company

Project Mix Avenue Substation

Project No. 180592 **File No.** 51.1210.001

Title Stormwater Pre-Post Verification

Computed By D. Fennell

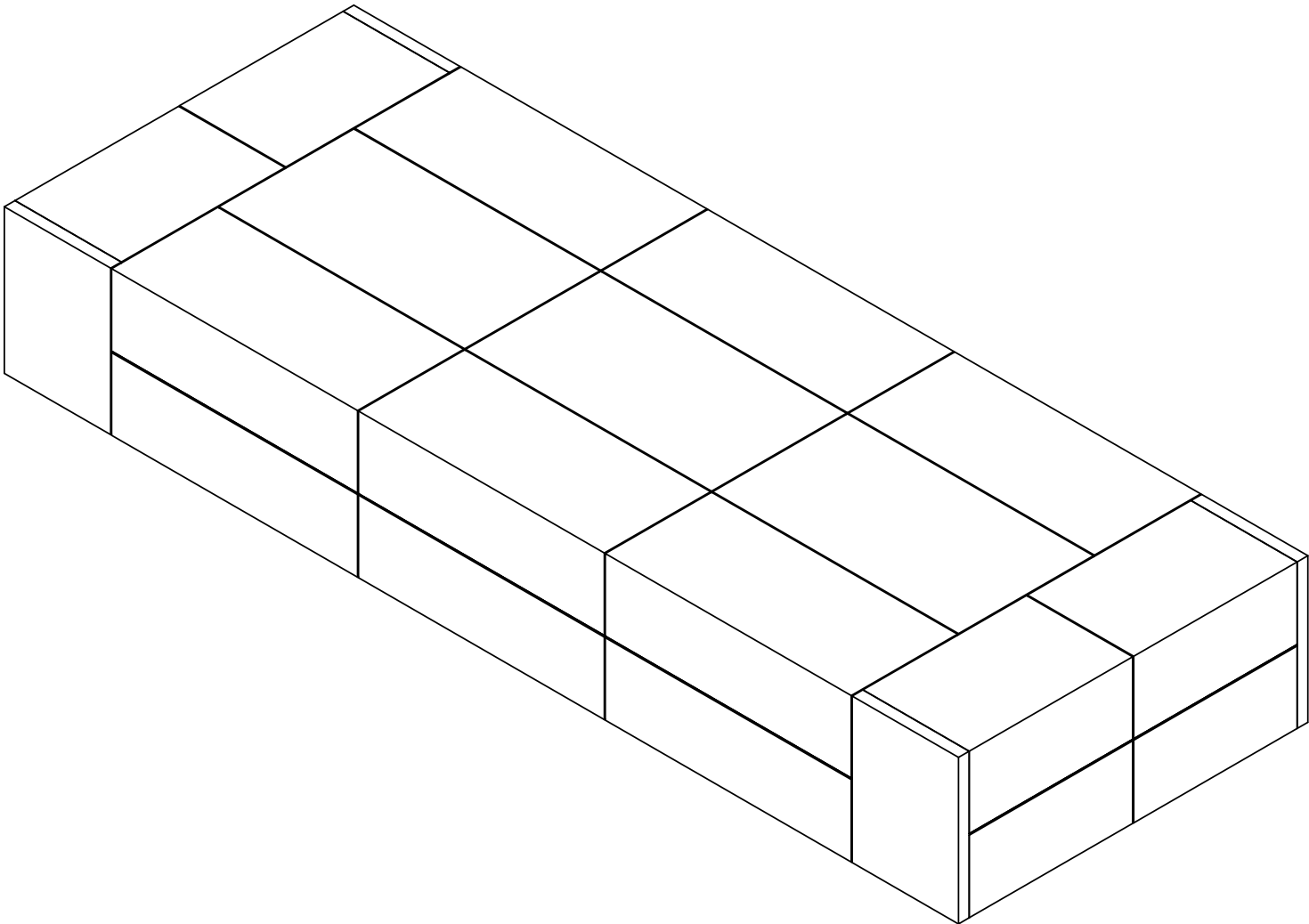
Date December 16, 2015

Verified By _____

Date _____

Page Page D1 of D6

Attachment D
Storm Trap Drawings



MIX AVENUE SUBSTATION
NEW HAVEN, CT

STORMTRAP®
PRECAST CONCRETE MODULAR STORMWATER MANAGEMENT SYSTEMS
THIS STORMTRAP DESIGN MAY BE COVERED BY 1 OR MORE OF THE
FOLLOWING U.S. PATENTS: NO. 6,991,402 B2, 7,160,058 B2, 7,344,335 B2
CA. PATENT NO. 2,445,609
2495 WEST BUNGALOW ROAD
MORRIS, IL 60450
P: 815-941-4663
F: 815-416-1100

BLACK & VEACH -
WATER GROUP

8400 WARD PARKWAY
KANSAS CITY, MO 64114
Phone: 913-458-6504
Fax:

MIX AVENUE SUBSTATION

NEW HAVEN, CT

DESIGN ASSUMPTIONS	
COVER:	MIN: 2.00' - MAX: 4.00'
GROUNDWATER TABLE:	AT ELEVATION 170
SOIL PRESSURE:	3000 PSF
LOADING:	AASHTO HS-20 HIGHWAY LOADING

DATE:

04-SEP-2015

APPROVED BY:

ISSUED FOR:

PRELIMINARY

SHEET INDEX		
PAGE	DESCRIPTION	REV.
0.0	COVER SHEET	1
1.0	DOUBLETRAP INSTALLATION SPECIFICATIONS	1
2.0	DOUBLETRAP INSTALLATION SPECIFICATIONS	1
3.0	DETAIL LAYOUT	1
4.0	STANDARD - 8'-0" DOUBLETRAP UNIT TYPES	1

REV.:	DATE:	DESC.	DWG.
1	04-SEP-2015	ISSUED FOR PRELIMINARY	JW

JOB SITE INFORMATION	
DESCRIPTION	
JOB NAME:	MIX AVENUE SUBSTATION
ENGINEERING COMPANY:	BLACK & VEACH - WATER GROUP
CONTACT NAME:	
CONTACT PHONE:	913-458-6504
CONTACT FAX:	
STORM TRAP SUPPLIER:	STORMTRAP
CONTACT NAME:	BRETT HOLMES
CONTACT PHONE:	815-405-3697
CONTACT EMAIL:	BHOLMES@STORMTRAP.COM
WATER STORAGE REQ'D:	8,700.00 CUBIC FEET
WATER STORAGE PROV:	8,983.26 CUBIC FEET
UNIT HEADROOM:	8'-0" DOUBLETRAP
UNIT QUANTITY:	26 TOTAL PIECES

SCALE:

NTS

SHEET TITLE:

COVER SHEET

SHEET NUMBER:

0.0

STORMTRAP INSTALLATION SPECIFICATION

1. STORMTRAP MODULES SHALL BE MANUFACTURED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/ OUTLET PIPE OPENINGS.
2. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891-09, STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES. THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS SHALL APPLY:

A. SPECIFICATIONS ON THE ENGINEER'S DRAWINGS SHALL TAKE PRECEDENCE.

B. STORMTRAP MODULES SHALL BE PLACED ON A LEVEL PAD OF 3/4" AGGREGATE, THAT EXTENDS 2'-0" PAST THE OUTSIDE OF THE SYSTEM, PER ASTM C891-09 STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES.

C. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED 3/4". IF THE SPACE EXCEEDS 3/4", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.

D. THE HORIZONTAL JOINT BETWEEN THE TOP AND BASE UNIT LEG CONNECTION OF THE STORMTRAP MODULES SHALL BE SEALED WITH PREFORMED MASTIC JOINT SEALER ACCORDING TO ASTM C891-09, 8.8 AND 8.12. SEE DETAIL "A"

E. ALL EXTERIOR JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH 0'-8" PRE-FORMED, COLD-APPLIED, SELF-ADHERING ELASTOMERIC RESIN BONDED TO A WOVEN HIGHLY PUNCTURE RESISTANT POLYMER WRAP CONFORMING TO ASTM C891-09 AND SHALL BE 0'-8" INTEGRATED PRIMER SEALANT AS APPROVED BY STORMTRAP. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:

1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE THE JOINT WRAP IS TO BE APPLIED.

2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (BUTYL SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.
- F. THE FILL PLACED AROUND THE STORMTRAP UNITS MUST BE DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL BE COMPACTED TO 95% STANDARD PROCTOR DENSITY OR OTHERWISE SPECIFIED BY ENGINEER. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES BOUNDING OR WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGE ACTION. (REFERENCE ARTICLE 502.10 I.D.O.T. S.S.R.B.C.) CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MATERIAL SHALL BE CLEAN, CRUSHED, ANGULAR No.5 (AASHTO M43) AGGREGATE.

G. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THE SELECTED WATER TIGHT SOLUTION PERFORMS AS SPECIFIED BY THE MANUFACTURER.

H. THE STANDARD STORMTRAP SYSTEM DESIGN IS NOT STRUCTURALLY EVALUATED FOR WATER TIGHT APPLICATIONS. CONTACT STORMTRAP FOR ADDITIONAL STRUCTURAL EVALUATION.
-
-
- 8'-0" DOUBLETRAP
- STORMTRAP SPECIFICATION
1. TOTAL COVER: MIN. 2.00' MAX. 4.00' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.

2. CONCRETE CHAMBER DESIGNED FOR AASHTO HS-20 HIGHWAY LOADING. MIN. SOIL PRESSURE 3000 PSF.

3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.

4. FOR STRUCTURA CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE AT ELEVATION 170. IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.

5. FOR STRUCTURAL CALCULATIONS THE SOIL DENSITY IS ASSUMED TO BE 120 PCF.

6. FOR FLOTATION CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE AT ELEVATION 170. IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.

7. STORMTRAP IS NOT WATERTIGHT. CONTACT STORMTRAP FOR WATERTIGHT OPTIONS. WATERTIGHT APPLICATION TO BE PROVIDED BY OTHERS.
- *FOR STRUCTURAL & FLOTATION CALCULATIONS THE GROUND WATER TABLES ASSUMED TO BE AT ELEVATION 170. IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.
- PRECAST CONCRETE MODULAR STORMWATER MANAGEMENT SYSTEMS
THIS STORMTRAP DESIGN MAY BE COVERED BY 1 OR MORE OF THE FOLLOWING U.S. PATENTS: NO. 5,991,492 B2; 7,160,058 B2; 7,344,335 B2
CA. PATENT NO. 2,445,609

2495 WEST BUNGALOW ROAD
MORRIS, IL 60450
P: 815-941-4663
F: 815-416-1100
- BLACK & VEACH - WATER GROUP

8400 WARD PARKWAY
KANSAS CITY, MO 64114
Phone: 913-458-6504
Fax:
- MIX AVENUE SUBSTATION

NEW HAVEN, CT
- | | | | |
|--------------|-------------|------------------------|------|
| DATE: | | | |
| 04-SEP-2015 | | | |
| APPROVED BY: | | | |
| ISSUED FOR: | | | |
| PRELIMINARY | | | |
| REV.: | DATE: | DESC. | DWG. |
| 1 | 04-SEP-2015 | ISSUED FOR PRELIMINARY | JW |
- | |
|--------|
| SCALE: |
| NTS |
- SHEET TITLE:

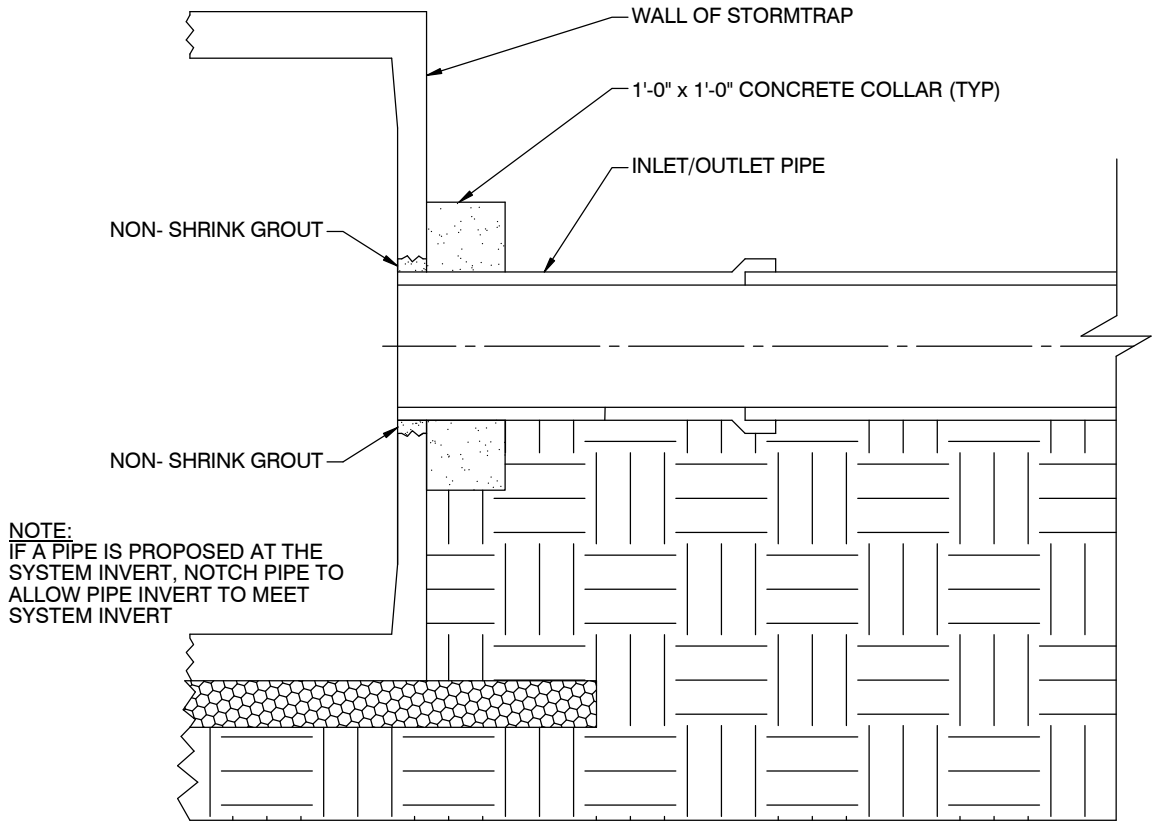
DOUBLETRAP
INSTALLATION
SPECIFICATIONS
- SHEET NUMBER:

1.0

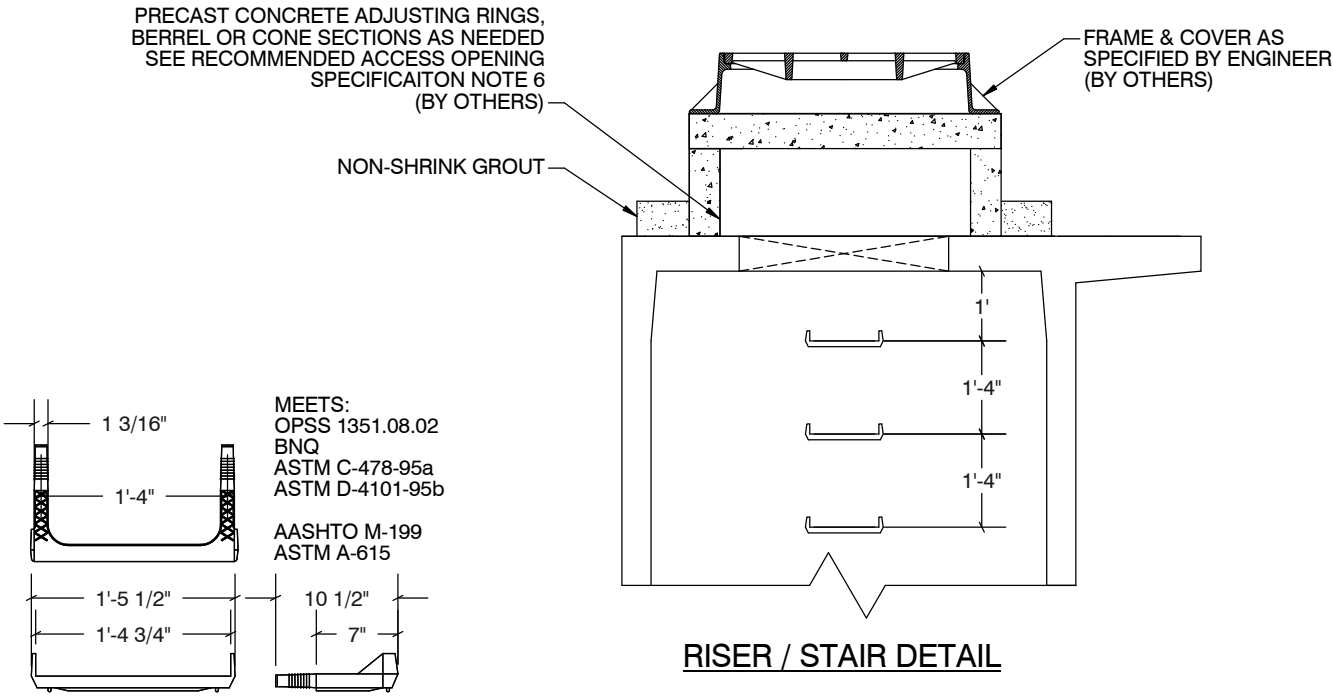
1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'-0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 2'-0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 1'-0" OF CLEARANCE IN ALL DIRECTIONS FROM THE EDGE OF THE STORMTRAP UNITS.
2. PLASTIC COATED STEEL STEPS PRODUCED BY M.A. INDUSTRIES PART #PS3-PFC (SEE DETAIL TO THE RIGHT) ARE PROVIDED INSIDE ANY UNIT WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE UNIT IS TO BE PLACED A DISTANCE OF 1'-0" FROM THE INSIDE EDGE OF THE STORMTRAP UNITS. ALL ENSUING STEPS SHALL BE PLACED WITH A MAXIMUM DISTANCE OF 1'-4" BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE UNIT.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO COINCIDE WITH THE ACCESS OPENING OR THE CENTER OF GRAVITY OF THE UNIT AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST ONE ACCESS OPENING PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE SECTIONS. (BY OTHERS)

1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'-0".
2. MAXIMUM OPENING SIZE TO BE DETERMINED BY UNIT HEIGHT. PREFERRED OPENING SIZE Ø36" OR LESS. ANY OPENING NEEDED THAT DOES NOT FIT THIS CRITERIA SHALL BE BROUGHT TO THE ATTENTION OF STORMTRAP FOR REVIEW.
3. CONNECTING PIPES SHALL BE INSTALLED WITH A 1'-0" CONCRETE COLLAR, AND A AGGREGATE CRADLE FOR AT LEAST ONE PIPE LENGTH, AS SHOWN. A STRUCTURAL GRADE CONCRETE OR GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI SHALL BE USED.
4. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH NON-SHRINK GROUT.

1. CLEAN AND LIGHTLY LUBRICATE ALL OF PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.



FOUNDATION PIPE CONNECTION



STAIR DETAIL

**BLACK & VEACH -
WATER GROUP**

**8400 WARD PARKWAY
KANSAS CITY, MO 64114
Phone: 913-458-6504
Fax:**

MIX AVENUE SUBSTATION
NEW HAVEN, CT

DATE:

04-SEP-2015

APPROVED BY:

PRELIMINARY

REV.:	DATE:	DESC.	DWG
1	04-SEP-2015	ISSUED FOR PRELIMINARY	JW

SCALE:

ENTS

SHEET TITLE:

RECOMMENDED DOUBLETRAP INSTALLATION SPECIFICATIONS

SHEET NUMBER:

2.0

BILL OF MATERIALS				
QTY.	UNIT TYPE	DESCRIPTION	TOP WEIGHT	BASE WEIGHT
0	I	8'-0" DOUBLETRAP	-	-
3	II	8'-0" DOUBLETRAP	16802	16802
0	III	8'-0" DOUBLETRAP	-	-
6	IV	8'-0" DOUBLETRAP	15104	15104
0	VII	8'-0" DOUBLETRAP	13407	13407
4	SPIV	8'-0" DOUBLETRAP	VARIES	
4	PANEL	8" THICK WALL PANELS	5964#	
3	JOINTWRAP	150' PER ROLL		
24	JOINTTAPE	14.5' PER ROLL		



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CA. PATENT NO. 2,445,609

2495 WEST BUNGALOW ROAD
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P: 815-941-4663
F: 815-416-1100

BLACK & VEACH -
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KANSAS CITY, MO 64114
Phone: 913-458-6504
Fax:

MIX AVENUE SUBSTATION

NEW HAVEN, CT

DATE:

04-SEP-2015

APPROVED BY:

ISSUED FOR:

PRELIMINARY

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1	04-SEP-2015	ISSUED FOR PRELIMINARY	JW

SCALE:

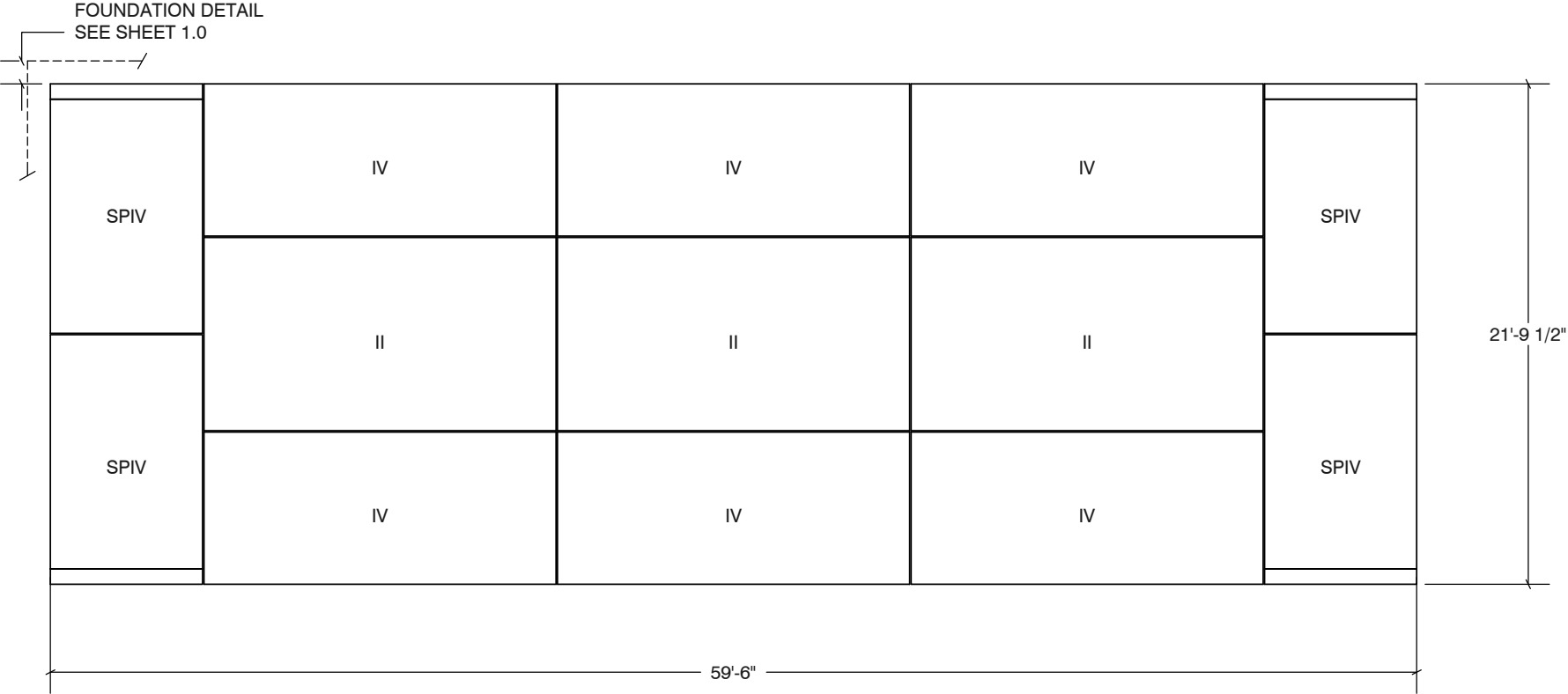
NTS

SHEET TITLE:

LAYOUT DETAIL

SHEET NUMBER:

3.0



DESIGN CRITERIA
ALLOWABLE MAX GRADE = 176.00
ALLOWABLE MIN GRADE = 174.00
INSIDE HEIGHT ELEVATION = 171.50
SYSTEM INVERT = 163.50
STORMTRAP VOLUME = 8,983.26 C.F. / 0.21 A.F.

- NOTES:
- DIMENSION OF STORMTRAP SYSTEM ALLOW FOR A 3/4" GAP BETWEEN EACH UNIT.
 - ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
 - SEE SHEET 2 FOR INSTALLATION SPECIFICATIONS.

LAYOUT DETAIL

STORMTRAP®
REGISTERED
PRECAST CONCRETE MODULAR STORMWATER MANAGEMENT SYSTEMS
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FOLLOWING U.S. PATENTS: NO. 6,981,402 B2; 7,160,058 B2; 7,344,335 B2
CAN. PATENT NO. 2,465,909

2495 WEST BUNGALOW ROAD
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KANSAS CITY, MO 64114
Phone: 913-458-6504
Fax:

MIX AVENUE SUBSTATION

NEW HAVEN, CT

DATE:

04-SEP-2015

APPROVED BY:

ISSUED FOR:

PRELIMINARY

REV.:	DATE:	DESC.	DWG.
1	04-SEP-2015	ISSUED FOR PRELIMINARY	JW

SCALE:

NTS

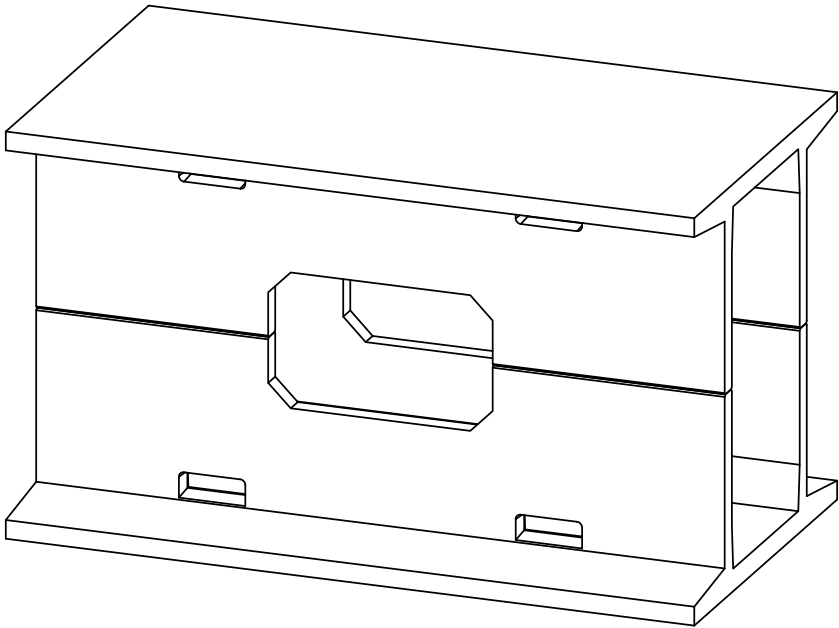
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8'-0" DOUBLETRAP
UNIT TYPES

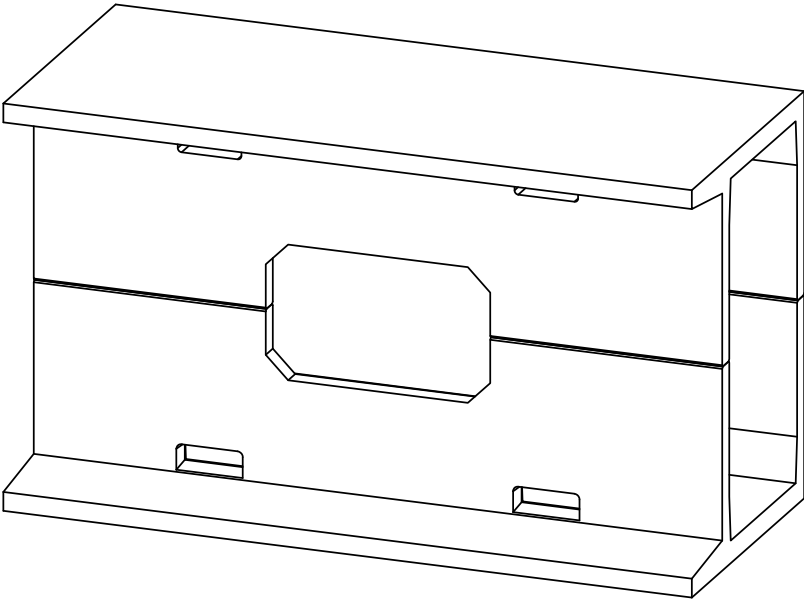
SHEET NUMBER:

4.0

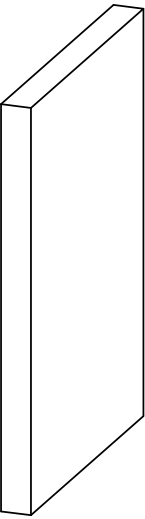
TYPE II



TYPE IV



TYPE IV
PANEL



- NOTES:
- 1. OPENING LOCATIONS VARY ON UNIT HEIGHT AND LENGTHS.
 - 2. SP - INDICATES A UNIT WITH MODIFICATIONS.
 - 3. P - INDICATES A UNIT WITH A PANEL ATTACHMENT.
 - 4. POCKET WINDOW OPENINGS ARE OPTIONAL.



BLACK & VEATCH

Client United Illuminating Company

Project Mix Avenue Substation

Project No. 180592 **File No.** 51.1210.001

Title Stormwater Pre-Post Verification

Computed By D. Fennell

Date December 16, 2015

Verified By

Date

Page Page E1 of E201

Attachment E Bentley Pond Pack Reports

180592-Mix Avenue Substation

Project Summary

Title	180592-Mix Avenue Substation
Engineer	Davis Fennell
Company	Black & Veatch
Date	12/11/2015

Notes	PRE VS POST 2 YEAR STORM
-------	--------------------------

Table of Contents

	Master Network Summary	2
HAMDEN-CT	Time-Depth Curve, 2 years	3
BYPASS		
	Time of Concentration Calculations, 2 years	5
Post to Trench		
	Time of Concentration Calculations, 2 years	7
PRE		
	Time of Concentration Calculations, 2 years	9
BYPASS		
	Unit Hydrograph Summary, 2 years	11
CDS Basin		
	Unit Hydrograph Summary, 2 years	13
Post to Pipe		
	Unit Hydrograph Summary, 2 years	15
Post to Trench		
	Unit Hydrograph Summary, 2 years	17
PRE		
	Unit Hydrograph Summary, 2 years	19
O-1		
	Addition Summary, 2 years	21
O-2		
	Addition Summary, 2 years	22
PO-1 (OUT)	Time vs. Elevation, 2 years	23
Composite Outlet Structure - 1		
	Outlet Input Data, 2 years	26
	Composite Rating Curve, 2 years	28
Outlet-1		
	Diverted Hydrograph, 2 years	29
PO-1		
	Elevation-Volume-Flow Table (Pond), 2 years	32
PO-1 (IN)		
	Level Pool Pond Routing Summary, 2 years	33
PO-1 (OUT)		

Table of Contents

	Pond Routed Hydrograph (total out), 2 years	34
PO-1 (IN)	Pond Inflow Summary, 2 years	37

180592-Mix Avenue Substation

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
PRE	Pre 2	2	0.258	12.350	2.00
Post to Trench	Post 2	2	0.153	12.250	1.41
Post to Pipe	Post 2	2	0.033	12.100	0.40
CDS Basin	Post 2	2	0.018	12.100	0.19
BYPASS	Post 2	2	0.211	12.500	1.40

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-1	Pre 2	2	0.258	12.350	2.00
O-2	Post 2	2	0.411	12.550	1.78

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
PO-1 (IN)	Post 2	2	0.204	12.200	1.72	(N/A)	(N/A)
PO-1 (OUT)	Post 2	2	0.201	12.850	0.44	166.53	0.078

180592-Mix Avenue Substation

Subsection: Time-Depth Curve

Label: HAMDEN-CT

Return Event: 2 years

Storm Event: 2 Year Storm

Time-Depth Curve: 2 Year Storm

Label	2 Year Storm
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	2 years

CUMULATIVE RAINFALL (in)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.1	0.1	0.1	0.1	0.1
3.500	0.1	0.1	0.1	0.1	0.1
4.000	0.1	0.1	0.2	0.2	0.2
4.500	0.2	0.2	0.2	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.2
5.500	0.2	0.2	0.2	0.2	0.2
6.000	0.2	0.2	0.2	0.3	0.3
6.500	0.3	0.3	0.3	0.3	0.3
7.000	0.3	0.3	0.3	0.3	0.3
7.500	0.3	0.3	0.4	0.4	0.4
8.000	0.4	0.4	0.4	0.4	0.4
8.500	0.4	0.4	0.4	0.5	0.5
9.000	0.5	0.5	0.5	0.5	0.5
9.500	0.5	0.6	0.6	0.6	0.6
10.000	0.6	0.6	0.7	0.7	0.7
10.500	0.7	0.7	0.8	0.8	0.8
11.000	0.8	0.9	0.9	0.9	0.9
11.500	1.0	1.0	1.1	1.2	1.4
12.000	1.6	1.9	2.1	2.2	2.3
12.500	2.3	2.4	2.4	2.4	2.4
13.000	2.5	2.5	2.5	2.5	2.6
13.500	2.6	2.6	2.6	2.6	2.7
14.000	2.7	2.7	2.7	2.7	2.7
14.500	2.8	2.8	2.8	2.8	2.8
15.000	2.8	2.8	2.8	2.9	2.9
15.500	2.9	2.9	2.9	2.9	2.9
16.000	2.9	2.9	2.9	2.9	3.0
16.500	3.0	3.0	3.0	3.0	3.0

180592-Mix Avenue Substation

Subsection: Time-Depth Curve
Label: HAMDEN-CT

Return Event: 2 years
Storm Event: 2 Year Storm

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	3.0	3.0	3.0	3.0	3.0
17.500	3.0	3.0	3.0	3.1	3.1
18.000	3.1	3.1	3.1	3.1	3.1
18.500	3.1	3.1	3.1	3.1	3.1
19.000	3.1	3.1	3.1	3.1	3.1
19.500	3.1	3.1	3.1	3.1	3.2
20.000	3.2	3.2	3.2	3.2	3.2
20.500	3.2	3.2	3.2	3.2	3.2
21.000	3.2	3.2	3.2	3.2	3.2
21.500	3.2	3.2	3.2	3.2	3.2
22.000	3.2	3.2	3.2	3.2	3.3
22.500	3.3	3.3	3.3	3.3	3.3
23.000	3.3	3.3	3.3	3.3	3.3
23.500	3.3	3.3	3.3	3.3	3.3
24.000	3.3	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 2 years
Storm Event: 2 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	300.00 ft
Manning's n	0.400
Slope	0.033 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.12 ft/s
Segment Time of Concentration	0.695 hours
Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	157.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.019 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.714 hours

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 2 years
Storm Event: 2 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: Post to Trench

Return Event: 2 years
Storm Event: 2 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.076 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.25 ft/s
Segment Time of Concentration	0.331 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.331 hours
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180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations

Label: Post to Trench

Return Event: 2 years

Storm Event: 2 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 2 years
Storm Event: 2 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	237.00 ft
Manning's n	0.400
Slope	0.068 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.430 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	332.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.033 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.463 hours
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180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 2 years
Storm Event: 2 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: BYPASS

Return Event: 2 years
Storm Event: 2 Year Storm

Storm Event	2 Year Storm
Return Event	2 years
Duration	24.000 hours
Depth	3.3 in
Time of Concentration (Composite)	0.714 hours
Area (User Defined)	1.500 acres
Computational Time Increment	0.095 hours
Time to Peak (Computed)	12.467 hours
Flow (Peak, Computed)	1.40 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	1.40 ft ³ /s
Drainage Area	
SCS CN (Composite)	83.120
Area (User Defined)	1.500 acres
Maximum Retention (Pervious)	2.0 in
Maximum Retention (Pervious, 20 percent)	0.4 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.7 in
Runoff Volume (Pervious)	0.213 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.211 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.714 hours
Computational Time Increment	0.095 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: BYPASS

Return Event: 2 years
Storm Event: 2 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	2.38 ft ³ /s
Unit peak time, Tp	0.476 hours
Unit receding limb, Tr	1.903 hours
Total unit time, Tb	2.379 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: CDS Basin

Return Event: 2 years
Storm Event: 2 Year Storm

Storm Event	2 Year Storm
Return Event	2 years
Duration	24.000 hours
Depth	3.3 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.070 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.19 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.19 ft ³ /s
Drainage Area	
SCS CN (Composite)	98.000
Area (User Defined)	0.070 acres
Maximum Retention (Pervious)	0.2 in
Maximum Retention (Pervious, 20 percent)	0.0 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.1 in
Runoff Volume (Pervious)	0.018 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.018 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: CDS Basin

Return Event: 2 years

Storm Event: 2 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	0.95 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Pipe

Return Event: 2 years

Storm Event: 2 Year Storm

Storm Event	2 Year Storm
Return Event	2 years
Duration	24.000 hours
Depth	3.3 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.170 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.40 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.40 ft ³ /s
Drainage Area	
SCS CN (Composite)	90.588
Area (User Defined)	0.170 acres
Maximum Retention (Pervious)	1.0 in
Maximum Retention (Pervious, 20 percent)	0.2 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.3 in
Runoff Volume (Pervious)	0.033 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.033 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Pipe

Return Event: 2 years

Storm Event: 2 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	2.31 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: Post to Trench

Return Event: 2 years
Storm Event: 2 Year Storm

Storm Event	2 Year Storm
Return Event	2 years
Duration	24.000 hours
Depth	3.3 in
Time of Concentration (Composite)	0.331 hours
Area (User Defined)	1.250 acres
Computational Time Increment	0.044 hours
Time to Peak (Computed)	12.256 hours
Flow (Peak, Computed)	1.42 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.250 hours
Flow (Peak Interpolated Output)	1.41 ft ³ /s
Drainage Area	
SCS CN (Composite)	80.000
Area (User Defined)	1.250 acres
Maximum Retention (Pervious)	2.5 in
Maximum Retention (Pervious, 20 percent)	0.5 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.5 in
Runoff Volume (Pervious)	0.154 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.153 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.331 hours
Computational Time Increment	0.044 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Trench

Return Event: 2 years

Storm Event: 2 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	4.28 ft ³ /s
Unit peak time, Tp	0.220 hours
Unit receding limb, Tr	0.882 hours
Total unit time, Tb	1.102 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: PRE

Return Event: 2 years
Storm Event: 2 Year Storm

Storm Event	2 Year Storm
Return Event	2 years
Duration	24.000 hours
Depth	3.3 in
Time of Concentration (Composite)	0.463 hours
Area (User Defined)	2.900 acres
Computational Time Increment	0.062 hours
Time to Peak (Computed)	12.350 hours
Flow (Peak, Computed)	2.00 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.350 hours
Flow (Peak Interpolated Output)	2.00 ft ³ /s
Drainage Area	
SCS CN (Composite)	73.455
Area (User Defined)	2.900 acres
Maximum Retention (Pervious)	3.6 in
Maximum Retention (Pervious, 20 percent)	0.7 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	1.1 in
Runoff Volume (Pervious)	0.259 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.258 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.463 hours
Computational Time Increment	0.062 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: PRE

Return Event: 2 years

Storm Event: 2 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	7.09 ft ³ /s
Unit peak time, Tp	0.309 hours
Unit receding limb, Tr	1.235 hours
Total unit time, Tb	1.544 hours

180592-Mix Avenue Substation

Subsection: Addition Summary

Label: O-1

Return Event: 2 years

Storm Event: 2 Year Storm

Summary for Hydrograph Addition at 'O-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	PRE

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	PRE	0.258	12.350	2.00
Flow (In)	O-1	0.258	12.350	2.00

180592-Mix Avenue Substation

Subsection: Addition Summary
Label: O-2

Return Event: 2 years
Storm Event: 2 Year Storm

Summary for Hydrograph Addition at 'O-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	BYPASS
Outlet-1	PO-1

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	BYPASS	0.211	12.500	1.40
Flow (From)	Outlet-1	0.201	12.850	0.44
Flow (In)	O-2	0.411	12.550	1.78

180592-Mix Avenue Substation

Subsection: Time vs. Elevation
Label: PO-1 (OUT)

Return Event: 2 years
Storm Event: 2 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	163.50	163.50	163.50	163.50	163.50
0.250	163.50	163.50	163.50	163.50	163.50
0.500	163.50	163.50	163.50	163.50	163.50
0.750	163.50	163.50	163.50	163.50	163.50
1.000	163.50	163.50	163.50	163.50	163.50
1.250	163.50	163.50	163.50	163.50	163.50
1.500	163.50	163.50	163.50	163.50	163.50
1.750	163.50	163.50	163.50	163.50	163.50
2.000	163.50	163.50	163.50	163.50	163.50
2.250	163.50	163.50	163.50	163.50	163.50
2.500	163.50	163.50	163.50	163.50	163.50
2.750	163.50	163.50	163.50	163.50	163.50
3.000	163.50	163.50	163.50	163.50	163.50
3.250	163.50	163.50	163.50	163.50	163.50
3.500	163.50	163.50	163.50	163.50	163.50
3.750	163.50	163.50	163.50	163.50	163.50
4.000	163.50	163.50	163.50	163.50	163.50
4.250	163.50	163.50	163.50	163.50	163.50
4.500	163.50	163.50	163.50	163.50	163.50
4.750	163.51	163.51	163.51	163.51	163.51
5.000	163.51	163.51	163.51	163.51	163.51
5.250	163.51	163.51	163.51	163.51	163.51
5.500	163.51	163.51	163.51	163.51	163.51
5.750	163.51	163.51	163.51	163.51	163.51
6.000	163.51	163.51	163.51	163.51	163.51
6.250	163.51	163.51	163.51	163.51	163.51
6.500	163.51	163.51	163.51	163.51	163.51
6.750	163.51	163.51	163.51	163.51	163.51
7.000	163.51	163.51	163.51	163.51	163.51
7.250	163.51	163.51	163.51	163.52	163.52
7.500	163.52	163.52	163.52	163.52	163.52
7.750	163.52	163.52	163.52	163.52	163.52
8.000	163.52	163.52	163.52	163.52	163.52
8.250	163.52	163.52	163.52	163.52	163.53
8.500	163.53	163.53	163.53	163.53	163.53
8.750	163.53	163.53	163.53	163.53	163.53
9.000	163.53	163.53	163.54	163.54	163.54
9.250	163.54	163.54	163.54	163.54	163.54
9.500	163.54	163.55	163.55	163.55	163.55
9.750	163.55	163.55	163.56	163.56	163.56
10.000	163.56	163.57	163.57	163.57	163.58

180592-Mix Avenue Substation

Subsection: Time vs. Elevation
Label: PO-1 (OUT)

Return Event: 2 years
Storm Event: 2 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.250	163.58	163.58	163.59	163.59	163.60
10.500	163.60	163.61	163.61	163.62	163.62
10.750	163.63	163.63	163.64	163.65	163.65
11.000	163.66	163.67	163.68	163.68	163.69
11.250	163.70	163.71	163.72	163.74	163.75
11.500	163.76	163.78	163.80	163.82	163.85
11.750	163.89	163.94	164.00	164.07	164.17
12.000	164.30	164.47	164.67	164.90	165.13
12.250	165.36	165.58	165.77	165.95	166.09
12.500	166.21	166.31	166.39	166.45	166.49
12.750	166.51	166.53	166.53	166.53	166.53
13.000	166.52	166.51	166.49	166.48	166.46
13.250	166.44	166.42	166.40	166.38	166.36
13.500	166.33	166.31	166.29	166.26	166.24
13.750	166.21	166.19	166.16	166.13	166.11
14.000	166.08	166.05	166.03	166.00	165.97
14.250	165.94	165.91	165.89	165.86	165.83
14.500	165.80	165.77	165.74	165.72	165.69
14.750	165.66	165.63	165.60	165.58	165.55
15.000	165.52	165.49	165.46	165.44	165.41
15.250	165.38	165.35	165.33	165.30	165.27
15.500	165.24	165.22	165.19	165.16	165.14
15.750	165.11	165.08	165.06	165.03	165.00
16.000	164.98	164.95	164.92	164.90	164.87
16.250	164.85	164.82	164.80	164.77	164.75
16.500	164.72	164.70	164.67	164.65	164.63
16.750	164.60	164.58	164.56	164.54	164.52
17.000	164.49	164.47	164.45	164.43	164.41
17.250	164.39	164.37	164.35	164.33	164.31
17.500	164.30	164.28	164.26	164.24	164.23
17.750	164.21	164.19	164.17	164.16	164.14
18.000	164.13	164.11	164.10	164.08	164.07
18.250	164.05	164.04	164.02	164.01	164.00
18.500	163.98	163.97	163.96	163.95	163.94
18.750	163.93	163.92	163.91	163.90	163.89
19.000	163.88	163.87	163.86	163.86	163.85
19.250	163.84	163.84	163.83	163.82	163.82
19.500	163.81	163.81	163.80	163.80	163.79
19.750	163.79	163.78	163.78	163.77	163.77
20.000	163.77	163.76	163.76	163.75	163.75
20.250	163.75	163.74	163.74	163.74	163.74

180592-Mix Avenue Substation

Subsection: Time vs. Elevation

Label: PO-1 (OUT)

Return Event: 2 years

Storm Event: 2 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.500	163.73	163.73	163.73	163.72	163.72
20.750	163.72	163.72	163.72	163.71	163.71
21.000	163.71	163.71	163.70	163.70	163.70
21.250	163.70	163.70	163.70	163.69	163.69
21.500	163.69	163.69	163.69	163.69	163.69
21.750	163.68	163.68	163.68	163.68	163.68
22.000	163.68	163.68	163.68	163.67	163.67
22.250	163.67	163.67	163.67	163.67	163.67
22.500	163.67	163.67	163.66	163.66	163.66
22.750	163.66	163.66	163.66	163.66	163.66
23.000	163.66	163.66	163.65	163.65	163.65
23.250	163.65	163.65	163.65	163.65	163.65
23.500	163.65	163.65	163.65	163.64	163.64
23.750	163.64	163.64	163.64	163.64	163.64
24.000	163.64	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Label: Composite Outlet Structure - 1

Return Event: 2 years

Storm Event: 2 Year Storm

Requested Pond Water Surface Elevations

Minimum (Headwater)	163.50 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	171.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	TW	163.50	171.50
Orifice-Circular	Orifice - 2	Forward	TW	166.50	171.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Label: Composite Outlet Structure - 1

Return Event: 2 years

Storm Event: 2 Year Storm

Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	163.50 ft
Orifice Diameter	3.0 in
Orifice Coefficient	0.600
Structure ID: Orifice - 2	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	166.50 ft
Orifice Diameter	6.0 in
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

180592-Mix Avenue Substation

Subsection: Composite Rating Curve
Label: Composite Outlet Structure - 1

Return Event: 2 years
Storm Event: 2 Year Storm

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
163.50	0.00	(N/A)	0.00
164.00	0.14	(N/A)	0.00
164.50	0.22	(N/A)	0.00
165.00	0.28	(N/A)	0.00
165.50	0.32	(N/A)	0.00
166.00	0.36	(N/A)	0.00
166.50	0.40	(N/A)	0.00
167.00	0.91	(N/A)	0.00
167.50	1.28	(N/A)	0.00
168.00	1.55	(N/A)	0.00
168.50	1.77	(N/A)	0.00
169.00	1.97	(N/A)	0.00
169.50	2.14	(N/A)	0.00
170.00	2.30	(N/A)	0.00
170.50	2.45	(N/A)	0.00
171.00	2.59	(N/A)	0.00
171.50	2.72	(N/A)	0.00

Contributing Structures

None Contributing
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph

Label: Outlet-1

Return Event: 2 years

Storm Event: 2 Year Storm

Peak Discharge	0.44 ft ³ /s
Time to Peak	12.850 hours
Hydrograph Volume	0.200 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
4.000	0.00	0.00	0.00	0.00	0.00
4.250	0.00	0.00	0.00	0.00	0.00
4.500	0.00	0.00	0.00	0.00	0.00
4.750	0.00	0.00	0.00	0.00	0.00
5.000	0.00	0.00	0.00	0.00	0.00
5.250	0.00	0.00	0.00	0.00	0.00
5.500	0.00	0.00	0.00	0.00	0.00
5.750	0.00	0.00	0.00	0.00	0.00
6.000	0.00	0.00	0.00	0.00	0.00
6.250	0.00	0.00	0.00	0.00	0.00
6.500	0.00	0.00	0.00	0.00	0.00
6.750	0.00	0.00	0.00	0.00	0.00
7.000	0.00	0.00	0.00	0.00	0.00
7.250	0.00	0.00	0.00	0.00	0.00
7.500	0.00	0.00	0.00	0.00	0.01
7.750	0.01	0.01	0.01	0.01	0.01
8.000	0.01	0.01	0.01	0.01	0.01
8.250	0.01	0.01	0.01	0.01	0.01
8.500	0.01	0.01	0.01	0.01	0.01
8.750	0.01	0.01	0.01	0.01	0.01
9.000	0.01	0.01	0.01	0.01	0.01
9.250	0.01	0.01	0.01	0.01	0.01
9.500	0.01	0.01	0.01	0.01	0.01
9.750	0.02	0.02	0.02	0.02	0.02
10.000	0.02	0.02	0.02	0.02	0.02
10.250	0.02	0.02	0.03	0.03	0.03
10.500	0.03	0.03	0.03	0.03	0.04
10.750	0.04	0.04	0.04	0.04	0.04
11.000	0.05	0.05	0.05	0.05	0.06
11.250	0.06	0.06	0.06	0.07	0.07
11.500	0.08	0.08	0.09	0.09	0.10
11.750	0.11	0.13	0.14	0.16	0.17
12.000	0.19	0.22	0.24	0.27	0.29
12.250	0.31	0.33	0.35	0.36	0.37
12.500	0.38	0.39	0.39	0.40	0.40
12.750	0.41	0.43	0.44	0.43	0.43
13.000	0.42	0.41	0.40	0.40	0.40

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 2 years
Storm Event: 2 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
13.250	0.40	0.39	0.39	0.39	0.39
13.500	0.39	0.39	0.38	0.38	0.38
13.750	0.38	0.38	0.38	0.37	0.37
14.000	0.37	0.37	0.37	0.36	0.36
14.250	0.36	0.36	0.35	0.35	0.35
14.500	0.35	0.35	0.34	0.34	0.34
14.750	0.34	0.33	0.33	0.33	0.33
15.000	0.33	0.32	0.32	0.32	0.32
15.250	0.31	0.31	0.31	0.30	0.30
15.500	0.30	0.30	0.29	0.29	0.29
15.750	0.29	0.28	0.28	0.28	0.28
16.000	0.27	0.27	0.27	0.27	0.26
16.250	0.26	0.26	0.25	0.25	0.25
16.500	0.25	0.24	0.24	0.24	0.24
16.750	0.23	0.23	0.23	0.23	0.22
17.000	0.22	0.22	0.21	0.21	0.21
17.250	0.20	0.20	0.20	0.20	0.19
17.500	0.19	0.19	0.18	0.18	0.18
17.750	0.18	0.17	0.17	0.17	0.17
18.000	0.16	0.16	0.16	0.16	0.15
18.250	0.15	0.15	0.15	0.15	0.14
18.500	0.14	0.14	0.13	0.13	0.13
18.750	0.12	0.12	0.12	0.12	0.11
19.000	0.11	0.11	0.11	0.10	0.10
19.250	0.10	0.10	0.10	0.09	0.09
19.500	0.09	0.09	0.09	0.09	0.08
19.750	0.08	0.08	0.08	0.08	0.08
20.000	0.08	0.08	0.07	0.07	0.07
20.250	0.07	0.07	0.07	0.07	0.07
20.500	0.07	0.07	0.07	0.06	0.06
20.750	0.06	0.06	0.06	0.06	0.06
21.000	0.06	0.06	0.06	0.06	0.06
21.250	0.06	0.06	0.06	0.06	0.06
21.500	0.06	0.05	0.05	0.05	0.05
21.750	0.05	0.05	0.05	0.05	0.05
22.000	0.05	0.05	0.05	0.05	0.05
22.250	0.05	0.05	0.05	0.05	0.05
22.500	0.05	0.05	0.05	0.05	0.05
22.750	0.05	0.05	0.05	0.05	0.05
23.000	0.05	0.04	0.04	0.04	0.04
23.250	0.04	0.04	0.04	0.04	0.04
23.500	0.04	0.04	0.04	0.04	0.04

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 2 years
Storm Event: 2 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
23.750	0.04	0.04	0.04	0.04	0.04
24.000	0.04	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Elevation-Volume-Flow Table (Pond)

Label: PO-1

Return Event: 2 years
Storm Event: 2 Year Storm

Infiltration	
Infiltration Method (Computed)	No Infiltration
Initial Conditions	
Elevation (Water Surface, Initial)	163.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ac-ft)	Area (acres)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
163.50	0.00	0.000	0.000	0.00	0.00	0.00
164.00	0.14	0.013	0.000	0.00	0.14	6.38
164.50	0.22	0.026	0.000	0.00	0.22	12.70
165.00	0.28	0.039	0.000	0.00	0.28	18.99
165.50	0.32	0.052	0.000	0.00	0.32	25.28
166.00	0.36	0.064	0.000	0.00	0.36	31.55
166.50	0.40	0.077	0.000	0.00	0.40	37.83
167.00	0.91	0.090	0.000	0.00	0.91	44.57
167.50	1.28	0.103	0.000	0.00	1.28	51.19
168.00	1.55	0.116	0.000	0.00	1.55	57.70
168.50	1.77	0.129	0.000	0.00	1.77	64.16
169.00	1.97	0.142	0.000	0.00	1.97	70.59
169.50	2.14	0.155	0.000	0.00	2.14	77.00
170.00	2.30	0.168	0.000	0.00	2.30	83.40
170.50	2.45	0.168	0.000	0.00	2.45	83.55
171.00	2.59	0.193	0.000	0.00	2.59	96.17
171.50	2.72	0.206	0.000	0.00	2.72	102.53

180592-Mix Avenue Substation

Subsection: Level Pool Pond Routing Summary
Label: PO-1 (IN)

Return Event: 2 years
Storm Event: 2 Year Storm

Infiltration			
Infiltration Method (Computed)		No Infiltration	
Initial Conditions			
Elevation (Water Surface, Initial)		163.50 ft	
Volume (Initial)		0.000 ac-ft	
Flow (Initial Outlet)		0.00 ft³/s	
Flow (Initial Infiltration)		0.00 ft³/s	
Flow (Initial, Total)		0.00 ft³/s	
Time Increment		0.050 hours	
Inflow/Outflow Hydrograph Summary			
Flow (Peak In)		1.72 ft³/s	Time to Peak (Flow, In)
Flow (Peak Outlet)		0.44 ft³/s	Time to Peak (Flow, Outlet)
			12.200 hours
			12.850 hours
Elevation (Water Surface, Peak)		166.53 ft	
Volume (Peak)		0.078 ac-ft	
Mass Balance (ac-ft)			
Volume (Initial)		0.000 ac-ft	
Volume (Total Inflow)		0.204 ac-ft	
Volume (Total Infiltration)		0.000 ac-ft	
Volume (Total Outlet Outflow)		0.201 ac-ft	
Volume (Retained)		0.003 ac-ft	
Volume (Unrouted)		0.000 ac-ft	
Error (Mass Balance)		0.1 %	

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Label: PO-1 (OUT)

Return Event: 2 years

Storm Event: 2 Year Storm

Peak Discharge	0.44 ft ³ /s
Time to Peak	12.850 hours
Hydrograph Volume	0.200 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
4.000	0.00	0.00	0.00	0.00	0.00
4.250	0.00	0.00	0.00	0.00	0.00
4.500	0.00	0.00	0.00	0.00	0.00
4.750	0.00	0.00	0.00	0.00	0.00
5.000	0.00	0.00	0.00	0.00	0.00
5.250	0.00	0.00	0.00	0.00	0.00
5.500	0.00	0.00	0.00	0.00	0.00
5.750	0.00	0.00	0.00	0.00	0.00
6.000	0.00	0.00	0.00	0.00	0.00
6.250	0.00	0.00	0.00	0.00	0.00
6.500	0.00	0.00	0.00	0.00	0.00
6.750	0.00	0.00	0.00	0.00	0.00
7.000	0.00	0.00	0.00	0.00	0.00
7.250	0.00	0.00	0.00	0.00	0.00
7.500	0.00	0.00	0.00	0.00	0.01
7.750	0.01	0.01	0.01	0.01	0.01
8.000	0.01	0.01	0.01	0.01	0.01
8.250	0.01	0.01	0.01	0.01	0.01
8.500	0.01	0.01	0.01	0.01	0.01
8.750	0.01	0.01	0.01	0.01	0.01
9.000	0.01	0.01	0.01	0.01	0.01
9.250	0.01	0.01	0.01	0.01	0.01
9.500	0.01	0.01	0.01	0.01	0.01
9.750	0.02	0.02	0.02	0.02	0.02
10.000	0.02	0.02	0.02	0.02	0.02
10.250	0.02	0.02	0.03	0.03	0.03
10.500	0.03	0.03	0.03	0.03	0.04
10.750	0.04	0.04	0.04	0.04	0.04
11.000	0.05	0.05	0.05	0.05	0.06
11.250	0.06	0.06	0.06	0.07	0.07
11.500	0.08	0.08	0.09	0.09	0.10
11.750	0.11	0.13	0.14	0.16	0.17
12.000	0.19	0.22	0.24	0.27	0.29
12.250	0.31	0.33	0.35	0.36	0.37
12.500	0.38	0.39	0.39	0.40	0.40
12.750	0.41	0.43	0.44	0.43	0.43
13.000	0.42	0.41	0.40	0.40	0.40

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)
Label: PO-1 (OUT)

Return Event: 2 years
Storm Event: 2 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
13.250	0.40	0.39	0.39	0.39	0.39
13.500	0.39	0.39	0.38	0.38	0.38
13.750	0.38	0.38	0.38	0.37	0.37
14.000	0.37	0.37	0.37	0.36	0.36
14.250	0.36	0.36	0.35	0.35	0.35
14.500	0.35	0.35	0.34	0.34	0.34
14.750	0.34	0.33	0.33	0.33	0.33
15.000	0.33	0.32	0.32	0.32	0.32
15.250	0.31	0.31	0.31	0.30	0.30
15.500	0.30	0.30	0.29	0.29	0.29
15.750	0.29	0.28	0.28	0.28	0.28
16.000	0.27	0.27	0.27	0.27	0.26
16.250	0.26	0.26	0.25	0.25	0.25
16.500	0.25	0.24	0.24	0.24	0.24
16.750	0.23	0.23	0.23	0.23	0.22
17.000	0.22	0.22	0.21	0.21	0.21
17.250	0.20	0.20	0.20	0.20	0.19
17.500	0.19	0.19	0.18	0.18	0.18
17.750	0.18	0.17	0.17	0.17	0.17
18.000	0.16	0.16	0.16	0.16	0.15
18.250	0.15	0.15	0.15	0.15	0.14
18.500	0.14	0.14	0.13	0.13	0.13
18.750	0.12	0.12	0.12	0.12	0.11
19.000	0.11	0.11	0.11	0.10	0.10
19.250	0.10	0.10	0.10	0.09	0.09
19.500	0.09	0.09	0.09	0.09	0.08
19.750	0.08	0.08	0.08	0.08	0.08
20.000	0.08	0.08	0.07	0.07	0.07
20.250	0.07	0.07	0.07	0.07	0.07
20.500	0.07	0.07	0.07	0.06	0.06
20.750	0.06	0.06	0.06	0.06	0.06
21.000	0.06	0.06	0.06	0.06	0.06
21.250	0.06	0.06	0.06	0.06	0.06
21.500	0.06	0.05	0.05	0.05	0.05
21.750	0.05	0.05	0.05	0.05	0.05
22.000	0.05	0.05	0.05	0.05	0.05
22.250	0.05	0.05	0.05	0.05	0.05
22.500	0.05	0.05	0.05	0.05	0.05
22.750	0.05	0.05	0.05	0.05	0.05
23.000	0.05	0.04	0.04	0.04	0.04
23.250	0.04	0.04	0.04	0.04	0.04
23.500	0.04	0.04	0.04	0.04	0.04

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 2 years

Label: PO-1 (OUT)

Storm Event: 2 Year Storm

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
23.750	0.04	0.04	0.04	0.04	0.04
24.000	0.04	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Pond Inflow Summary

Label: PO-1 (IN)

Return Event: 2 years

Storm Event: 2 Year Storm

Summary for Hydrograph Addition at 'PO-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	CDS Basin
<Catchment to Outflow Node>	Post to Pipe
<Catchment to Outflow Node>	Post to Trench

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	CDS Basin	0.018	12.100	0.19
Flow (From)	Post to Pipe	0.033	12.100	0.40
Flow (From)	Post to Trench	0.153	12.250	1.41
Flow (In)	PO-1	0.204	12.200	1.72

180592-Mix Avenue Substation

Index

B

BYPASS (Time of Concentration Calculations, 2 years)...5, 6

BYPASS (Unit Hydrograph Summary, 2 years)...11, 12

C

CDS Basin (Unit Hydrograph Summary, 2 years)...13, 14

Composite Outlet Structure - 1 (Composite Rating Curve, 2 years)...28

Composite Outlet Structure - 1 (Outlet Input Data, 2 years)...26, 27

H

HAMDEN-CT (Time-Depth Curve, 2 years)...3, 4

M

Master Network Summary...2

O

O-1 (Addition Summary, 2 years)...21

O-2 (Addition Summary, 2 years)...22

Outlet-1 (Diverted Hydrograph, 2 years)...29, 30, 31

P

PO-1 (Elevation-Volume-Flow Table (Pond), 2 years)...32

PO-1 (IN) (Level Pool Pond Routing Summary, 2 years)...33

PO-1 (IN) (Pond Inflow Summary, 2 years)...37

PO-1 (OUT) (Pond Routed Hydrograph (total out), 2 years)...34, 35, 36

PO-1 (OUT) (Time vs. Elevation, 2 years)...23, 24, 25

Post to Pipe (Unit Hydrograph Summary, 2 years)...15, 16

Post to Trench (Time of Concentration Calculations, 2 years)...7, 8

Post to Trench (Unit Hydrograph Summary, 2 years)...17, 18

PRE (Time of Concentration Calculations, 2 years)...9, 10

PRE (Unit Hydrograph Summary, 2 years)...19, 20

180592-Mix Avenue Substation

Project Summary

Title	180592-Mix Avenue Substation
Engineer	Davis Fennell
Company	Black & Veatch
Date	12/11/2015

Notes	PRE VS POST 10 YEAR STORM
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Table of Contents

	Master Network Summary	2
HAMDEN-CT	Time-Depth Curve, 10 years	3
BYPASS		
	Time of Concentration Calculations, 10 years	5
Post to Trench		
	Time of Concentration Calculations, 10 years	7
PRE		
	Time of Concentration Calculations, 10 years	9
BYPASS		
	Unit Hydrograph Summary, 10 years	11
CDS Basin		
	Unit Hydrograph Summary, 10 years	13
Post to Pipe		
	Unit Hydrograph Summary, 10 years	15
Post to Trench		
	Unit Hydrograph Summary, 10 years	17
PRE		
	Unit Hydrograph Summary, 10 years	19
O-1		
	Addition Summary, 10 years	21
O-2		
	Addition Summary, 10 years	22
PO-1 (OUT)	Time vs. Elevation, 10 years	23
Composite Outlet Structure - 1		
	Outlet Input Data, 10 years	26
	Composite Rating Curve, 10 years	28
Outlet-1		
	Diverted Hydrograph, 10 years	29
PO-1		
	Elevation-Volume-Flow Table (Pond), 10 years	32
PO-1 (IN)		
	Level Pool Pond Routing Summary, 10 years	33
PO-1 (OUT)		

Table of Contents

	Pond Routed Hydrograph (total out), 10 years	34
PO-1 (IN)	Pond Inflow Summary, 10 years	37

180592-Mix Avenue Substation

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
PRE	Pre 10	10	0.557	12.350	4.52
Post to Trench	Post 10	10	0.300	12.250	2.79
Post to Pipe	Post 10	10	0.056	12.100	0.65
CDS Basin	Post 10	10	0.028	12.100	0.29
BYPASS	Post 10	10	0.395	12.500	2.62

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-1	Pre 10	10	0.557	12.350	4.52
O-2	Post 10	10	0.773	12.500	4.28

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
PO-1 (IN)	Post 10	10	0.384	12.200	3.30	(N/A)	(N/A)
PO-1 (OUT)	Post 10	10	0.378	12.550	1.67	168.27	0.123

180592-Mix Avenue Substation

Subsection: Time-Depth Curve

Label: HAMDEN-CT

Return Event: 10 years

Storm Event: 10 Year Storm

Time-Depth Curve: 10 Year Storm

Label	10 Year Storm
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	10 years

CUMULATIVE RAINFALL (in)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.2	0.2	0.2	0.2	0.2
3.500	0.2	0.2	0.2	0.2	0.2
4.000	0.2	0.2	0.2	0.2	0.2
4.500	0.2	0.3	0.3	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.3
5.500	0.3	0.3	0.3	0.3	0.4
6.000	0.4	0.4	0.4	0.4	0.4
6.500	0.4	0.4	0.4	0.4	0.4
7.000	0.5	0.5	0.5	0.5	0.5
7.500	0.5	0.5	0.5	0.5	0.6
8.000	0.6	0.6	0.6	0.6	0.6
8.500	0.6	0.7	0.7	0.7	0.7
9.000	0.7	0.7	0.8	0.8	0.8
9.500	0.8	0.9	0.9	0.9	0.9
10.000	0.9	1.0	1.0	1.0	1.1
10.500	1.1	1.1	1.1	1.2	1.2
11.000	1.2	1.3	1.3	1.4	1.4
11.500	1.5	1.6	1.7	1.9	2.1
12.000	2.5	2.9	3.1	3.3	3.4
12.500	3.5	3.6	3.6	3.7	3.7
13.000	3.7	3.8	3.8	3.9	3.9
13.500	3.9	3.9	4.0	4.0	4.0
14.000	4.1	4.1	4.1	4.1	4.1
14.500	4.2	4.2	4.2	4.2	4.3
15.000	4.3	4.3	4.3	4.3	4.3
15.500	4.4	4.4	4.4	4.4	4.4
16.000	4.4	4.4	4.5	4.5	4.5
16.500	4.5	4.5	4.5	4.5	4.5

180592-Mix Avenue Substation

Subsection: Time-Depth Curve
Label: HAMDEN-CT

Return Event: 10 years
Storm Event: 10 Year Storm

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	4.5	4.6	4.6	4.6	4.6
17.500	4.6	4.6	4.6	4.6	4.6
18.000	4.6	4.6	4.7	4.7	4.7
18.500	4.7	4.7	4.7	4.7	4.7
19.000	4.7	4.7	4.7	4.7	4.7
19.500	4.8	4.8	4.8	4.8	4.8
20.000	4.8	4.8	4.8	4.8	4.8
20.500	4.8	4.8	4.8	4.8	4.8
21.000	4.8	4.9	4.9	4.9	4.9
21.500	4.9	4.9	4.9	4.9	4.9
22.000	4.9	4.9	4.9	4.9	4.9
22.500	4.9	4.9	4.9	4.9	4.9
23.000	5.0	5.0	5.0	5.0	5.0
23.500	5.0	5.0	5.0	5.0	5.0
24.000	5.0	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 10 years
Storm Event: 10 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.400
Slope	0.033 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.12 ft/s
Segment Time of Concentration	0.695 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	157.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.019 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.714 hours
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180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 10 years
Storm Event: 10 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: Post to Trench

Return Event: 10 years
Storm Event: 10 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.076 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.25 ft/s
Segment Time of Concentration	0.331 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.331 hours
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180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations

Label: Post to Trench

Return Event: 10 years

Storm Event: 10 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 10 years
Storm Event: 10 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	237.00 ft
Manning's n	0.400
Slope	0.068 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.430 hours
Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	332.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.033 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.463 hours

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 10 years
Storm Event: 10 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: BYPASS

Return Event: 10 years
Storm Event: 10 Year Storm

Storm Event	10 Year Storm
Return Event	10 years
Duration	24.000 hours
Depth	5.0 in
Time of Concentration (Composite)	0.714 hours
Area (User Defined)	1.500 acres
Computational Time Increment	0.095 hours
Time to Peak (Computed)	12.467 hours
Flow (Peak, Computed)	2.64 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	2.62 ft ³ /s
Drainage Area	
SCS CN (Composite)	83.120
Area (User Defined)	1.500 acres
Maximum Retention (Pervious)	2.0 in
Maximum Retention (Pervious, 20 percent)	0.4 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.2 in
Runoff Volume (Pervious)	0.398 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.395 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.714 hours
Computational Time Increment	0.095 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: BYPASS

Return Event: 10 years

Storm Event: 10 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	2.38 ft ³ /s
Unit peak time, Tp	0.476 hours
Unit receding limb, Tr	1.903 hours
Total unit time, Tb	2.379 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: CDS Basin

Return Event: 10 years
Storm Event: 10 Year Storm

Storm Event	10 Year Storm
Return Event	10 years
Duration	24.000 hours
Depth	5.0 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.070 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.29 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.29 ft ³ /s
Drainage Area	
SCS CN (Composite)	98.000
Area (User Defined)	0.070 acres
Maximum Retention (Pervious)	0.2 in
Maximum Retention (Pervious, 20 percent)	0.0 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.8 in
Runoff Volume (Pervious)	0.028 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.028 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: CDS Basin

Return Event: 10 years

Storm Event: 10 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	0.95 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Pipe

Return Event: 10 years

Storm Event: 10 Year Storm

Storm Event	10 Year Storm
Return Event	10 years
Duration	24.000 hours
Depth	5.0 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.170 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.65 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.65 ft ³ /s
Drainage Area	
SCS CN (Composite)	90.588
Area (User Defined)	0.170 acres
Maximum Retention (Pervious)	1.0 in
Maximum Retention (Pervious, 20 percent)	0.2 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.9 in
Runoff Volume (Pervious)	0.056 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.056 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 10 years

Label: Post to Pipe

Storm Event: 10 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	2.31 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Trench

Return Event: 10 years

Storm Event: 10 Year Storm

Storm Event	10 Year Storm
Return Event	10 years
Duration	24.000 hours
Depth	5.0 in
Time of Concentration (Composite)	0.331 hours
Area (User Defined)	1.250 acres
Computational Time Increment	0.044 hours
Time to Peak (Computed)	12.256 hours
Flow (Peak, Computed)	2.79 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.250 hours
Flow (Peak Interpolated Output)	2.79 ft ³ /s
Drainage Area	
SCS CN (Composite)	80.000
Area (User Defined)	1.250 acres
Maximum Retention (Pervious)	2.5 in
Maximum Retention (Pervious, 20 percent)	0.5 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.9 in
Runoff Volume (Pervious)	0.301 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.300 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.331 hours
Computational Time Increment	0.044 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 10 years

Label: Post to Trench

Storm Event: 10 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	4.28 ft ³ /s
Unit peak time, Tp	0.220 hours
Unit receding limb, Tr	0.882 hours
Total unit time, Tb	1.102 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: PRE

Return Event: 10 years
Storm Event: 10 Year Storm

Storm Event	10 Year Storm
Return Event	10 years
Duration	24.000 hours
Depth	5.0 in
Time of Concentration (Composite)	0.463 hours
Area (User Defined)	2.900 acres
Computational Time Increment	0.062 hours
Time to Peak (Computed)	12.350 hours
Flow (Peak, Computed)	4.52 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.350 hours
Flow (Peak Interpolated Output)	4.52 ft ³ /s
Drainage Area	
SCS CN (Composite)	73.455
Area (User Defined)	2.900 acres
Maximum Retention (Pervious)	3.6 in
Maximum Retention (Pervious, 20 percent)	0.7 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.3 in
Runoff Volume (Pervious)	0.560 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.557 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.463 hours
Computational Time Increment	0.062 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: PRE

Return Event: 10 years

Storm Event: 10 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	7.09 ft ³ /s
Unit peak time, Tp	0.309 hours
Unit receding limb, Tr	1.235 hours
Total unit time, Tb	1.544 hours

180592-Mix Avenue Substation

Subsection: Addition Summary

Label: O-1

Return Event: 10 years

Storm Event: 10 Year Storm

Summary for Hydrograph Addition at 'O-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	PRE

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	PRE	0.557	12.350	4.52
Flow (In)	O-1	0.557	12.350	4.52

180592-Mix Avenue Substation

Subsection: Addition Summary

Label: O-2

Return Event: 10 years

Storm Event: 10 Year Storm

Summary for Hydrograph Addition at 'O-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	BYPASS
Outlet-1	PO-1

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	BYPASS	0.395	12.500	2.62
Flow (From)	Outlet-1	0.378	12.550	1.67
Flow (In)	O-2	0.773	12.500	4.28

180592-Mix Avenue Substation

Subsection: Time vs. Elevation
Label: PO-1 (OUT)

Return Event: 10 years
Storm Event: 10 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	163.50	163.50	163.50	163.50	163.50
0.250	163.50	163.50	163.50	163.50	163.50
0.500	163.50	163.50	163.50	163.50	163.50
0.750	163.50	163.50	163.50	163.50	163.50
1.000	163.50	163.50	163.50	163.50	163.50
1.250	163.50	163.50	163.50	163.50	163.50
1.500	163.50	163.50	163.50	163.50	163.50
1.750	163.50	163.50	163.50	163.50	163.50
2.000	163.50	163.50	163.50	163.50	163.50
2.250	163.50	163.50	163.50	163.50	163.50
2.500	163.50	163.50	163.50	163.50	163.50
2.750	163.50	163.50	163.50	163.50	163.50
3.000	163.50	163.50	163.51	163.51	163.51
3.250	163.51	163.51	163.51	163.51	163.51
3.500	163.51	163.51	163.51	163.51	163.51
3.750	163.51	163.51	163.51	163.51	163.51
4.000	163.51	163.51	163.51	163.51	163.51
4.250	163.51	163.51	163.51	163.51	163.51
4.500	163.51	163.51	163.51	163.51	163.51
4.750	163.51	163.51	163.51	163.51	163.51
5.000	163.51	163.51	163.51	163.51	163.51
5.250	163.51	163.51	163.51	163.52	163.52
5.500	163.52	163.52	163.52	163.52	163.52
5.750	163.52	163.52	163.52	163.52	163.52
6.000	163.52	163.52	163.52	163.52	163.52
6.250	163.52	163.52	163.52	163.52	163.52
6.500	163.52	163.52	163.52	163.53	163.53
6.750	163.53	163.53	163.53	163.53	163.53
7.000	163.53	163.53	163.53	163.53	163.53
7.250	163.53	163.53	163.53	163.53	163.54
7.500	163.54	163.54	163.54	163.54	163.54
7.750	163.54	163.54	163.54	163.54	163.55
8.000	163.55	163.55	163.55	163.55	163.55
8.250	163.56	163.56	163.56	163.56	163.57
8.500	163.57	163.57	163.57	163.58	163.58
8.750	163.58	163.59	163.59	163.60	163.60
9.000	163.60	163.61	163.61	163.62	163.62
9.250	163.63	163.63	163.64	163.65	163.65
9.500	163.66	163.66	163.67	163.68	163.68
9.750	163.69	163.70	163.71	163.71	163.72
10.000	163.73	163.74	163.74	163.75	163.76

180592-Mix Avenue Substation

Subsection: Time vs. Elevation
Label: PO-1 (OUT)

Return Event: 10 years
Storm Event: 10 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.250	163.77	163.78	163.79	163.80	163.81
10.500	163.82	163.83	163.85	163.86	163.87
10.750	163.88	163.90	163.91	163.93	163.94
11.000	163.96	163.97	163.99	164.00	164.02
11.250	164.04	164.07	164.09	164.12	164.15
11.500	164.18	164.22	164.26	164.31	164.38
11.750	164.46	164.57	164.70	164.86	165.06
12.000	165.32	165.66	166.06	166.51	166.93
12.250	167.30	167.61	167.86	168.04	168.17
12.500	168.24	168.27	168.25	168.21	168.14
12.750	168.05	167.95	167.84	167.73	167.62
13.000	167.52	167.41	167.31	167.22	167.14
13.250	167.06	166.99	166.92	166.87	166.82
13.500	166.77	166.73	166.70	166.67	166.64
13.750	166.62	166.60	166.58	166.56	166.55
14.000	166.53	166.52	166.51	166.49	166.48
14.250	166.47	166.46	166.44	166.43	166.41
14.500	166.40	166.38	166.36	166.35	166.33
14.750	166.31	166.30	166.28	166.26	166.24
15.000	166.22	166.20	166.18	166.16	166.14
15.250	166.12	166.10	166.08	166.05	166.03
15.500	166.01	165.99	165.96	165.94	165.92
15.750	165.89	165.87	165.84	165.82	165.79
16.000	165.77	165.74	165.72	165.69	165.66
16.250	165.64	165.61	165.59	165.56	165.53
16.500	165.51	165.48	165.46	165.43	165.40
16.750	165.38	165.35	165.33	165.30	165.28
17.000	165.25	165.23	165.20	165.18	165.15
17.250	165.13	165.11	165.08	165.06	165.03
17.500	165.01	164.99	164.96	164.94	164.91
17.750	164.89	164.87	164.85	164.82	164.80
18.000	164.78	164.76	164.73	164.71	164.69
18.250	164.67	164.65	164.63	164.61	164.58
18.500	164.56	164.54	164.52	164.51	164.49
18.750	164.47	164.45	164.43	164.41	164.40
19.000	164.38	164.36	164.35	164.33	164.32
19.250	164.30	164.28	164.27	164.26	164.24
19.500	164.23	164.21	164.20	164.19	164.17
19.750	164.16	164.15	164.14	164.12	164.11
20.000	164.10	164.09	164.08	164.07	164.06
20.250	164.05	164.04	164.03	164.02	164.01

180592-Mix Avenue Substation

Subsection: Time vs. Elevation

Label: PO-1 (OUT)

Return Event: 10 years

Storm Event: 10 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.500	164.00	163.99	163.98	163.97	163.96
20.750	163.95	163.95	163.94	163.93	163.92
21.000	163.92	163.91	163.90	163.90	163.89
21.250	163.89	163.88	163.88	163.87	163.87
21.500	163.86	163.86	163.85	163.85	163.85
21.750	163.84	163.84	163.83	163.83	163.83
22.000	163.82	163.82	163.82	163.81	163.81
22.250	163.81	163.81	163.80	163.80	163.80
22.500	163.80	163.79	163.79	163.79	163.79
22.750	163.78	163.78	163.78	163.78	163.77
23.000	163.77	163.77	163.77	163.77	163.76
23.250	163.76	163.76	163.76	163.76	163.76
23.500	163.75	163.75	163.75	163.75	163.75
23.750	163.74	163.74	163.74	163.74	163.74
24.000	163.74	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 10 years

Label: Composite Outlet Structure - 1

Storm Event: 10 Year Storm

Requested Pond Water Surface Elevations

Minimum (Headwater)	163.50 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	171.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	TW	163.50	171.50
Orifice-Circular	Orifice - 2	Forward	TW	166.50	171.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 10 years

Label: Composite Outlet Structure - 1

Storm Event: 10 Year Storm

Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	163.50 ft
Orifice Diameter	3.0 in
Orifice Coefficient	0.600
Structure ID: Orifice - 2	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	166.50 ft
Orifice Diameter	6.0 in
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

180592-Mix Avenue Substation

Subsection: Composite Rating Curve
Label: Composite Outlet Structure - 1

Return Event: 10 years
Storm Event: 10 Year Storm

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
163.50	0.00	(N/A)	0.00
164.00	0.14	(N/A)	0.00
164.50	0.22	(N/A)	0.00
165.00	0.28	(N/A)	0.00
165.50	0.32	(N/A)	0.00
166.00	0.36	(N/A)	0.00
166.50	0.40	(N/A)	0.00
167.00	0.91	(N/A)	0.00
167.50	1.28	(N/A)	0.00
168.00	1.55	(N/A)	0.00
168.50	1.77	(N/A)	0.00
169.00	1.97	(N/A)	0.00
169.50	2.14	(N/A)	0.00
170.00	2.30	(N/A)	0.00
170.50	2.45	(N/A)	0.00
171.00	2.59	(N/A)	0.00
171.50	2.72	(N/A)	0.00

Contributing Structures

None Contributing
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph

Return Event: 10 years

Label: Outlet-1

Storm Event: 10 Year Storm

Peak Discharge	1.67 ft ³ /s
Time to Peak	12.550 hours
Hydrograph Volume	0.378 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
2.600	0.00	0.00	0.00	0.00	0.00
2.850	0.00	0.00	0.00	0.00	0.00
3.100	0.00	0.00	0.00	0.00	0.00
3.350	0.00	0.00	0.00	0.00	0.00
3.600	0.00	0.00	0.00	0.00	0.00
3.850	0.00	0.00	0.00	0.00	0.00
4.100	0.00	0.00	0.00	0.00	0.00
4.350	0.00	0.00	0.00	0.00	0.00
4.600	0.00	0.00	0.00	0.00	0.00
4.850	0.00	0.00	0.00	0.00	0.00
5.100	0.00	0.00	0.00	0.00	0.00
5.350	0.00	0.00	0.00	0.00	0.00
5.600	0.00	0.00	0.00	0.01	0.01
5.850	0.01	0.01	0.01	0.01	0.01
6.100	0.01	0.01	0.01	0.01	0.01
6.350	0.01	0.01	0.01	0.01	0.01
6.600	0.01	0.01	0.01	0.01	0.01
6.850	0.01	0.01	0.01	0.01	0.01
7.100	0.01	0.01	0.01	0.01	0.01
7.350	0.01	0.01	0.01	0.01	0.01
7.600	0.01	0.01	0.01	0.01	0.01
7.850	0.01	0.01	0.01	0.01	0.01
8.100	0.01	0.01	0.02	0.02	0.02
8.350	0.02	0.02	0.02	0.02	0.02
8.600	0.02	0.02	0.02	0.02	0.03
8.850	0.03	0.03	0.03	0.03	0.03
9.100	0.03	0.03	0.04	0.04	0.04
9.350	0.04	0.04	0.04	0.05	0.05
9.600	0.05	0.05	0.05	0.06	0.06
9.850	0.06	0.06	0.06	0.07	0.07
10.100	0.07	0.07	0.08	0.08	0.08
10.350	0.08	0.09	0.09	0.09	0.10
10.600	0.10	0.10	0.11	0.11	0.11
10.850	0.12	0.12	0.13	0.13	0.14
11.100	0.14	0.15	0.15	0.15	0.15
11.350	0.16	0.16	0.17	0.17	0.18
11.600	0.18	0.19	0.20	0.22	0.23

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 10 years
Storm Event: 10 Year Storm

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
11.850	0.24	0.26	0.28	0.31	0.34
12.100	0.37	0.41	0.84	1.13	1.34
12.350	1.48	1.57	1.62	1.66	1.67
12.600	1.66	1.64	1.61	1.57	1.52
12.850	1.47	1.41	1.35	1.29	1.22
13.100	1.14	1.07	1.01	0.95	0.89
13.350	0.83	0.77	0.72	0.68	0.64
13.600	0.60	0.57	0.55	0.52	0.50
13.850	0.48	0.46	0.45	0.43	0.42
14.100	0.41	0.40	0.40	0.40	0.40
14.350	0.40	0.40	0.39	0.39	0.39
14.600	0.39	0.39	0.39	0.39	0.39
14.850	0.38	0.38	0.38	0.38	0.38
15.100	0.38	0.38	0.37	0.37	0.37
15.350	0.37	0.37	0.37	0.36	0.36
15.600	0.36	0.36	0.36	0.36	0.35
15.850	0.35	0.35	0.35	0.35	0.34
16.100	0.34	0.34	0.34	0.33	0.33
16.350	0.33	0.33	0.33	0.32	0.32
16.600	0.32	0.32	0.31	0.31	0.31
16.850	0.31	0.31	0.30	0.30	0.30
17.100	0.30	0.29	0.29	0.29	0.29
17.350	0.28	0.28	0.28	0.28	0.28
17.600	0.27	0.27	0.27	0.26	0.26
17.850	0.26	0.26	0.25	0.25	0.25
18.100	0.25	0.24	0.24	0.24	0.24
18.350	0.24	0.23	0.23	0.23	0.23
18.600	0.22	0.22	0.22	0.22	0.21
18.850	0.21	0.21	0.21	0.20	0.20
19.100	0.20	0.20	0.19	0.19	0.19
19.350	0.19	0.18	0.18	0.18	0.18
19.600	0.18	0.17	0.17	0.17	0.17
19.850	0.17	0.16	0.16	0.16	0.16
20.100	0.16	0.16	0.15	0.15	0.15
20.350	0.15	0.15	0.15	0.14	0.14
20.600	0.14	0.14	0.13	0.13	0.13
20.850	0.13	0.12	0.12	0.12	0.12
21.100	0.12	0.12	0.11	0.11	0.11
21.350	0.11	0.11	0.11	0.11	0.10
21.600	0.10	0.10	0.10	0.10	0.10
21.850	0.10	0.10	0.09	0.09	0.09
22.100	0.09	0.09	0.09	0.09	0.09

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph

Label: Outlet-1

Return Event: 10 years

Storm Event: 10 Year Storm

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
22.350	0.09	0.09	0.09	0.09	0.08
22.600	0.08	0.08	0.08	0.08	0.08
22.850	0.08	0.08	0.08	0.08	0.08
23.100	0.08	0.08	0.08	0.08	0.08
23.350	0.07	0.07	0.07	0.07	0.07
23.600	0.07	0.07	0.07	0.07	0.07
23.850	0.07	0.07	0.07	0.07	(N/A)

180592-Mix Avenue Substation

Subsection: Elevation-Volume-Flow Table (Pond)

Label: PO-1

Return Event: 10 years

Storm Event: 10 Year Storm

Infiltration	
Infiltration Method (Computed)	No Infiltration
Initial Conditions	
Elevation (Water Surface, Initial)	163.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ac-ft)	Area (acres)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
163.50	0.00	0.000	0.000	0.00	0.00	0.00
164.00	0.14	0.013	0.000	0.00	0.14	6.38
164.50	0.22	0.026	0.000	0.00	0.22	12.70
165.00	0.28	0.039	0.000	0.00	0.28	18.99
165.50	0.32	0.052	0.000	0.00	0.32	25.28
166.00	0.36	0.064	0.000	0.00	0.36	31.55
166.50	0.40	0.077	0.000	0.00	0.40	37.83
167.00	0.91	0.090	0.000	0.00	0.91	44.57
167.50	1.28	0.103	0.000	0.00	1.28	51.19
168.00	1.55	0.116	0.000	0.00	1.55	57.70
168.50	1.77	0.129	0.000	0.00	1.77	64.16
169.00	1.97	0.142	0.000	0.00	1.97	70.59
169.50	2.14	0.155	0.000	0.00	2.14	77.00
170.00	2.30	0.168	0.000	0.00	2.30	83.40
170.50	2.45	0.168	0.000	0.00	2.45	83.55
171.00	2.59	0.193	0.000	0.00	2.59	96.17
171.50	2.72	0.206	0.000	0.00	2.72	102.53

180592-Mix Avenue Substation

Subsection: Level Pool Pond Routing Summary
Label: PO-1 (IN)

Return Event: 10 years
Storm Event: 10 Year Storm

Infiltration			
Infiltration Method (Computed)		No Infiltration	
Initial Conditions			
Elevation (Water Surface, Initial)		163.50 ft	
Volume (Initial)		0.000 ac-ft	
Flow (Initial Outlet)		0.00 ft³/s	
Flow (Initial Infiltration)		0.00 ft³/s	
Flow (Initial, Total)		0.00 ft³/s	
Time Increment		0.050 hours	
Inflow/Outflow Hydrograph Summary			
Flow (Peak In)		3.30 ft³/s	Time to Peak (Flow, In)
Flow (Peak Outlet)		1.67 ft³/s	Time to Peak (Flow, Outlet)
			12.200 hours
			12.550 hours
Peak Conditions			
Elevation (Water Surface, Peak)		168.27 ft	
Volume (Peak)		0.123 ac-ft	
Mass Balance (ac-ft)			
Volume (Initial)		0.000 ac-ft	
Volume (Total Inflow)		0.384 ac-ft	
Volume (Total Infiltration)		0.000 ac-ft	
Volume (Total Outlet Outflow)		0.378 ac-ft	
Volume (Retained)		0.006 ac-ft	
Volume (Unrouted)		0.000 ac-ft	
Error (Mass Balance)		0.1 %	

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 10 years

Label: PO-1 (OUT)

Storm Event: 10 Year Storm

Peak Discharge	1.67 ft ³ /s
Time to Peak	12.550 hours
Hydrograph Volume	0.378 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
2.600	0.00	0.00	0.00	0.00	0.00
2.850	0.00	0.00	0.00	0.00	0.00
3.100	0.00	0.00	0.00	0.00	0.00
3.350	0.00	0.00	0.00	0.00	0.00
3.600	0.00	0.00	0.00	0.00	0.00
3.850	0.00	0.00	0.00	0.00	0.00
4.100	0.00	0.00	0.00	0.00	0.00
4.350	0.00	0.00	0.00	0.00	0.00
4.600	0.00	0.00	0.00	0.00	0.00
4.850	0.00	0.00	0.00	0.00	0.00
5.100	0.00	0.00	0.00	0.00	0.00
5.350	0.00	0.00	0.00	0.00	0.00
5.600	0.00	0.00	0.00	0.01	0.01
5.850	0.01	0.01	0.01	0.01	0.01
6.100	0.01	0.01	0.01	0.01	0.01
6.350	0.01	0.01	0.01	0.01	0.01
6.600	0.01	0.01	0.01	0.01	0.01
6.850	0.01	0.01	0.01	0.01	0.01
7.100	0.01	0.01	0.01	0.01	0.01
7.350	0.01	0.01	0.01	0.01	0.01
7.600	0.01	0.01	0.01	0.01	0.01
7.850	0.01	0.01	0.01	0.01	0.01
8.100	0.01	0.01	0.02	0.02	0.02
8.350	0.02	0.02	0.02	0.02	0.02
8.600	0.02	0.02	0.02	0.02	0.03
8.850	0.03	0.03	0.03	0.03	0.03
9.100	0.03	0.03	0.04	0.04	0.04
9.350	0.04	0.04	0.04	0.05	0.05
9.600	0.05	0.05	0.05	0.06	0.06
9.850	0.06	0.06	0.06	0.07	0.07
10.100	0.07	0.07	0.08	0.08	0.08
10.350	0.08	0.09	0.09	0.09	0.10
10.600	0.10	0.10	0.11	0.11	0.11
10.850	0.12	0.12	0.13	0.13	0.14
11.100	0.14	0.15	0.15	0.15	0.15
11.350	0.16	0.16	0.17	0.17	0.18
11.600	0.18	0.19	0.20	0.22	0.23

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)
Label: PO-1 (OUT)

Return Event: 10 years
Storm Event: 10 Year Storm

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
11.850	0.24	0.26	0.28	0.31	0.34
12.100	0.37	0.41	0.84	1.13	1.34
12.350	1.48	1.57	1.62	1.66	1.67
12.600	1.66	1.64	1.61	1.57	1.52
12.850	1.47	1.41	1.35	1.29	1.22
13.100	1.14	1.07	1.01	0.95	0.89
13.350	0.83	0.77	0.72	0.68	0.64
13.600	0.60	0.57	0.55	0.52	0.50
13.850	0.48	0.46	0.45	0.43	0.42
14.100	0.41	0.40	0.40	0.40	0.40
14.350	0.40	0.40	0.39	0.39	0.39
14.600	0.39	0.39	0.39	0.39	0.39
14.850	0.38	0.38	0.38	0.38	0.38
15.100	0.38	0.38	0.37	0.37	0.37
15.350	0.37	0.37	0.37	0.36	0.36
15.600	0.36	0.36	0.36	0.36	0.35
15.850	0.35	0.35	0.35	0.35	0.34
16.100	0.34	0.34	0.34	0.33	0.33
16.350	0.33	0.33	0.33	0.32	0.32
16.600	0.32	0.32	0.31	0.31	0.31
16.850	0.31	0.31	0.30	0.30	0.30
17.100	0.30	0.29	0.29	0.29	0.29
17.350	0.28	0.28	0.28	0.28	0.28
17.600	0.27	0.27	0.27	0.26	0.26
17.850	0.26	0.26	0.25	0.25	0.25
18.100	0.25	0.24	0.24	0.24	0.24
18.350	0.24	0.23	0.23	0.23	0.23
18.600	0.22	0.22	0.22	0.22	0.21
18.850	0.21	0.21	0.21	0.20	0.20
19.100	0.20	0.20	0.19	0.19	0.19
19.350	0.19	0.18	0.18	0.18	0.18
19.600	0.18	0.17	0.17	0.17	0.17
19.850	0.17	0.16	0.16	0.16	0.16
20.100	0.16	0.16	0.15	0.15	0.15
20.350	0.15	0.15	0.15	0.14	0.14
20.600	0.14	0.14	0.13	0.13	0.13
20.850	0.13	0.12	0.12	0.12	0.12
21.100	0.12	0.12	0.11	0.11	0.11
21.350	0.11	0.11	0.11	0.11	0.10
21.600	0.10	0.10	0.10	0.10	0.10
21.850	0.10	0.10	0.09	0.09	0.09
22.100	0.09	0.09	0.09	0.09	0.09

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 10 years

Label: PO-1 (OUT)

Storm Event: 10 Year Storm

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
22.350	0.09	0.09	0.09	0.09	0.08
22.600	0.08	0.08	0.08	0.08	0.08
22.850	0.08	0.08	0.08	0.08	0.08
23.100	0.08	0.08	0.08	0.08	0.08
23.350	0.07	0.07	0.07	0.07	0.07
23.600	0.07	0.07	0.07	0.07	0.07
23.850	0.07	0.07	0.07	0.07	(N/A)

180592-Mix Avenue Substation

Subsection: Pond Inflow Summary

Label: PO-1 (IN)

Return Event: 10 years

Storm Event: 10 Year Storm

Summary for Hydrograph Addition at 'PO-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	CDS Basin
<Catchment to Outflow Node>	Post to Pipe
<Catchment to Outflow Node>	Post to Trench

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	CDS Basin	0.028	12.100	0.29
Flow (From)	Post to Pipe	0.056	12.100	0.65
Flow (From)	Post to Trench	0.300	12.250	2.79
Flow (In)	PO-1	0.384	12.200	3.30

180592-Mix Avenue Substation

Index

B

BYPASS (Time of Concentration Calculations, 10 years)...5, 6

BYPASS (Unit Hydrograph Summary, 10 years)...11, 12

C

CDS Basin (Unit Hydrograph Summary, 10 years)...13, 14

Composite Outlet Structure - 1 (Composite Rating Curve, 10 years)...28

Composite Outlet Structure - 1 (Outlet Input Data, 10 years)...26, 27

H

HAMDEN-CT (Time-Depth Curve, 10 years)...3, 4

M

Master Network Summary...2

O

O-1 (Addition Summary, 10 years)...21

O-2 (Addition Summary, 10 years)...22

Outlet-1 (Diverted Hydrograph, 10 years)...29, 30, 31

P

PO-1 (Elevation-Volume-Flow Table (Pond), 10 years)...32

PO-1 (IN) (Level Pool Pond Routing Summary, 10 years)...33

PO-1 (IN) (Pond Inflow Summary, 10 years)...37

PO-1 (OUT) (Pond Routed Hydrograph (total out), 10 years)...34, 35, 36

PO-1 (OUT) (Time vs. Elevation, 10 years)...23, 24, 25

Post to Pipe (Unit Hydrograph Summary, 10 years)...15, 16

Post to Trench (Time of Concentration Calculations, 10 years)...7, 8

Post to Trench (Unit Hydrograph Summary, 10 years)...17, 18

PRE (Time of Concentration Calculations, 10 years)...9, 10

PRE (Unit Hydrograph Summary, 10 years)...19, 20

180592-Mix Avenue Substation

Project Summary

Title	180592-Mix Avenue Substation
Engineer	Davis Fennell
Company	Black & Veatch
Date	12/11/2015

Notes	PRE VS POST 25 YEAR STORM
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Table of Contents

	Master Network Summary	2
HAMDEN-CT	Time-Depth Curve, 25 years	3
BYPASS		
	Time of Concentration Calculations, 25 years	5
Post to Trench		
	Time of Concentration Calculations, 25 years	7
PRE		
	Time of Concentration Calculations, 25 years	9
BYPASS		
	Unit Hydrograph Summary, 25 years	11
CDS Basin		
	Unit Hydrograph Summary, 25 years	13
Post to Pipe		
	Unit Hydrograph Summary, 25 years	15
Post to Trench		
	Unit Hydrograph Summary, 25 years	17
PRE		
	Unit Hydrograph Summary, 25 years	19
O-1		
	Addition Summary, 25 years	21
O-2		
	Addition Summary, 25 years	22
PO-1 (OUT)	Time vs. Elevation, 25 years	23
Composite Outlet Structure - 1		
	Outlet Input Data, 25 years	26
	Composite Rating Curve, 25 years	28
Outlet-1		
	Diverted Hydrograph, 25 years	29
PO-1		
	Elevation-Volume-Flow Table (Pond), 25 years	32
PO-1 (IN)		
	Level Pool Pond Routing Summary, 25 years	33
PO-1 (OUT)		

Table of Contents

	Pond Routed Hydrograph (total out), 25 years	34
PO-1 (IN)	Pond Inflow Summary, 25 years	37

180592-Mix Avenue Substation

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
PRE	Pre 25	25	0.673	12.350	5.49
Post to Trench	Post 25	25	0.355	12.250	3.29
Post to Pipe	Post 25	25	0.064	12.100	0.74
CDS Basin	Post 25	25	0.031	12.100	0.33
BYPASS	Post 25	25	0.463	12.500	3.07

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-1	Pre 25	25	0.673	12.350	5.49
O-2	Post 25	25	0.907	12.500	5.02

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
PO-1 (IN)	Post 25	25	0.451	12.200	3.88	(N/A)	(N/A)
PO-1 (OUT)	Post 25	25	0.444	12.550	1.96	169.00	0.142

180592-Mix Avenue Substation

Subsection: Time-Depth Curve

Label: HAMDEN-CT

Return Event: 25 years

Storm Event: 25 Year Storm

Time-Depth Curve: 25 Year Storm

Label	25 Year Storm
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	25 years

CUMULATIVE RAINFALL (in)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.2	0.2	0.2
3.000	0.2	0.2	0.2	0.2	0.2
3.500	0.2	0.2	0.2	0.2	0.2
4.000	0.2	0.2	0.3	0.3	0.3
4.500	0.3	0.3	0.3	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.4
5.500	0.4	0.4	0.4	0.4	0.4
6.000	0.4	0.4	0.4	0.4	0.4
6.500	0.5	0.5	0.5	0.5	0.5
7.000	0.5	0.5	0.5	0.5	0.6
7.500	0.6	0.6	0.6	0.6	0.6
8.000	0.6	0.7	0.7	0.7	0.7
8.500	0.7	0.7	0.8	0.8	0.8
9.000	0.8	0.8	0.9	0.9	0.9
9.500	0.9	1.0	1.0	1.0	1.0
10.000	1.1	1.1	1.1	1.1	1.2
10.500	1.2	1.2	1.3	1.3	1.4
11.000	1.4	1.4	1.5	1.5	1.6
11.500	1.7	1.8	1.9	2.1	2.3
12.000	2.8	3.3	3.5	3.7	3.8
12.500	3.9	4.0	4.1	4.1	4.2
13.000	4.2	4.2	4.3	4.3	4.4
13.500	4.4	4.4	4.5	4.5	4.5
14.000	4.5	4.6	4.6	4.6	4.6
14.500	4.7	4.7	4.7	4.7	4.8
15.000	4.8	4.8	4.8	4.8	4.9
15.500	4.9	4.9	4.9	4.9	4.9
16.000	5.0	5.0	5.0	5.0	5.0
16.500	5.0	5.0	5.1	5.1	5.1

180592-Mix Avenue Substation

Subsection: Time-Depth Curve

Label: HAMDEN-CT

Return Event: 25 years

Storm Event: 25 Year Storm

CUMULATIVE RAINFALL (in)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	5.1	5.1	5.1	5.1	5.1
17.500	5.1	5.2	5.2	5.2	5.2
18.000	5.2	5.2	5.2	5.2	5.2
18.500	5.2	5.2	5.3	5.3	5.3
19.000	5.3	5.3	5.3	5.3	5.3
19.500	5.3	5.3	5.3	5.3	5.4
20.000	5.4	5.4	5.4	5.4	5.4
20.500	5.4	5.4	5.4	5.4	5.4
21.000	5.4	5.4	5.4	5.4	5.5
21.500	5.5	5.5	5.5	5.5	5.5
22.000	5.5	5.5	5.5	5.5	5.5
22.500	5.5	5.5	5.5	5.5	5.5
23.000	5.5	5.6	5.6	5.6	5.6
23.500	5.6	5.6	5.6	5.6	5.6
24.000	5.6	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 25 years
Storm Event: 25 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	300.00 ft
Manning's n	0.400
Slope	0.033 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.12 ft/s
Segment Time of Concentration	0.695 hours
Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	157.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.019 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.714 hours

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 25 years
Storm Event: 25 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: Post to Trench

Return Event: 25 years
Storm Event: 25 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.076 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.25 ft/s
Segment Time of Concentration	0.331 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.331 hours
--------------------------------------	-------------

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations

Label: Post to Trench

Return Event: 25 years

Storm Event: 25 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 25 years
Storm Event: 25 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	237.00 ft
Manning's n	0.400
Slope	0.068 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.430 hours
Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	332.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.033 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.463 hours

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 25 years
Storm Event: 25 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: BYPASS

Return Event: 25 years
Storm Event: 25 Year Storm

Storm Event	25 Year Storm
Return Event	25 years
Duration	24.000 hours
Depth	5.6 in
Time of Concentration (Composite)	0.714 hours
Area (User Defined)	1.500 acres
Computational Time Increment	0.095 hours
Time to Peak (Computed)	12.467 hours
Flow (Peak, Computed)	3.09 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	3.07 ft ³ /s
Drainage Area	
SCS CN (Composite)	83.120
Area (User Defined)	1.500 acres
Maximum Retention (Pervious)	2.0 in
Maximum Retention (Pervious, 20 percent)	0.4 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.7 in
Runoff Volume (Pervious)	0.467 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.463 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.714 hours
Computational Time Increment	0.095 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: BYPASS

Return Event: 25 years

Storm Event: 25 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	2.38 ft ³ /s
Unit peak time, Tp	0.476 hours
Unit receding limb, Tr	1.903 hours
Total unit time, Tb	2.379 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: CDS Basin

Return Event: 25 years
Storm Event: 25 Year Storm

Storm Event	25 Year Storm
Return Event	25 years
Duration	24.000 hours
Depth	5.6 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.070 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.33 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.33 ft ³ /s
Drainage Area	
SCS CN (Composite)	98.000
Area (User Defined)	0.070 acres
Maximum Retention (Pervious)	0.2 in
Maximum Retention (Pervious, 20 percent)	0.0 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	5.4 in
Runoff Volume (Pervious)	0.031 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.031 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: CDS Basin

Return Event: 25 years

Storm Event: 25 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	0.95 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Pipe

Return Event: 25 years

Storm Event: 25 Year Storm

Storm Event	25 Year Storm
Return Event	25 years
Duration	24.000 hours
Depth	5.6 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.170 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.74 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.74 ft ³ /s
Drainage Area	
SCS CN (Composite)	90.588
Area (User Defined)	0.170 acres
Maximum Retention (Pervious)	1.0 in
Maximum Retention (Pervious, 20 percent)	0.2 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.5 in
Runoff Volume (Pervious)	0.064 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.064 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 25 years

Label: Post to Pipe

Storm Event: 25 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	2.31 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: Post to Trench

Return Event: 25 years
Storm Event: 25 Year Storm

Storm Event	25 Year Storm
Return Event	25 years
Duration	24.000 hours
Depth	5.6 in
Time of Concentration (Composite)	0.331 hours
Area (User Defined)	1.250 acres
Computational Time Increment	0.044 hours
Time to Peak (Computed)	12.212 hours
Flow (Peak, Computed)	3.30 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.250 hours
Flow (Peak Interpolated Output)	3.29 ft ³ /s
Drainage Area	
SCS CN (Composite)	80.000
Area (User Defined)	1.250 acres
Maximum Retention (Pervious)	2.5 in
Maximum Retention (Pervious, 20 percent)	0.5 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.4 in
Runoff Volume (Pervious)	0.356 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.355 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.331 hours
Computational Time Increment	0.044 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 25 years

Label: Post to Trench

Storm Event: 25 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	4.28 ft ³ /s
Unit peak time, Tp	0.220 hours
Unit receding limb, Tr	0.882 hours
Total unit time, Tb	1.102 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: PRE

Return Event: 25 years
Storm Event: 25 Year Storm

Storm Event	25 Year Storm
Return Event	25 years
Duration	24.000 hours
Depth	5.6 in
Time of Concentration (Composite)	0.463 hours
Area (User Defined)	2.900 acres
Computational Time Increment	0.062 hours
Time to Peak (Computed)	12.350 hours
Flow (Peak, Computed)	5.49 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.350 hours
Flow (Peak Interpolated Output)	5.49 ft ³ /s
Drainage Area	
SCS CN (Composite)	73.455
Area (User Defined)	2.900 acres
Maximum Retention (Pervious)	3.6 in
Maximum Retention (Pervious, 20 percent)	0.7 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.8 in
Runoff Volume (Pervious)	0.677 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.673 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.463 hours
Computational Time Increment	0.062 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: PRE

Return Event: 25 years

Storm Event: 25 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	7.09 ft ³ /s
Unit peak time, Tp	0.309 hours
Unit receding limb, Tr	1.235 hours
Total unit time, Tb	1.544 hours

180592-Mix Avenue Substation

Subsection: Addition Summary

Label: O-1

Return Event: 25 years

Storm Event: 25 Year Storm

Summary for Hydrograph Addition at 'O-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	PRE

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	PRE	0.673	12.350	5.49
Flow (In)	O-1	0.673	12.350	5.49

180592-Mix Avenue Substation

Subsection: Addition Summary
Label: O-2

Return Event: 25 years
Storm Event: 25 Year Storm

Summary for Hydrograph Addition at 'O-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	BYPASS
Outlet-1	PO-1

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	BYPASS	0.463	12.500	3.07
Flow (From)	Outlet-1	0.444	12.550	1.96
Flow (In)	O-2	0.907	12.500	5.02

180592-Mix Avenue Substation

Subsection: Time vs. Elevation
Label: PO-1 (OUT)

Return Event: 25 years
Storm Event: 25 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	163.50	163.50	163.50	163.50	163.50
0.250	163.50	163.50	163.50	163.50	163.50
0.500	163.50	163.50	163.50	163.50	163.50
0.750	163.50	163.50	163.50	163.50	163.50
1.000	163.50	163.50	163.50	163.50	163.50
1.250	163.50	163.50	163.50	163.50	163.50
1.500	163.50	163.50	163.50	163.50	163.50
1.750	163.50	163.50	163.50	163.50	163.50
2.000	163.50	163.50	163.50	163.50	163.50
2.250	163.50	163.50	163.50	163.50	163.50
2.500	163.50	163.50	163.50	163.50	163.50
2.750	163.51	163.51	163.51	163.51	163.51
3.000	163.51	163.51	163.51	163.51	163.51
3.250	163.51	163.51	163.51	163.51	163.51
3.500	163.51	163.51	163.51	163.51	163.51
3.750	163.51	163.51	163.51	163.51	163.51
4.000	163.51	163.51	163.51	163.51	163.51
4.250	163.51	163.51	163.51	163.51	163.51
4.500	163.51	163.51	163.51	163.51	163.51
4.750	163.51	163.51	163.52	163.52	163.52
5.000	163.52	163.52	163.52	163.52	163.52
5.250	163.52	163.52	163.52	163.52	163.52
5.500	163.52	163.52	163.52	163.52	163.52
5.750	163.52	163.52	163.52	163.52	163.52
6.000	163.52	163.52	163.53	163.53	163.53
6.250	163.53	163.53	163.53	163.53	163.53
6.500	163.53	163.53	163.53	163.53	163.53
6.750	163.53	163.53	163.53	163.53	163.54
7.000	163.54	163.54	163.54	163.54	163.54
7.250	163.54	163.54	163.54	163.54	163.55
7.500	163.55	163.55	163.55	163.55	163.55
7.750	163.56	163.56	163.56	163.56	163.56
8.000	163.57	163.57	163.57	163.57	163.58
8.250	163.58	163.58	163.59	163.59	163.59
8.500	163.60	163.60	163.61	163.61	163.62
8.750	163.62	163.63	163.63	163.64	163.64
9.000	163.65	163.65	163.66	163.67	163.67
9.250	163.68	163.69	163.69	163.70	163.71
9.500	163.72	163.72	163.73	163.74	163.75
9.750	163.76	163.77	163.78	163.78	163.79
10.000	163.80	163.81	163.82	163.83	163.84

180592-Mix Avenue Substation

Subsection: Time vs. Elevation

Label: PO-1 (OUT)

Return Event: 25 years

Storm Event: 25 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.250	163.86	163.87	163.88	163.89	163.90
10.500	163.92	163.93	163.95	163.96	163.98
10.750	163.99	164.01	164.02	164.04	164.06
11.000	164.08	164.10	164.12	164.15	164.17
11.250	164.20	164.23	164.26	164.29	164.33
11.500	164.37	164.42	164.47	164.54	164.62
11.750	164.72	164.85	165.00	165.19	165.43
12.000	165.75	166.15	166.61	167.09	167.53
12.250	167.92	168.26	168.54	168.75	168.89
12.500	168.97	169.00	168.98	168.92	168.83
12.750	168.73	168.60	168.47	168.33	168.20
13.000	168.06	167.92	167.79	167.66	167.54
13.250	167.43	167.33	167.23	167.15	167.07
13.500	167.00	166.94	166.88	166.83	166.79
13.750	166.75	166.72	166.69	166.67	166.64
14.000	166.62	166.60	166.58	166.57	166.55
14.250	166.54	166.53	166.52	166.51	166.50
14.500	166.49	166.48	166.47	166.46	166.44
14.750	166.43	166.42	166.41	166.39	166.38
15.000	166.36	166.35	166.33	166.32	166.30
15.250	166.28	166.27	166.25	166.23	166.21
15.500	166.19	166.17	166.15	166.13	166.11
15.750	166.09	166.06	166.04	166.02	166.00
16.000	165.97	165.95	165.92	165.90	165.88
16.250	165.85	165.83	165.80	165.78	165.75
16.500	165.72	165.70	165.67	165.65	165.62
16.750	165.60	165.57	165.55	165.52	165.50
17.000	165.47	165.45	165.42	165.40	165.38
17.250	165.35	165.33	165.30	165.28	165.25
17.500	165.23	165.21	165.18	165.16	165.13
17.750	165.11	165.09	165.06	165.04	165.01
18.000	164.99	164.97	164.94	164.92	164.90
18.250	164.87	164.85	164.83	164.81	164.79
18.500	164.76	164.74	164.72	164.70	164.68
18.750	164.66	164.64	164.62	164.60	164.58
19.000	164.57	164.55	164.53	164.51	164.49
19.250	164.47	164.46	164.44	164.42	164.41
19.500	164.39	164.38	164.36	164.35	164.33
19.750	164.32	164.30	164.29	164.28	164.26
20.000	164.25	164.24	164.22	164.21	164.20
20.250	164.19	164.17	164.16	164.15	164.14

180592-Mix Avenue Substation

Subsection: Time vs. Elevation

Return Event: 25 years

Label: PO-1 (OUT)

Storm Event: 25 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.500	164.13	164.12	164.11	164.10	164.09
20.750	164.08	164.07	164.06	164.05	164.04
21.000	164.03	164.02	164.01	164.00	163.99
21.250	163.99	163.98	163.97	163.96	163.96
21.500	163.95	163.94	163.94	163.93	163.92
21.750	163.92	163.91	163.91	163.90	163.90
22.000	163.89	163.89	163.88	163.88	163.87
22.250	163.87	163.87	163.86	163.86	163.85
22.500	163.85	163.85	163.84	163.84	163.84
22.750	163.83	163.83	163.83	163.83	163.82
23.000	163.82	163.82	163.81	163.81	163.81
23.250	163.81	163.80	163.80	163.80	163.80
23.500	163.79	163.79	163.79	163.79	163.79
23.750	163.78	163.78	163.78	163.78	163.78
24.000	163.77	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 25 years

Label: Composite Outlet Structure - 1

Storm Event: 25 Year Storm

Requested Pond Water Surface Elevations

Minimum (Headwater)	163.50 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	171.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	TW	163.50	171.50
Orifice-Circular	Orifice - 2	Forward	TW	166.50	171.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 25 years

Label: Composite Outlet Structure - 1

Storm Event: 25 Year Storm

Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	163.50 ft
Orifice Diameter	3.0 in
Orifice Coefficient	0.600
Structure ID: Orifice - 2	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	166.50 ft
Orifice Diameter	6.0 in
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

180592-Mix Avenue Substation

Subsection: Composite Rating Curve
Label: Composite Outlet Structure - 1

Return Event: 25 years
Storm Event: 25 Year Storm

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
163.50	0.00	(N/A)	0.00
164.00	0.14	(N/A)	0.00
164.50	0.22	(N/A)	0.00
165.00	0.28	(N/A)	0.00
165.50	0.32	(N/A)	0.00
166.00	0.36	(N/A)	0.00
166.50	0.40	(N/A)	0.00
167.00	0.91	(N/A)	0.00
167.50	1.28	(N/A)	0.00
168.00	1.55	(N/A)	0.00
168.50	1.77	(N/A)	0.00
169.00	1.97	(N/A)	0.00
169.50	2.14	(N/A)	0.00
170.00	2.30	(N/A)	0.00
170.50	2.45	(N/A)	0.00
171.00	2.59	(N/A)	0.00
171.50	2.72	(N/A)	0.00

Contributing Structures

None Contributing
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph

Label: Outlet-1

Return Event: 25 years

Storm Event: 25 Year Storm

Peak Discharge	1.96 ft ³ /s
Time to Peak	12.550 hours
Hydrograph Volume	0.443 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
2.300	0.00	0.00	0.00	0.00	0.00
2.550	0.00	0.00	0.00	0.00	0.00
2.800	0.00	0.00	0.00	0.00	0.00
3.050	0.00	0.00	0.00	0.00	0.00
3.300	0.00	0.00	0.00	0.00	0.00
3.550	0.00	0.00	0.00	0.00	0.00
3.800	0.00	0.00	0.00	0.00	0.00
4.050	0.00	0.00	0.00	0.00	0.00
4.300	0.00	0.00	0.00	0.00	0.00
4.550	0.00	0.00	0.00	0.00	0.00
4.800	0.00	0.00	0.00	0.00	0.00
5.050	0.00	0.00	0.01	0.01	0.01
5.300	0.01	0.01	0.01	0.01	0.01
5.550	0.01	0.01	0.01	0.01	0.01
5.800	0.01	0.01	0.01	0.01	0.01
6.050	0.01	0.01	0.01	0.01	0.01
6.300	0.01	0.01	0.01	0.01	0.01
6.550	0.01	0.01	0.01	0.01	0.01
6.800	0.01	0.01	0.01	0.01	0.01
7.050	0.01	0.01	0.01	0.01	0.01
7.300	0.01	0.01	0.01	0.01	0.01
7.550	0.01	0.01	0.01	0.02	0.02
7.800	0.02	0.02	0.02	0.02	0.02
8.050	0.02	0.02	0.02	0.02	0.02
8.300	0.02	0.03	0.03	0.03	0.03
8.550	0.03	0.03	0.03	0.03	0.04
8.800	0.04	0.04	0.04	0.04	0.04
9.050	0.04	0.05	0.05	0.05	0.05
9.300	0.05	0.06	0.06	0.06	0.06
9.550	0.06	0.07	0.07	0.07	0.07
9.800	0.08	0.08	0.08	0.09	0.09
10.050	0.09	0.09	0.10	0.10	0.10
10.300	0.11	0.11	0.11	0.12	0.12
10.550	0.12	0.13	0.13	0.14	0.14
10.800	0.15	0.15	0.15	0.15	0.16
11.050	0.16	0.16	0.17	0.17	0.17
11.300	0.18	0.18	0.19	0.20	0.20

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 25 years
Storm Event: 25 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
11.550	0.21	0.22	0.23	0.23	0.25
11.800	0.26	0.28	0.29	0.32	0.34
12.050	0.37	0.52	0.98	1.30	1.51
12.300	1.67	1.79	1.87	1.92	1.95
12.550	1.96	1.96	1.93	1.90	1.86
12.800	1.81	1.76	1.70	1.64	1.58
13.050	1.51	1.44	1.37	1.31	1.23
13.300	1.15	1.08	1.02	0.96	0.90
13.550	0.84	0.79	0.74	0.69	0.66
13.800	0.62	0.59	0.57	0.54	0.52
14.050	0.50	0.49	0.47	0.46	0.44
14.300	0.43	0.42	0.41	0.40	0.40
14.550	0.40	0.40	0.40	0.40	0.40
14.800	0.39	0.39	0.39	0.39	0.39
15.050	0.39	0.39	0.39	0.39	0.38
15.300	0.38	0.38	0.38	0.38	0.38
15.550	0.38	0.38	0.37	0.37	0.37
15.800	0.37	0.37	0.37	0.36	0.36
16.050	0.36	0.36	0.36	0.35	0.35
16.300	0.35	0.35	0.35	0.34	0.34
16.550	0.34	0.34	0.34	0.33	0.33
16.800	0.33	0.33	0.33	0.32	0.32
17.050	0.32	0.32	0.31	0.31	0.31
17.300	0.31	0.31	0.30	0.30	0.30
17.550	0.30	0.29	0.29	0.29	0.29
17.800	0.28	0.28	0.28	0.28	0.28
18.050	0.27	0.27	0.27	0.27	0.26
18.300	0.26	0.26	0.26	0.25	0.25
18.550	0.25	0.25	0.24	0.24	0.24
18.800	0.24	0.23	0.23	0.23	0.23
19.050	0.23	0.22	0.22	0.22	0.22
19.300	0.21	0.21	0.21	0.21	0.20
19.550	0.20	0.20	0.20	0.20	0.19
19.800	0.19	0.19	0.19	0.18	0.18
20.050	0.18	0.18	0.18	0.17	0.17
20.300	0.17	0.17	0.17	0.17	0.16
20.550	0.16	0.16	0.16	0.16	0.16
20.800	0.15	0.15	0.15	0.15	0.15
21.050	0.15	0.15	0.15	0.14	0.14
21.300	0.14	0.14	0.13	0.13	0.13
21.550	0.13	0.13	0.12	0.12	0.12
21.800	0.12	0.12	0.12	0.11	0.11

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 25 years
Storm Event: 25 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
22.050	0.11	0.11	0.11	0.11	0.11
22.300	0.11	0.10	0.10	0.10	0.10
22.550	0.10	0.10	0.10	0.10	0.10
22.800	0.10	0.09	0.09	0.09	0.09
23.050	0.09	0.09	0.09	0.09	0.09
23.300	0.09	0.09	0.09	0.09	0.09
23.550	0.08	0.08	0.08	0.08	0.08
23.800	0.08	0.08	0.08	0.08	0.08

180592-Mix Avenue Substation

Subsection: Elevation-Volume-Flow Table (Pond)

Label: PO-1

Return Event: 25 years
Storm Event: 25 Year Storm

Infiltration	
Infiltration Method (Computed)	No Infiltration
Initial Conditions	
Elevation (Water Surface, Initial)	163.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ac-ft)	Area (acres)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
163.50	0.00	0.000	0.000	0.00	0.00	0.00
164.00	0.14	0.013	0.000	0.00	0.14	6.38
164.50	0.22	0.026	0.000	0.00	0.22	12.70
165.00	0.28	0.039	0.000	0.00	0.28	18.99
165.50	0.32	0.052	0.000	0.00	0.32	25.28
166.00	0.36	0.064	0.000	0.00	0.36	31.55
166.50	0.40	0.077	0.000	0.00	0.40	37.83
167.00	0.91	0.090	0.000	0.00	0.91	44.57
167.50	1.28	0.103	0.000	0.00	1.28	51.19
168.00	1.55	0.116	0.000	0.00	1.55	57.70
168.50	1.77	0.129	0.000	0.00	1.77	64.16
169.00	1.97	0.142	0.000	0.00	1.97	70.59
169.50	2.14	0.155	0.000	0.00	2.14	77.00
170.00	2.30	0.168	0.000	0.00	2.30	83.40
170.50	2.45	0.168	0.000	0.00	2.45	83.55
171.00	2.59	0.193	0.000	0.00	2.59	96.17
171.50	2.72	0.206	0.000	0.00	2.72	102.53

180592-Mix Avenue Substation

Subsection: Level Pool Pond Routing Summary
Label: PO-1 (IN)

Return Event: 25 years
Storm Event: 25 Year Storm

Infiltration			
Infiltration Method (Computed)		No Infiltration	
Initial Conditions			
Elevation (Water Surface, Initial)		163.50 ft	
Volume (Initial)		0.000 ac-ft	
Flow (Initial Outlet)		0.00 ft³/s	
Flow (Initial Infiltration)		0.00 ft³/s	
Flow (Initial, Total)		0.00 ft³/s	
Time Increment		0.050 hours	
Inflow/Outflow Hydrograph Summary			
Flow (Peak In)		3.88 ft³/s	Time to Peak (Flow, In)
Flow (Peak Outlet)		1.96 ft³/s	Time to Peak (Flow, Outlet)
			12.200 hours
			12.550 hours
Peak Conditions			
Elevation (Water Surface, Peak)		169.00 ft	
Volume (Peak)		0.142 ac-ft	
Mass Balance (ac-ft)			
Volume (Initial)		0.000 ac-ft	
Volume (Total Inflow)		0.451 ac-ft	
Volume (Total Infiltration)		0.000 ac-ft	
Volume (Total Outlet Outflow)		0.444 ac-ft	
Volume (Retained)		0.007 ac-ft	
Volume (Unrouted)		0.000 ac-ft	
Error (Mass Balance)		0.1 %	

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 25 years

Label: PO-1 (OUT)

Storm Event: 25 Year Storm

Peak Discharge	1.96 ft ³ /s
Time to Peak	12.550 hours
Hydrograph Volume	0.443 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
2.300	0.00	0.00	0.00	0.00	0.00
2.550	0.00	0.00	0.00	0.00	0.00
2.800	0.00	0.00	0.00	0.00	0.00
3.050	0.00	0.00	0.00	0.00	0.00
3.300	0.00	0.00	0.00	0.00	0.00
3.550	0.00	0.00	0.00	0.00	0.00
3.800	0.00	0.00	0.00	0.00	0.00
4.050	0.00	0.00	0.00	0.00	0.00
4.300	0.00	0.00	0.00	0.00	0.00
4.550	0.00	0.00	0.00	0.00	0.00
4.800	0.00	0.00	0.00	0.00	0.00
5.050	0.00	0.00	0.01	0.01	0.01
5.300	0.01	0.01	0.01	0.01	0.01
5.550	0.01	0.01	0.01	0.01	0.01
5.800	0.01	0.01	0.01	0.01	0.01
6.050	0.01	0.01	0.01	0.01	0.01
6.300	0.01	0.01	0.01	0.01	0.01
6.550	0.01	0.01	0.01	0.01	0.01
6.800	0.01	0.01	0.01	0.01	0.01
7.050	0.01	0.01	0.01	0.01	0.01
7.300	0.01	0.01	0.01	0.01	0.01
7.550	0.01	0.01	0.01	0.02	0.02
7.800	0.02	0.02	0.02	0.02	0.02
8.050	0.02	0.02	0.02	0.02	0.02
8.300	0.02	0.03	0.03	0.03	0.03
8.550	0.03	0.03	0.03	0.03	0.04
8.800	0.04	0.04	0.04	0.04	0.04
9.050	0.04	0.05	0.05	0.05	0.05
9.300	0.05	0.06	0.06	0.06	0.06
9.550	0.06	0.07	0.07	0.07	0.07
9.800	0.08	0.08	0.08	0.09	0.09
10.050	0.09	0.09	0.10	0.10	0.10
10.300	0.11	0.11	0.11	0.12	0.12
10.550	0.12	0.13	0.13	0.14	0.14
10.800	0.15	0.15	0.15	0.15	0.16
11.050	0.16	0.16	0.17	0.17	0.17
11.300	0.18	0.18	0.19	0.20	0.20

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)
Label: PO-1 (OUT)

Return Event: 25 years
Storm Event: 25 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
11.550	0.21	0.22	0.23	0.23	0.25
11.800	0.26	0.28	0.29	0.32	0.34
12.050	0.37	0.52	0.98	1.30	1.51
12.300	1.67	1.79	1.87	1.92	1.95
12.550	1.96	1.96	1.93	1.90	1.86
12.800	1.81	1.76	1.70	1.64	1.58
13.050	1.51	1.44	1.37	1.31	1.23
13.300	1.15	1.08	1.02	0.96	0.90
13.550	0.84	0.79	0.74	0.69	0.66
13.800	0.62	0.59	0.57	0.54	0.52
14.050	0.50	0.49	0.47	0.46	0.44
14.300	0.43	0.42	0.41	0.40	0.40
14.550	0.40	0.40	0.40	0.40	0.40
14.800	0.39	0.39	0.39	0.39	0.39
15.050	0.39	0.39	0.39	0.39	0.38
15.300	0.38	0.38	0.38	0.38	0.38
15.550	0.38	0.38	0.37	0.37	0.37
15.800	0.37	0.37	0.37	0.36	0.36
16.050	0.36	0.36	0.36	0.35	0.35
16.300	0.35	0.35	0.35	0.34	0.34
16.550	0.34	0.34	0.34	0.33	0.33
16.800	0.33	0.33	0.33	0.32	0.32
17.050	0.32	0.32	0.31	0.31	0.31
17.300	0.31	0.31	0.30	0.30	0.30
17.550	0.30	0.29	0.29	0.29	0.29
17.800	0.28	0.28	0.28	0.28	0.28
18.050	0.27	0.27	0.27	0.27	0.26
18.300	0.26	0.26	0.26	0.25	0.25
18.550	0.25	0.25	0.24	0.24	0.24
18.800	0.24	0.23	0.23	0.23	0.23
19.050	0.23	0.22	0.22	0.22	0.22
19.300	0.21	0.21	0.21	0.21	0.20
19.550	0.20	0.20	0.20	0.20	0.19
19.800	0.19	0.19	0.19	0.18	0.18
20.050	0.18	0.18	0.18	0.17	0.17
20.300	0.17	0.17	0.17	0.17	0.16
20.550	0.16	0.16	0.16	0.16	0.16
20.800	0.15	0.15	0.15	0.15	0.15
21.050	0.15	0.15	0.15	0.14	0.14
21.300	0.14	0.14	0.13	0.13	0.13
21.550	0.13	0.13	0.12	0.12	0.12
21.800	0.12	0.12	0.12	0.11	0.11

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 25 years

Label: PO-1 (OUT)

Storm Event: 25 Year Storm

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
22.050	0.11	0.11	0.11	0.11	0.11
22.300	0.11	0.10	0.10	0.10	0.10
22.550	0.10	0.10	0.10	0.10	0.10
22.800	0.10	0.09	0.09	0.09	0.09
23.050	0.09	0.09	0.09	0.09	0.09
23.300	0.09	0.09	0.09	0.09	0.09
23.550	0.08	0.08	0.08	0.08	0.08
23.800	0.08	0.08	0.08	0.08	0.08

180592-Mix Avenue Substation

Subsection: Pond Inflow Summary

Label: PO-1 (IN)

Return Event: 25 years

Storm Event: 25 Year Storm

Summary for Hydrograph Addition at 'PO-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	CDS Basin
<Catchment to Outflow Node>	Post to Pipe
<Catchment to Outflow Node>	Post to Trench

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	CDS Basin	0.031	12.100	0.33
Flow (From)	Post to Pipe	0.064	12.100	0.74
Flow (From)	Post to Trench	0.355	12.250	3.29
Flow (In)	PO-1	0.451	12.200	3.88

180592-Mix Avenue Substation

Index

B

BYPASS (Time of Concentration Calculations, 25 years)...5, 6

BYPASS (Unit Hydrograph Summary, 25 years)...11, 12

C

CDS Basin (Unit Hydrograph Summary, 25 years)...13, 14

Composite Outlet Structure - 1 (Composite Rating Curve, 25 years)...28

Composite Outlet Structure - 1 (Outlet Input Data, 25 years)...26, 27

H

HAMDEN-CT (Time-Depth Curve, 25 years)...3, 4

M

Master Network Summary...2

O

O-1 (Addition Summary, 25 years)...21

O-2 (Addition Summary, 25 years)...22

Outlet-1 (Diverted Hydrograph, 25 years)...29, 30, 31

P

PO-1 (Elevation-Volume-Flow Table (Pond), 25 years)...32

PO-1 (IN) (Level Pool Pond Routing Summary, 25 years)...33

PO-1 (IN) (Pond Inflow Summary, 25 years)...37

PO-1 (OUT) (Pond Routed Hydrograph (total out), 25 years)...34, 35, 36

PO-1 (OUT) (Time vs. Elevation, 25 years)...23, 24, 25

Post to Pipe (Unit Hydrograph Summary, 25 years)...15, 16

Post to Trench (Time of Concentration Calculations, 25 years)...7, 8

Post to Trench (Unit Hydrograph Summary, 25 years)...17, 18

PRE (Time of Concentration Calculations, 25 years)...9, 10

PRE (Unit Hydrograph Summary, 25 years)...19, 20

180592-Mix Avenue Substation

Project Summary

Title	180592-Mix Avenue Substation
Engineer	Davis Fennell
Company	Black & Veatch
Date	12/11/2015

Notes	PRE VS POST 50 YEAR STORM
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Table of Contents

	Master Network Summary	2
HAMDEN-CT	Time-Depth Curve, 50 years	3
BYPASS		
	Time of Concentration Calculations, 50 years	5
Post to Trench		
	Time of Concentration Calculations, 50 years	7
PRE		
	Time of Concentration Calculations, 50 years	9
BYPASS		
	Unit Hydrograph Summary, 50 years	11
CDS Basin		
	Unit Hydrograph Summary, 50 years	13
Post to Pipe		
	Unit Hydrograph Summary, 50 years	15
Post to Trench		
	Unit Hydrograph Summary, 50 years	17
PRE		
	Unit Hydrograph Summary, 50 years	19
O-1		
	Addition Summary, 50 years	21
O-2		
	Addition Summary, 50 years	22
PO-1 (OUT)	Time vs. Elevation, 50 years	23
PO-1	Time vs. Volume, 50 years	24
PO-1	Elevation vs. Volume Curve, 50 years	25
Composite Outlet Structure - 1		
	Outlet Input Data, 50 years	26
	Composite Rating Curve, 50 years	28
Outlet-1		
	Diverted Hydrograph, 50 years	29
PO-1		
	Elevation-Volume-Flow Table (Pond), 50 years	30
PO-1 (IN)		

Table of Contents

	Level Pool Pond Routing Summary, 50 years	31
PO-1 (OUT)		
	Pond Routed Hydrograph (total out), 50 years	32
PO-1 (IN)		
	Pond Inflow Summary, 50 years	33

180592-Mix Avenue Substation

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
PRE	Pre 50	50	0.834	12.350	6.81
Post to Trench	Post 50	50	0.413	12.500	2.44
Post to Pipe	Post 50	50	0.081	12.000	0.79
CDS Basin	Post 50	50	0.039	12.000	0.35
BYPASS	Post 50	50	0.555	12.500	3.66

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-1	Pre 50	50	0.834	12.350	6.81
O-2	Post 50	50	1.079	12.500	5.72

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
PO-1 (IN)	Post 50	50	0.533	12.000	3.13	(N/A)	(N/A)
PO-1 (OUT)	Post 50	50	0.525	12.500	2.06	169.27	0.149

180592-Mix Avenue Substation

Subsection: Time-Depth Curve

Label: HAMDEN-CT

Return Event: 50 years

Storm Event: 50 Year Storm

Time-Depth Curve: 50 Year Storm

Label	50 Year Storm
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	50 years

CUMULATIVE RAINFALL (in)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.2
2.500	0.2	0.2	0.2	0.2	0.2
3.000	0.2	0.2	0.2	0.2	0.2
3.500	0.2	0.2	0.3	0.3	0.3
4.000	0.3	0.3	0.3	0.3	0.3
4.500	0.3	0.3	0.3	0.3	0.4
5.000	0.4	0.4	0.4	0.4	0.4
5.500	0.4	0.4	0.4	0.4	0.5
6.000	0.5	0.5	0.5	0.5	0.5
6.500	0.5	0.5	0.5	0.6	0.6
7.000	0.6	0.6	0.6	0.6	0.6
7.500	0.7	0.7	0.7	0.7	0.7
8.000	0.7	0.7	0.8	0.8	0.8
8.500	0.8	0.8	0.9	0.9	0.9
9.000	0.9	1.0	1.0	1.0	1.0
9.500	1.1	1.1	1.1	1.1	1.2
10.000	1.2	1.2	1.3	1.3	1.3
10.500	1.4	1.4	1.5	1.5	1.6
11.000	1.6	1.6	1.7	1.8	1.8
11.500	1.9	2.0	2.2	2.4	2.7
12.000	3.2	3.7	4.0	4.2	4.4
12.500	4.5	4.6	4.6	4.7	4.8
13.000	4.8	4.8	4.9	4.9	5.0
13.500	5.0	5.1	5.1	5.1	5.2
14.000	5.2	5.2	5.3	5.3	5.3
14.500	5.3	5.4	5.4	5.4	5.4
15.000	5.5	5.5	5.5	5.5	5.6
15.500	5.6	5.6	5.6	5.6	5.7
16.000	5.7	5.7	5.7	5.7	5.7
16.500	5.7	5.8	5.8	5.8	5.8

180592-Mix Avenue Substation

Subsection: Time-Depth Curve
Label: HAMDEN-CT

Return Event: 50 years
Storm Event: 50 Year Storm

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	5.8	5.8	5.8	5.9	5.9
17.500	5.9	5.9	5.9	5.9	5.9
18.000	5.9	5.9	6.0	6.0	6.0
18.500	6.0	6.0	6.0	6.0	6.0
19.000	6.0	6.0	6.1	6.1	6.1
19.500	6.1	6.1	6.1	6.1	6.1
20.000	6.1	6.1	6.1	6.1	6.2
20.500	6.2	6.2	6.2	6.2	6.2
21.000	6.2	6.2	6.2	6.2	6.2
21.500	6.2	6.2	6.3	6.3	6.3
22.000	6.3	6.3	6.3	6.3	6.3
22.500	6.3	6.3	6.3	6.3	6.3
23.000	6.3	6.3	6.4	6.4	6.4
23.500	6.4	6.4	6.4	6.4	6.4
24.000	6.4	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 50 years
Storm Event: 50 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.400
Slope	0.033 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.12 ft/s
Segment Time of Concentration	0.695 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	157.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.019 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.714 hours
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180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 50 years
Storm Event: 50 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: Post to Trench

Return Event: 50 years
Storm Event: 50 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.076 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.25 ft/s
Segment Time of Concentration	0.331 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.331 hours
-----------------------------------	-------------

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations

Return Event: 50 years

Label: Post to Trench

Storm Event: 50 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 50 years
Storm Event: 50 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	237.00 ft
Manning's n	0.400
Slope	0.068 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.430 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	332.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.033 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.463 hours
-----------------------------------	-------------

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 50 years
Storm Event: 50 Year Storm

=== SCS Channel Flow

$T_c = \frac{R = Q_a / W_p}{V = (1.49 * (R^{2/3}) * (S_f^{*-0.5})) / n}$
 $(L_f / V) / 3600$
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Where: Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Unpaved surface:
 $V = 16.1345 * (S_f^{*0.5})$
Tc = Paved Surface:
 $V = 20.3282 * (S_f^{*0.5})$
 $(L_f / V) / 3600$
V= Velocity, ft/sec
Where: Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: BYPASS

Return Event: 50 years
Storm Event: 50 Year Storm

Storm Event	50 Year Storm
Return Event	50 years
Duration	24.000 hours
Depth	6.4 in
Time of Concentration (Composite)	0.714 hours
Area (User Defined)	1.500 acres
Computational Time Increment	0.095 hours
Time to Peak (Computed)	12.467 hours
Flow (Peak, Computed)	3.69 ft ³ /s
Output Increment	0.500 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	3.66 ft ³ /s
Drainage Area	
SCS CN (Composite)	83.120
Area (User Defined)	1.500 acres
Maximum Retention (Pervious)	2.0 in
Maximum Retention (Pervious, 20 percent)	0.4 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.5 in
Runoff Volume (Pervious)	0.560 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.555 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.714 hours
Computational Time Increment	0.095 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: BYPASS

Return Event: 50 years

Storm Event: 50 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	2.38 ft ³ /s
Unit peak time, Tp	0.476 hours
Unit receding limb, Tr	1.903 hours
Total unit time, Tb	2.379 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: CDS Basin

Return Event: 50 years
Storm Event: 50 Year Storm

Storm Event	50 Year Storm
Return Event	50 years
Duration	24.000 hours
Depth	6.4 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.070 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.38 ft ³ /s
Output Increment	0.500 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	0.35 ft ³ /s
Drainage Area	
SCS CN (Composite)	98.000
Area (User Defined)	0.070 acres
Maximum Retention (Pervious)	0.2 in
Maximum Retention (Pervious, 20 percent)	0.0 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	6.2 in
Runoff Volume (Pervious)	0.036 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.039 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: CDS Basin

Return Event: 50 years

Storm Event: 50 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	0.95 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Pipe

Return Event: 50 years

Storm Event: 50 Year Storm

Storm Event	50 Year Storm
Return Event	50 years
Duration	24.000 hours
Depth	6.4 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.170 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.86 ft ³ /s
Output Increment	0.500 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	0.79 ft ³ /s
Drainage Area	
SCS CN (Composite)	90.588
Area (User Defined)	0.170 acres
Maximum Retention (Pervious)	1.0 in
Maximum Retention (Pervious, 20 percent)	0.2 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	5.3 in
Runoff Volume (Pervious)	0.075 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.081 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 50 years

Label: Post to Pipe

Storm Event: 50 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	2.31 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Trench

Return Event: 50 years

Storm Event: 50 Year Storm

Storm Event	50 Year Storm
Return Event	50 years
Duration	24.000 hours
Depth	6.4 in
Time of Concentration (Composite)	0.331 hours
Area (User Defined)	1.250 acres
Computational Time Increment	0.044 hours
Time to Peak (Computed)	12.212 hours
Flow (Peak, Computed)	3.98 ft ³ /s
Output Increment	0.500 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	2.44 ft ³ /s
Drainage Area	
SCS CN (Composite)	80.000
Area (User Defined)	1.250 acres
Maximum Retention (Pervious)	2.5 in
Maximum Retention (Pervious, 20 percent)	0.5 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.1 in
Runoff Volume (Pervious)	0.432 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.413 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.331 hours
Computational Time Increment	0.044 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Trench

Return Event: 50 years

Storm Event: 50 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	4.28 ft ³ /s
Unit peak time, Tp	0.220 hours
Unit receding limb, Tr	0.882 hours
Total unit time, Tb	1.102 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: PRE

Return Event: 50 years
Storm Event: 50 Year Storm

Storm Event	50 Year Storm
Return Event	50 years
Duration	24.000 hours
Depth	6.4 in
Time of Concentration (Composite)	0.463 hours
Area (User Defined)	2.900 acres
Computational Time Increment	0.062 hours
Time to Peak (Computed)	12.350 hours
Flow (Peak, Computed)	6.81 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.350 hours
Flow (Peak Interpolated Output)	6.81 ft ³ /s
Drainage Area	
SCS CN (Composite)	73.455
Area (User Defined)	2.900 acres
Maximum Retention (Pervious)	3.6 in
Maximum Retention (Pervious, 20 percent)	0.7 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.5 in
Runoff Volume (Pervious)	0.838 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.834 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.463 hours
Computational Time Increment	0.062 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: PRE

Return Event: 50 years

Storm Event: 50 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	7.09 ft ³ /s
Unit peak time, Tp	0.309 hours
Unit receding limb, Tr	1.235 hours
Total unit time, Tb	1.544 hours

180592-Mix Avenue Substation

Subsection: Addition Summary

Label: O-1

Return Event: 50 years
Storm Event: 50 Year Storm

Summary for Hydrograph Addition at 'O-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	PRE

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	PRE	0.834	12.350	6.81
Flow (In)	O-1	0.834	12.350	6.81

180592-Mix Avenue Substation

Subsection: Addition Summary

Label: O-2

Return Event: 50 years

Storm Event: 50 Year Storm

Summary for Hydrograph Addition at 'O-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	BYPASS
Outlet-1	PO-1

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	BYPASS	0.555	12.500	3.66
Flow (From)	Outlet-1	0.525	12.500	2.06
Flow (In)	O-2	1.079	12.500	5.72

180592-Mix Avenue Substation

Subsection: Time vs. Elevation

Return Event: 50 years

Label: PO-1 (OUT)

Storm Event: 50 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.500 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	163.50	163.50	163.50	163.50	163.50
2.500	163.51	163.51	163.51	163.51	163.52
5.000	163.52	163.53	163.53	163.54	163.55
7.500	163.57	163.60	163.65	163.72	163.80
10.000	163.91	164.06	164.28	164.69	166.86
12.500	169.27	168.92	167.48	166.76	166.56
15.000	166.47	166.35	166.18	165.96	165.72
17.500	165.49	165.25	165.01	164.80	164.61
20.000	164.45	164.31	164.19	164.09	164.01
22.500	163.94	163.89	163.86	163.83	(N/A)

180592-Mix Avenue Substation

Subsection: Time vs. Volume
Label: PO-1

Return Event: 50 years
Storm Event: 50 Year Storm

Time vs. Volume (ac-ft)

Output Time increment = 0.500 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
0.000	0.000	0.000	0.000	0.000	0.000
2.500	0.000	0.000	0.000	0.000	0.000
5.000	0.001	0.001	0.001	0.001	0.001
7.500	0.002	0.003	0.004	0.006	0.008
10.000	0.011	0.014	0.020	0.031	0.087
12.500	0.149	0.140	0.103	0.084	0.079
15.000	0.076	0.074	0.069	0.063	0.057
17.500	0.051	0.045	0.039	0.034	0.029
20.000	0.024	0.021	0.018	0.015	0.013
22.500	0.011	0.010	0.009	0.008	(N/A)

180592-Mix Avenue Substation

Subsection: Elevation vs. Volume Curve
Label: PO-1

Return Event: 50 years
Storm Event: 50 Year Storm

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ac-ft)
163.50	0.000
164.00	0.013
164.50	0.026
165.00	0.039
165.50	0.052
166.00	0.064
166.50	0.077
167.00	0.090
167.50	0.103
168.00	0.116
168.50	0.129
169.00	0.142
169.50	0.155
170.00	0.168
170.50	0.168
171.00	0.193
171.50	0.206

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 50 years

Label: Composite Outlet Structure - 1

Storm Event: 50 Year Storm

Requested Pond Water Surface Elevations

Minimum (Headwater)	163.50 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	171.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	TW	163.50	171.50
Orifice-Circular	Orifice - 2	Forward	TW	166.50	171.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 50 years

Label: Composite Outlet Structure - 1

Storm Event: 50 Year Storm

Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	163.50 ft
Orifice Diameter	3.0 in
Orifice Coefficient	0.600
Structure ID: Orifice - 2	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	166.50 ft
Orifice Diameter	6.0 in
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

180592-Mix Avenue Substation

Subsection: Composite Rating Curve
Label: Composite Outlet Structure - 1

Return Event: 50 years
Storm Event: 50 Year Storm

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
163.50	0.00	(N/A)	0.00
164.00	0.14	(N/A)	0.00
164.50	0.22	(N/A)	0.00
165.00	0.28	(N/A)	0.00
165.50	0.32	(N/A)	0.00
166.00	0.36	(N/A)	0.00
166.50	0.40	(N/A)	0.00
167.00	0.91	(N/A)	0.00
167.50	1.28	(N/A)	0.00
168.00	1.55	(N/A)	0.00
168.50	1.77	(N/A)	0.00
169.00	1.97	(N/A)	0.00
169.50	2.14	(N/A)	0.00
170.00	2.30	(N/A)	0.00
170.50	2.45	(N/A)	0.00
171.00	2.59	(N/A)	0.00
171.50	2.72	(N/A)	0.00

Contributing Structures

None Contributing
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 50 years
Storm Event: 50 Year Storm

Peak Discharge	2.06 ft ³ /s
Time to Peak	12.500 hours
Hydrograph Volume	0.525 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.500 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
1.500	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.01	0.01	0.01
6.500	0.01	0.01	0.02	0.03	0.04
9.000	0.06	0.09	0.12	0.15	0.19
11.500	0.24	0.76	2.06	1.93	1.27
14.000	0.67	0.46	0.40	0.39	0.38
16.500	0.36	0.34	0.32	0.30	0.28
19.000	0.25	0.23	0.21	0.19	0.17
21.500	0.16	0.15	0.13	0.11	0.10
24.000	0.09	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Elevation-Volume-Flow Table (Pond)
Label: PO-1

Return Event: 50 years
Storm Event: 50 Year Storm

Infiltration	
Infiltration Method (Computed)	No Infiltration
Initial Conditions	
Elevation (Water Surface, Initial)	163.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	0.500 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ac-ft)	Area (acres)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
163.50	0.00	0.000	0.000	0.00	0.00	0.00
164.00	0.14	0.013	0.000	0.00	0.14	0.77
164.50	0.22	0.026	0.000	0.00	0.22	1.47
165.00	0.28	0.039	0.000	0.00	0.28	2.15
165.50	0.32	0.052	0.000	0.00	0.32	2.82
166.00	0.36	0.064	0.000	0.00	0.36	3.48
166.50	0.40	0.077	0.000	0.00	0.40	4.14
167.00	0.91	0.090	0.000	0.00	0.91	5.27
167.50	1.28	0.103	0.000	0.00	1.28	6.27
168.00	1.55	0.116	0.000	0.00	1.55	7.17
168.50	1.77	0.129	0.000	0.00	1.77	8.01
169.00	1.97	0.142	0.000	0.00	1.97	8.83
169.50	2.14	0.155	0.000	0.00	2.14	9.63
170.00	2.30	0.168	0.000	0.00	2.30	10.41
170.50	2.45	0.168	0.000	0.00	2.45	10.56
171.00	2.59	0.193	0.000	0.00	2.59	11.95
171.50	2.72	0.206	0.000	0.00	2.72	12.70

180592-Mix Avenue Substation

Subsection: Level Pool Pond Routing Summary
Label: PO-1 (IN)

Return Event: 50 years
Storm Event: 50 Year Storm

Infiltration			
Infiltration Method (Computed)		No Infiltration	
Initial Conditions			
Elevation (Water Surface, Initial)	163.50 ft		
Volume (Initial)	0.000 ac-ft		
Flow (Initial Outlet)	0.00 ft³/s		
Flow (Initial Infiltration)	0.00 ft³/s		
Flow (Initial, Total)	0.00 ft³/s		
Time Increment	0.500 hours		
Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	3.13 ft³/s	Time to Peak (Flow, In)	12.000 hours
Flow (Peak Outlet)	2.06 ft³/s	Time to Peak (Flow, Outlet)	12.500 hours
Peak Conditions			
Elevation (Water Surface, Peak)	169.27 ft		
Volume (Peak)	0.149 ac-ft		
Mass Balance (ac-ft)			
Volume (Initial)	0.000 ac-ft		
Volume (Total Inflow)	0.533 ac-ft		
Volume (Total Infiltration)	0.000 ac-ft		
Volume (Total Outlet Outflow)	0.525 ac-ft		
Volume (Retained)	0.005 ac-ft		
Volume (Unrouted)	-0.003 ac-ft		
Error (Mass Balance)	0.6 %		

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 50 years

Label: PO-1 (OUT)

Storm Event: 50 Year Storm

Peak Discharge	2.06 ft ³ /s
Time to Peak	12.500 hours
Hydrograph Volume	0.525 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.500 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
1.500	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.01	0.01	0.01
6.500	0.01	0.01	0.02	0.03	0.04
9.000	0.06	0.09	0.12	0.15	0.19
11.500	0.24	0.76	2.06	1.93	1.27
14.000	0.67	0.46	0.40	0.39	0.38
16.500	0.36	0.34	0.32	0.30	0.28
19.000	0.25	0.23	0.21	0.19	0.17
21.500	0.16	0.15	0.13	0.11	0.10
24.000	0.09	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Pond Inflow Summary

Label: PO-1 (IN)

Return Event: 50 years

Storm Event: 50 Year Storm

Summary for Hydrograph Addition at 'PO-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	CDS Basin
<Catchment to Outflow Node>	Post to Pipe
<Catchment to Outflow Node>	Post to Trench

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	CDS Basin	0.039	12.000	0.35
Flow (From)	Post to Pipe	0.081	12.000	0.79
Flow (From)	Post to Trench	0.413	12.500	2.44
Flow (In)	PO-1	0.533	12.000	3.13

180592-Mix Avenue Substation

Index

B

BYPASS (Time of Concentration Calculations, 50 years)...5, 6

BYPASS (Unit Hydrograph Summary, 50 years)...11, 12

C

CDS Basin (Unit Hydrograph Summary, 50 years)...13, 14

Composite Outlet Structure - 1 (Composite Rating Curve, 50 years)...28

Composite Outlet Structure - 1 (Outlet Input Data, 50 years)...26, 27

H

HAMDEN-CT (Time-Depth Curve, 50 years)...3, 4

M

Master Network Summary...2

O

O-1 (Addition Summary, 50 years)...21

O-2 (Addition Summary, 50 years)...22

Outlet-1 (Diverted Hydrograph, 50 years)...29

P

PO-1 (Elevation vs. Volume Curve, 50 years)...25

PO-1 (Elevation-Volume-Flow Table (Pond), 50 years)...30

PO-1 (IN) (Level Pool Pond Routing Summary, 50 years)...31

PO-1 (IN) (Pond Inflow Summary, 50 years)...33

PO-1 (OUT) (Pond Routed Hydrograph (total out), 50 years)...32

PO-1 (OUT) (Time vs. Elevation, 50 years)...23

PO-1 (Time vs. Volume, 50 years)...24

Post to Pipe (Unit Hydrograph Summary, 50 years)...15, 16

Post to Trench (Time of Concentration Calculations, 50 years)...7, 8

Post to Trench (Unit Hydrograph Summary, 50 years)...17, 18

PRE (Time of Concentration Calculations, 50 years)...9, 10

PRE (Unit Hydrograph Summary, 50 years)...19, 20

180592-Mix Avenue Substation

Project Summary

Title	180592-Mix Avenue Substation
Engineer	Davis Fennell
Company	Black & Veatch
Date	12/11/2015

Notes	PRE VS POST 100 YEAR STORM
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Table of Contents

	Master Network Summary	2
HAMDEN-CT	Time-Depth Curve, 100 years	3
BYPASS		
	Time of Concentration Calculations, 100 years	5
Post to Trench		
	Time of Concentration Calculations, 100 years	7
PRE		
	Time of Concentration Calculations, 100 years	9
BYPASS		
	Unit Hydrograph Summary, 100 years	11
CDS Basin		
	Unit Hydrograph Summary, 100 years	13
Post to Pipe		
	Unit Hydrograph Summary, 100 years	15
Post to Trench		
	Unit Hydrograph Summary, 100 years	17
PRE		
	Unit Hydrograph Summary, 100 years	19
O-1		
	Addition Summary, 100 years	21
O-2		
	Addition Summary, 100 years	22
PO-1 (OUT)	Time vs. Elevation, 100 years	23
PO-1	Time vs. Volume, 100 years	26
PO-1	Elevation vs. Volume Curve, 100 years	29
Composite Outlet Structure - 1		
	Outlet Input Data, 100 years	30
	Composite Rating Curve, 100 years	32
Outlet-1		
	Diverted Hydrograph, 100 years	33
PO-1		
	Elevation-Volume-Flow Table (Pond), 100 years	36
PO-1 (IN)		

Table of Contents

	Level Pool Pond Routing Summary, 100 years	37
PO-1 (OUT)		
	Pond Routed Hydrograph (total out), 100 years	38
PO-1 (IN)		
	Pond Inflow Summary, 100 years	41

180592-Mix Avenue Substation

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
PRE	Pre 100	100	0.979	12.350	7.98
Post to Trench	Post 100	100	0.497	12.250	4.57
Post to Pipe	Post 100	100	0.085	12.100	0.97
CDS Basin	Post 100	100	0.040	12.100	0.42
BYPASS	Post 100	100	0.638	12.500	4.18

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-1	Pre 100	100	0.979	12.350	7.98
O-2	Post 100	100	1.250	12.500	6.76

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
PO-1 (IN)	Post 100	100	0.622	12.200	5.34	(N/A)	(N/A)
PO-1 (OUT)	Post 100	100	0.612	12.550	2.59	171.01	0.194

180592-Mix Avenue Substation

Subsection: Time-Depth Curve

Label: HAMDEN-CT

Return Event: 100 years

Storm Event: 100 Year Storm

Time-Depth Curve: 100 Year Storm

Label	100 Year Storm
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.2	0.2
3.000	0.2	0.2	0.2	0.2	0.3
3.500	0.3	0.3	0.3	0.3	0.3
4.000	0.3	0.3	0.3	0.3	0.3
4.500	0.4	0.4	0.4	0.4	0.4
5.000	0.4	0.4	0.4	0.4	0.4
5.500	0.5	0.5	0.5	0.5	0.5
6.000	0.5	0.5	0.5	0.5	0.6
6.500	0.6	0.6	0.6	0.6	0.6
7.000	0.6	0.7	0.7	0.7	0.7
7.500	0.7	0.7	0.8	0.8	0.8
8.000	0.8	0.8	0.8	0.9	0.9
8.500	0.9	0.9	1.0	1.0	1.0
9.000	1.0	1.1	1.1	1.1	1.1
9.500	1.2	1.2	1.2	1.3	1.3
10.000	1.3	1.4	1.4	1.5	1.5
10.500	1.5	1.6	1.6	1.7	1.7
11.000	1.8	1.8	1.9	2.0	2.0
11.500	2.1	2.2	2.4	2.7	3.0
12.000	3.5	4.1	4.4	4.7	4.9
12.500	5.0	5.1	5.1	5.2	5.3
13.000	5.3	5.4	5.4	5.5	5.5
13.500	5.6	5.6	5.6	5.7	5.7
14.000	5.8	5.8	5.8	5.9	5.9
14.500	5.9	6.0	6.0	6.0	6.0
15.000	6.1	6.1	6.1	6.1	6.2
15.500	6.2	6.2	6.2	6.3	6.3
16.000	6.3	6.3	6.3	6.3	6.4
16.500	6.4	6.4	6.4	6.4	6.4

180592-Mix Avenue Substation

Subsection: Time-Depth Curve
Label: HAMDEN-CT

Return Event: 100 years
Storm Event: 100 Year Storm

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	6.5	6.5	6.5	6.5	6.5
17.500	6.5	6.5	6.6	6.6	6.6
18.000	6.6	6.6	6.6	6.6	6.6
18.500	6.6	6.7	6.7	6.7	6.7
19.000	6.7	6.7	6.7	6.7	6.7
19.500	6.7	6.8	6.8	6.8	6.8
20.000	6.8	6.8	6.8	6.8	6.8
20.500	6.8	6.8	6.9	6.9	6.9
21.000	6.9	6.9	6.9	6.9	6.9
21.500	6.9	6.9	6.9	6.9	7.0
22.000	7.0	7.0	7.0	7.0	7.0
22.500	7.0	7.0	7.0	7.0	7.0
23.000	7.0	7.0	7.0	7.1	7.1
23.500	7.1	7.1	7.1	7.1	7.1
24.000	7.1	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 100 years
Storm Event: 100 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.400
Slope	0.033 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.12 ft/s
Segment Time of Concentration	0.695 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	157.00 ft
Is Paved?	False
Slope	0.020 ft/ft
Average Velocity	2.28 ft/s
Segment Time of Concentration	0.019 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.714 hours
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180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: BYPASS

Return Event: 100 years
Storm Event: 100 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Tc =
$$\text{Unpaved surface:}$$
$$V = 16.1345 * (Sf^{*0.5})$$
$$\text{Paved Surface:}$$
$$V = 20.3282 * (Sf^{*0.5})$$
$$(Lf / V) / 3600$$

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: Post to Trench

Return Event: 100 years
Storm Event: 100 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	300.00 ft
Manning's n	0.240
Slope	0.076 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.25 ft/s
Segment Time of Concentration	0.331 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.331 hours
-----------------------------------	-------------

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations

Return Event: 100 years

Label: Post to Trench

Storm Event: 100 Year Storm

=== SCS Channel Flow

Tc =
$$R = Qa / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$$
$$(Lf / V) / 3600$$

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 100 years
Storm Event: 100 Year Storm

Time of Concentration Results

Segment #1: TR-55 Sheet Flow

Hydraulic Length	237.00 ft
Manning's n	0.400
Slope	0.068 ft/ft
2 Year 24 Hour Depth	3.3 in
Average Velocity	0.15 ft/s
Segment Time of Concentration	0.430 hours

Segment #2: TR-55 Shallow Concentrated Flow

Hydraulic Length	332.00 ft
Is Paved?	False
Slope	0.030 ft/ft
Average Velocity	2.79 ft/s
Segment Time of Concentration	0.033 hours

Time of Concentration (Composite)

Time of Concentration (Composite)	0.463 hours
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180592-Mix Avenue Substation

Subsection: Time of Concentration Calculations
Label: PRE

Return Event: 100 years
Storm Event: 100 Year Storm

=== SCS Channel Flow

Tc = $R = Qa / Wp$
 $V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n$
 $(Lf / V) / 3600$
 R= Hydraulic radius
 Aq= Flow area, square feet
 Wp= Wetted perimeter, feet
 V= Velocity, ft/sec
 Where: Sf= Slope, ft/ft
 n= Manning's n
 Tc= Time of concentration, hours
 Lf= Flow length, feet

=== SCS TR-55 Shallow Concentration Flow

Unpaved surface:
 $V = 16.1345 * (Sf^{*0.5})$
 Tc = Paved Surface:
 $V = 20.3282 * (Sf^{*0.5})$
 $(Lf / V) / 3600$
 V= Velocity, ft/sec
 Sf= Slope, ft/ft
 Where: Tc= Time of concentration, hours
 Lf= Flow length, feet

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: BYPASS

Return Event: 100 years
Storm Event: 100 Year Storm

Storm Event	100 Year Storm
Return Event	100 years
Duration	24.000 hours
Depth	7.1 in
Time of Concentration (Composite)	0.714 hours
Area (User Defined)	1.500 acres
Computational Time Increment	0.095 hours
Time to Peak (Computed)	12.467 hours
Flow (Peak, Computed)	4.21 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	4.18 ft ³ /s
Drainage Area	
SCS CN (Composite)	83.120
Area (User Defined)	1.500 acres
Maximum Retention (Pervious)	2.0 in
Maximum Retention (Pervious, 20 percent)	0.4 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	5.1 in
Runoff Volume (Pervious)	0.642 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.638 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.714 hours
Computational Time Increment	0.095 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: BYPASS

Return Event: 100 years
Storm Event: 100 Year Storm

SCS Unit Hydrograph Parameters	
Unit peak, qp	2.38 ft ³ /s
Unit peak time, Tp	0.476 hours
Unit receding limb, Tr	1.903 hours
Total unit time, Tb	2.379 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: CDS Basin

Return Event: 100 years
Storm Event: 100 Year Storm

Storm Event	100 Year Storm
Return Event	100 years
Duration	24.000 hours
Depth	7.1 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.070 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.42 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.42 ft ³ /s
Drainage Area	
SCS CN (Composite)	98.000
Area (User Defined)	0.070 acres
Maximum Retention (Pervious)	0.2 in
Maximum Retention (Pervious, 20 percent)	0.0 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	6.9 in
Runoff Volume (Pervious)	0.040 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.040 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 100 years

Label: CDS Basin

Storm Event: 100 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	0.95 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Label: Post to Pipe

Return Event: 100 years

Storm Event: 100 Year Storm

Storm Event	100 Year Storm
Return Event	100 years
Duration	24.000 hours
Depth	7.1 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	0.170 acres
Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.100 hours
Flow (Peak, Computed)	0.97 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	0.97 ft ³ /s
Drainage Area	
SCS CN (Composite)	90.588
Area (User Defined)	0.170 acres
Maximum Retention (Pervious)	1.0 in
Maximum Retention (Pervious, 20 percent)	0.2 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	6.0 in
Runoff Volume (Pervious)	0.085 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.085 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 100 years

Label: Post to Pipe

Storm Event: 100 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	2.31 ft ³ /s
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: Post to Trench

Return Event: 100 years
Storm Event: 100 Year Storm

Storm Event	100 Year Storm
Return Event	100 years
Duration	24.000 hours
Depth	7.1 in
Time of Concentration (Composite)	0.331 hours
Area (User Defined)	1.250 acres
Computational Time Increment	0.044 hours
Time to Peak (Computed)	12.212 hours
Flow (Peak, Computed)	4.59 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.250 hours
Flow (Peak Interpolated Output)	4.57 ft ³ /s
Drainage Area	
SCS CN (Composite)	80.000
Area (User Defined)	1.250 acres
Maximum Retention (Pervious)	2.5 in
Maximum Retention (Pervious, 20 percent)	0.5 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.8 in
Runoff Volume (Pervious)	0.499 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.497 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.331 hours
Computational Time Increment	0.044 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 100 years

Label: Post to Trench

Storm Event: 100 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	4.28 ft ³ /s
Unit peak time, Tp	0.220 hours
Unit receding limb, Tr	0.882 hours
Total unit time, Tb	1.102 hours

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary
Label: PRE

Return Event: 100 years
Storm Event: 100 Year Storm

Storm Event	100 Year Storm
Return Event	100 years
Duration	24.000 hours
Depth	7.1 in
Time of Concentration (Composite)	0.463 hours
Area (User Defined)	2.900 acres
Computational Time Increment	0.062 hours
Time to Peak (Computed)	12.350 hours
Flow (Peak, Computed)	7.98 ft ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.350 hours
Flow (Peak Interpolated Output)	7.98 ft ³ /s
Drainage Area	
SCS CN (Composite)	73.455
Area (User Defined)	2.900 acres
Maximum Retention (Pervious)	3.6 in
Maximum Retention (Pervious, 20 percent)	0.7 in
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.1 in
Runoff Volume (Pervious)	0.984 ac-ft
Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.979 ac-ft
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.463 hours
Computational Time Increment	0.062 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

180592-Mix Avenue Substation

Subsection: Unit Hydrograph Summary

Return Event: 100 years

Label: PRE

Storm Event: 100 Year Storm

SCS Unit Hydrograph Parameters

Unit peak, qp	7.09 ft ³ /s
Unit peak time, Tp	0.309 hours
Unit receding limb, Tr	1.235 hours
Total unit time, Tb	1.544 hours

180592-Mix Avenue Substation

Subsection: Addition Summary
Label: O-1

Return Event: 100 years
Storm Event: 100 Year Storm

Summary for Hydrograph Addition at 'O-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	PRE

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	PRE	0.979	12.350	7.98
Flow (In)	O-1	0.979	12.350	7.98

180592-Mix Avenue Substation

Subsection: Addition Summary
Label: O-2

Return Event: 100 years
Storm Event: 100 Year Storm

Summary for Hydrograph Addition at 'O-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	BYPASS
Outlet-1	PO-1

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	BYPASS	0.638	12.500	4.18
Flow (From)	Outlet-1	0.612	12.550	2.59
Flow (In)	O-2	1.250	12.500	6.76

180592-Mix Avenue Substation

Subsection: Time vs. Elevation
Label: PO-1 (OUT)

Return Event: 100 years
Storm Event: 100 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	163.50	163.50	163.50	163.50	163.50
0.250	163.50	163.50	163.50	163.50	163.50
0.500	163.50	163.50	163.50	163.50	163.50
0.750	163.50	163.50	163.50	163.50	163.50
1.000	163.50	163.50	163.50	163.50	163.50
1.250	163.50	163.50	163.50	163.50	163.50
1.500	163.50	163.50	163.50	163.50	163.50
1.750	163.50	163.50	163.50	163.50	163.50
2.000	163.50	163.50	163.51	163.51	163.51
2.250	163.51	163.51	163.51	163.51	163.51
2.500	163.51	163.51	163.51	163.51	163.51
2.750	163.51	163.51	163.51	163.51	163.51
3.000	163.51	163.51	163.51	163.51	163.51
3.250	163.51	163.51	163.51	163.51	163.51
3.500	163.51	163.51	163.51	163.51	163.51
3.750	163.51	163.51	163.52	163.52	163.52
4.000	163.52	163.52	163.52	163.52	163.52
4.250	163.52	163.52	163.52	163.52	163.52
4.500	163.52	163.52	163.52	163.52	163.52
4.750	163.52	163.52	163.53	163.53	163.53
5.000	163.53	163.53	163.53	163.53	163.53
5.250	163.53	163.53	163.53	163.53	163.53
5.500	163.53	163.53	163.53	163.53	163.53
5.750	163.54	163.54	163.54	163.54	163.54
6.000	163.54	163.54	163.54	163.54	163.54
6.250	163.54	163.54	163.54	163.55	163.55
6.500	163.55	163.55	163.55	163.55	163.55
6.750	163.56	163.56	163.56	163.56	163.57
7.000	163.57	163.57	163.57	163.58	163.58
7.250	163.58	163.59	163.59	163.59	163.60
7.500	163.60	163.60	163.61	163.61	163.62
7.750	163.62	163.62	163.63	163.63	163.64
8.000	163.64	163.65	163.65	163.66	163.66
8.250	163.67	163.67	163.68	163.69	163.69
8.500	163.70	163.71	163.71	163.72	163.73
8.750	163.74	163.74	163.75	163.76	163.77
9.000	163.78	163.79	163.80	163.81	163.82
9.250	163.83	163.84	163.85	163.86	163.87
9.500	163.88	163.90	163.91	163.92	163.93
9.750	163.95	163.96	163.97	163.99	164.00
10.000	164.01	164.03	164.04	164.06	164.08

180592-Mix Avenue Substation

Subsection: Time vs. Elevation
Label: PO-1 (OUT)

Return Event: 100 years
Storm Event: 100 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.250	164.10	164.11	164.13	164.15	164.18
10.500	164.20	164.22	164.25	164.27	164.30
10.750	164.32	164.35	164.38	164.41	164.45
11.000	164.48	164.51	164.55	164.59	164.63
11.250	164.67	164.72	164.77	164.82	164.88
11.500	164.95	165.02	165.10	165.20	165.32
11.750	165.47	165.65	165.88	166.15	166.49
12.000	166.91	167.38	167.91	168.47	169.02
12.250	169.54	170.00	170.69	170.82	170.92
12.500	170.98	171.01	171.00	170.96	170.90
12.750	170.83	170.74	170.64	170.54	169.87
13.000	169.67	169.48	169.28	169.08	168.90
13.250	168.71	168.54	168.37	168.21	168.06
13.500	167.92	167.78	167.66	167.54	167.43
13.750	167.34	167.25	167.17	167.10	167.03
14.000	166.97	166.92	166.87	166.83	166.80
14.250	166.76	166.74	166.71	166.69	166.67
14.500	166.65	166.63	166.62	166.61	166.59
14.750	166.58	166.57	166.56	166.55	166.55
15.000	166.54	166.53	166.52	166.52	166.51
15.250	166.50	166.50	166.49	166.48	166.47
15.500	166.46	166.45	166.44	166.43	166.42
15.750	166.41	166.39	166.38	166.36	166.35
16.000	166.33	166.31	166.29	166.27	166.26
16.250	166.24	166.22	166.20	166.18	166.15
16.500	166.13	166.11	166.09	166.07	166.05
16.750	166.03	166.00	165.98	165.96	165.94
17.000	165.92	165.89	165.87	165.85	165.83
17.250	165.80	165.78	165.76	165.73	165.71
17.500	165.69	165.67	165.64	165.62	165.59
17.750	165.57	165.55	165.52	165.50	165.48
18.000	165.45	165.43	165.40	165.38	165.36
18.250	165.33	165.31	165.28	165.26	165.24
18.500	165.22	165.19	165.17	165.15	165.13
18.750	165.10	165.08	165.06	165.04	165.02
19.000	165.00	164.98	164.96	164.94	164.92
19.250	164.90	164.88	164.86	164.84	164.82
19.500	164.80	164.78	164.76	164.75	164.73
19.750	164.71	164.69	164.68	164.66	164.64
20.000	164.63	164.61	164.59	164.58	164.56
20.250	164.55	164.53	164.52	164.50	164.49

180592-Mix Avenue Substation

Subsection: Time vs. Elevation

Return Event: 100 years

Label: PO-1 (OUT)

Storm Event: 100 Year Storm

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.500	164.47	164.46	164.44	164.43	164.42
20.750	164.40	164.39	164.38	164.36	164.35
21.000	164.34	164.33	164.31	164.30	164.29
21.250	164.28	164.27	164.26	164.25	164.24
21.500	164.23	164.22	164.21	164.20	164.19
21.750	164.18	164.17	164.16	164.15	164.14
22.000	164.13	164.12	164.11	164.11	164.10
22.250	164.09	164.08	164.07	164.06	164.06
22.500	164.05	164.04	164.03	164.03	164.02
22.750	164.01	164.00	164.00	163.99	163.98
23.000	163.98	163.97	163.96	163.96	163.95
23.250	163.95	163.94	163.94	163.93	163.93
23.500	163.92	163.92	163.91	163.91	163.90
23.750	163.90	163.90	163.89	163.89	163.88
24.000	163.88	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Time vs. Volume
Label: PO-1

Return Event: 100 years
Storm Event: 100 Year Storm

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
0.000	0.000	0.000	0.000	0.000	0.000
0.250	0.000	0.000	0.000	0.000	0.000
0.500	0.000	0.000	0.000	0.000	0.000
0.750	0.000	0.000	0.000	0.000	0.000
1.000	0.000	0.000	0.000	0.000	0.000
1.250	0.000	0.000	0.000	0.000	0.000
1.500	0.000	0.000	0.000	0.000	0.000
1.750	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.000	0.000	0.000	0.000
2.250	0.000	0.000	0.000	0.000	0.000
2.500	0.000	0.000	0.000	0.000	0.000
2.750	0.000	0.000	0.000	0.000	0.000
3.000	0.000	0.000	0.000	0.000	0.000
3.250	0.000	0.000	0.000	0.000	0.000
3.500	0.000	0.000	0.000	0.000	0.000
3.750	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.000	0.000	0.000	0.000
4.250	0.000	0.001	0.001	0.001	0.001
4.500	0.001	0.001	0.001	0.001	0.001
4.750	0.001	0.001	0.001	0.001	0.001
5.000	0.001	0.001	0.001	0.001	0.001
5.250	0.001	0.001	0.001	0.001	0.001
5.500	0.001	0.001	0.001	0.001	0.001
5.750	0.001	0.001	0.001	0.001	0.001
6.000	0.001	0.001	0.001	0.001	0.001
6.250	0.001	0.001	0.001	0.001	0.001
6.500	0.001	0.001	0.001	0.001	0.001
6.750	0.001	0.002	0.002	0.002	0.002
7.000	0.002	0.002	0.002	0.002	0.002
7.250	0.002	0.002	0.002	0.002	0.002
7.500	0.003	0.003	0.003	0.003	0.003
7.750	0.003	0.003	0.003	0.003	0.004
8.000	0.004	0.004	0.004	0.004	0.004
8.250	0.004	0.004	0.005	0.005	0.005
8.500	0.005	0.005	0.005	0.006	0.006
8.750	0.006	0.006	0.006	0.007	0.007
9.000	0.007	0.007	0.008	0.008	0.008
9.250	0.008	0.009	0.009	0.009	0.010
9.500	0.010	0.010	0.011	0.011	0.011
9.750	0.012	0.012	0.012	0.013	0.013
10.000	0.013	0.014	0.014	0.014	0.015

180592-Mix Avenue Substation

Subsection: Time vs. Volume
Label: PO-1

Return Event: 100 years
Storm Event: 100 Year Storm

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
10.250	0.015	0.016	0.016	0.017	0.017
10.500	0.018	0.019	0.019	0.020	0.021
10.750	0.021	0.022	0.023	0.024	0.024
11.000	0.025	0.026	0.027	0.028	0.029
11.250	0.030	0.031	0.033	0.034	0.036
11.500	0.037	0.039	0.041	0.044	0.047
11.750	0.051	0.055	0.061	0.068	0.077
12.000	0.088	0.100	0.114	0.128	0.142
12.250	0.156	0.168	0.177	0.184	0.189
12.500	0.192	0.194	0.193	0.191	0.188
12.750	0.185	0.180	0.175	0.170	0.164
13.000	0.159	0.154	0.149	0.144	0.139
13.250	0.134	0.130	0.126	0.121	0.118
13.500	0.114	0.110	0.107	0.104	0.101
13.750	0.099	0.097	0.095	0.093	0.091
14.000	0.090	0.088	0.087	0.086	0.085
14.250	0.084	0.083	0.083	0.082	0.082
14.500	0.081	0.081	0.080	0.080	0.080
14.750	0.079	0.079	0.079	0.079	0.079
15.000	0.078	0.078	0.078	0.078	0.078
15.250	0.077	0.077	0.077	0.077	0.077
15.500	0.076	0.076	0.076	0.076	0.075
15.750	0.075	0.075	0.074	0.074	0.073
16.000	0.073	0.072	0.072	0.072	0.071
16.250	0.071	0.070	0.069	0.069	0.068
16.500	0.068	0.067	0.067	0.066	0.066
16.750	0.065	0.065	0.064	0.063	0.063
17.000	0.062	0.062	0.061	0.061	0.060
17.250	0.059	0.059	0.058	0.058	0.057
17.500	0.056	0.056	0.055	0.055	0.054
17.750	0.053	0.053	0.052	0.052	0.051
18.000	0.050	0.050	0.049	0.048	0.048
18.250	0.047	0.047	0.046	0.045	0.045
18.500	0.044	0.044	0.043	0.042	0.042
18.750	0.041	0.041	0.040	0.040	0.039
19.000	0.039	0.038	0.038	0.037	0.037
19.250	0.036	0.035	0.035	0.035	0.034
19.500	0.034	0.033	0.033	0.032	0.032
19.750	0.031	0.031	0.030	0.030	0.029
20.000	0.029	0.029	0.028	0.028	0.027
20.250	0.027	0.027	0.026	0.026	0.025

180592-Mix Avenue Substation

Subsection: Time vs. Volume
Label: PO-1

Return Event: 100 years
Storm Event: 100 Year Storm

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
20.500	0.025	0.025	0.024	0.024	0.024
20.750	0.023	0.023	0.023	0.022	0.022
21.000	0.022	0.021	0.021	0.021	0.020
21.250	0.020	0.020	0.020	0.019	0.019
21.500	0.019	0.018	0.018	0.018	0.018
21.750	0.017	0.017	0.017	0.017	0.016
22.000	0.016	0.016	0.016	0.016	0.015
22.250	0.015	0.015	0.015	0.015	0.014
22.500	0.014	0.014	0.014	0.014	0.013
22.750	0.013	0.013	0.013	0.013	0.012
23.000	0.012	0.012	0.012	0.012	0.012
23.250	0.012	0.011	0.011	0.011	0.011
23.500	0.011	0.011	0.011	0.011	0.010
23.750	0.010	0.010	0.010	0.010	0.010
24.000	0.010	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Elevation vs. Volume Curve
Label: PO-1

Return Event: 100 years
Storm Event: 100 Year Storm

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ac-ft)
163.50	0.000
164.00	0.013
164.50	0.026
165.00	0.039
165.50	0.052
166.00	0.064
166.50	0.077
167.00	0.090
167.50	0.103
168.00	0.116
168.50	0.129
169.00	0.142
169.50	0.155
170.00	0.168
170.50	0.168
171.00	0.193
171.50	0.206

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 100 years

Label: Composite Outlet Structure - 1

Storm Event: 100 Year Storm

Requested Pond Water Surface Elevations

Minimum (Headwater)	163.50 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	171.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	TW	163.50	171.50
Orifice-Circular	Orifice - 2	Forward	TW	166.50	171.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Outlet Input Data

Return Event: 100 years

Label: Composite Outlet Structure - 1

Storm Event: 100 Year Storm

Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	163.50 ft
Orifice Diameter	3.0 in
Orifice Coefficient	0.600
Structure ID: Orifice - 2	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	166.50 ft
Orifice Diameter	6.0 in
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

180592-Mix Avenue Substation

Subsection: Composite Rating Curve
Label: Composite Outlet Structure - 1

Return Event: 100 years
Storm Event: 100 Year Storm

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
163.50	0.00	(N/A)	0.00
164.00	0.14	(N/A)	0.00
164.50	0.22	(N/A)	0.00
165.00	0.28	(N/A)	0.00
165.50	0.32	(N/A)	0.00
166.00	0.36	(N/A)	0.00
166.50	0.40	(N/A)	0.00
167.00	0.91	(N/A)	0.00
167.50	1.28	(N/A)	0.00
168.00	1.55	(N/A)	0.00
168.50	1.77	(N/A)	0.00
169.00	1.97	(N/A)	0.00
169.50	2.14	(N/A)	0.00
170.00	2.30	(N/A)	0.00
170.50	2.45	(N/A)	0.00
171.00	2.59	(N/A)	0.00
171.50	2.72	(N/A)	0.00

Contributing Structures

None Contributing
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2
Orifice - 1 + Orifice - 2

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph

Return Event: 100 years

Label: Outlet-1

Storm Event: 100 Year Storm

Peak Discharge	2.59 ft ³ /s
Time to Peak	12.550 hours
Hydrograph Volume	0.612 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
1.750	0.00	0.00	0.00	0.00	0.00
2.000	0.00	0.00	0.00	0.00	0.00
2.250	0.00	0.00	0.00	0.00	0.00
2.500	0.00	0.00	0.00	0.00	0.00
2.750	0.00	0.00	0.00	0.00	0.00
3.000	0.00	0.00	0.00	0.00	0.00
3.250	0.00	0.00	0.00	0.00	0.00
3.500	0.00	0.00	0.00	0.00	0.00
3.750	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.01	0.01	0.01
4.250	0.01	0.01	0.01	0.01	0.01
4.500	0.01	0.01	0.01	0.01	0.01
4.750	0.01	0.01	0.01	0.01	0.01
5.000	0.01	0.01	0.01	0.01	0.01
5.250	0.01	0.01	0.01	0.01	0.01
5.500	0.01	0.01	0.01	0.01	0.01
5.750	0.01	0.01	0.01	0.01	0.01
6.000	0.01	0.01	0.01	0.01	0.01
6.250	0.01	0.01	0.01	0.01	0.01
6.500	0.01	0.01	0.01	0.02	0.02
6.750	0.02	0.02	0.02	0.02	0.02
7.000	0.02	0.02	0.02	0.02	0.02
7.250	0.02	0.02	0.03	0.03	0.03
7.500	0.03	0.03	0.03	0.03	0.03
7.750	0.03	0.04	0.04	0.04	0.04
8.000	0.04	0.04	0.04	0.05	0.05
8.250	0.05	0.05	0.05	0.05	0.06
8.500	0.06	0.06	0.06	0.06	0.07
8.750	0.07	0.07	0.07	0.08	0.08
9.000	0.08	0.08	0.09	0.09	0.09
9.250	0.09	0.10	0.10	0.10	0.11
9.500	0.11	0.11	0.12	0.12	0.13
9.750	0.13	0.13	0.14	0.14	0.14
10.000	0.15	0.15	0.15	0.15	0.16
10.250	0.16	0.16	0.17	0.17	0.17
10.500	0.17	0.18	0.18	0.19	0.19
10.750	0.19	0.20	0.20	0.21	0.21

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 100 years
Storm Event: 100 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
11.000	0.22	0.22	0.23	0.23	0.24
11.250	0.24	0.25	0.25	0.26	0.26
11.500	0.27	0.28	0.29	0.30	0.31
11.750	0.32	0.34	0.35	0.38	0.40
12.000	0.82	1.19	1.50	1.76	1.97
12.250	2.15	2.30	2.50	2.54	2.57
12.500	2.58	2.59	2.59	2.58	2.56
12.750	2.54	2.52	2.49	2.46	2.26
13.000	2.20	2.13	2.06	1.99	1.93
13.250	1.85	1.79	1.71	1.64	1.58
13.500	1.51	1.43	1.37	1.31	1.23
13.750	1.16	1.09	1.03	0.98	0.93
14.000	0.88	0.83	0.78	0.74	0.70
14.250	0.67	0.64	0.61	0.59	0.57
14.500	0.55	0.54	0.52	0.51	0.50
14.750	0.48	0.47	0.47	0.46	0.45
15.000	0.44	0.43	0.42	0.42	0.41
15.250	0.40	0.40	0.40	0.40	0.40
15.500	0.40	0.40	0.40	0.40	0.39
15.750	0.39	0.39	0.39	0.39	0.39
16.000	0.39	0.39	0.39	0.38	0.38
16.250	0.38	0.38	0.38	0.38	0.38
16.500	0.37	0.37	0.37	0.37	0.37
16.750	0.37	0.36	0.36	0.36	0.36
17.000	0.36	0.36	0.35	0.35	0.35
17.250	0.35	0.35	0.34	0.34	0.34
17.500	0.34	0.34	0.34	0.33	0.33
17.750	0.33	0.33	0.33	0.32	0.32
18.000	0.32	0.32	0.31	0.31	0.31
18.250	0.31	0.31	0.30	0.30	0.30
18.500	0.30	0.29	0.29	0.29	0.29
18.750	0.29	0.28	0.28	0.28	0.28
19.000	0.28	0.27	0.27	0.27	0.27
19.250	0.27	0.26	0.26	0.26	0.26
19.500	0.25	0.25	0.25	0.25	0.25
19.750	0.24	0.24	0.24	0.24	0.24
20.000	0.24	0.23	0.23	0.23	0.23
20.250	0.23	0.22	0.22	0.22	0.22
20.500	0.22	0.21	0.21	0.21	0.21
20.750	0.21	0.20	0.20	0.20	0.20
21.000	0.20	0.19	0.19	0.19	0.19
21.250	0.19	0.19	0.18	0.18	0.18

180592-Mix Avenue Substation

Subsection: Diverted Hydrograph
Label: Outlet-1

Return Event: 100 years
Storm Event: 100 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
21.500	0.18	0.18	0.18	0.17	0.17
21.750	0.17	0.17	0.17	0.17	0.17
22.000	0.16	0.16	0.16	0.16	0.16
22.250	0.16	0.16	0.16	0.15	0.15
22.500	0.15	0.15	0.15	0.15	0.15
22.750	0.15	0.15	0.14	0.14	0.14
23.000	0.14	0.14	0.13	0.13	0.13
23.250	0.13	0.13	0.13	0.12	0.12
23.500	0.12	0.12	0.12	0.12	0.12
23.750	0.12	0.11	0.11	0.11	0.11
24.000	0.11	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Elevation-Volume-Flow Table (Pond)

Label: PO-1

Return Event: 100 years

Storm Event: 100 Year Storm

Infiltration	
Infiltration Method (Computed)	No Infiltration
Initial Conditions	
Elevation (Water Surface, Initial)	163.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ac-ft)	Area (acres)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
163.50	0.00	0.000	0.000	0.00	0.00	0.00
164.00	0.14	0.013	0.000	0.00	0.14	6.38
164.50	0.22	0.026	0.000	0.00	0.22	12.70
165.00	0.28	0.039	0.000	0.00	0.28	18.99
165.50	0.32	0.052	0.000	0.00	0.32	25.28
166.00	0.36	0.064	0.000	0.00	0.36	31.55
166.50	0.40	0.077	0.000	0.00	0.40	37.83
167.00	0.91	0.090	0.000	0.00	0.91	44.57
167.50	1.28	0.103	0.000	0.00	1.28	51.19
168.00	1.55	0.116	0.000	0.00	1.55	57.70
168.50	1.77	0.129	0.000	0.00	1.77	64.16
169.00	1.97	0.142	0.000	0.00	1.97	70.59
169.50	2.14	0.155	0.000	0.00	2.14	77.00
170.00	2.30	0.168	0.000	0.00	2.30	83.40
170.50	2.45	0.168	0.000	0.00	2.45	83.55
171.00	2.59	0.193	0.000	0.00	2.59	96.17
171.50	2.72	0.206	0.000	0.00	2.72	102.53

180592-Mix Avenue Substation

Subsection: Level Pool Pond Routing Summary
Label: PO-1 (IN)

Return Event: 100 years
Storm Event: 100 Year Storm

Infiltration			
Infiltration Method (Computed)		No Infiltration	
Initial Conditions			
Elevation (Water Surface, Initial)		163.50 ft	
Volume (Initial)		0.000 ac-ft	
Flow (Initial Outlet)		0.00 ft³/s	
Flow (Initial Infiltration)		0.00 ft³/s	
Flow (Initial, Total)		0.00 ft³/s	
Time Increment		0.050 hours	
Inflow/Outflow Hydrograph Summary			
Flow (Peak In)		5.34 ft³/s	Time to Peak (Flow, In)
Flow (Peak Outlet)		2.59 ft³/s	Time to Peak (Flow, Outlet)
			12.200 hours
			12.550 hours
Peak Conditions			
Elevation (Water Surface, Peak)		171.01 ft	
Volume (Peak)		0.194 ac-ft	
Mass Balance (ac-ft)			
Volume (Initial)		0.000 ac-ft	
Volume (Total Inflow)		0.622 ac-ft	
Volume (Total Infiltration)		0.000 ac-ft	
Volume (Total Outlet Outflow)		0.612 ac-ft	
Volume (Retained)		0.009 ac-ft	
Volume (Unrouted)		0.000 ac-ft	
Error (Mass Balance)		0.1 %	

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 100 years

Label: PO-1 (OUT)

Storm Event: 100 Year Storm

Peak Discharge	2.59 ft ³ /s
Time to Peak	12.550 hours
Hydrograph Volume	0.612 ac-ft

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
1.750	0.00	0.00	0.00	0.00	0.00
2.000	0.00	0.00	0.00	0.00	0.00
2.250	0.00	0.00	0.00	0.00	0.00
2.500	0.00	0.00	0.00	0.00	0.00
2.750	0.00	0.00	0.00	0.00	0.00
3.000	0.00	0.00	0.00	0.00	0.00
3.250	0.00	0.00	0.00	0.00	0.00
3.500	0.00	0.00	0.00	0.00	0.00
3.750	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.01	0.01	0.01
4.250	0.01	0.01	0.01	0.01	0.01
4.500	0.01	0.01	0.01	0.01	0.01
4.750	0.01	0.01	0.01	0.01	0.01
5.000	0.01	0.01	0.01	0.01	0.01
5.250	0.01	0.01	0.01	0.01	0.01
5.500	0.01	0.01	0.01	0.01	0.01
5.750	0.01	0.01	0.01	0.01	0.01
6.000	0.01	0.01	0.01	0.01	0.01
6.250	0.01	0.01	0.01	0.01	0.01
6.500	0.01	0.01	0.01	0.02	0.02
6.750	0.02	0.02	0.02	0.02	0.02
7.000	0.02	0.02	0.02	0.02	0.02
7.250	0.02	0.02	0.03	0.03	0.03
7.500	0.03	0.03	0.03	0.03	0.03
7.750	0.03	0.04	0.04	0.04	0.04
8.000	0.04	0.04	0.04	0.05	0.05
8.250	0.05	0.05	0.05	0.05	0.06
8.500	0.06	0.06	0.06	0.06	0.07
8.750	0.07	0.07	0.07	0.08	0.08
9.000	0.08	0.08	0.09	0.09	0.09
9.250	0.09	0.10	0.10	0.10	0.11
9.500	0.11	0.11	0.12	0.12	0.13
9.750	0.13	0.13	0.14	0.14	0.14
10.000	0.15	0.15	0.15	0.15	0.16
10.250	0.16	0.16	0.17	0.17	0.17
10.500	0.17	0.18	0.18	0.19	0.19
10.750	0.19	0.20	0.20	0.21	0.21

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)
Label: PO-1 (OUT)

Return Event: 100 years
Storm Event: 100 Year Storm

HYDROGRAPH ORDINATES (ft³/s) Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
11.000	0.22	0.22	0.23	0.23	0.24
11.250	0.24	0.25	0.25	0.26	0.26
11.500	0.27	0.28	0.29	0.30	0.31
11.750	0.32	0.34	0.35	0.38	0.40
12.000	0.82	1.19	1.50	1.76	1.97
12.250	2.15	2.30	2.50	2.54	2.57
12.500	2.58	2.59	2.59	2.58	2.56
12.750	2.54	2.52	2.49	2.46	2.26
13.000	2.20	2.13	2.06	1.99	1.93
13.250	1.85	1.79	1.71	1.64	1.58
13.500	1.51	1.43	1.37	1.31	1.23
13.750	1.16	1.09	1.03	0.98	0.93
14.000	0.88	0.83	0.78	0.74	0.70
14.250	0.67	0.64	0.61	0.59	0.57
14.500	0.55	0.54	0.52	0.51	0.50
14.750	0.48	0.47	0.47	0.46	0.45
15.000	0.44	0.43	0.42	0.42	0.41
15.250	0.40	0.40	0.40	0.40	0.40
15.500	0.40	0.40	0.40	0.40	0.39
15.750	0.39	0.39	0.39	0.39	0.39
16.000	0.39	0.39	0.39	0.38	0.38
16.250	0.38	0.38	0.38	0.38	0.38
16.500	0.37	0.37	0.37	0.37	0.37
16.750	0.37	0.36	0.36	0.36	0.36
17.000	0.36	0.36	0.35	0.35	0.35
17.250	0.35	0.35	0.34	0.34	0.34
17.500	0.34	0.34	0.34	0.33	0.33
17.750	0.33	0.33	0.33	0.32	0.32
18.000	0.32	0.32	0.31	0.31	0.31
18.250	0.31	0.31	0.30	0.30	0.30
18.500	0.30	0.29	0.29	0.29	0.29
18.750	0.29	0.28	0.28	0.28	0.28
19.000	0.28	0.27	0.27	0.27	0.27
19.250	0.27	0.26	0.26	0.26	0.26
19.500	0.25	0.25	0.25	0.25	0.25
19.750	0.24	0.24	0.24	0.24	0.24
20.000	0.24	0.23	0.23	0.23	0.23
20.250	0.23	0.22	0.22	0.22	0.22
20.500	0.22	0.21	0.21	0.21	0.21
20.750	0.21	0.20	0.20	0.20	0.20
21.000	0.20	0.19	0.19	0.19	0.19
21.250	0.19	0.19	0.18	0.18	0.18

180592-Mix Avenue Substation

Subsection: Pond Routed Hydrograph (total out)

Return Event: 100 years

Label: PO-1 (OUT)

Storm Event: 100 Year Storm

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
21.500	0.18	0.18	0.18	0.17	0.17
21.750	0.17	0.17	0.17	0.17	0.17
22.000	0.16	0.16	0.16	0.16	0.16
22.250	0.16	0.16	0.16	0.15	0.15
22.500	0.15	0.15	0.15	0.15	0.15
22.750	0.15	0.15	0.14	0.14	0.14
23.000	0.14	0.14	0.13	0.13	0.13
23.250	0.13	0.13	0.13	0.12	0.12
23.500	0.12	0.12	0.12	0.12	0.12
23.750	0.12	0.11	0.11	0.11	0.11
24.000	0.11	(N/A)	(N/A)	(N/A)	(N/A)

180592-Mix Avenue Substation

Subsection: Pond Inflow Summary

Label: PO-1 (IN)

Return Event: 100 years

Storm Event: 100 Year Storm

Summary for Hydrograph Addition at 'PO-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	CDS Basin
<Catchment to Outflow Node>	Post to Pipe
<Catchment to Outflow Node>	Post to Trench

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	CDS Basin	0.040	12.100	0.42
Flow (From)	Post to Pipe	0.085	12.100	0.97
Flow (From)	Post to Trench	0.497	12.250	4.57
Flow (In)	PO-1	0.622	12.200	5.34

180592-Mix Avenue Substation

Index

B

BYPASS (Time of Concentration Calculations, 100 years)...5, 6

BYPASS (Unit Hydrograph Summary, 100 years)...11, 12

C

CDS Basin (Unit Hydrograph Summary, 100 years)...13, 14

Composite Outlet Structure - 1 (Composite Rating Curve, 100 years)...32

Composite Outlet Structure - 1 (Outlet Input Data, 100 years)...30, 31

H

HAMDEN-CT (Time-Depth Curve, 100 years)...3, 4

M

Master Network Summary...2

O

O-1 (Addition Summary, 100 years)...21

O-2 (Addition Summary, 100 years)...22

Outlet-1 (Diverted Hydrograph, 100 years)...33, 34, 35

P

PO-1 (Elevation vs. Volume Curve, 100 years)...29

PO-1 (Elevation-Volume-Flow Table (Pond), 100 years)...36

PO-1 (IN) (Level Pool Pond Routing Summary, 100 years)...37

PO-1 (IN) (Pond Inflow Summary, 100 years)...41

PO-1 (OUT) (Pond Routed Hydrograph (total out), 100 years)...38, 39, 40

PO-1 (OUT) (Time vs. Elevation, 100 years)...23, 24, 25

PO-1 (Time vs. Volume, 100 years)...26, 27, 28

Post to Pipe (Unit Hydrograph Summary, 100 years)...15, 16

Post to Trench (Time of Concentration Calculations, 100 years)...7, 8

Post to Trench (Unit Hydrograph Summary, 100 years)...17, 18

PRE (Time of Concentration Calculations, 100 years)...9, 10

PRE (Unit Hydrograph Summary, 100 years)...19, 20



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Project No. 180592 **File No.** 51.1210.001

Title Stormwater Pre-Post Verification

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Page Page F1 of F2

Attachment F
Rainfall Depth in Inches

Some of the sizing criteria presented in this chapter may not be practical to meet due to space limitations, soil conditions, and other site constraints which are common in redevelopment or retrofit applications. Treatment practices sized for smaller treatment volumes/flows or exemptions from certain criteria may be appropriate in these situations, at the discretion of the review authority. Conditions where the recommended sizing criteria may not be applicable are identified in the following sections.

7.3 Criteria Summary

Table 7-1 summarizes the hydrologic sizing criteria for stormwater treatment practices in Connecticut. As indicated in **Table 7-1**, the sizing criteria are based on stormwater runoff generated by 24-hour duration storms of various return frequencies (i.e., design storms). **Table 7-2** lists 24-hour design rainfall depths for each county in Connecticut. The rationale for and application of these criteria are described in the following sections.

Table 7-2 Design Rainfall Amounts By County					
County	24-Hour Rainfall Amount (inches)				
	1-yr	2-yr	10-yr	25-yr	100-yr
Fairfield	2.7	3.3	5.0	5.7	7.2
Hartford	2.6	3.2	4.7	5.5	6.9
Litchfield	2.6	3.2	4.7	5.5	7.0
Middlesex	2.7	3.3	5.0	5.6	7.1
New Haven	2.7	3.3	5.0	5.6	7.1
New London	2.7	3.4	5.0	5.7	7.1
Tolland	2.6	3.2	4.8	5.5	6.9
Windham	2.6	3.2	4.8	5.5	6.9

Source: TP-40, Department of Commerce, Weather Bureau, May 1961; NWS Hydro-35, Department of Commerce, National Weather Service, June 1977.

7.4 Pollutant Reduction

The pollutant reduction criterion is designed to improve the water quality of stormwater discharges by treating a prescribed water quality volume or associated peak flow, referred to as the water quality flow. Most treatment practices described in this Manual use a volume-based sizing criterion. The exceptions are grass drainage channels, proprietary stormwater treatment devices, and flow diversion structures, where a peak flow rate is utilized.

7.4.1 Water Quality Volume (WQV)

Description

The water quality volume (WQV) is the amount of stormwater runoff from any given storm that should be captured and treated in order to remove a majority of stormwater pollutants on an average annual basis. The recommended WQV, which results in the capture and treatment of the entire runoff volume for 90 percent of the average annual storm events, is equivalent to the runoff associated with the first one-inch of rainfall. The WQV is calculated using the following equation:

$$WQV = \frac{(1")(R)(A)}{12}$$

where: WQV = water quality volume (ac-ft)
R = volumetric runoff coefficient
= 0.05+0.009(I)
I = percent impervious cover
A = site area in acres

- The volumetric runoff coefficient R can also be determined from commonly available tabulated values for various land use, vegetative cover, soil, and ground slope conditions. However, the use of the above equation is recommended since it is directly related to the amount of impervious cover at a site, thereby providing incentive to reduce site imperviousness and the required runoff treatment volume. Reducing imperviousness and design techniques described in Chapter Four can significantly reduce the WQV.
- Impervious cover should be measured from the site plan and includes all impermeable surfaces that are directly connected to the stormwater treatment practice such as paved and gravel roads, rooftops, driveways, parking lots, side-walks, pools, patios and decks. In the absence of site-specific information or for large residential developments, impervious cover may be estimated based on average impervious coverage values for various parcel sizes listed in **Table 7-3**. The values shown in **Table 7-3** were derived from research by the University of Connecticut, Cooperative Extension System NEMO Project (Prisloe et al.,).
- The WQV should be treated by an acceptable stormwater treatment practice or group of practices described in this Manual. The WQV should be used for the design of the stormwater treatment practices described in this Manual, except grass drainage channels and proprietary stormwater treatment devices (e.g., hydrodynamic separators, catch basin inserts, and media filters), which should be designed based on the water quality flow (WQF).



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Computed By D. Fennell

Date December 16, 2015

Verified By _____

Date _____

Page Page G1 of G7

Attachment G
CONN-DOT Drainage Manual Section 6.9

6.9 Rational Method

6.9.1 Introduction

The rational method is recommended for estimating the design storm peak runoff for areas as large as 81 ha (200 ac). This method, while first introduced in 1889, is still used in many engineering offices in the United States. Even though it has frequently come under criticism for its simplistic approach, no other drainage design method has received such widespread use.

6.9.2 Application

Some precautions should be considered when applying the rational method.

- The first step in applying the rational method is to obtain a good topographic map and define the boundaries of the drainage area in question. A field inspection of the area should also be made to determine if the natural drainage divides have been altered.
- In determining the runoff coefficient C value for the drainage area, thought should be given to future changes in land use that might occur during the service life of the proposed facility that could result in an inadequate drainage system.
- The charts, graphs and tables included in this section are not intended to replace reasonable and prudent engineering judgment which should permeate each step in the design process.

6.9.3 Characteristics

Characteristics of the rational method which limit its use to 81 ha (200 ac) include:

- (1) The rate of runoff resulting from any rainfall intensity is a maximum when the rainfall intensity lasts as long or longer than the time of concentration. That is, the entire drainage area does not contribute to the peak discharge until the time of concentration has elapsed.

This assumption limits the size of the drainage basin that can be evaluated by the rational method. For large drainage areas, the time of concentration can be so large that constant rainfall intensities for such long periods do not occur and shorter more intense rainfalls can produce larger peak flows. For this reason, the rational method is inappropriate for watersheds greater than about 81 ha (200 ac).

- (2) The frequency of peak discharges is the same as that of the rainfall intensity for the given time of concentration.

Frequencies of peak discharges depend on rainfall frequencies, antecedent moisture conditions in the watershed, and the response characteristics of the drainage system. For small and largely impervious areas, rainfall frequency is the dominant factor. For larger drainage basins, the response characteristics control. For drainage areas with few impervious surfaces (less urban development), antecedent moisture conditions usually govern, especially for rainfall events with a return period of 10 years or less.

- (3) The fraction of rainfall that becomes runoff (C) is independent of rainfall intensity or volume.

The assumption is reasonable for impervious areas, such as streets, rooftops and parking lots. For pervious areas, the fraction of runoff varies with rainfall intensity and the accumulated volume of rainfall. Thus, the art necessary for application of the rational method involves the selection of a coefficient that is appropriate for the storm, soil and land use conditions. Many guidelines and tables have been established, but seldom, if ever, have they been supported with empirical evidence.

(4) The peak rate of runoff is sufficient information for the design.

Modern drainage practice often includes detention of urban storm runoff to reduce the peak rate of runoff downstream. With only the peak rate of runoff, the rational method severely limits the evaluation of design alternatives available in urban and in some instances, rural drainage design.

6.9.4 Equation

The rational formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area, runoff coefficient and mean rainfall intensity for a duration equal to the time of concentration (the time required for water to flow from the most remote point of the basin to the location being analyzed). The rational formula is expressed as follows:

$$Q = 0.00278 CIA \quad (Q = CIA) \quad (6.1)$$

where: Q = maximum rate of runoff, m³/s (ft³/s)
C = runoff coefficient representing a ratio of runoff to rainfall
I = average rainfall intensity for a duration equal to the time of concentration, for a selected return period, mm/h (in/h)
A = drainage area tributary to the design location, ha (acres)

6.9.5 Infrequent Storm

The runoff coefficients given in Tables 6-3 through 6-5 are applicable for storms of 2-year to 10-year frequencies. Less frequent, higher intensity storms will require modification of the runoff coefficient because infiltration and other losses have a proportionally smaller effect on runoff (Wright-McLaughlin 1969). The adjustment of the rational method for use with major storms can be made by multiplying the right side of the rational formula by a frequency factor C_f . The rational formula now becomes:

$$Q = 0.00278 CC_f IA \quad (Q = CC_f IA) \quad (6.2)$$

C_f values are listed in Table 6-2. The product of C_f times C shall not exceed 1.0.

Table 6-2 Frequency Factors For Rational Formula

<u>Recurrence Interval (years)</u>	<u>C_f</u>
25	1.1
50	1.2
100	1.25

6.9.6 Procedures

The results of using the rational formula to estimate peak discharges are very sensitive to the parameters that are used. The designer must use good engineering judgment in estimating values that are used in the method. Following is a discussion of the different variables used in the rational method.

Time Of Concentration

The time of concentration is the time required for water to flow from the hydraulically most remote point of the drainage area to the point under investigation. Use of the rational formula requires the time of concentration (t_c) for each design point within the drainage basin. The duration of rainfall is then set equal to the time of concentration and is used to estimate the design average rainfall intensity (I).

Appendix C (Travel Time Estimation) at the end of this chapter describes the method based on the NRCS Technical Release No. 55 (2nd Edition). This method shall be used for the rational method. Note: under certain circumstances, where tributary areas are very small or completely paved, the computed time of concentration would be very short. For design purposes the minimum time of concentration for paved areas shall be 5 minutes and 10 minutes for grassed areas.

Common Errors

Two common errors should be avoided when calculating t_c . First, in some cases runoff from a portion of the drainage area which is highly impervious may result in a greater peak discharge than would occur if the entire area were considered. In these cases, adjustments can be made to the drainage area by disregarding those areas where flow time is too slow to add to the peak discharge. Sometimes it is necessary to estimate several different times of concentration to determine the design flow that is critical for a particular application.

Second, when designing a drainage system, the overland flow path is not necessarily perpendicular to the contours shown on available mapping. Often the land will be graded and swales will intercept the natural contour and conduct the water to the streets which reduces the time of concentration.

Rainfall Intensity

The rainfall intensity (I) is the average rainfall rate mm/h (in/h) for a duration equal to the time of concentration for a selected return period. Once a particular return period has been selected for design and a time of concentration calculated for the drainage area, the rainfall intensity can be

determined from Rainfall-Intensity-Duration curves. The rainfall intensity can be determined from rainfall-intensity-duration Table B-2 which can be found in Appendix B.

Runoff Coefficient

The runoff coefficient C is the variable of the rational method least susceptible to precise determination and requires judgment and understanding on the part of the designer. While engineering judgment will always be required in the selection of runoff coefficients, a typical coefficient represents the integrated effects of many drainage basin parameters, the following discussion considers only the effects of soil groups, land use and average land slope.

Methods for determining the runoff coefficient are presented based on hydrologic soil groups and land slope (Table 6-3), land use (Table 6-4) and a composite coefficient for complex watersheds (Table 6-5).

Table 6-3 gives the recommended coefficient C of runoff for pervious surfaces by selected hydrologic soil groupings and slope ranges. From this table the C values for non-urban areas such as forest land, agricultural land, and open space can be determined. Soil properties influence the relationship between runoff and rainfall since soils have differing rates of infiltration. Infiltration is the movement of water through the soil surface into the soil. Based on infiltration rates, the NRCS has divided soils into four hydrologic soil groups as follows:

- Group A Soils having a low runoff potential due to high infiltration rates. These soils consist primarily of deep, well drained sands and gravels.
- Group B Soils having a moderately low runoff potential due to moderate infiltration rates. These soils consist primarily of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
- Group C Soils having a moderately high runoff potential due to slow infiltration rates. These soils consist primarily of soils in which a layer exists near the surface that impedes the downward movement of water or soils with moderately fine to fine texture.
- Group D Soils having a high runoff potential due to very slow infiltration rates. These soils consist primarily of clays with high swelling potential, soils with permanently high water tables, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious parent material.

The NRCS has developed detailed soil surveys for all counties within Connecticut. From these documents, the designer can determine the nature and relative percentages of the soils within a given watershed. It is important to note that the level of effort required in the determination of soil types is commensurate with the size of the watershed and the design objectives. Normally, in the computation of discharge quantities for gutter flow analysis and related storm drainage design, a detailed evaluation of soil types is not necessary, as contributing areas adjoining highways are usually relatively small. However, in the design of cross culverts, channels or interceptor ditches the determination of soil types will provide valuable assistance to the design engineer in the evaluation of the runoff potential from a particular watershed.

The second factor for consideration in the determination of a runoff coefficient is land use. As unimproved areas are developed, the potential for increased runoff becomes greater due to the loss of vegetative cover, the reduction in retention by surface depressions and the increase in impervious surface area. Table 6-4 lists recommended ranges for the runoff coefficient value classified with respect to the general character of the tributary area. **The potential for future watershed development should be considered by the designer.**

The final element to be factored into the determination of runoff coefficients is the land slope. As the slope of the drainage basin increases, the selected C value should also increase. This is caused by the fact that as the slope of the drainage area increases, the velocity of overland and channel flow will increase allowing less opportunity for water to infiltrate the ground surface. Thus, more of the rainfall will become runoff from the drainage area.

In summary, it should be reiterated that in assigning a value to the runoff coefficient for use in the rational method, the engineer must rely heavily on experience and judgement.

Table 6-3 Recommended Coefficient Of Runoff For Pervious Surfaces By Selected Hydrologic Soil Groupings And Slope Ranges

<u>Slope</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Flat (0 - 1%)	0.04-0.09	0.07-0.12	0.11-0.16	0.15-0.20
Average (2 - 6%)	0.09-0.14	0.12-0.17	0.16-0.21	0.20-0.25
Steep (Over 6%)	0.13-0.18	0.18-0.24	0.23-0.31	0.28-0.38

Source: Storm Drainage Design Manual, Erie and Niagara Counties Regional Planning Board.

Table 6-4 Recommended Coefficient Of Runoff Values For Various Selected Land Uses

<u>Description of Area</u>	<u>Runoff Coefficients</u>
Business: Downtown areas	0.70-0.95
Neighborhood areas	0.50-0.70
Residential: Single-family areas	0.30-0.50
Multi units, detached	0.40-0.60
Multi units, attached	0.60-0.75
Suburban	0.25-0.40
Residential (0.5 ha (1.2 ac) lots or more)	0.30-0.45
Apartment dwelling areas	0.50-0.70
Industrial: Light areas	0.50-0.80
Heavy areas	0.60-0.90
Parks, cemeteries	0.10-0.25
Playgrounds	0.20-0.40
Railroad yard areas	0.20-0.40
Unimproved areas	0.10-0.30

Table 6-5 Coefficients For Composite Runoff Analysis

<u>Surface</u>		<u>Runoff Coefficients</u>
Street:	Asphalt	0.70-0.95
	Concrete	0.80-0.95
Drives and walks		0.75-0.85
Roofs		0.75-0.95



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Page Page H1 of H2

Attachment H

Intensity in Inches/Hour



NOAA Atlas 14, Volume 10, Version 2
Location name: Hamden, Connecticut, US*
Latitude: 41.3722°, Longitude: -72.9238°
Elevation: 183 ft*
* source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	4.15 (3.20–5.22)	5.00 (3.85–6.30)	6.41 (4.92–8.09)	7.56 (5.78–9.62)	9.16 (6.79–12.2)	10.4 (7.56–14.2)	11.6 (8.23–16.6)	13.2 (8.87–19.3)	15.3 (9.90–23.2)	16.9 (10.7–26.1)
10-min	2.94 (2.27–3.70)	3.55 (2.73–4.46)	4.54 (3.49–5.73)	5.36 (4.09–6.82)	6.49 (4.81–8.66)	7.36 (5.36–10.1)	8.23 (5.83–11.7)	9.35 (6.28–13.7)	10.8 (7.01–16.4)	11.9 (7.56–18.5)
15-min	2.30 (1.78–2.90)	2.78 (2.14–3.50)	3.56 (2.73–4.50)	4.20 (3.21–5.34)	5.09 (3.78–6.80)	5.77 (4.20–7.90)	6.46 (4.58–9.20)	7.33 (4.92–10.7)	8.49 (5.50–12.9)	9.37 (5.93–14.5)
30-min	1.59 (1.23–2.00)	1.92 (1.48–2.41)	2.45 (1.88–3.10)	2.89 (2.21–3.68)	3.50 (2.60–4.68)	3.97 (2.89–5.43)	4.44 (3.15–6.33)	5.04 (3.39–7.36)	5.84 (3.78–8.86)	6.44 (4.08–9.99)
60-min	1.01 (0.783–1.28)	1.22 (0.942–1.54)	1.56 (1.20–1.97)	1.84 (1.41–2.34)	2.23 (1.65–2.98)	2.53 (1.84–3.46)	2.83 (2.00–4.03)	3.21 (2.16–4.69)	3.72 (2.41–5.64)	4.10 (2.60–6.36)
2-hr	0.668 (0.518–0.834)	0.798 (0.619–0.998)	1.01 (0.782–1.27)	1.19 (0.914–1.50)	1.43 (1.07–1.90)	1.62 (1.18–2.20)	1.81 (1.29–2.56)	2.05 (1.38–2.97)	2.37 (1.54–3.58)	2.62 (1.66–4.03)
3-hr	0.518 (0.404–0.645)	0.618 (0.481–0.770)	0.781 (0.606–0.977)	0.916 (0.707–1.15)	1.10 (0.826–1.46)	1.25 (0.915–1.69)	1.39 (0.993–1.96)	1.58 (1.07–2.28)	1.83 (1.19–2.75)	2.02 (1.28–3.10)
6-hr	0.331 (0.260–0.409)	0.396 (0.310–0.490)	0.501 (0.392–0.623)	0.589 (0.457–0.736)	0.710 (0.535–0.933)	0.802 (0.593–1.08)	0.895 (0.644–1.26)	1.02 (0.692–1.47)	1.19 (0.775–1.77)	1.31 (0.837–2.00)
12-hr	0.204 (0.161–0.251)	0.246 (0.194–0.303)	0.314 (0.247–0.388)	0.371 (0.290–0.461)	0.449 (0.341–0.587)	0.510 (0.379–0.683)	0.570 (0.413–0.798)	0.653 (0.445–0.932)	0.764 (0.500–1.13)	0.848 (0.542–1.28)
24-hr	0.121 (0.096–0.147)	0.148 (0.117–0.180)	0.191 (0.151–0.235)	0.228 (0.179–0.281)	0.278 (0.212–0.362)	0.317 (0.237–0.423)	0.355 (0.260–0.497)	0.412 (0.282–0.585)	0.488 (0.321–0.719)	0.545 (0.350–0.820)
2-day	0.068 (0.054–0.082)	0.084 (0.067–0.102)	0.111 (0.089–0.136)	0.134 (0.106–0.164)	0.165 (0.127–0.214)	0.188 (0.142–0.251)	0.212 (0.157–0.297)	0.250 (0.171–0.352)	0.300 (0.198–0.439)	0.338 (0.218–0.505)
3-day	0.049 (0.039–0.059)	0.061 (0.049–0.074)	0.081 (0.065–0.098)	0.098 (0.078–0.119)	0.120 (0.093–0.156)	0.138 (0.104–0.183)	0.155 (0.115–0.217)	0.183 (0.126–0.257)	0.221 (0.146–0.322)	0.249 (0.160–0.370)
4-day	0.040 (0.032–0.048)	0.049 (0.040–0.059)	0.065 (0.052–0.079)	0.078 (0.062–0.095)	0.096 (0.074–0.124)	0.110 (0.084–0.146)	0.124 (0.092–0.172)	0.146 (0.101–0.205)	0.176 (0.116–0.255)	0.198 (0.128–0.294)
7-day	0.027 (0.022–0.032)	0.033 (0.027–0.040)	0.043 (0.035–0.052)	0.051 (0.041–0.062)	0.062 (0.049–0.080)	0.071 (0.054–0.094)	0.080 (0.059–0.110)	0.093 (0.064–0.130)	0.111 (0.074–0.161)	0.125 (0.081–0.184)
10-day	0.022 (0.018–0.026)	0.026 (0.021–0.031)	0.034 (0.027–0.040)	0.040 (0.032–0.048)	0.048 (0.037–0.061)	0.054 (0.042–0.071)	0.061 (0.045–0.083)	0.070 (0.049–0.097)	0.083 (0.055–0.119)	0.092 (0.060–0.135)
20-day	0.016 (0.013–0.018)	0.018 (0.015–0.021)	0.022 (0.018–0.026)	0.025 (0.020–0.030)	0.030 (0.023–0.037)	0.033 (0.025–0.043)	0.037 (0.027–0.049)	0.041 (0.029–0.056)	0.047 (0.031–0.067)	0.051 (0.033–0.075)
30-day	0.013 (0.011–0.015)	0.015 (0.012–0.017)	0.017 (0.014–0.020)	0.020 (0.016–0.023)	0.023 (0.018–0.028)	0.025 (0.019–0.032)	0.027 (0.020–0.036)	0.030 (0.021–0.041)	0.034 (0.023–0.048)	0.037 (0.024–0.053)
45-day	0.011 (0.009–0.013)	0.012 (0.010–0.014)	0.014 (0.011–0.016)	0.015 (0.012–0.018)	0.017 (0.014–0.022)	0.019 (0.015–0.024)	0.021 (0.015–0.027)	0.022 (0.016–0.030)	0.025 (0.017–0.035)	0.026 (0.017–0.038)
60-day	0.009 (0.008–0.011)	0.010 (0.008–0.012)	0.012 (0.010–0.014)	0.013 (0.011–0.015)	0.015 (0.011–0.018)	0.016 (0.012–0.020)	0.017 (0.013–0.022)	0.018 (0.013–0.025)	0.020 (0.013–0.028)	0.021 (0.014–0.030)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical



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Page Page 11 of 18

Attachment I Flow Master Reports

Worksheet for TRENCH DRAIN

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00300	ft/ft
Normal Depth	1.00	ft
Bottom Width	0.83	ft

Results

Discharge	2.48	ft ³ /s
Flow Area	0.83	ft ²
Wetted Perimeter	2.83	ft
Hydraulic Radius	0.29	ft
Top Width	0.83	ft
Critical Depth	0.65	ft
Critical Slope	0.00853	ft/ft
Velocity	2.99	ft/s
Velocity Head	0.14	ft
Specific Energy	1.14	ft
Froude Number	0.53	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.65	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00853	ft/ft

Worksheet for TRENCH DRAIN OUTLET

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00830	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	3.52	ft³/s

Results

Discharge	3.52	ft³/s
Normal Depth	1.00	ft
Flow Area	0.79	ft²
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.80	ft
Percent Full	100.0	%
Critical Slope	0.00866	ft/ft
Velocity	4.48	ft/s
Velocity Head	0.31	ft
Specific Energy	1.31	ft
Froude Number	0.00	
Maximum Discharge	3.78	ft³/s
Discharge Full	3.52	ft³/s
Slope Full	0.00830	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for TRENCH DRAIN OUTLET

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.80	ft
Channel Slope	0.00830	ft/ft
Critical Slope	0.00866	ft/ft

Worksheet for ROAD CULVERT

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.02000	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft

Results

Discharge	5.46	ft ³ /s
Flow Area	0.79	ft ²
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.94	ft
Percent Full	100.0	%
Critical Slope	0.01728	ft/ft
Velocity	6.95	ft/s
Velocity Head	0.75	ft
Specific Energy	1.75	ft
Froude Number	0.00	
Maximum Discharge	5.87	ft ³ /s
Discharge Full	5.46	ft ³ /s
Slope Full	0.02000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for ROAD CULVERT

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.94	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01728	ft/ft

Worksheet for CHAMBER DISCHARGE

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.01000	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft

Results

Discharge	3.86	ft ³ /s
Flow Area	0.79	ft ²
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.83	ft
Percent Full	100.0	%
Critical Slope	0.00969	ft/ft
Velocity	4.91	ft/s
Velocity Head	0.38	ft
Specific Energy	1.38	ft
Froude Number	0.00	
Maximum Discharge	4.15	ft ³ /s
Discharge Full	3.86	ft ³ /s
Slope Full	0.01000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for CHAMBER DISCHARGE

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.83	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00969	ft/ft



BLACK & VEATCH

Client United Illuminating Company

Project Mix Avenue Substation

Project No. 180592 **File No.** 51.1210.001

Title Stormwater Pre-Post Verification

Computed By D. Fennell

Date December 16, 2015

Verified By _____

Date _____

Page Page J1 of J2

Attachment J

Storm Trap Elevation-Volume Data



P.O. BOX 782 - MORRIS IL • 87-STORMTRAP • V

September 4, 2015
Page 1 o

MIX AVENUE SUBSTATION - NEW HAVEN, CT
STAGE STORAGE BREAKDOWN
8'-0" DoubleTrap
TOTAL VOLUME: 8983.26 (C.F.)

Storage	Type II QTY	Type IV QTY	SPIV 1 QTY	SPIV 2 QTY	SPIV 3 QTY	SPIV 4 QTY	Total Units
	3	6	1	1	1	1	13
0.25	87.86	133.62	14.81	14.81	14.81	14.81	280.73
0.50	175.72	267.24	29.62	29.62	29.62	29.62	561.45
0.75	263.58	400.86	44.43	44.43	44.43	44.43	842.18
1.00	351.45	534.48	59.25	59.25	59.25	59.25	1,122.91
1.25	439.31	668.10	74.06	74.06	74.06	74.06	1,403.63
1.50	527.17	801.71	88.87	88.87	88.87	88.87	1,684.36
1.75	615.03	935.33	103.68	103.68	103.68	103.68	1,965.09
2.00	702.89	1,068.95	118.49	118.49	118.49	118.49	2,245.82
2.25	790.75	1,202.57	133.30	133.30	133.30	133.30	2,526.54
2.50	878.61	1,336.19	148.12	148.12	148.12	148.12	2,807.27
2.75	966.48	1,469.81	162.93	162.93	162.93	162.93	3,088.00
3.00	1,054.34	1,603.43	177.74	177.74	177.74	177.74	3,368.72
3.25	1,142.20	1,737.05	192.55	192.55	192.55	192.55	3,649.45
3.50	1,230.06	1,870.67	207.36	207.36	207.36	207.36	3,930.18
3.75	1,317.92	2,004.29	222.17	222.17	222.17	222.17	4,210.90
4.00	1,405.78	2,137.91	236.99	236.99	236.99	236.99	4,491.63
4.25	1,493.64	2,271.53	251.80	251.80	251.80	251.80	4,772.36
4.50	1,581.51	2,405.14	266.61	266.61	266.61	266.61	5,053.08
4.75	1,669.37	2,538.76	281.42	281.42	281.42	281.42	5,333.81
5.00	1,757.23	2,672.38	296.23	296.23	296.23	296.23	5,614.54
5.25	1,845.09	2,806.00	311.04	311.04	311.04	311.04	5,895.27
5.50	1,932.95	2,939.62	325.86	325.86	325.86	325.86	6,175.99
5.67	1,992.70	3,030.48	335.93	335.93	335.93	335.93	6,366.89
5.75	2,020.81	3,073.24	340.67	340.67	340.67	340.67	6,456.72
6.00	2,108.67	3,206.86	355.48	355.48	355.48	355.48	6,737.45
6.25	2,196.53	3,340.48	370.29	370.29	370.29	370.29	7,018.17
6.50	2,284.40	3,474.10	385.10	385.10	385.10	385.10	7,298.90
6.75	2,372.26	3,607.72	399.91	399.91	399.91	399.91	7,579.63
7.00	2,460.12	3,741.34	414.72	414.72	414.72	414.72	7,860.35
7.25	2,547.98	3,874.96	429.54	429.54	429.54	429.54	8,141.08
7.50	2,635.84	4,008.57	444.35	444.35	444.35	444.35	8,421.81
7.75	2,723.70	4,142.19	459.16	459.16	459.16	459.16	8,702.53
8.00	2,811.56	4,275.81	473.97	473.97	473.97	473.97	8,983.26



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