C&S Engineers, Inc.
141 Elm Street, Suite 100
Buffalo, New York 14203

Preliminary Stormwater Management Plan

Lee's Summit Senior Apartments
830-900 NE Douglas Street, Lee's Summit, MO 63366

Prepared for:
Clover Communities Lee's Summit LLC
348 Harris Hill Road
Williamsville, NY 14221

July 11, 2023

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Appendices:

1.0 Introduction

C&S Engineering, Inc. is pleased to submit this Preliminary Stormwater Management Plan for Lee's Summit Senior Apartments located at 830-900 NE Douglas Street in Lee's Summit, Jackson County, Missouri. The site is situated on three parcels that will be combined to total 6.54± acres and the property is planned to be developed as a multi-family development. The property is bound by NE Douglas Street to the east and unplatted land to the north, west, and south. See Appendix "A" for the project aerial map.

2.0 Existing Conditions and Drainage Computations

The project is located in the Little Cedar Creek Watershed and Salt Fork River Basin. The site is undeveloped/wooded with an average 10%± slope that drains southwesterly to a stream along the southern property line. Offsite stormwater runoff from areas draining to NE Douglas Street (from E Chipman Road to Lee's Summit North High School), as well as from the adjacent northern and southern properties, also flow onto the project site and into the stream along the southern property line. Under existing conditions, the site consists of one (1) drainage area encompassing the aforementioned areas which all drain westerly to the stream onsite and outlet to the adjacent western property. Refer to Appendix "C" for the Existing Conditions Drainage Map.

The USDA NRCS Soil Survey shows the site soils being "Arisburg-Urban land complex" and "Udarents-Urban land-Sampsel complex" which are listed as specific hydrologic soil group type "C". The existing land cover type is woods/grass in good condition and the site is not located in a 100-year flood plain. Due to site constraints, the portion of the stream that crosses the southwest corner of the site will need to be rerouted through an enclosed drainage pipe. This is allowed under APWA Section 5605.3.B.1 since the tributary area of the stream is less than 40 acres.

The City of Lee's Summit follows the Comprehensive Control Strategy for stormwater detention which is outlined in Section 5601.5.A.4.a of the Kansas City Metropolitan Chapter American Public Work Associated Standard Specifications and Design Criteria. This is the most stringent of the strategies listed in this Design and Construction Manual and requires that the post-development peak discharge rates from the site shall not exceed those listed below.

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre
- 40-hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall)

Therefore, the allowable release rates for the project site are as follows:

Table 1 – Allowable Runoff

Watershed Area	Curve Number (CN)	Site Area (acres)	2-YR Peak Flow (cfs)	10-YR Peak Flow (cfs)	100-YR Peak Flow (cfs)
Project Site	77	6.54	3.27	13.08	19.61

3.0 Proposed Conditions and Drainage Computations

Development will consist of the following:

- Construction of a four-story senior apartment building (35,575 sf) and accessory garages;
- Construction of asphalt paved parking lots and concrete sidewalks;
- Installation of domestic water and fire service lines;
- Installation of sanitary laterals;
- Installation of a stormwater sewer system;
- And associated site restoration.

Under proposed conditions, the site will consist of four (4) drainage areas. Drainage area 1S consists of the proposed building, asphalt pavement, concrete sidewalks, accessory garages, lawn areas, and a wooded area from the adjacent northern property that drains onto our site. Drainage area 1S has been divided into three (3) separate sub-areas (1AS, 1BS, and 1CS) to more accurately model runoff from various surface conditions within the total drainage area 1S. Sub-area 1CS includes wooded land from the northern adjacent property where stormwater flows onto the project site. Stormwater runoff from 1AS, 1BS, and 1CS will sheet flow to inlets and be conveyed to a dry extended detention basin which outlets to the existing stream channel before flowing offsite. Drainage area 2S consists of the lawn areas on the western perimeter of the site where runoff is not able to be detained due to grading constraints. Stormwater runoff from this drainage area will sheet flow to the adjacent western property. Drainage area 3S consists of NE Douglas Street (from E Chipman Road to Lee's Summit North High School) and area from the adjacent southern property that drains northerly and onto our site. Stormwater runoff from this drainage area will be conveyed to the existing stream at the project's southern property line. A portion of the stream located at the southwest corner of the parcel will be rerouted via an enclosed drainage system before being outletted back into the stream channel and flow west offsite. Drainage area 4S consists of the wooded area on the adjacent northern property. Stormwater runoff from this drainage area will sheet flow into a swale behind the proposed garages on the northern portion of the site where it will be routed around the proposed development and allowed to continue west as it does per existing conditions.

Upon completion, the proposed project will add 2.86 acres of new impervious cover. The total anticipated ground disturbance during construction of this project will be approximately 6.54 acres. Due to the increase in impervious areas, stormwater detention is required. Additionally, since this project will disturb more than

one acre, a Storm Water Pollution Prevention Plan (SWPPP), in accordance with the Missouri Department of Natural Resources standards must be prepared.

3.1 Post Construction Water Quality & Quantity Controls

Per the City of Lee's Summit municipal code, detention facilities must comply with the "Comperhensive Control" method of detention outlined in APWA 5600. This states that the allowable peak runoff rate for the site is 0.5 cfs per acre for the 50% storm event, 2.0 cfs per acre for the 10% storm event, and 3.0 cfs per acre for the 1% storm event. In addition, the "Comprehensive Control" method required the water quality event (1.37" rainfall/24-hr) to be detained and released over a period of 40 hours.

The project proposes the construction of a dry extended detention basin for stormwater quantity control as well as for the extended detention of the water quality storm. The system will utilize a 3'x3' precast structure as a control structure. The stormwater runoff rates will be controlled through a combination of a perforated riser (six (6) vertical 1-inch perforations) to control the water quality event, an 11" wide by 3" high orifice to control the 2-year discharge rate, and two (2) 26" wide by 4" high orifice to control the 10-year and 100-year discharge rates. Stormwater will flow from the control structure, through an 18" HDPE pipe to the existing on-site stream before being conveyed to the adjacent western property.

The City of Lee's Summit requires the 40 hour extended detention of the 90% mean annual storm event (1.37"/24-hour rainfall) and references the MARC/APWA BMP Manual to calculate water quality volumes and design of water quality outlets. Chapter 6 of the MARC/APWA BMP Manual was referenced to calculate the total water quality volume from the 90% mean annual event. The water quality volume required is 14,740 cf. Chapter 8.10 of the MARC/APWA BMP Manual was referenced to calculate the water quality orifice size. A single orifice will not work for this development because it was found to be less than the minimum 4-inch diameter orifice requirement. Therefore, a perforated riser with six (6) vertical, 1-inch perforations will be used as the water quality outlet. Please refer to calculations in Appendix "D" for calculations.

The stormwater detention calculations were completed using HYDROCAD, version 10 software.
Refer to Tale 3 for a summary of the allowable and post development discharge rates and associated detention volumes and water surface elevations.

Table 2 – Proposed Watersheds

Watershed Area	Time of Conc. (min)	Drainage Area (acre)	Composite Curve Number (CN)	2-YR Peak Flow (cfs)	10-YR Peak Flow (cfs)	100-YR Peak Flow (cfs)
1AS	5.0	2.93	98	1.70	3.54	7.17
1BS	11.3	2.59	74	15.57	23.95	39.11
1CS	16.5	0.40	70	5.16	10.98	22.42
2S	6.1	0.71	74	0.54	1.26	2.75

Table 3 – Proposed Detention Conditions

Storm Event	Proposed Discharge Rate (cfs)	Detention Volume (cf)	Water Surface Elevation (ft)
2-YR	1.86	26,382	1,010.62
10-YR	9.06	39,352	1,011.73
100-YR	14.73	67,796	1,013.68

Table 4 – Proposed Runoff

Node	Storm Event	Allowable Release Rate (cfs)	Proposed Release Rate (cfs)
1P Dry Detention Pond	2-YR	N/A	1.86
	10-YR	N/A	9.06
	100-YR	N/A	14.73
2S Undetained	2-YR	N/A	1.70
	10-YR	N/A	3.54
	100-YR	N/A	7.17
2P Total	**2-YR**	**3.27**	**3.21**
	10-YR	**13.08**	**10.36**
	100-YR	**19.61**	**19.56**

3.2 Stream By-Pass

Along the southern property line of the site, there is a stream that originates at the outlet of the NE Douglas Street enclosed drainage system. This intermittent system conveys runoff from areas draining to NE Douglas Street (from E Chipman Road to Lee's Summit North High School) as well as from the adjacent southern properties. The planned development includes installing a 30-inch diameter HDPE culvert to by-pass existing flows from the stream around the proposed dry detention pond. The pipe reconnects and outlets at the existing stream. The culvert is sized to convey the 1% storm. Please refer to the culvert size calculations in Appendix "D" which reference APWA Section 5602.

4.0 Conclusion

This report and attached exhibits complete the Preliminary Stormwater Management Plan for Lee's Summit Senior Apartments located at 830-900 NE Douglas Street in Jackson County, Missouri. Please feel free to contact C&S Engineers if you need further information or have additional questions.

Sincerely,

C&S Engineers, Inc.

Digitally signed by Eric J. Daniel
Date: 2023.07.12 13:50:28-04'00'

Eric Daniel, P.E.
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(716) 955-3012

Enclosures

Appendix A

Project Location Map

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

LEES SUMMIT QUADRANGLE
MISSOURI - JACKSON COUNTY
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 15S

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery....................NAIP, June 2020 - June 2020
Roads....................U.S. Census Bureau, 2016
Names....................GNIS, 1980 - 2020
Hydrography....................National Hydrography Dataset, 2001 - 2018
Contours....................National Elevation Dataset, 2008
Boundaries....................Multiple sources; see metadata file 2018 - 2019
Public Land Survey System....................BLM, 2020
Wetlands....................FWS National Wetlands Inventory Not Available

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
UD
Grid Zone Designation 15S

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

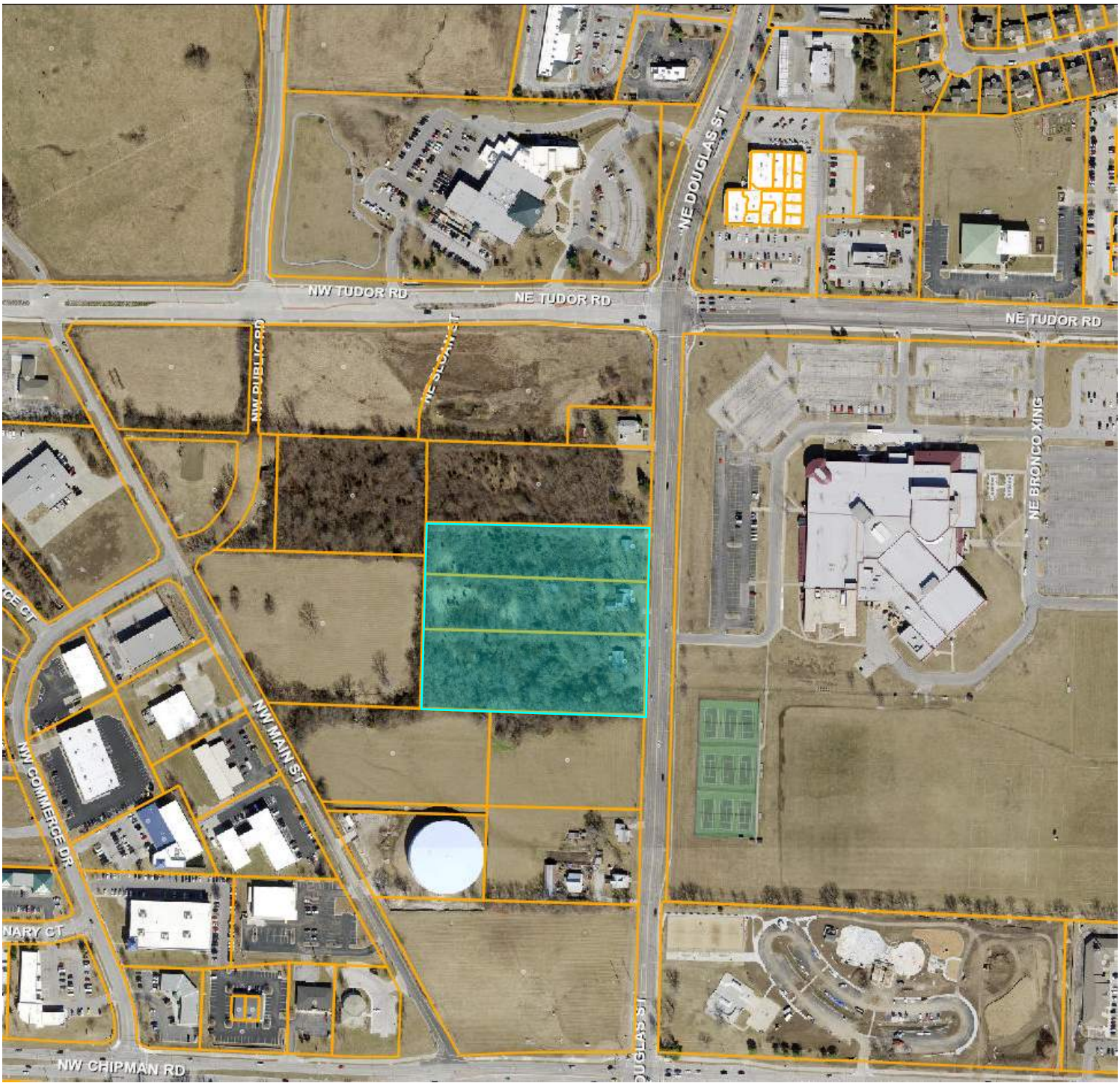
QUADRANGLE LOCATION

ADJOINING QUADRANGLES
1 Kansas City
2 Independence
3 Blue Springs
4 Grandview
5 Lake Jacomo
6 Belton
7 Raymore
8 Pleasant Hill

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

LEES SUMMIT, MO
2021

NSN. 7643016374242
NGA REF NO. USGSX24K25324


NW TUDOR RD
NE TUDOR RD
NE TUDOR RD
NE DOUGLAS ST
NW PUBLIC RD
NE SLOAN ST
NW MAIN ST
NW COMMERCE DR
NE BRONCO XING
NW CHIPMAN RD

Appendix B

NRCS Soil Map

United States Department of Agriculture

NRCS

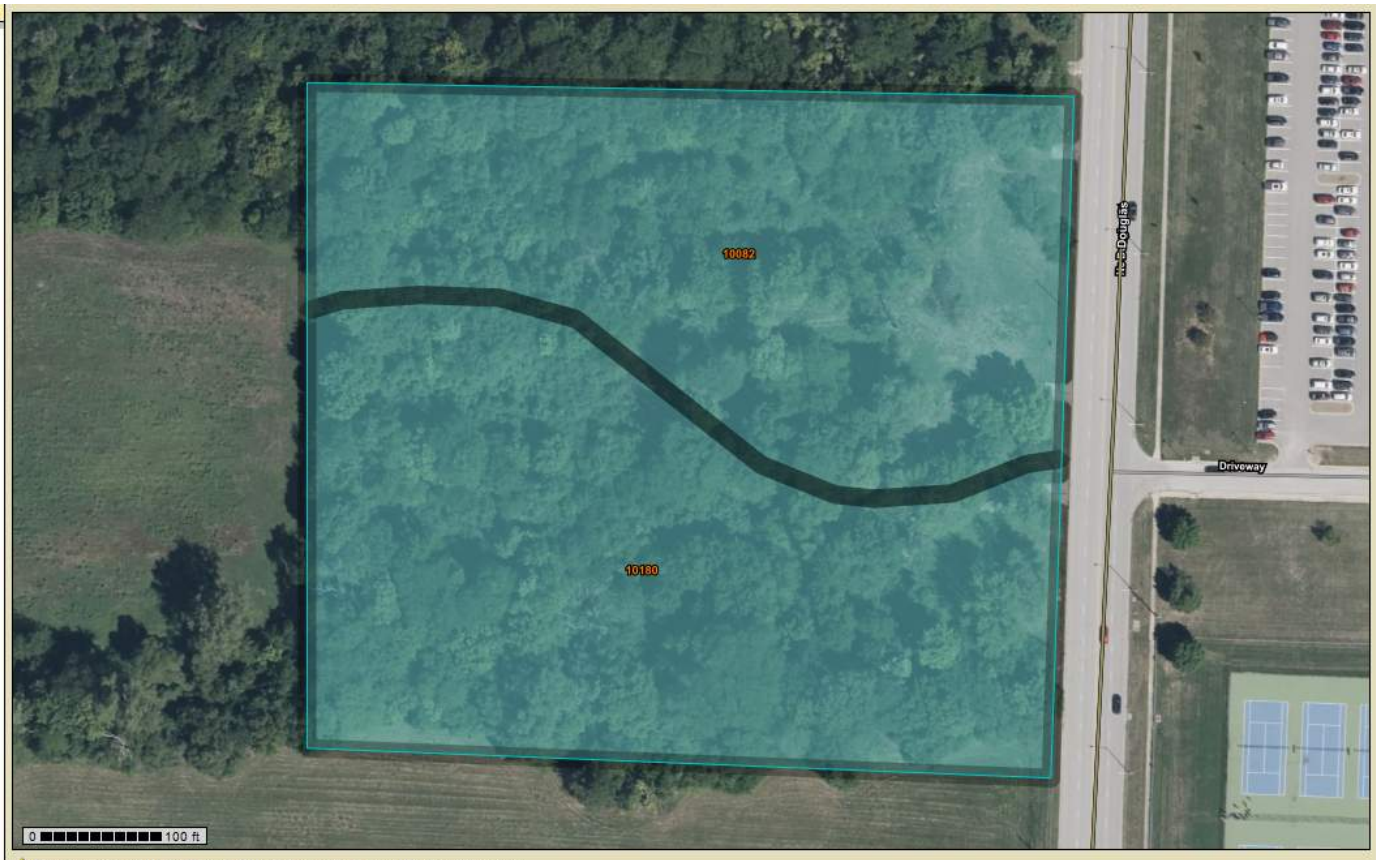
Natural Resources Conservation Service

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 Jackson County, Missouri

Clover Communities - Lee's Summit

June 20, 2023



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

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Jackson County, Missouri (MO095)

Summary by Map Unit — Jackson County, Missouri (MO095)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	3.7	45.9%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	4.4	54.1%
Totals for Area of Interest			**8.1**	**100.0%**

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 (https://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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

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

Map Scale: 1:1,480 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 24, Aug 31, 2022

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	3.8	46.9%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	4.3	53.1%
Totals for Area of Interest		**8.1**	**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 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.

Jackson County, Missouri

10082—Arisburg-Urban land complex, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w7ld
Elevation: 750 to 1,130 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Arisburg and similar soils: 61 percent
Urban land: 30 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arisburg

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 13 inches: silt loam
Bt - 13 to 19 inches: silty clay loam
Btg - 19 to 56 inches: silty clay loam
BCg - 56 to 79 inches: silty clay loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R107XB007MO - Loess Upland Prairie
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Hydric soil rating: Yes

Greenton

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Sharpsburg

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

10180—Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1n85h
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 43 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 175 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Udarents and similar soils: 46 percent
Urban land: 39 percent
Sampsel and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udarents

Setting

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mine spoil or earthy fill

Typical profile

C1 - 0 to 5 inches: silt loam
C2 - 5 to 80 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R107XB002MO - Deep Loess Upland Prairie
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Across-slope shape: Convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Sampsel

Setting

Landform: Hillslopes

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 13 inches: silty clay loam
Bt - 13 to 80 inches: silty clay

Properties and qualities

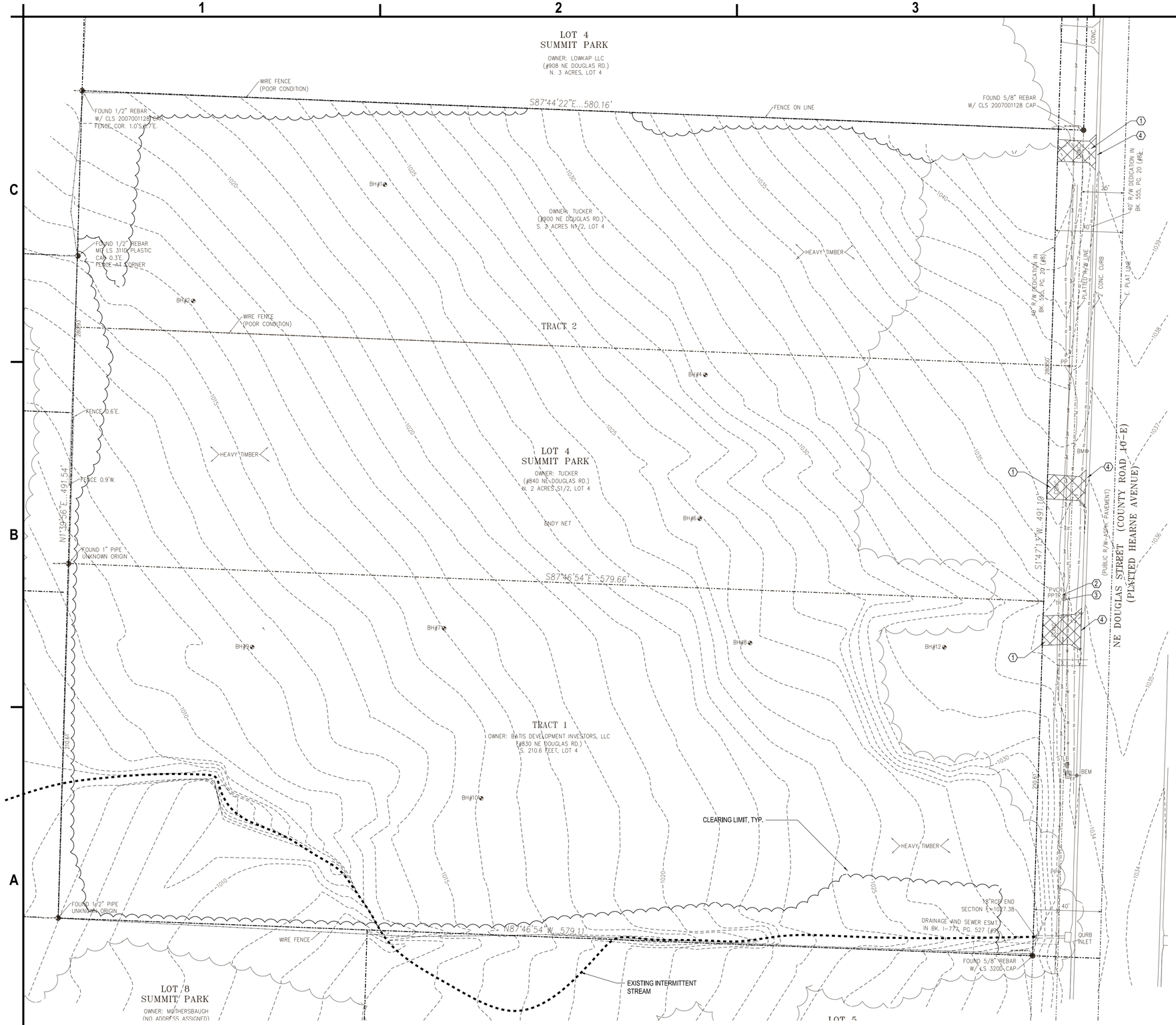
Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Appendix C

Existing Conditions/Drainage Plan



DEMOLITION PLAN NOTES

1. CONTRACTOR TO REMOVE & DISPOSE OF ALL ITEMS INDICATED & ANY ITEMS INCIDENTAL TO THE CONSTRUCTION AS REQUIRED.

2. CONTRACTOR SHALL PROTECT/PRESERVE ALL EXISTING ITEMS TO REMAIN, INCLUDING, BUT NOT LIMITED TO BUILDINGS, PAVEMENT, OVERHEAD & BURIED UTILITIES, TREES LANDSCAPING, ETC. DAMAGE TO ITEMS SCHEDULED TO REMAIN SHALL BE REPAIRED OR REPLANTED AT NO ADDITIONAL COST TO THE OWNER.

3. UTILITIES SHOWN ARE APPROXIMATE. CONTRACTOR SHALL HAVE ALL UNDER-GROUND FACILITIES LOCATED AND MARKED PRIOR TO EXCAVATION/DEMOLITION/CONSTRUCTION.

4. CONTRACTOR SHALL LEGALLY DISPOSE OF ALL MATERIALS/DEBRIS REMOVED FROM THE SITE.

5. CONTRACTOR TO OBTAIN HIGHWAY WORK PERMIT PRIOR TO THE START OF CONSTRUCTION. CALL FOR STAKEOUT OF UTILITIES BEFORE STARTING WORK. NOTIFY ENGINEER OR OWNER'S REPRESENTATIVE OF ANY DISCREPANCIES FOUND IN THE FIELD.

6. THIS PLAN IS PREPARED FROM A SURVEY SHOWING KNOWN SURFACE FEATURES. IT IS INTENDED AS A GUIDE TO THE CONTRACTOR, NOT AS A COMPLETE AND UNIVERSAL DEMOLITION PLAN. SEE THE SITE PLAN. MORE FEATURES (NOT INDICATED) MAY REQUIRE DEMOLITION TO CONSTRUCT THE SITE PLAN. CONTRACTOR MUST VISIT THE SITE TO CONFIRM DEMOLITION EFFORT PRIOR TO BIDDING.

7. REMOVE CONCRETE SIDEWALK AND/OR PAVEMENT TO THE LIMITS INDICATED. SAW CUT CONCRETE TO THE NEAREST EXISTING CONTROL/EXPANSION JOINT.

8. MAINTAIN STORM SEWER CONTINUITY & POSITIVE DRAINAGE DURING DEMOLITION, REMOVAL & CONSTRUCTION OF STORM SEWERS & INLETS.

DEMOLITION PLAN SHEET KEYNOTES

① REMOVE EXISTING CONCRETE PAVEMENT & SUBBASE
② RELOCATE UTILITY POLE - COORDINATE WITH UTILITY COMPANIES
③ RELOCATE UTILITY PEDESTAL - COORDINATE WITH UTILITY COMPANIES
④ SAWCUT AND REMOVE DROP CURB AND GUTTER. INSTALL NEW C-G1 CURB GUTTER

DEMOLITION PLAN LEGEND

▨	CONCRETE/ASPHALT PAVEMENT TO BE REMOVED
×	ITEM TO BE REMOVED
⌒⌒⌒	CLEARING LIMIT
–··–··–	PROPERTY LINE

PLAN
NORTH

A1 **EXISTING CONDITIONS AND DEMOLITION PLAN**
SCALE: 1"=30'

30 0 30 60 Ft.
30'

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Certificate No. 20080269910

PRELIMINARY
NOT FOR
CONSTRUCTION

Eric J. Daniel, P.E.
License No. PE-2023008829
Date: 03/30/2023

LEE'S SUMMIT
SENIOR APARTMENTS
830-900 NE DOUGLAS STREET
LEE'S SUMMIT, MO

MARK	DATE	DESCRIPTION

REVISIONS

PROJECT NO:	F53.519.002
DATE:	JULY 13, 2023
DRAWN BY:	S. SCHIENER
DESIGNED BY:	E. DANIEL
CHECKED BY:	CHECKED BY

EXISTING
CONDITIONS AND
DEMOLITION PLAN

C-101

NE DOUGLAS STREET (COUNTY ROAD 10-E)
(PLATTED HEARNE AVENUE)

LOT 3 SUMMIT PARK

LOT 4
SUMMIT PARK

LOT 14
SUMMIT PARK

TRACT 2

TRACT 1

LOT 5
SUMMIT PARK

LOT 13
SUMMIT PARK

LOT 10
SUMMIT PARK

LOT 9
SUMMIT PARK

LOT 8
SUMMIT PARK

LOT 2A
LEE'S SUMMIT POLICE AND COURT FACILITY

1E - EXISTING DRAINAGE AREA
IMPERV = 164,367 SF
LAWN = 393,342 SF
WOODS = 360,691 SF

EXISTING DRAINAGE MAP

SCALE: 1"=60'

PLAN NORTH

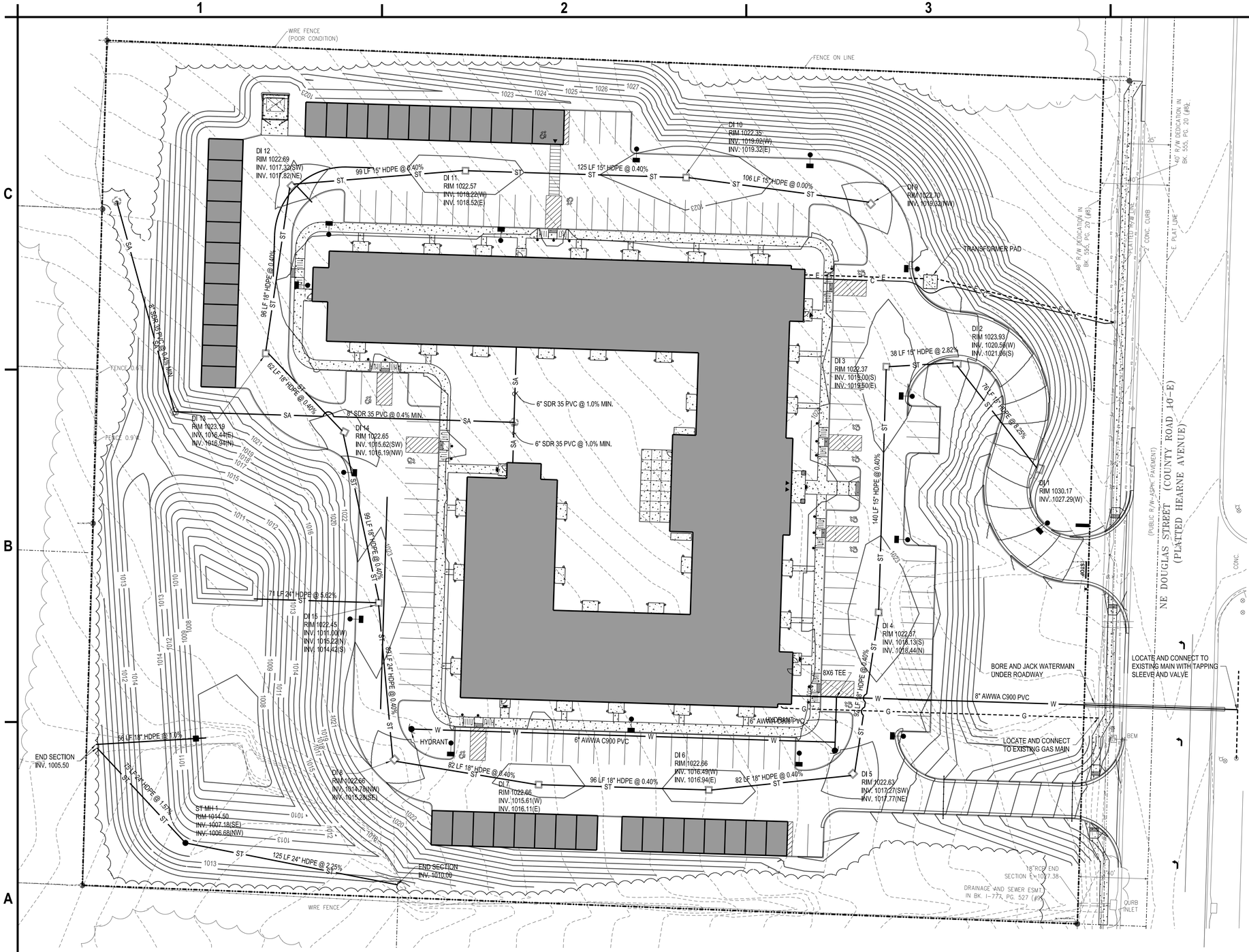
EXISTING DRAINAGE AREA

TIME OF CONCENTRATION

60' 60 0 60 120 FT.

Appendix D

Proposed Conditions/Drainage Plan



UTILITY PLAN LEGEND

EXISTING SANITARY SEWER	SA
EXISTING STORM SEWER	ST
EXISTING WATER MAIN	W
EXISTING ELECTRIC -BURIED	E
EXISTING OVERHEAD POWER LINE	OHP
EXISTING GAS	G
PROPOSED SANITARY SEWER	SA
PROPOSED STORM SEWER	ST
PROPOSED WATER MAIN	W
PROPOSED ELECTRIC	E
PROPOSED GAS	G
PROPOSED COMMUNICATIONS	C
PROPOSED HYDRANT	
PROPOSED MANHOLE	
PROPOSED CATCH BASIN	
PROPOSED YARD DRAIN	YD
PROPOSED CLEAN OUT	C.O.
PROPOSED LIGHT STANDARD	

PLAN NORTH

30 0 30 60 Ft.
30'

A1 PROPOSED CONDITIONS
SCALE: 1"=30'

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NOT FOR CONSTRUCTION

Eric J. Daniel, P.E.
License No. PE-2023008829
Date: 03/30/2023

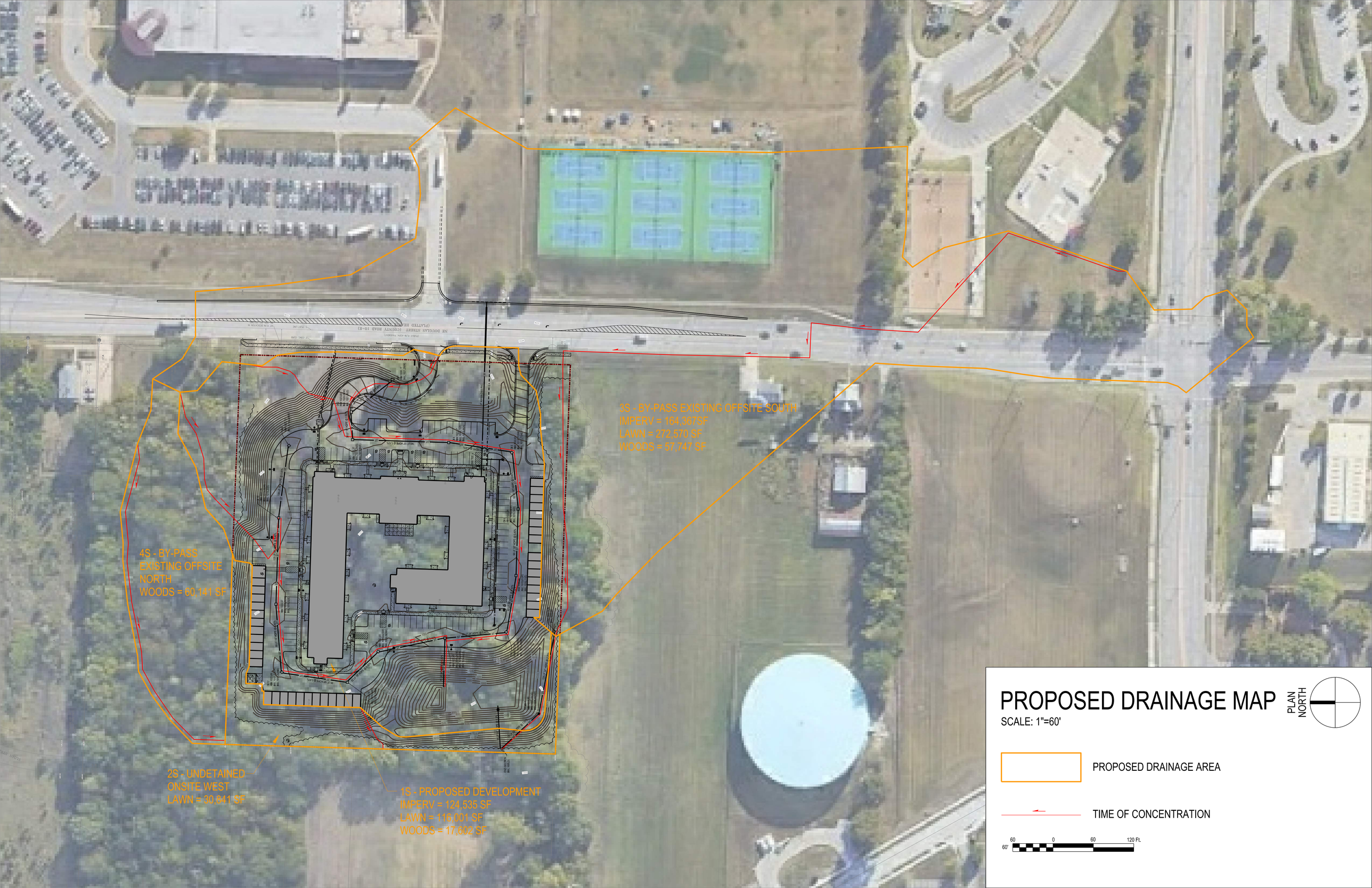
LEE'S SUMMIT SENIOR APARTMENTS
830-900 NE DOUGLAS STREET
LEE'S SUMMIT, MO

MARK	DATE	DESCRIPTION
		REVISIONS

PROJECT NO:	F53.519.002
DATE:	JULY 13, 2023
DRAWN BY:	S. SCHIENER
DESIGNED BY:	E. DANIEL
CHECKED BY:	CHECKED BY

PROPOSED CONDITIONS

-


3S - BY-PASS EXISTING OFFSITE SOUTH
IMPERV = 164,367SF
LAWN = 272,570 SF
WOODS = 57,747 SF
4S - BY-PASS
EXISTING OFFSITE
NORTH
WOODS = 50,141 SF
2S - UNDETAINED
ONSITE WEST
LAWN = 30,841 SF
1S - PROPOSED DEVELOPMENT
IMPERV = 124,535 SF
LAWN = 116,001 SF
WOODS = 17,692 SF
NE DOUGLAS STREET (COUNTY ROAD 10-E)
PROPOSED DRAINAGE MAP
SCALE: 1"=60'
PLAN NORTH
PROPOSED DRAINAGE AREA
TIME OF CONCENTRATION
60' 60 0 60 120 FT.

DATE: July 2023
PROJECT NAME: Clover Communities - Lee's Summit

Stormwater Quality Calculations

Impervious Areas (refer to Existing & Proposed Drainage Analysis Maps)

$I_{Existing} := 0.00$ — I Existing = Existing Impervious Area (acres) per Existing Drainage Analysis Map

$I_{Proposed} := 2.93$ — I Proposed = Proposed Impervious Area (acres) per Proposed Drainage Analysis Map

$I_{ExistingToRemain} := 0$ — I Existing To Remain = Existing Impervious Area (acres) to remain per Proposed Drainage Analysis Map

$I_{New} := I_{Proposed} - I_{Existing}$ — I New = New Impervious Area (acres)

$I_{New} = 2.93$

$I_{Redeveloped} := I_{Existing} - I_{ExistingToRemain}$ — I Redeveloped = Redeveloped Impervious Area (acres)

$I_{Redeveloped} = 0.000$

$A_{TotalDisturbance} := 6.54$ — Total Site Disturbance Area = Limit of Drainage Areas

$A_{RedevelopedDisturbance} := 0.00$ — Site Disturbance Area for redeveloped impervious area

$A_{NewDisturbance} := A_{TotalDisturbance} - A_{RedevelopedDisturbance}$

$A_{NewDisturbance} = 6.540$ — Site Disturbance Area for new impervious area

{p}{f}

Water Quality Volume Required - New (WQv Required)

$P := 1.37$ — *90% Rainfall Event (inches)*

$A_n := 6.54$ — *Contributing Area (acres)*

$A_i := I_{New} = 2.930$ — *Impervious Area within Contributing Area (acres)*

$I := \frac{A_i}{A_n} \cdot 100$ — *Percent impervious cover*

$I = 44.801$

$R_v := 0.05 + 0.009 \cdot I$ — **0.05 + 0.009(I)**

$R_v = 0.453$

$WQ_{vNew} := \frac{P \cdot R_v \cdot A_n}{12}$

$WQ_{vNew} = 0.338$ — *Water Quality Volume Required for New Impervious Area (acre-feet)*

$WQ_{vNew} \cdot 43560 = 14740$ — *Water Quality Volume Required for New Impervious Area (cubic feet)*

{p}{f}

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet

Designer: MRO
Checked By: ED
Company: C&S Engineers
Date: Jul-23
Project: Lee's Summit Senior Apartments
Location: 830-900 NE Douglas St

I. Basin Water Quality Storage Volume

Step 1) Tributary area to EDDB, A_T (ac)	A_T (ac) =	6.5
Step 2) Calculate WQv using methodology in Section 6 of the Q2 Manual	WQv (ac-ft) =	0.34
Step 3) Add 20 percent to account for silt and sediment deposition in the basin.	V_{design} (ac-ft) =	0.41

IIa. Water Quality Outlet Type

Step 1) Set water quality outlet type: — Outlet Type = 2
- Type 1 = single orifice
- Type 2 = perforated riser or plate
- Type 3 = v-notch weir

Step 2) Proceed to step IIb, IIc, or IId based on water quality outlet type selected

IIb. Water Quality Outlet, Single Orifice

Step 1) Depth of water quality volume at outlet, Z_{WQ} (ft) — Z_{WQ} (ft) = 2.0

Step 2) Average head of water quality volume over invert of orifice, H_{WQ} (ft)
$H_{WQ} = 0.5 * Z_{WQ}$ — H_{WQ} (ft) = 1

Step 3) Average water quality outflow rate, Q_{WQ} (cfs)
$Q_{WQ} = (WQv * 43{,}560)/(40 * 3{,}600)$ — Q_{WQ} (cfs) = 0.10

Step 4) Set value of orifice discharge coefficient, C_o
$C_o = 0.66$ when thickness of riser/weir plate is = or < orifice diameter
$C_o = 0.80$ when thickness of riser/weir plate is > orifice diameter — C_o = 0.66

Step 5) Water quality outlet orifice diameter (m inimum of 4 inches), D_o (in)
$D_o = 12 * 2 * (Q_{WQ}/(C_o * \pi * (2 * g * H)^{0.5}))^{0.5}$ — D_o (in) = 1.9
(If orifice diameter < 4 inches, use outlet type 2 or 3) — Use outlet type 2 or 3

Step 6) To size outlet orifice for EDDB with an irregular stage-volume relationship, use the Single Orifice Worksheet

IIc. Water Quality Outlet, Perforated Riser

Step 1) Depth at outlet above lowest perforation, Z_{WQ} (ft) — Z_{WQ} (ft) = 2.0

Step 2) Recommended maximum outlet area per row, A_o (in^2)
$A_o = (WQv)/(0.013 * Z_{WQ}^2 + 0.22 * Z_{WQ} - 0.10)$ — A_o (in^2) = 0.9

Step 3) Circular perforation diameter per row assuming a single column, D_1 (in) — D_1 (in) = 1.05

Step 4) Number of columns, n_c — n_c = 1

Step 5) Design circular perforation diameter (should be between 1 and 2 inches), D_{perf} (in) — D_{perf} (in) = 1.05

Step 6) Horizontal perforation column spacing when $n_c > 1$, center to center, S_c — S_c (in) = NA
If D_{perf} >/= 1.0 in, S_c = 4

Step 7) Number of rows (4" vertical spacing between perforations, center to center), n_r — n_r = 6

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet

Designer: MRO
Checked By: ED
Company: C&S Engineers
Date: Jul-23
Project: Lee's Summit Senior Apartments
Location: 830-900 NE Douglas St

IId. Water Quality Outlet, V-notch Weir

Step 1) Depth of water quality volume above permanent pool, Z_{WQ} (ft)	Z_{WQ} (ft) =	2.0
Step 2) Average head of water quality pool volume over invert of v-notch, H_{WQ} (ft) $H_{WQ} = 0.5 * Z_{WQ}$	H_{WQ} (ft) =	1
Step 3) Average water quality pool outflow rate, Q_{WQ} (cfs) $Q_{WQ} = (WQv * 43{,}560)/(40 * 3{,}600)$	Q_{WQ} (cfs) =	0.10
Step 4) V-notch weir coefficient, C_v	C_v =	2.5
Step 5) V-notch weir angle, θ (deg) $\theta = 2 * (180/\pi) * \arctan(Q_{WQ}/(C_v * H_{WQ}^{5/2}))$ V-notch angle should be at least 20 degrees. Set to 20 degrees if calculated angle is smaller.	θ (deg) =	5
Step 6) Top width of V-notch weir $Wv = 2*Z_{WQ} * TAN(\theta/2)$	W_V (ft) =	0.16

Step 7) To calculate v-notch angle for EDDB with an irregular stage-volume relationship, use the V-notch Weir Worksheet

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Project Lee's Summit Senior Apts. Sheet of
File #
Prepared by NJRO Date 7/12/23
Checked by ED Date

Stream by-Pass Pipe Sizing

Per 5602.2 (APWA 5600)
↳ watersheds less than 200 Ac.

$Q = KCiA$

K = 1.25 for 1% Design storm (Table 5602-1)

$$C = \frac{(3.77\,Ac)(0.9) + (0.637\,Ac)(0.3) + (6.26\,Ac)(0.3)}{10.667\,AC}$$

(IMPERV. / WOODS / GRASS)

C = 0.512

$i = \frac{331}{T_c + 30}$ T_c = 16.1 min (per 5602.7)
(Table 5602-5)

i = 7.18

A = 10.667 AC

$Q = (1.25)(0.512)(7.18)(10.667)$

Q = 49.02 cfs.

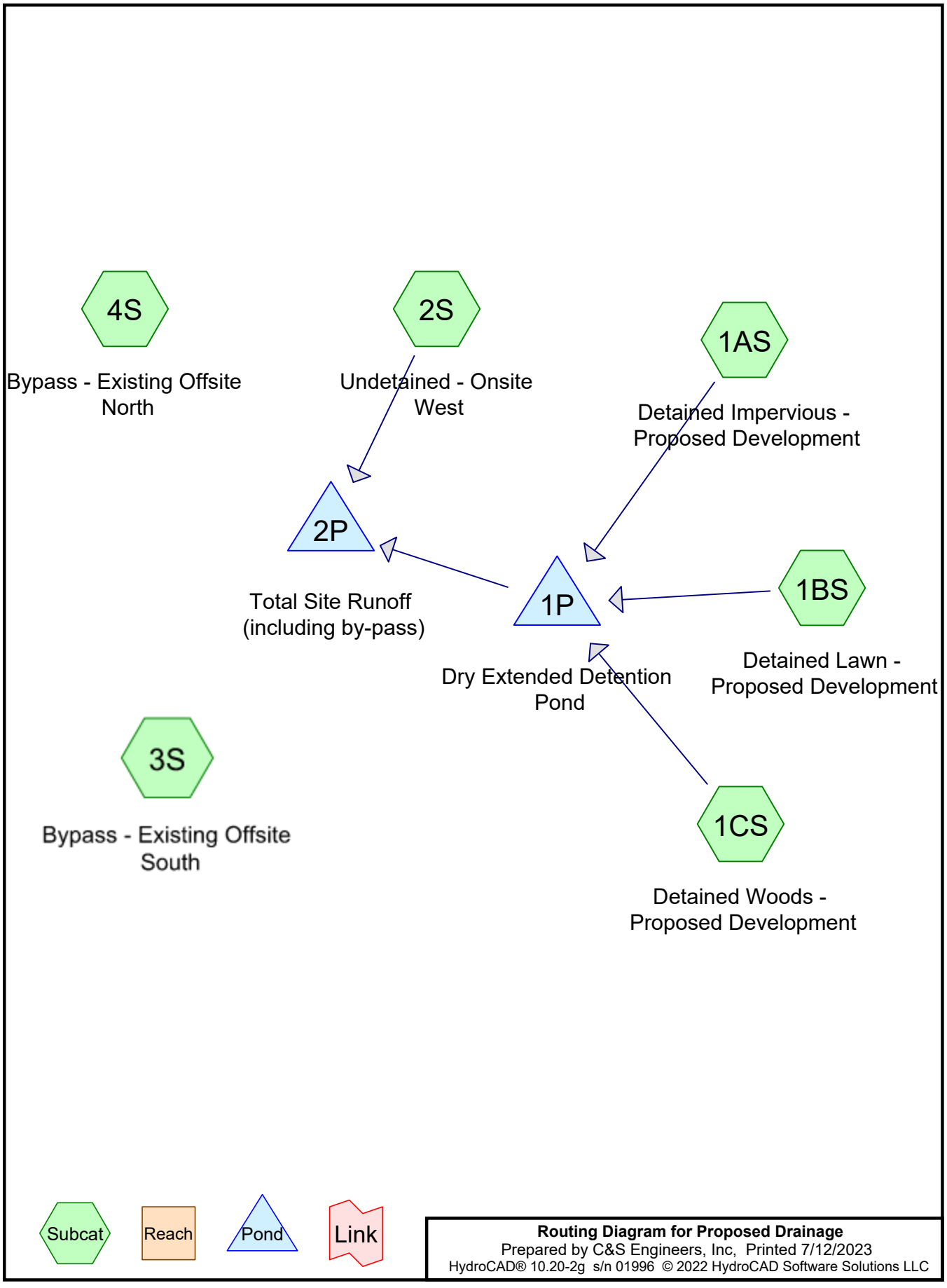
Per mannings Pipe size equations, A 30" diameter pipe @ 1.46% can convey 49.69 cfs. Therefore, use a 30" diameter pipe.

MANNING'S EQUATION FOR CIRCULAR PIPES FLOWING FULL

HYDRAULIC SLOPE (%): 1.46
ROUGHNESS COEFF (N): 0.013
PIPE MATERIAL: HDPE (SMOOTH INTERIOR)

DIAMETER (IN)	AREA (SF)	WETTED PERM. (FT)	HYD. RADIUS (FT)	VELOCITY (FT/S)	FLOW (CFS)
6	0.20	1.57	0.125	3.46	0.68
8	0.35	2.09	0.167	4.19	1.46
10	0.55	2.62	0.208	4.86	2.65
12	0.79	3.14	0.250	5.49	4.31
15	1.23	3.93	0.313	6.38	7.82
18	1.77	4.71	0.375	7.20	12.72
24	3.14	6.28	0.500	8.72	27.40
30	4.91	7.85	0.625	10.12	49.69
36	7.07	9.42	0.750	11.43	80.80
60	19.63	15.71	1.250	16.07	315.56

Note: Flows were calculated using Manning's Formula (as referenced in APWA 5603.1.A)


4S
Bypass - Existing Offsite North
2S
Undetained - Onsite West
1AS
Detained Impervious - Proposed Development
2P
Total Site Runoff (including by-pass)
1P
Dry Extended Detention Pond
1BS
Detained Lawn - Proposed Development
3S
Bypass - Existing Offsite South
1CS
Detained Woods - Proposed Development
Subcat
Reach
Pond
Link
Routing Diagram for Proposed Drainage
Prepared by C&S Engineers, Inc, Printed 7/12/2023
HydroCAD® 10.20-2g s/n 01996 © 2022 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	Type II 24-hr		Default	24.00	1	3.71	2
2	10-YR	Type II 24-hr		Default	24.00	1	5.68	2
3	100-YR	Type II 24-hr		Default	24.00	1	9.25	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.301	74	>75% Grass cover, Good, HSG C (1BS, 2S)
2.928	98	Paved parking, HSG C (1AS)
1.785	70	Woods, Good, HSG C (1CS, 4S)
8.014	**82**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
8.014	HSG C	1AS, 1BS, 1CS, 2S, 4S
0.000	HSG D	
0.000	Other	
8.014		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	3.301	0.000	0.000	3.301	>75% Grass cover, Good	1BS, 2S
0.000	0.000	2.928	0.000	0.000	2.928	Paved parking	1AS
0.000	0.000	1.785	0.000	0.000	1.785	Woods, Good	1CS, 4S
0.000	**0.000**	**8.014**	**0.000**	**0.000**	**8.014**	**TOTAL AREA**	

Time span=0.00-100.00 hrs, dt=0.05 hrs, 2001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1AS: Detained Runoff Area=127,547 sf 100.00% Impervious Runoff Depth=3.48"
Flow Length=820' Tc=5.0 min CN=98 Runoff=15.57 cfs 0.848 af

Subcatchment1BS: Detained Lawn - Runoff Area=112,989 sf 0.00% Impervious Runoff Depth=1.39"
Flow Length=810' Tc=11.3 min CN=74 Runoff=5.16 cfs 0.300 af

Subcatchment1CS: Detained Woods - Runoff Area=17,602 sf 0.00% Impervious Runoff Depth=1.14"
Flow Length=479' Slope=0.0100 '/' Tc=16.5 min CN=70 Runoff=0.54 cfs 0.038 af

Subcatchment2S: Undetained - Onsite West Runoff Area=30,814 sf 0.00% Impervious Runoff Depth=1.39"
Flow Length=72' Tc=6.1 min CN=74 Runoff=1.70 cfs 0.082 af

Subcatchment4S: Bypass - Existing Offsite Runoff Area=60,141 sf 0.00% Impervious Runoff Depth=1.14"
Flow Length=514' Tc=11.9 min CN=70 Runoff=2.16 cfs 0.131 af

Pond 1P: Dry Extended Detention Pond Peak Elev=1,010.62' Storage=26,382 cf Inflow=19.55 cfs 1.186 af
Outflow=1.86 cfs 1.186 af

Pond 2P: Total Site Runoff (including by-pass) Inflow=3.21 cfs 1.268 af
Primary=3.21 cfs 1.268 af

Total Runoff Area = 8.014 ac Runoff Volume = 1.399 af Average Runoff Depth = 2.10"
63.46% Pervious = 5.086 ac 36.54% Impervious = 2.928 ac

Summary for Subcatchment 1AS: Detained Impervious - Proposed Development

[49] Hint: Tc<2dt may require smaller dt
[47] Hint: Peak is 241% of capacity of segment #3

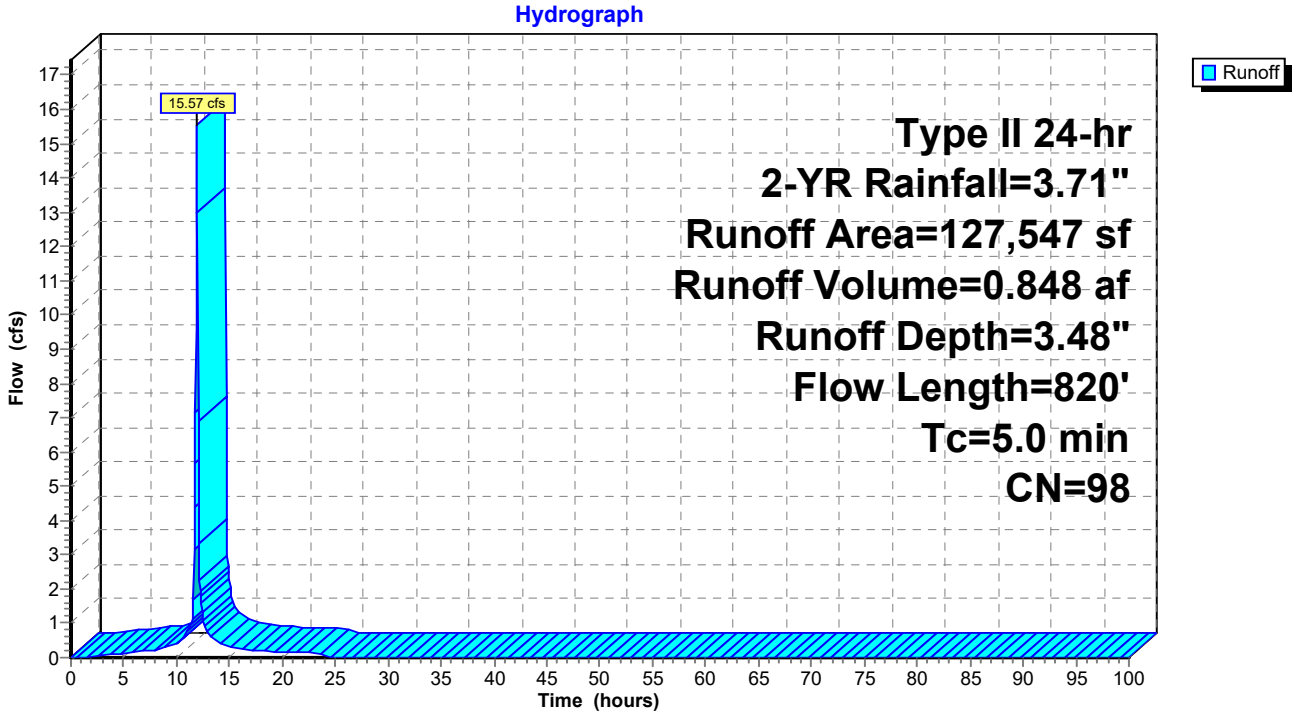
Runoff = 15.57 cfs @ 11.95 hrs, Volume= 0.848 af, Depth= 3.48"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.71"

Area (sf)	CN	Description
127,547	98	Paved parking, HSG C
127,547	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0650	2.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.71"
0.4	120	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.9	600	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
3.0	820	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1AS: Detained Impervious - Proposed Development



Summary for Subcatchment 1BS: Detained Lawn - Proposed Development

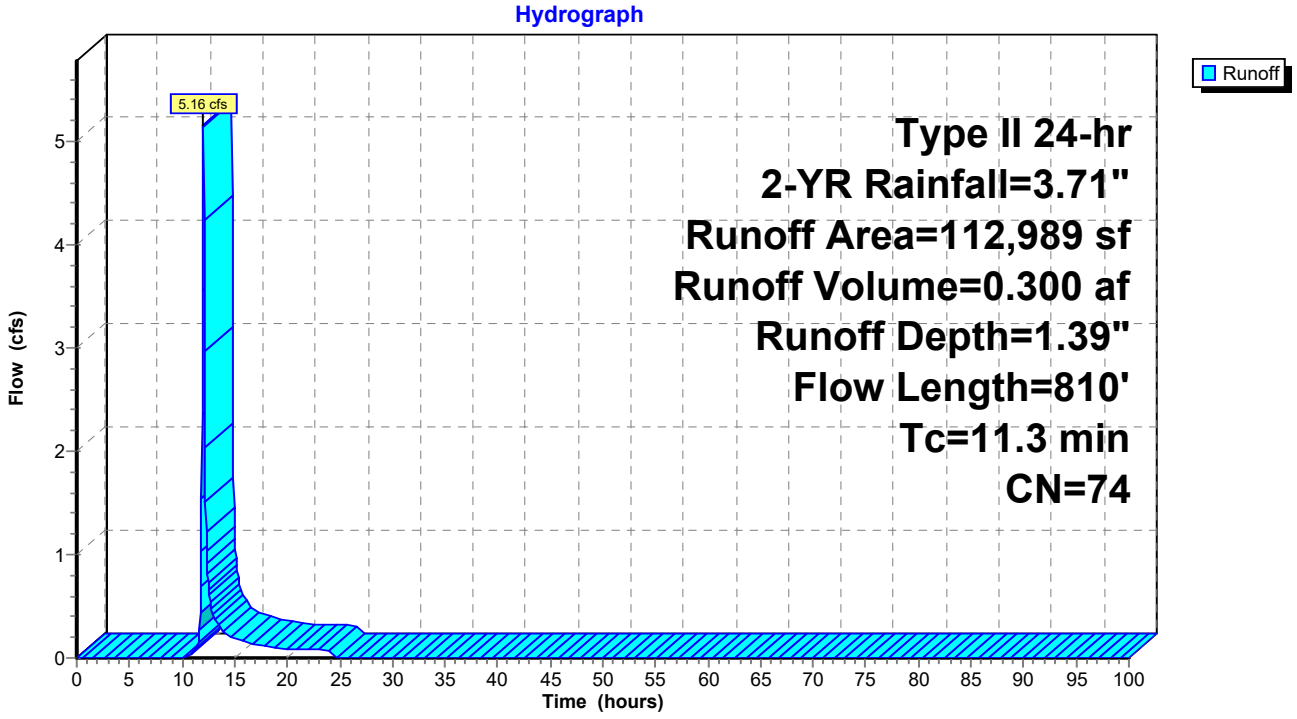
Runoff = 5.16 cfs @ 12.04 hrs, Volume= 0.300 af, Depth= 1.39"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.71"

Area (sf)	CN	Description
112,989	74	>75% Grass cover, Good, HSG C
112,989	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0540	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
0.2	38	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	72	0.0420	4.16		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.9	600	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
11.3	810	Total			

Subcatchment 1BS: Detained Lawn - Proposed Development



Summary for Subcatchment 1CS: Detained Woods - Proposed Development

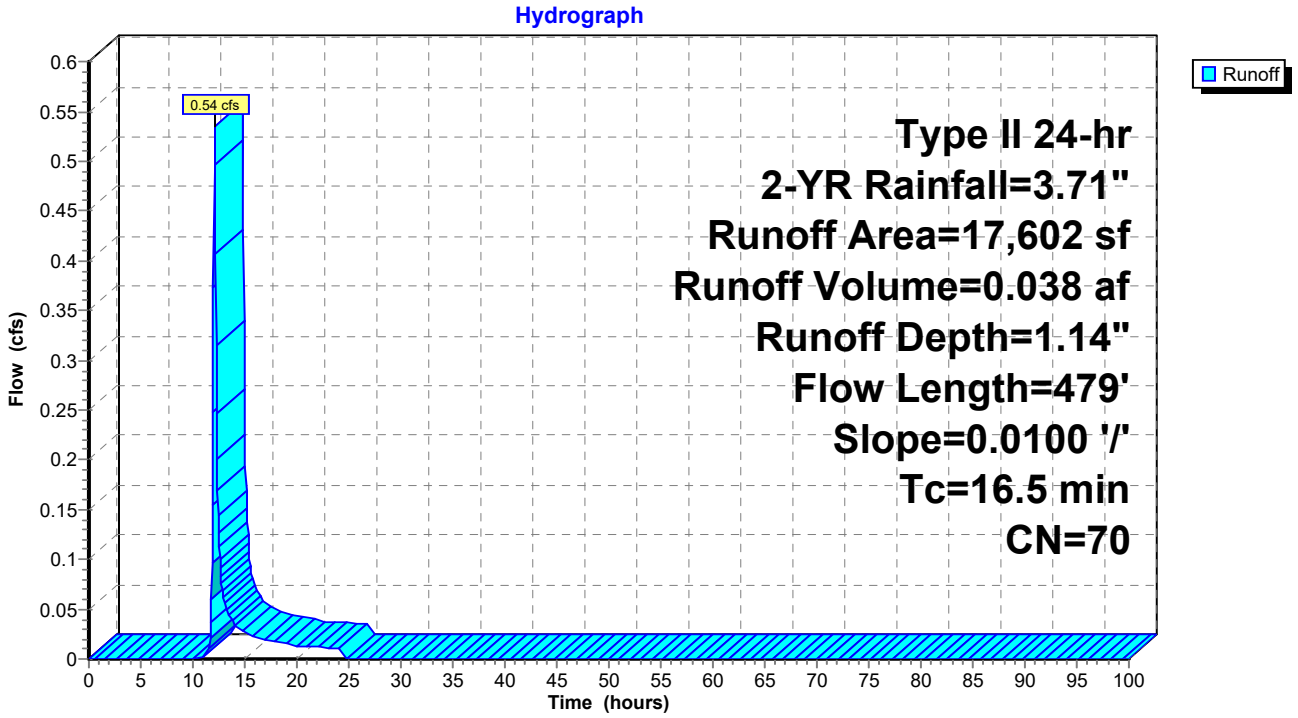
Runoff = 0.54 cfs @ 12.10 hrs, Volume= 0.038 af, Depth= 1.14"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.71"

Area (sf)	CN	Description
17,602	70	Woods, Good, HSG C
17,602	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Per APWA Section 5600 of Storm Drainage System**
1.5	479	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
16.5	479	Total			

Subcatchment 1CS: Detained Woods - Proposed Development



Summary for Subcatchment 2S: Undetained - Onsite West

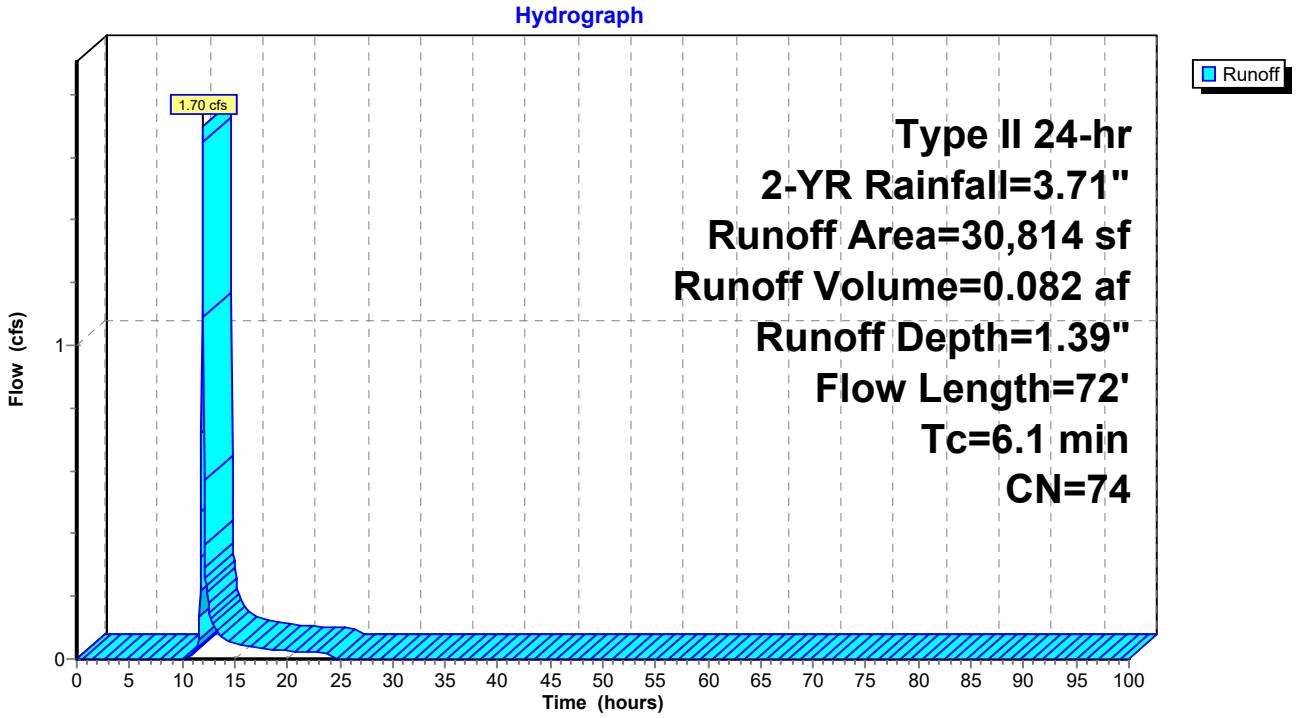
Runoff = 1.70 cfs @ 11.98 hrs, Volume= 0.082 af, Depth= 1.39"
Routed to Pond 2P : Total Site Runoff (including by-pass)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.71"

Area (sf)	CN	Description
30,814	74	>75% Grass cover, Good, HSG C
30,814	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	41	0.3000	0.31		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
3.9	31	0.0420	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
6.1	72	Total			

Subcatchment 2S: Undetained - Onsite West



Summary for Subcatchment 4S: Bypass - Existing Offsite North

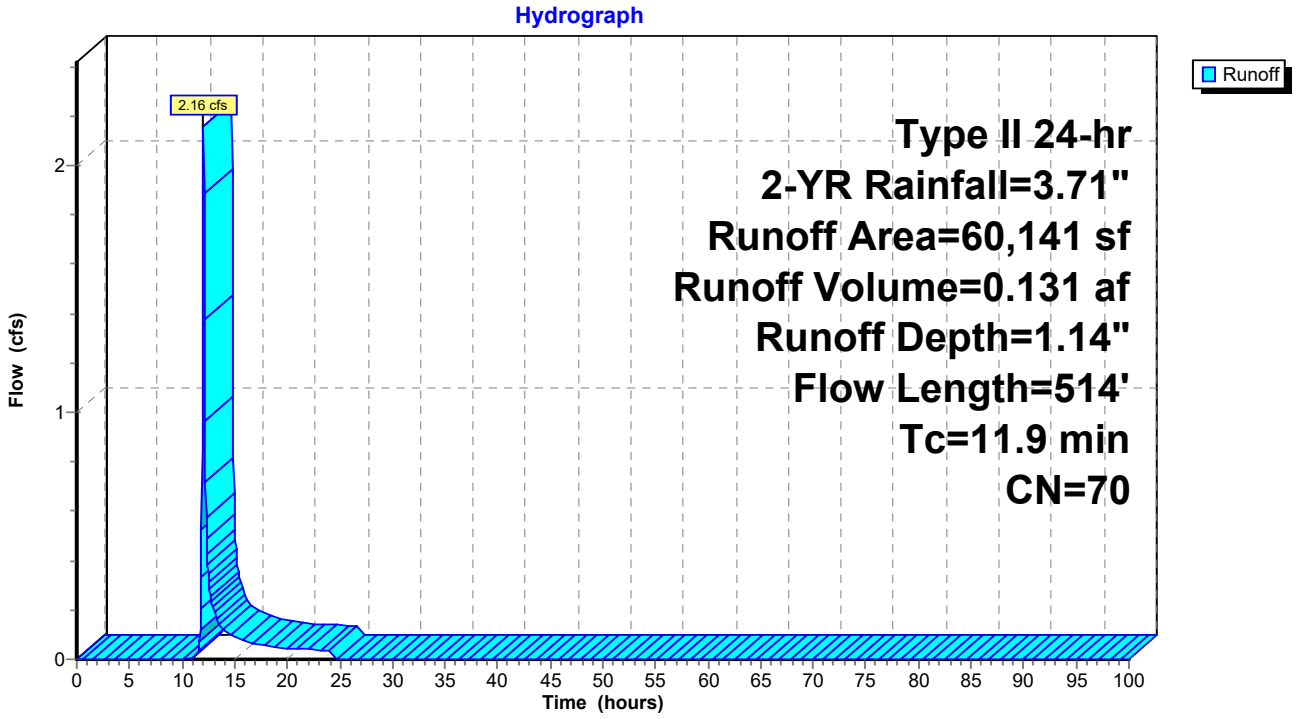
Runoff = 2.16 cfs @ 12.05 hrs, Volume= 0.131 af, Depth= 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.71"

Area (sf)	CN	Description
60,141	70	Woods, Good, HSG C
60,141	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.4750	0.30		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.71"
6.3	414	0.0475	1.09		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.9	514	Total			

Subcatchment 4S: Bypass - Existing Offsite North



Summary for Pond 1P: Dry Extended Detention Pond

Inflow Area = 5.926 ac, 49.41% Impervious, Inflow Depth = 2.40" for 2-YR event
Inflow = 19.55 cfs @ 11.96 hrs, Volume= 1.186 af
Outflow = 1.86 cfs @ 12.54 hrs, Volume= 1.186 af, Atten= 90%, Lag= 34.4 min
Primary = 1.86 cfs @ 12.54 hrs, Volume= 1.186 af
Routed to Pond 2P : Total Site Runoff (including by-pass)

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Peak Elev= 1,010.62' @ 12.54 hrs Storage= 26,382 cf

Plug-Flow detention time= 277.8 min calculated for 1.186 af (100% of inflow)
Center-of-Mass det. time= 278.3 min (1,057.6 - 779.3)

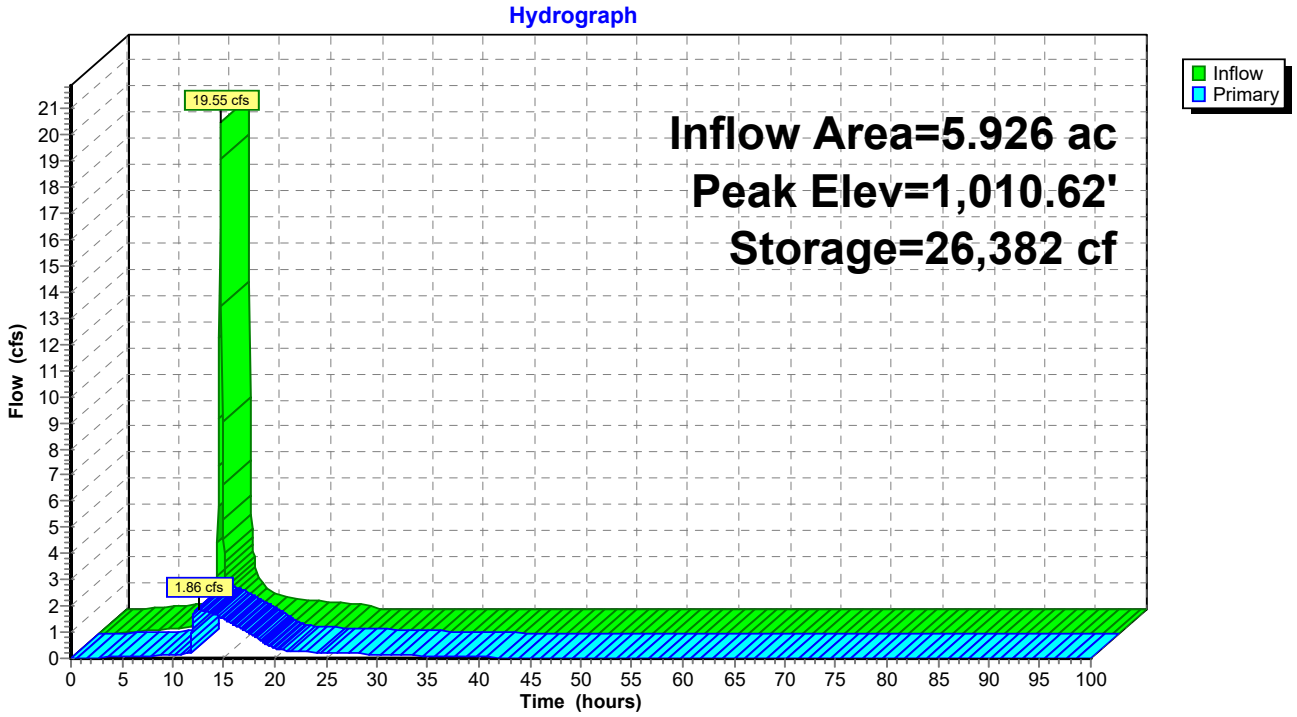
Volume	Invert	Avail.Storage	Storage Description
#1	1,006.00'	72,943 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
1,006.00	0
1,006.50	85
1,007.00	678
1,008.00	3,867
1,009.00	11,136
1,010.00	19,914
1,011.00	30,353
1,012.00	42,598
1,013.00	56,797
1,013.50	64,681
1,013.99	72,943

Device	Routing	Invert	Outlet Devices
#1	Primary	1,005.75'	**18.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,005.75' / 1,005.24' S= 0.0093 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	1,006.00'	**1.0" Vert. Orifice/Grate** X 6 rows with 4.0" cc spacing C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,008.50'	**11.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	1,010.62'	**26.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.86 cfs @ 12.54 hrs HW=1,010.62' (Free Discharge)
└─**1=Culvert** (Passes 1.86 cfs of 17.27 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.30 cfs @ 9.29 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.56 cfs @ 6.80 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: Dry Extended Detention Pond



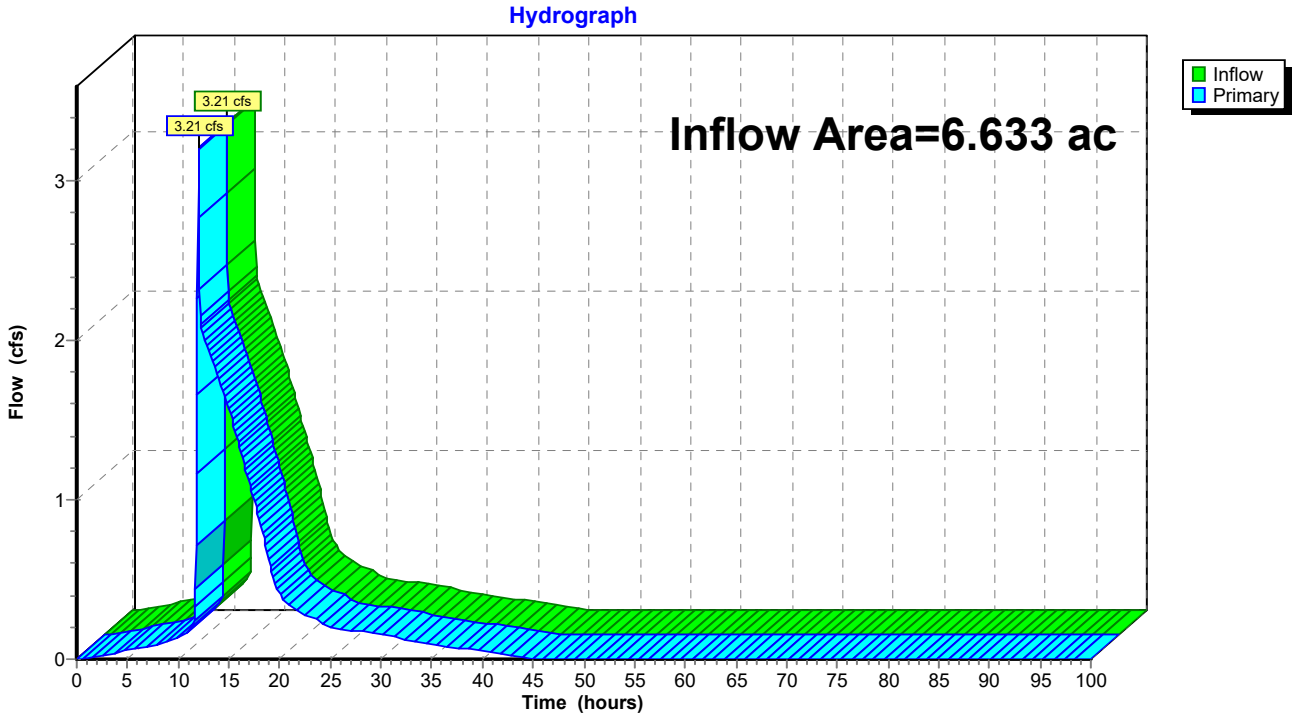
Summary for Pond 2P: Total Site Runoff (including by-pass)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.633 ac, 44.14% Impervious, Inflow Depth = 2.29" for 2-YR event
Inflow = 3.21 cfs @ 11.99 hrs, Volume= 1.268 af
Primary = 3.21 cfs @ 11.99 hrs, Volume= 1.268 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs

Pond 2P: Total Site Runoff (including by-pass)



Time span=0.00-100.00 hrs, dt=0.05 hrs, 2001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1AS: Detained Runoff Area=127,547 sf 100.00% Impervious Runoff Depth=5.44"
Flow Length=820' Tc=5.0 min CN=98 Runoff=23.95 cfs 1.328 af

Subcatchment1BS: Detained Lawn - Runoff Area=112,989 sf 0.00% Impervious Runoff Depth=2.92"
Flow Length=810' Tc=11.3 min CN=74 Runoff=10.98 cfs 0.631 af

Subcatchment1CS: Detained Woods - Runoff Area=17,602 sf 0.00% Impervious Runoff Depth=2.55"
Flow Length=479' Slope=0.0100 '/' Tc=16.5 min CN=70 Runoff=1.26 cfs 0.086 af

Subcatchment2S: Undetained - Onsite West Runoff Area=30,814 sf 0.00% Impervious Runoff Depth=2.92"
Flow Length=72' Tc=6.1 min CN=74 Runoff=3.54 cfs 0.172 af

Subcatchment4S: Bypass - Existing Offsite Runoff Area=60,141 sf 0.00% Impervious Runoff Depth=2.55"
Flow Length=514' Tc=11.9 min CN=70 Runoff=5.01 cfs 0.294 af

Pond 1P: Dry Extended Detention Pond Peak Elev=1,011.73' Storage=39,352 cf Inflow=33.20 cfs 2.045 af
Outflow=9.06 cfs 2.045 af

Pond 2P: Total Site Runoff (including by-pass) Inflow=10.36 cfs 2.217 af
Primary=10.36 cfs 2.217 af

Total Runoff Area = 8.014 ac Runoff Volume = 2.510 af Average Runoff Depth = 3.76"
63.46% Pervious = 5.086 ac 36.54% Impervious = 2.928 ac

Summary for Subcatchment 1AS: Detained Impervious - Proposed Development

[49] Hint: Tc<2dt may require smaller dt
[47] Hint: Peak is 371% of capacity of segment #3

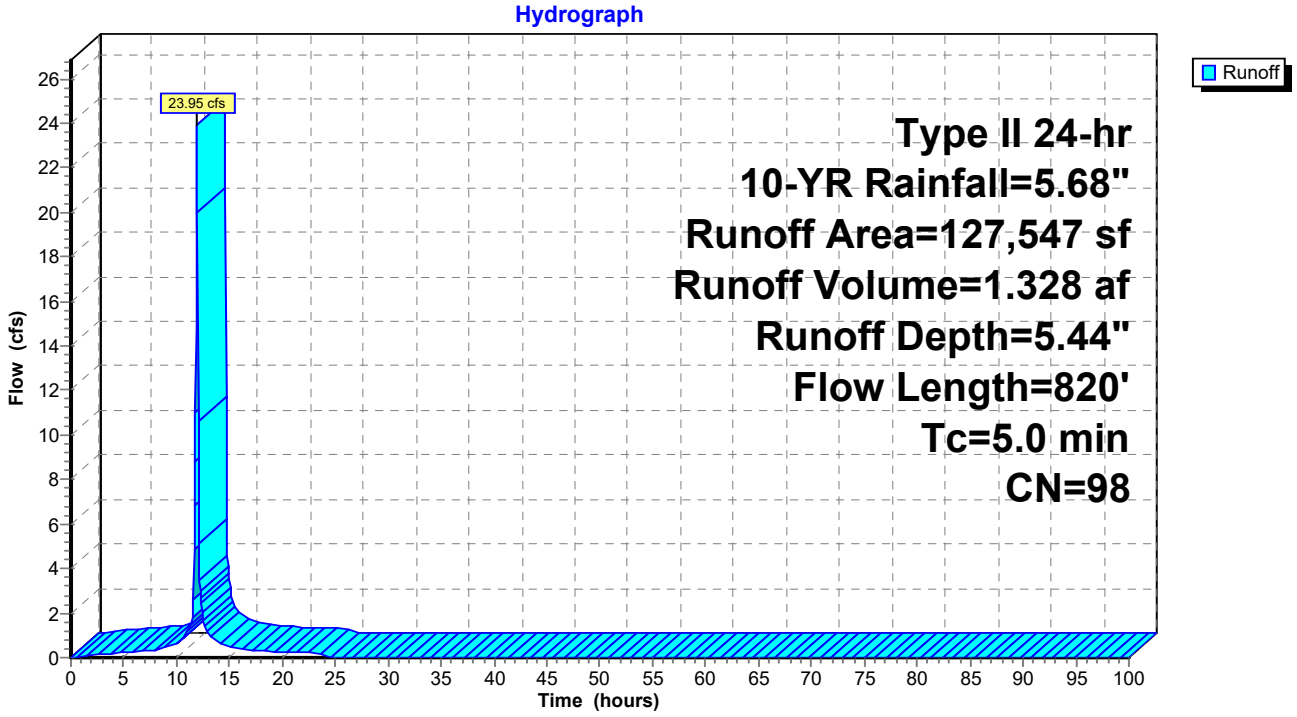
Runoff = 23.95 cfs @ 11.95 hrs, Volume= 1.328 af, Depth= 5.44"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=5.68"

Area (sf)	CN	Description
127,547	98	Paved parking, HSG C
127,547	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0650	2.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.71"
0.4	120	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.9	600	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
3.0	820	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1AS: Detained Impervious - Proposed Development



Summary for Subcatchment 1BS: Detained Lawn - Proposed Development

[47] Hint: Peak is 170% of capacity of segment #4

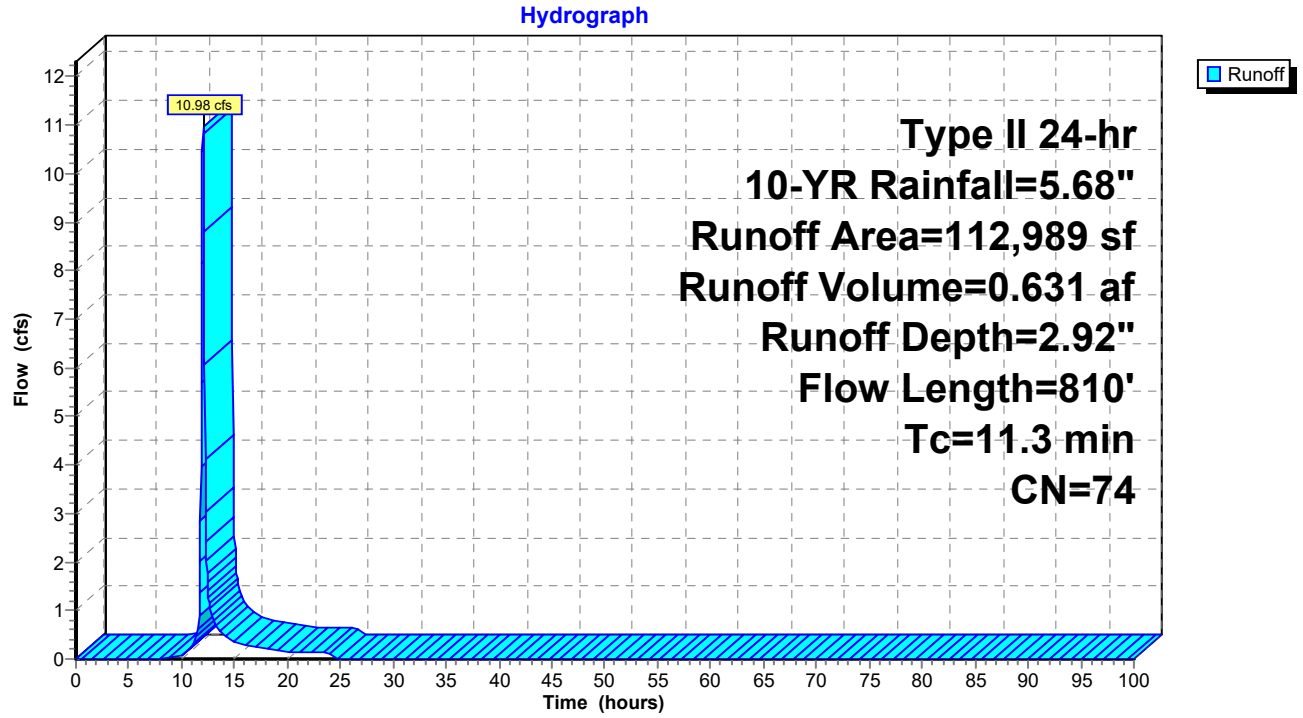
Runoff = 10.98 cfs @ 12.03 hrs, Volume= 0.631 af, Depth= 2.92"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=5.68"

Area (sf)	CN	Description
112,989	74	>75% Grass cover, Good, HSG C
112,989	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0540	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
0.2	38	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	72	0.0420	4.16		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.9	600	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
11.3	810	Total			

Subcatchment 1BS: Detained Lawn - Proposed Development



Summary for Subcatchment 1CS: Detained Woods - Proposed Development

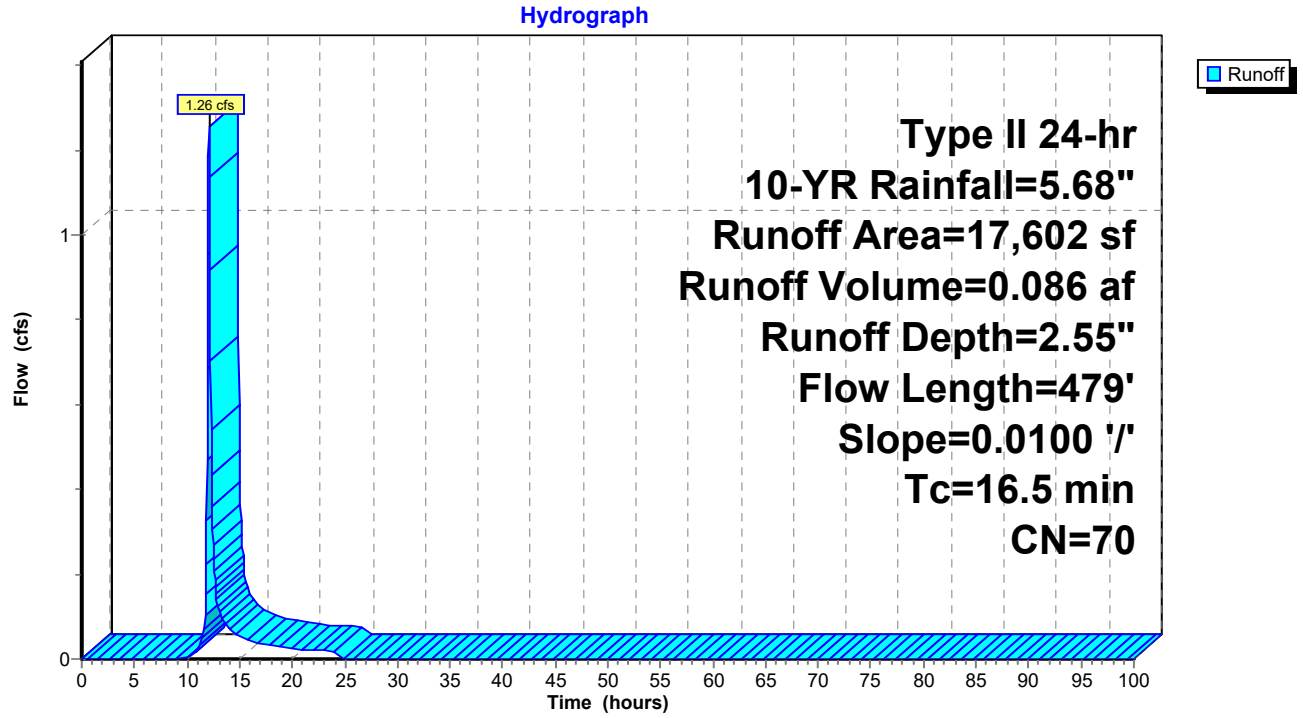
Runoff = 1.26 cfs @ 12.09 hrs, Volume= 0.086 af, Depth= 2.55"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=5.68"

Area (sf)	CN	Description
17,602	70	Woods, Good, HSG C
17,602	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Per APWA Section 5600 of Storm Drainage System**
1.5	479	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
16.5	479	Total			

Subcatchment 1CS: Detained Woods - Proposed Development



Summary for Subcatchment 2S: Undetained - Onsite West

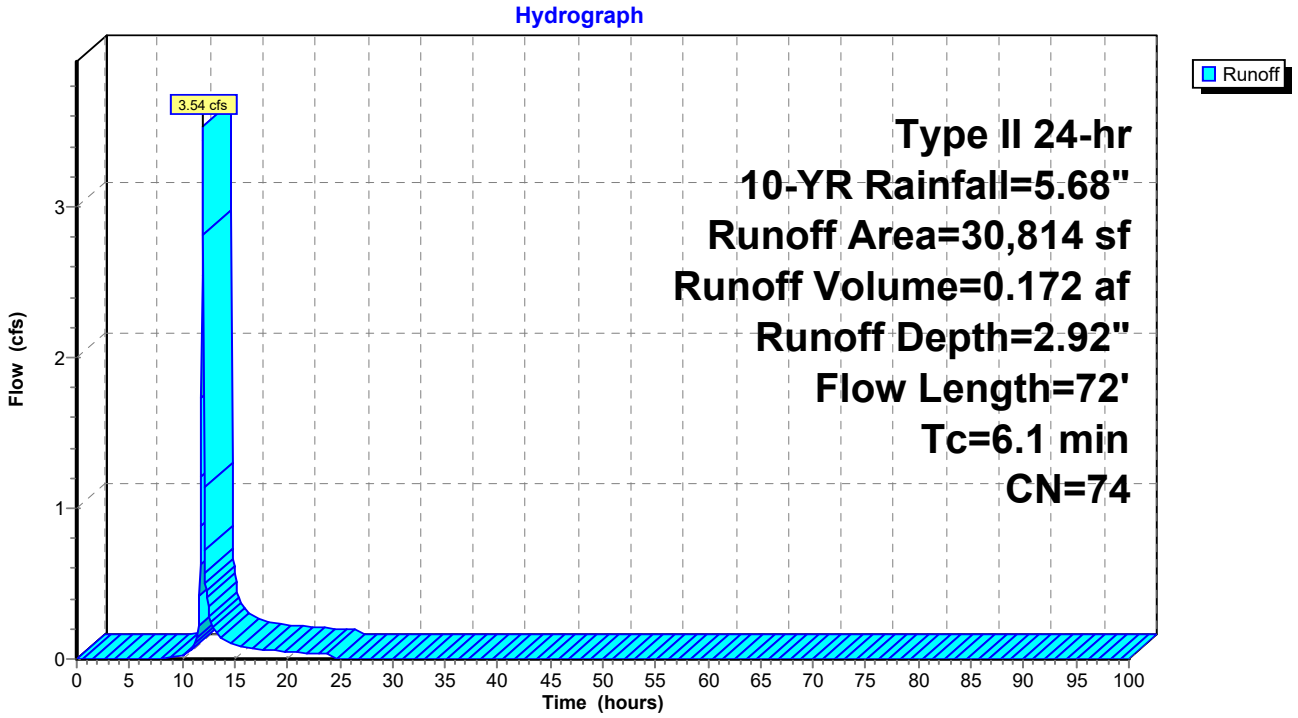
Runoff = 3.54 cfs @ 11.97 hrs, Volume= 0.172 af, Depth= 2.92"
Routed to Pond 2P : Total Site Runoff (including by-pass)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=5.68"

Area (sf)	CN	Description
30,814	74	>75% Grass cover, Good, HSG C
30,814	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	41	0.3000	0.31		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
3.9	31	0.0420	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
6.1	72	Total			

Subcatchment 2S: Undetained - Onsite West



Summary for Subcatchment 4S: Bypass - Existing Offsite North

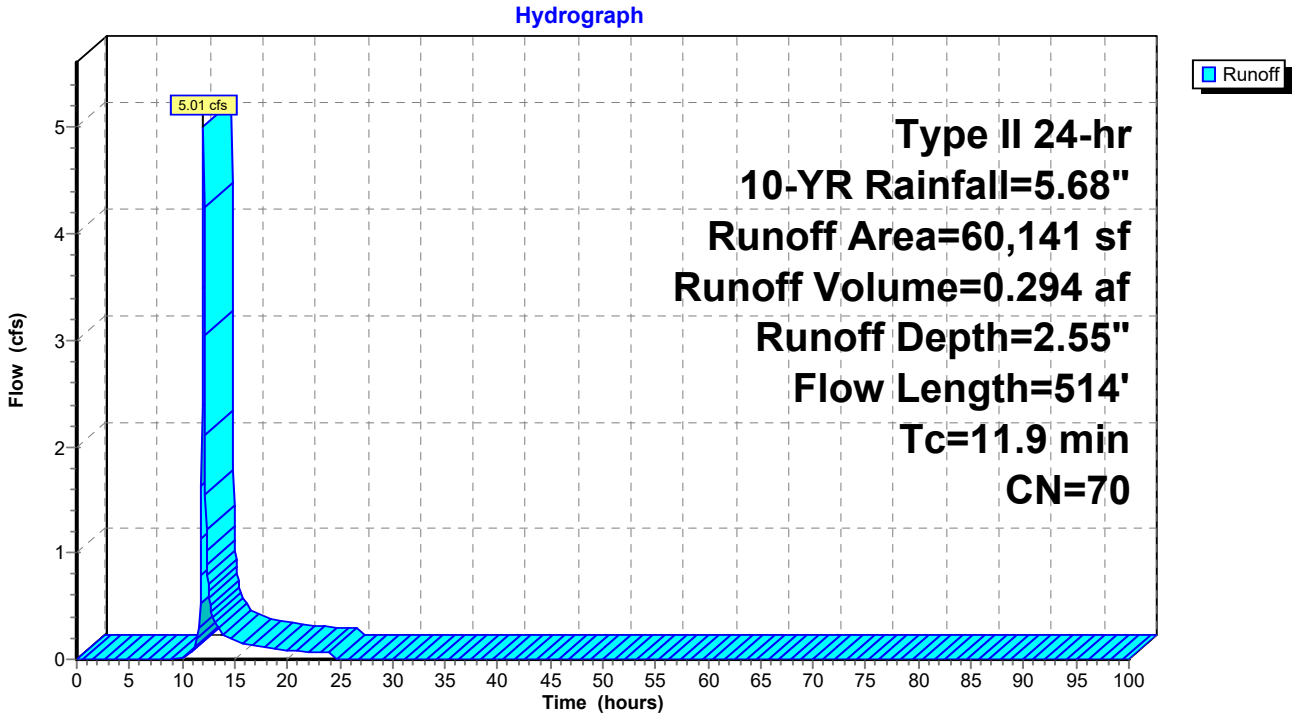
Runoff = 5.01 cfs @ 12.04 hrs, Volume= 0.294 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=5.68"

Area (sf)	CN	Description
60,141	70	Woods, Good, HSG C
60,141	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.4750	0.30		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.71"
6.3	414	0.0475	1.09		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.9	514	Total			

Subcatchment 4S: Bypass - Existing Offsite North



Summary for Pond 1P: Dry Extended Detention Pond

Inflow Area = 5.926 ac, 49.41% Impervious, Inflow Depth = 4.14" for 10-YR event
Inflow = 33.20 cfs @ 11.97 hrs, Volume= 2.045 af
Outflow = 9.06 cfs @ 12.18 hrs, Volume= 2.045 af, Atten= 73%, Lag= 13.0 min
Primary = 9.06 cfs @ 12.18 hrs, Volume= 2.045 af
Routed to Pond 2P : Total Site Runoff (including by-pass)

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Peak Elev= 1,011.73' @ 12.18 hrs Storage= 39,352 cf

Plug-Flow detention time= 204.1 min calculated for 2.044 af (100% of inflow)
Center-of-Mass det. time= 204.7 min (978.5 - 773.8)

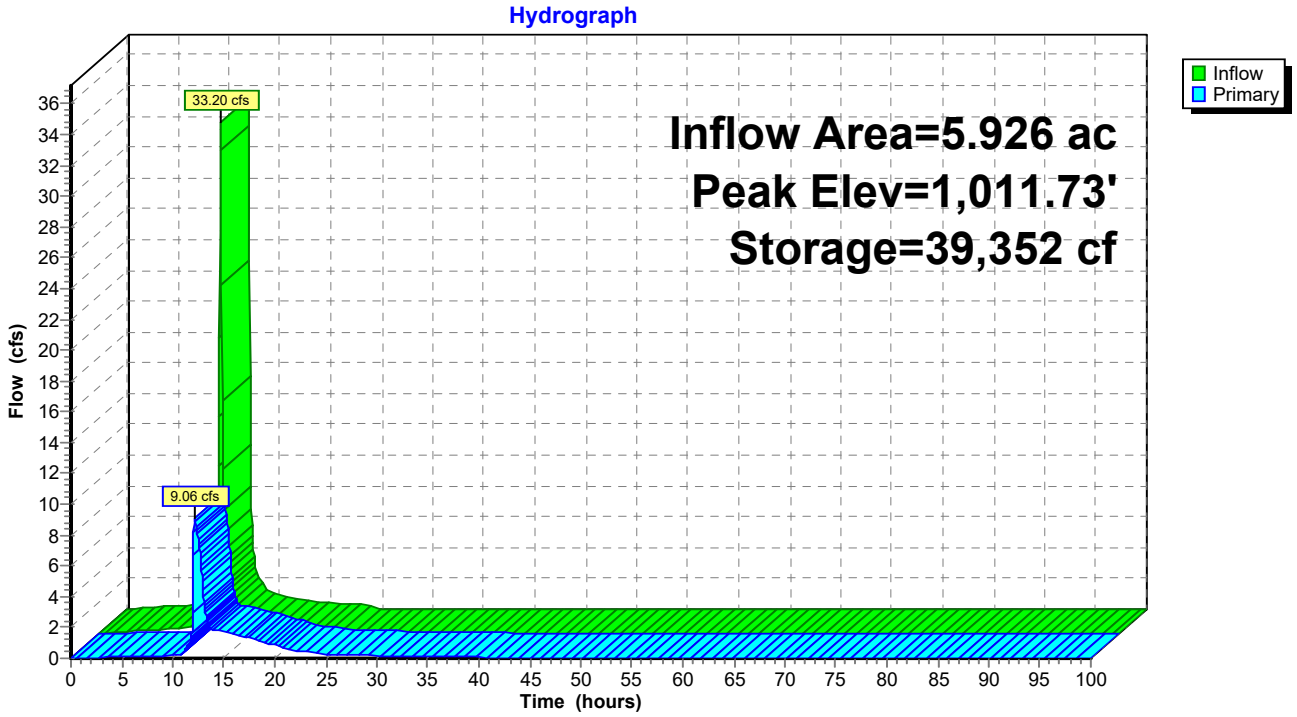
Volume	Invert	Avail.Storage	Storage Description
#1	1,006.00'	72,943 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
1,006.00	0
1,006.50	85
1,007.00	678
1,008.00	3,867
1,009.00	11,136
1,010.00	19,914
1,011.00	30,353
1,012.00	42,598
1,013.00	56,797
1,013.50	64,681
1,013.99	72,943

Device	Routing	Invert	Outlet Devices
#1	Primary	1,005.75'	**18.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,005.75' / 1,005.24' S= 0.0093 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	1,006.00'	**1.0" Vert. Orifice/Grate** X 6 rows with 4.0" cc spacing C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,008.50'	**11.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	1,010.62'	**26.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=9.04 cfs @ 12.18 hrs HW=1,011.73' (Free Discharge)
└**1=Culvert** (Passes 9.04 cfs of 19.46 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.35 cfs @ 10.59 fps)
  ├**3=Orifice/Grate** (Orifice Controls 1.94 cfs @ 8.49 fps)
  └**4=Orifice/Grate** (Orifice Controls 6.75 cfs @ 4.67 fps)

Pond 1P: Dry Extended Detention Pond



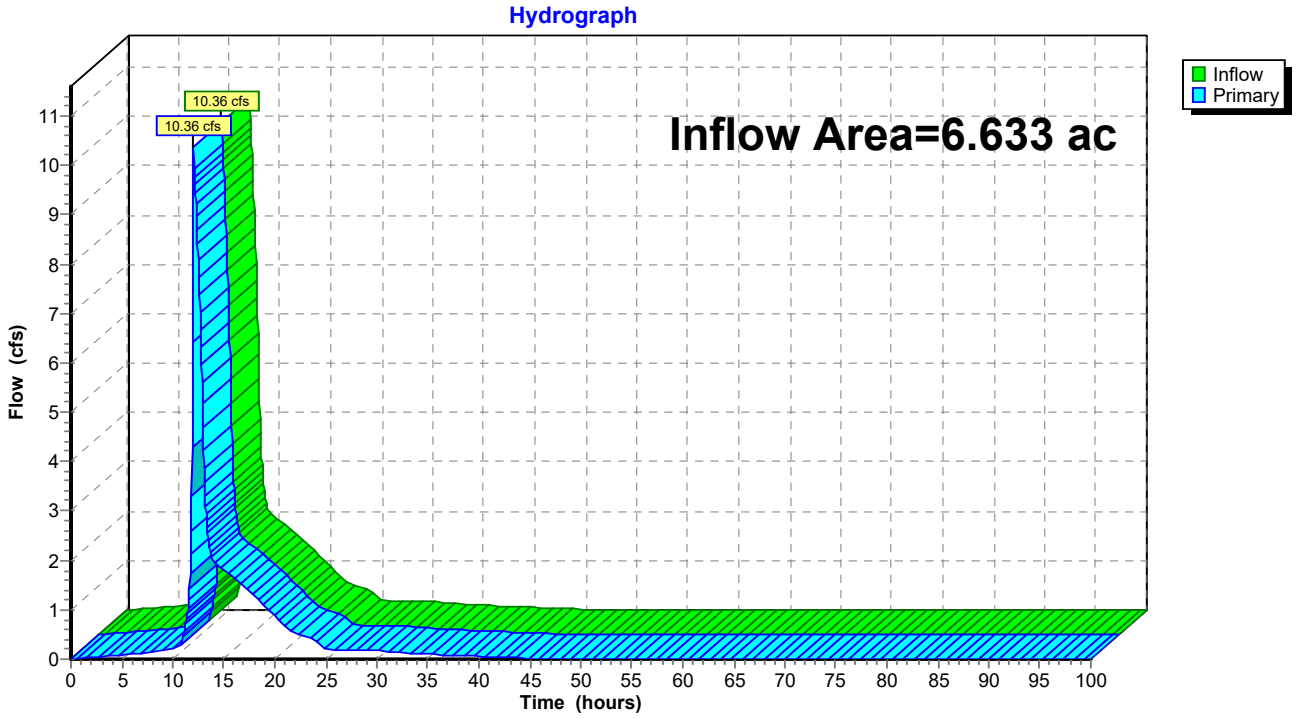
Summary for Pond 2P: Total Site Runoff (including by-pass)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.633 ac, 44.14% Impervious, Inflow Depth = 4.01" for 10-YR event
Inflow = 10.36 cfs @ 12.04 hrs, Volume= 2.217 af
Primary = 10.36 cfs @ 12.04 hrs, Volume= 2.217 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs

Pond 2P: Total Site Runoff (including by-pass)



Time span=0.00-100.00 hrs, dt=0.05 hrs, 2001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1AS: Detained Runoff Area=127,547 sf 100.00% Impervious Runoff Depth=9.01"
Flow Length=820' Tc=5.0 min CN=98 Runoff=39.11 cfs 2.198 af

Subcatchment1BS: Detained Lawn - Runoff Area=112,989 sf 0.00% Impervious Runoff Depth=6.06"
Flow Length=810' Tc=11.3 min CN=74 Runoff=22.42 cfs 1.309 af

Subcatchment1CS: Detained Woods - Runoff Area=17,602 sf 0.00% Impervious Runoff Depth=5.56"
Flow Length=479' Slope=0.0100 '/' Tc=16.5 min CN=70 Runoff=2.75 cfs 0.187 af

Subcatchment2S: Undetained - Onsite West Runoff Area=30,814 sf 0.00% Impervious Runoff Depth=6.06"
Flow Length=72' Tc=6.1 min CN=74 Runoff=7.17 cfs 0.357 af

Subcatchment4S: Bypass - Existing Offsite Runoff Area=60,141 sf 0.00% Impervious Runoff Depth=5.56"
Flow Length=514' Tc=11.9 min CN=70 Runoff=10.85 cfs 0.639 af

Pond 1P: Dry Extended Detention Pond Peak Elev=1,013.68' Storage=67,796 cf Inflow=59.05 cfs 3.695 af
Outflow=14.73 cfs 3.695 af

Pond 2P: Total Site Runoff (including by-pass) Inflow=19.56 cfs 4.052 af
Primary=19.56 cfs 4.052 af

Total Runoff Area = 8.014 ac Runoff Volume = 4.691 af Average Runoff Depth = 7.02"
63.46% Pervious = 5.086 ac 36.54% Impervious = 2.928 ac

Summary for Subcatchment 1AS: Detained Impervious - Proposed Development

[49] Hint: Tc<2dt may require smaller dt
[47] Hint: Peak is 605% of capacity of segment #3

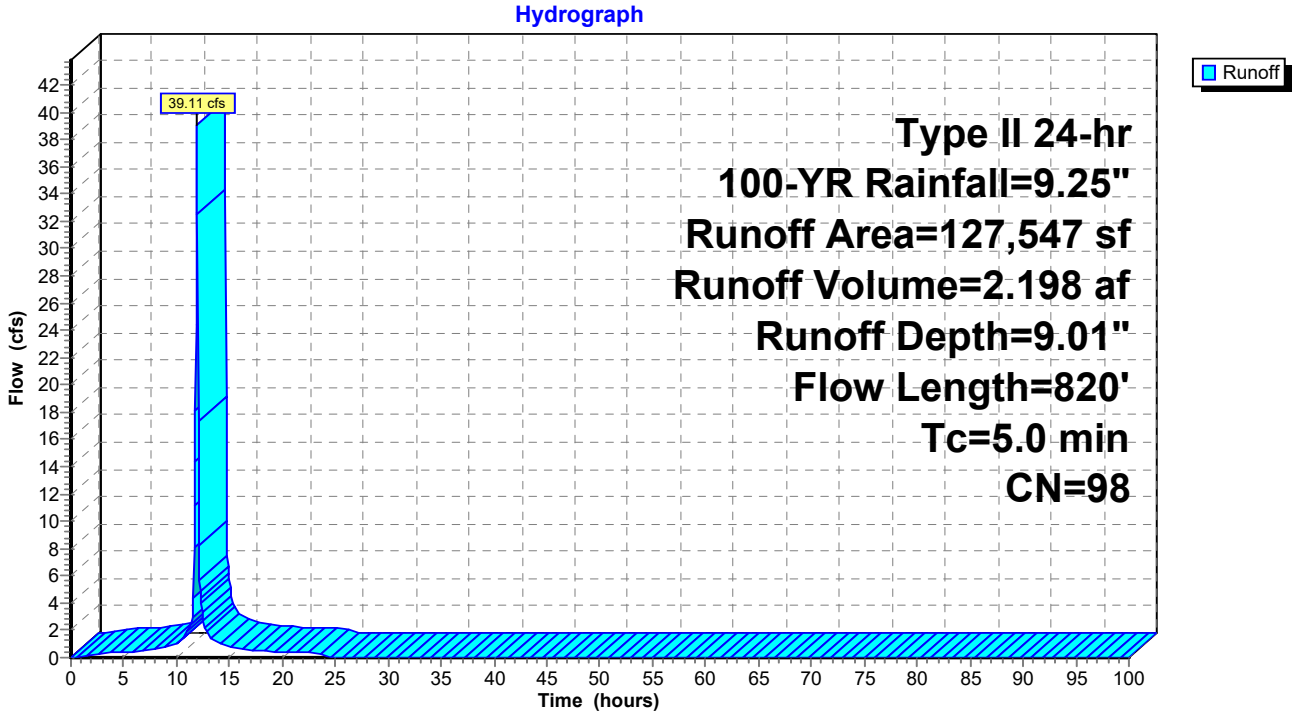
Runoff = 39.11 cfs @ 11.95 hrs, Volume= 2.198 af, Depth= 9.01"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=9.25"

Area (sf)	CN	Description
127,547	98	Paved parking, HSG C
127,547	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0650	2.37		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.71"
0.4	120	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.9	600	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
3.0	820	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1AS: Detained Impervious - Proposed Development



Summary for Subcatchment 1BS: Detained Lawn - Proposed Development

[47] Hint: Peak is 347% of capacity of segment #4

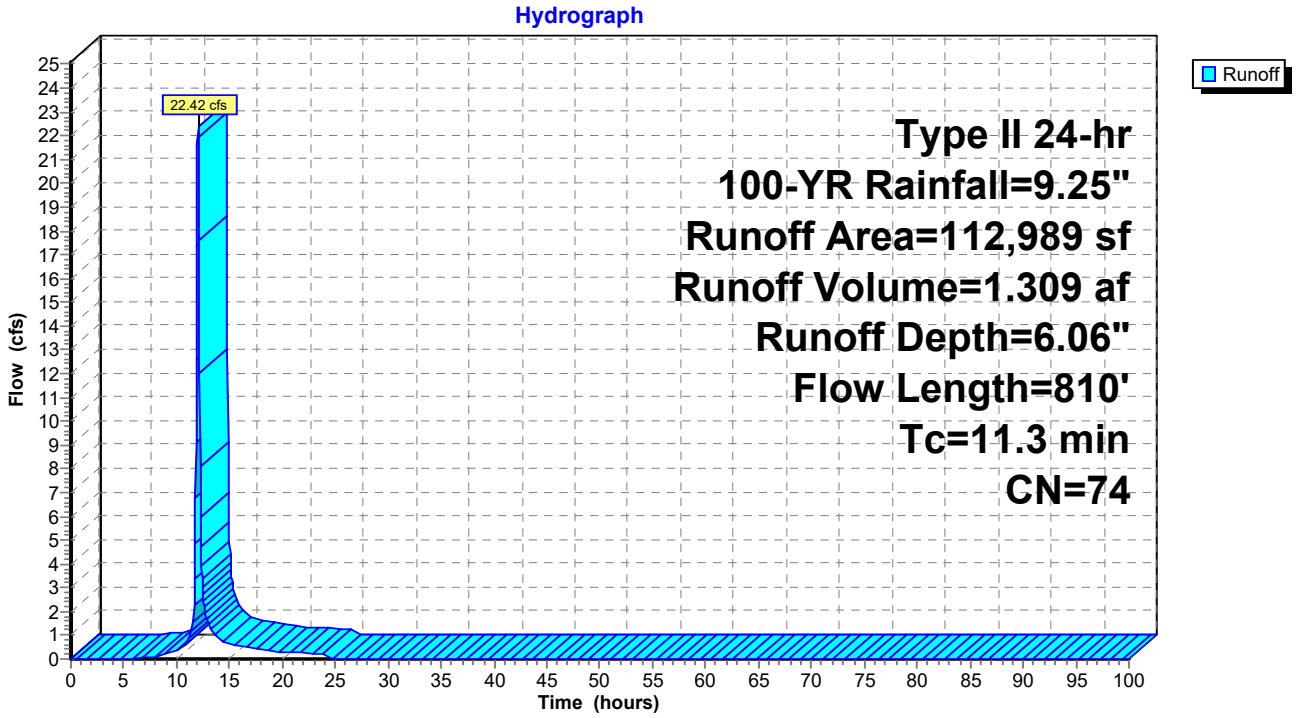
Runoff = 22.42 cfs @ 12.03 hrs, Volume= 1.309 af, Depth= 6.06"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=9.25"

Area (sf)	CN	Description
112,989	74	>75% Grass cover, Good, HSG C
112,989	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0540	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
0.2	38	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	72	0.0420	4.16		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.9	600	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
11.3	810	Total			

Subcatchment 1BS: Detained Lawn - Proposed Development



Summary for Subcatchment 1CS: Detained Woods - Proposed Development

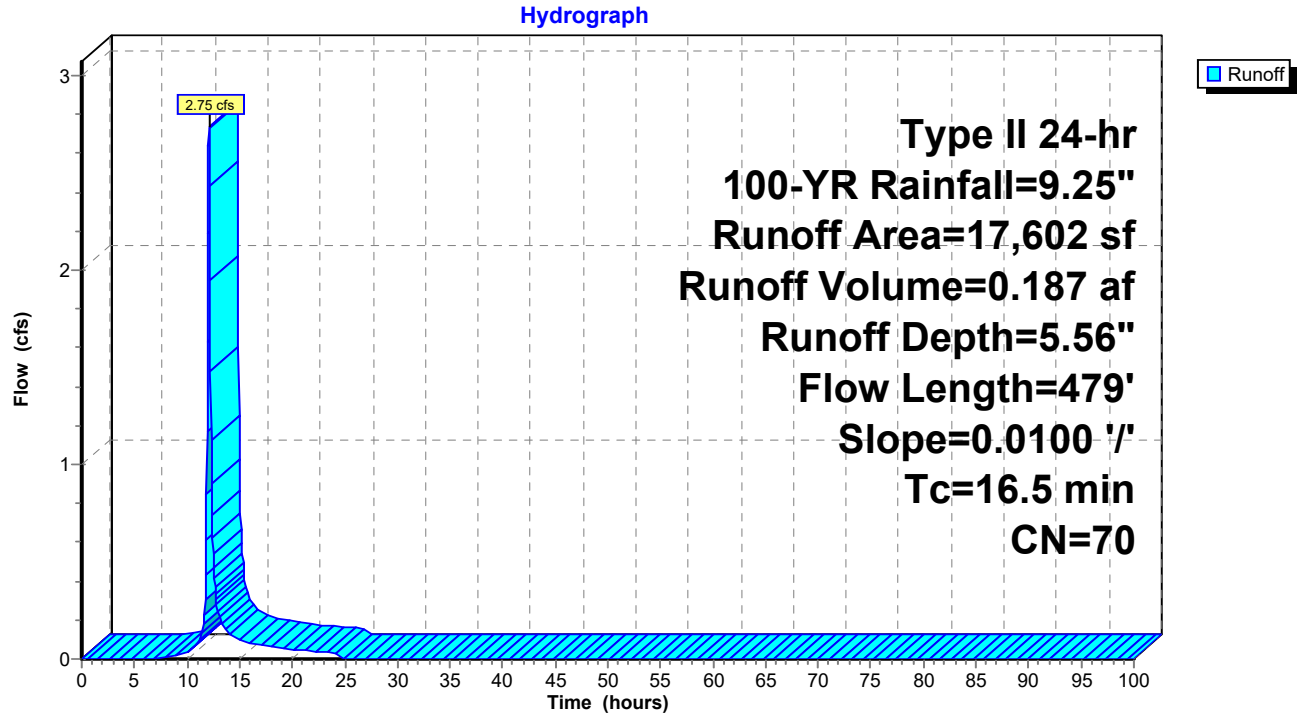
Runoff = 2.75 cfs @ 12.09 hrs, Volume= 0.187 af, Depth= 5.56"
Routed to Pond 1P : Dry Extended Detention Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=9.25"

Area (sf)	CN	Description
17,602	70	Woods, Good, HSG C
17,602	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Per APWA Section 5600 of Storm Drainage System**
1.5	479	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
16.5	479	Total			

Subcatchment 1CS: Detained Woods - Proposed Development



Summary for Subcatchment 2S: Undetained - Onsite West

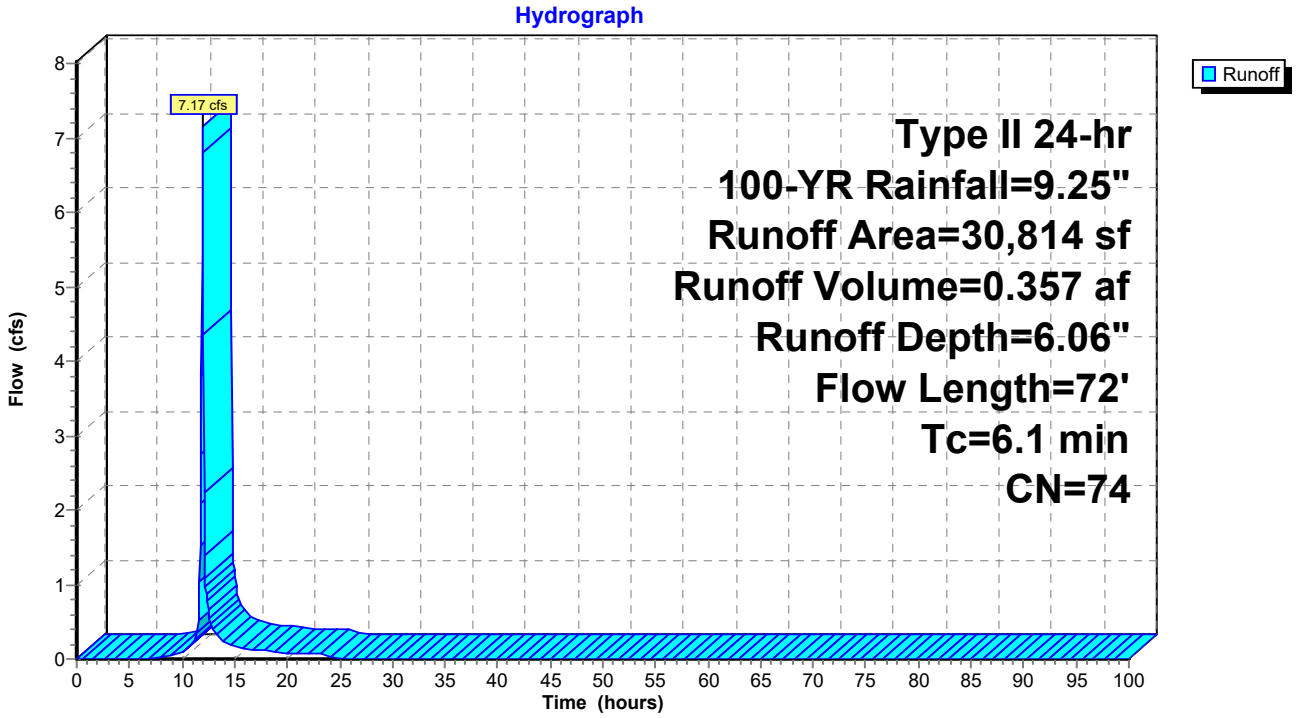
Runoff = 7.17 cfs @ 11.97 hrs, Volume= 0.357 af, Depth= 6.06"
Routed to Pond 2P : Total Site Runoff (including by-pass)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=9.25"

Area (sf)	CN	Description
30,814	74	>75% Grass cover, Good, HSG C
30,814	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	41	0.3000	0.31		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
3.9	31	0.0420	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.71"
6.1	72	Total			

Subcatchment 2S: Undetained - Onsite West



Summary for Subcatchment 4S: Bypass - Existing Offsite North

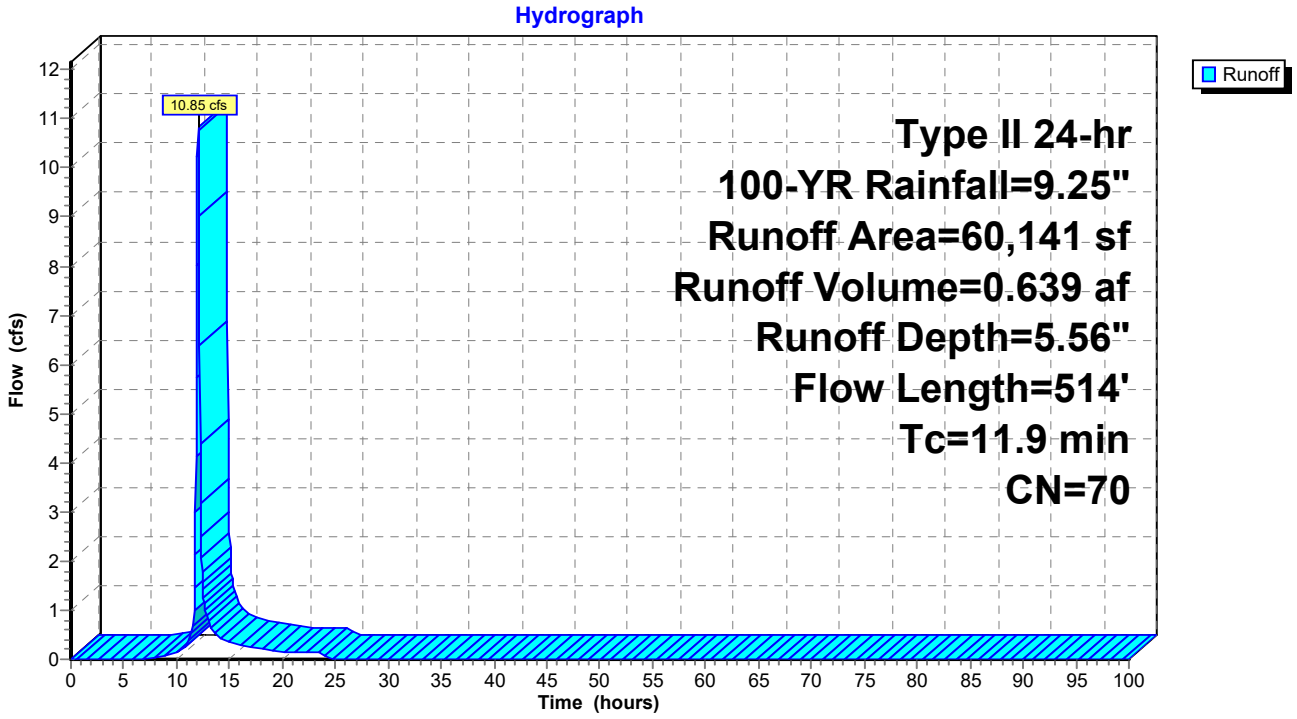
Runoff = 10.85 cfs @ 12.04 hrs, Volume= 0.639 af, Depth= 5.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=9.25"

Area (sf)	CN	Description
60,141	70	Woods, Good, HSG C
60,141	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.4750	0.30		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.71"
6.3	414	0.0475	1.09		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.9	514	Total			

Subcatchment 4S: Bypass - Existing Offsite North



Summary for Pond 1P: Dry Extended Detention Pond

Inflow Area = 5.926 ac, 49.41% Impervious, Inflow Depth = 7.48" for 100-YR event
Inflow = 59.05 cfs @ 11.97 hrs, Volume= 3.695 af
Outflow = 14.73 cfs @ 12.21 hrs, Volume= 3.695 af, Atten= 75%, Lag= 14.4 min
Primary = 14.73 cfs @ 12.21 hrs, Volume= 3.695 af
Routed to Pond 2P : Total Site Runoff (including by-pass)

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs
Peak Elev= 1,013.68' @ 12.21 hrs Storage= 67,796 cf

Plug-Flow detention time= 157.2 min calculated for 3.693 af (100% of inflow)
Center-of-Mass det. time= 157.8 min (924.3 - 766.5)

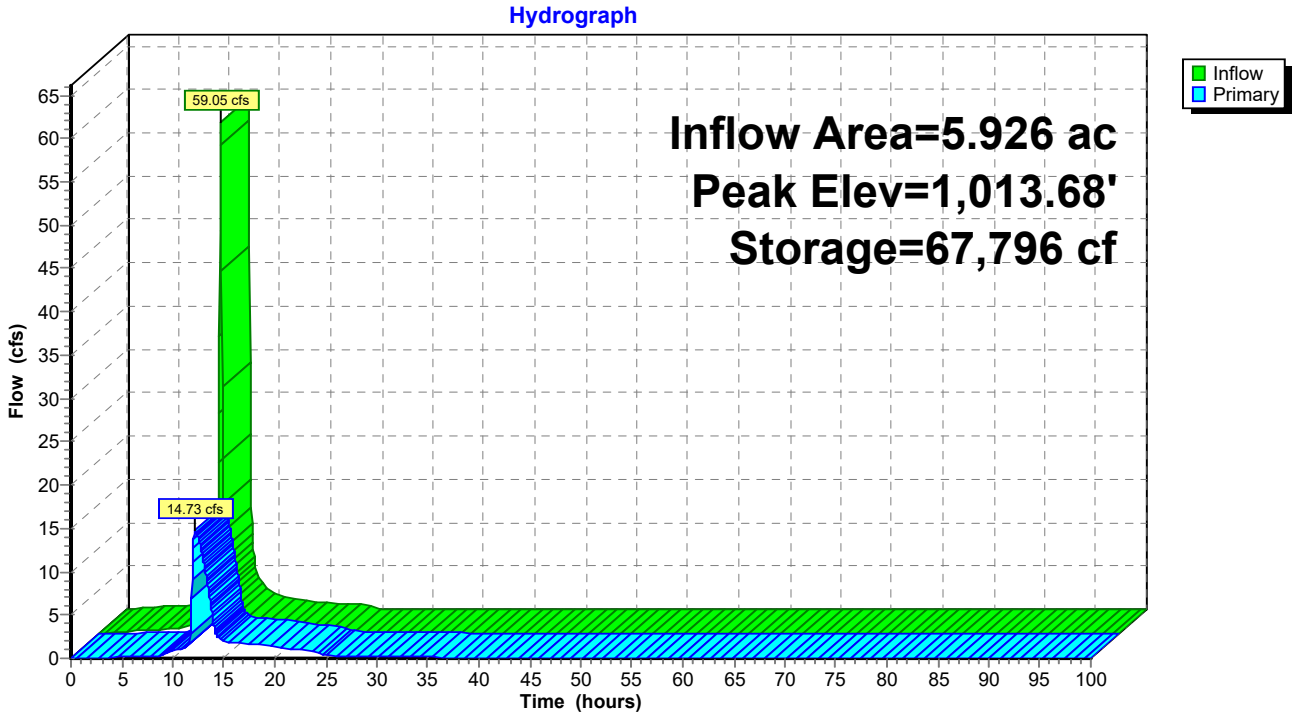
Volume	Invert	Avail.Storage	Storage Description
#1	1,006.00'	72,943 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
1,006.00	0
1,006.50	85
1,007.00	678
1,008.00	3,867
1,009.00	11,136
1,010.00	19,914
1,011.00	30,353
1,012.00	42,598
1,013.00	56,797
1,013.50	64,681
1,013.99	72,943

Device	Routing	Invert	Outlet Devices
#1	Primary	1,005.75'	**18.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,005.75' / 1,005.24' S= 0.0093 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	1,006.00'	**1.0" Vert. Orifice/Grate** X 6 rows with 4.0" cc spacing C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,008.50'	**11.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	1,010.62'	**26.0" W x 4.0" H Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=14.72 cfs @ 12.21 hrs HW=1,013.68' (Free Discharge)
└**1=Culvert** (Passes 14.72 cfs of 22.80 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.41 cfs @ 12.55 fps)
  ├**3=Orifice/Grate** (Orifice Controls 2.48 cfs @ 10.83 fps)
  └**4=Orifice/Grate** (Orifice Controls 11.83 cfs @ 8.19 fps)

Pond 1P: Dry Extended Detention Pond



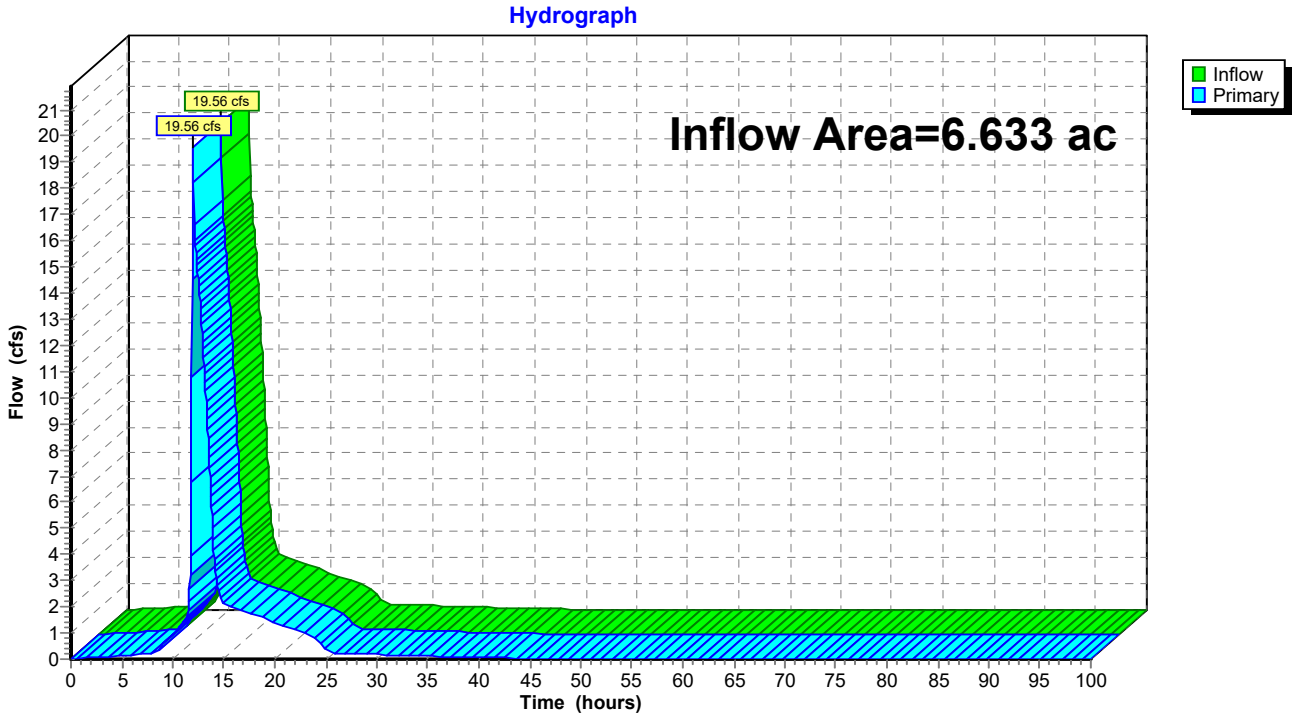
Summary for Pond 2P: Total Site Runoff (including by-pass)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.633 ac, 44.14% Impervious, Inflow Depth = 7.33" for 100-YR event
Inflow = 19.56 cfs @ 12.00 hrs, Volume= 4.052 af
Primary = 19.56 cfs @ 12.00 hrs, Volume= 4.052 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs

Pond 2P: Total Site Runoff (including by-pass)



Appendix E

FEMA FIRM Panel

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the U.S.D.A Farm Service National Agriculture ImageryProgram (NAIP) dated 2014. Produced at scale of 1:24,000.

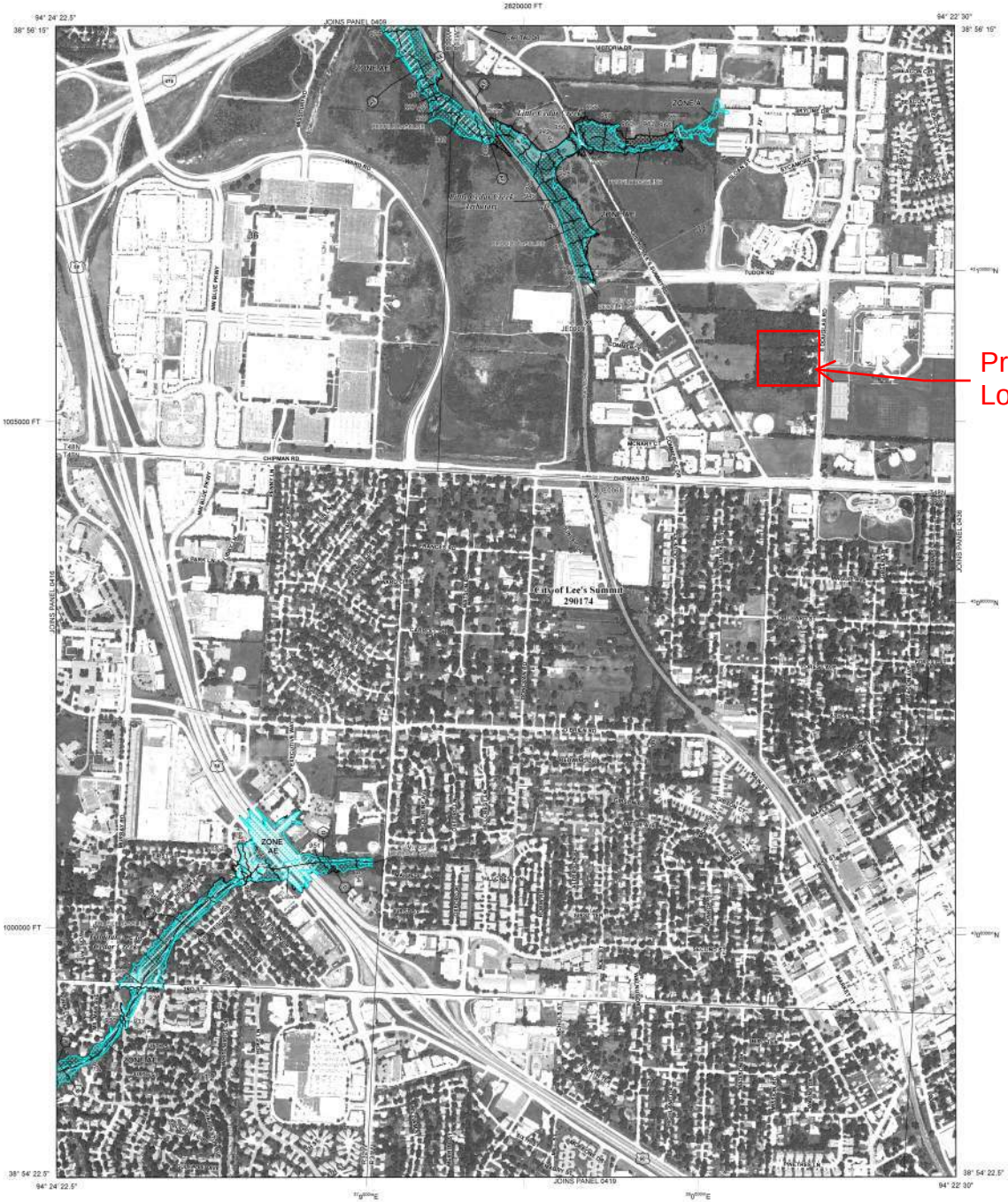
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

Cross section line

Transect line

Coltect

Bridge

40° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

5100000 FT 5800-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection

DX510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 29, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
January 20, 2017 - to change Special Flood Hazard Areas

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0417G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 417 OF 625

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LEE'S SUMMIT, CITY OF	290174	0417	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29095C0417G

MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM