MACRO STORM WATER DRAINAGE STUDY

LIVING FAITH CHURCH
Site Acreage: 9.63 Acres

1121 SW Hook Road
Lee's Summit, MO

PREPARED BY:

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 S.E. 30th Street Lee's Summit, MO 64082
816.623.9888 • engineeringsolutionskc.com

Matthew J. Schlicht, PE

Revision

Date	Comment	By

MACRO STORM WATER DRAINAGE STUDY

LIVING FAITH CHURCH
Site Acreage: 9.63 Acres

1121 SW Hook Road
Lee's Summit, MO

PREPARED BY:

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 S.E. 30th Street Lee's Summit, MO 64082
816.623.9888 • engineeringsolutionskc.com

Revision

Date	Comment	By

Matthew J. Schlicht, PE

TABLE OF CONTENTS

3. GENERAL INFORMATION

This storm study has been prepared to evaluate potential hydrologic and hydraulic issues related to the proposed project and recommend improvements designed to mitigate any anticipated negative downstream impacts. The proposed project will consist of an expansion of the existing Living Faith Church along with the construction of a new parking lot and associated utility infrastructure. Living Faith Church is located at 1121 SW Hook Road and consists of 9.63 acres+/-. The existing site drains generally from north to south. An enclosed storm sewer system is located on the property which collects runoff from the north parking lot and conveys it to the south. Runoff from the site is tributary to Raintree Lake. See Exhibit A for an aerial image of the proposed project site along with an aerial image of the surrounding area. The site is located in Section 25, Township 47N, Range 32W, Lee's Summit, Jackson County, Missouri.

3.1 FEMA FLOODPLAIN DETERMINATION

The property is located in an Area of Minimal Flood Hazard, Zone X, according to FEMA Firm Map Number 29095C0532G, dated January 20, 2017.

See Exhibit B for a FIRMette which includes the proposed project site.

3.2 NRCS SOIL CLASSIFICATION

Soil classifications published by the United States Department of Agriculture/National Resources Conservation Service (USDA/NRCS) website for Jackson County, Missouri, Version 23, September 1, 2021. The existing site contains two major soil types:

10000	Arisburg Silt Loam, 1 to 5 Percent Slopes Hydrologic Soils Group (HSG): Type C
10116	Sampsel Silty Clay Loam, 2 to 5 Percent Slopes HSG: Type C/D

See Exhibit C for a detailed soils report of the proposed project site.

4. METHODOLOGY

The study utilized a field topo to create the Existing Drainage Area Map. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Using the above criteria, the proposed site was evaluated using the Soil Conservation Service, SCS TR-55 method to calculate storm runoff volumes, peak rates of discharge, pre and post developed hydrographs and required storage volumes for detention facilities. TR-55 was first introduced in 1975 by the SCS particularly for small urbanizing watersheds. The analysis contains results for the 2, 10 and 100-year design storms.

Hydraflow Hydrographs Extension for AutoCAD Civil 3D was utilized to model the various SCS TR-55 stormwater rainfall runoff events. The following SCS TR-55 Unit Hydrograph variables were utilized;

- AMC II Soil Moisture Conditions
- 24-Hour SCS Type II Rainfall Distribution (Shape Factor 484)
- SCS Runoff Curve Numbers per SCS TR-55 (Tables 2-2a to 2-2c)

Time of Concentration has been calculated using the following formulas:

- Sheet Flow (Max. 100 LF): APWA 5602.5 Time Inlet, $T_I = 1.8 * (1.1-C) * L^{1/2} / S^{1/3}$
- Shallow Concentrated Flow: SCS TR-55 Appendix F: Unpaved $V=16.1345(S)^{0.5}$ Paved $V=20.3282(S)^{0.5}$
  Shallow Concentrated Travel Time (min): SCS TR-55 Eq-3-1, $T_t = L / V \times 60$
- Channel Flow Improved: Manning's Equation (Full Flow)
  Channel Flow Unimproved: APWA 5602.7.A. Travel Time, Table 5602-6

Avg. Channel Slope (%)	Velocity (fps)
< 2	7
2 to 5	10
>5	15

5. EXISTING CONDITIONS ANALYSIS

A building and parking lot currently exist on the northern portion of the property adjacent to Hook Road. The remainder of the site consists mainly of meadow with some sparse trees sprinkled throughout. Detention was not required for the existing development. The City is requiring that attenuation measures be utilized to meet current storm water regulations for the proposed project. The site contains one sub-basin which will encompass all of the proposed hard infrastructure improvements and a majority of the existing hard infrastructure. The sub-basin will be referred to as Sub-basin A for the purposes of this report. Sub-basin A contains 5.29 acres and drains to Point of Interest A located in the southeast portion of the site. The Existing Drainage Area Map is located in Exhibit D.

The following tables summarize the results of the Existing Conditions analysis. Composite curve number calculations by sub-basin may be found in Exhibit E. Time of concentration calculations by sub-basin may be found in Exhibit F. A complete breakdown of TR-55 unit hydrographs may be found in Exhibit G.

Table 5-1 Existing Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
A	5.29	78	13.40

Table 5-2 Existing Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	11.15	21.54	37.62

Per APWA 5608.4 and City of Lee's Summit criteria, post development peak discharge rates from the site shall not exceed those indicated 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

Per City direction all onsite area is to be multiplied by the above factors to determine allowable peak release rates. Any offsite area contributing shall utilize its percentage of existing peak discharge which will be added to allowable onsite to determine the total allowable peak discharge at the point of interest.

Allowable Release Example Calculations: Sub-basin A (2-Yr): (5.29 x 0.5) = 2.65 cfs

Table 5-3 Existing Conditions Sub-basin/Point of Interest Allowable Peak Discharge Release Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	2.65	10.58	15.87

6. PROPOSED CONDITIONS ANALYSIS

The church plans to expand their existing facility along with adding an additional parking lot. Sub-basin A will encompass the proposed improvements. Runoff will be conveyed to the proposed detention basin at POI A via the existing enclosed storm sewer system and a set of swales. Sub-basin A was analyzed in the proposed conditions analysis to determine if any negative impacts are anticipated downstream due to the new development. The proposed condition accounts for an additional 1.02 acres of impervious area. The Proposed Drainage Area Map is located in Exhibit H.

The following tables summarize the results of the Proposed Conditions analysis.

Table 6-1 Proposed Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
A	5.29	83	13.40

Table 6-2 Proposed Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	13.90	24.78	41.04

As shown above in Table 6-2 Sub-basin A will require detention to attenuate peak discharge rates below Allowable Release Rates as shown in Table 5-3 for Sub-basin A. The church has plans for future buildout on the site which would include the expansion of their existing and proposed facilities. The future improvements would consist of an additional 0.55 aces of impervious area beyond the proposed conditions accounting for an additional 1.57 acres total of impervious area. The future improvement areas have been identified with hatching on the Proposed Drainage Area Map.

The following tables summarize the results of the Future Conditions analysis.

Table 6-3 Future Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
A	5.29	85	13.40

Table 6-4 Future Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	15.04	26.02	42.27

The proposed detention system will be designed to accommodate both the Proposed and Future development as currently planned.

6.1 DETENTION

A new single stage earthen detention basin is being proposed in Sub-basin A to attenuate both proposed and future peak discharge rates. Following are a list of design parameters for the detention system.

Designation: Detention Basin A
Type: Earthen Basin
Side Slopes: 3:1 Max.
Bottom Slope: 2% Min., Turf Lined
Basin Bottom Elevation: 1006.60 @ Influent Pipe
Basin Top Berm Elevation: 1012.50

Basin Volume: 78,559 cf @ 1012.00
Control Structure: 5'x6' deep precast concrete box, with interior 6" baffle wall
Baffle Wall Orifices: (6) 1" Diameter on 4" Centers, FL=1006.30 (Bottom Orifice)
(1) 36" Wide x 12" High Rectangular Orifice, FL=1009.00
Baffle Wall Crest Elevation: N/A
Control Structure Top Elevation: 1011.18
Control Structure Overflow Weir Openings: N/A
Control Structure Influent Pipe: 24" HDPE, FL (In) = 1006.60, FL (Out) = 1006.40, L=18.70', S=1.07%
Control Structure Effluent Pipe: 24" HDPE, FL (In) = 1066.20, FL (Out) = 1006.00, L=18.53', S=1.08%
Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1011.18, Crest Length=90'
Consecutive 100-YR Q=42.27 cfs, Emergency Spillway HGL=1011.50, Freeboard=1.00'
Emergency Spillway: Q=42.27 cfs
Control Structure Overflow: N/A

The Detention Basin Plan is located in Exhibit I. See Table 6-5 for a summary of detention basin data.

Table 6-5 Future Conditions Detention Basin Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
Basin A						
2-Year	15.04	721	0.96	786	1009.16	22,256
10-Year	26.02	721	7.23	733	1009.78	33,049
100-Year	42.27	721	15.84	731	1010.68	50,265

As shown in the table above all proposed peak flowrates have been attenuated.

Table 6-6 below provides a comparison of runoff data between Proposed and Existing Conditions in addition to Proposed Conditions and Allowable Release Rates at each Point of Interest.

Table 6-6 Point of Interest Discharge Comparison

		Q2 (cfs)	**Q10 (cfs)**	**Q100 (cfs)**
Point A	Proposed	0.96	7.23	15.84
	Existing	11.15	21.54	37.62
	Difference	-10.19	-14.31	-21.78
	Allowable	2.65	10.58	15.87
	Difference	-1.69	-3.35	-0.03

Peak discharge rates at Point A will be reduced below allowable for all design storms analyzed.

7. 40 HOUR EXTENDED DETENTION/INFILTRATION BMP

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The proposed detention facilities will release the water quality event over a period of 40-72 hours. See Exhibit J for 40 hour extended detention calculations for Basin A.

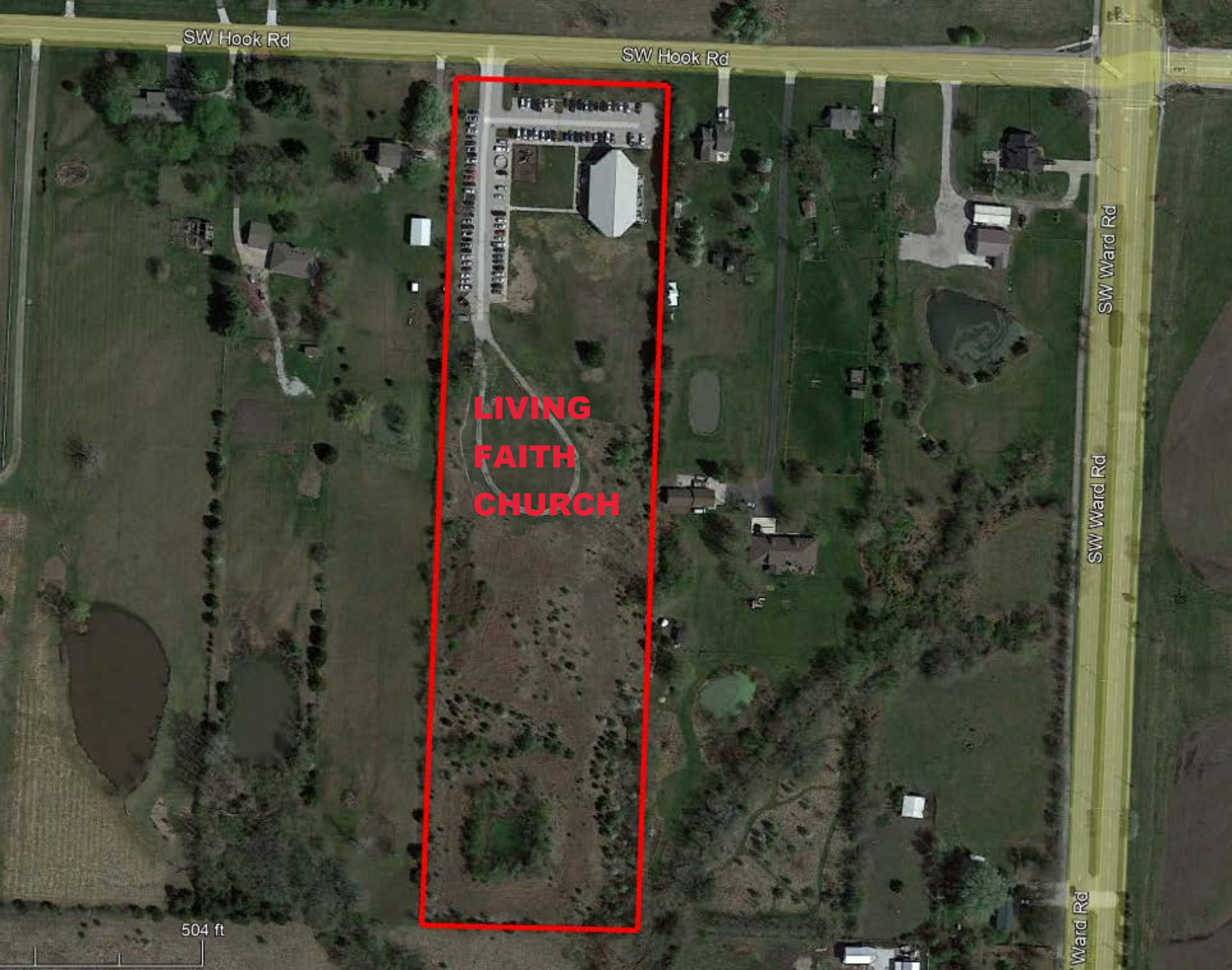
8. CONCLUSIONS & RECOMMENDATIONS

This macro storm water drainage study reveals that the proposed development will not generate any negative downstream hydraulic impacts. A new earthen detention basin is being proposed to provide detention for the proposed development along with a potential future addition. In conclusion, both proposed and future peak discharge rates for POI A are below both existing and allowable release rates. The study is in conformance with

all applicable City of Lee's Summit standards and criteria therefore Engineering Solutions recommends approval of this macro storm water drainage study.

Exhibit A

Aerial Image
&
Aerial Image of Surrounding Area


SW Hook Rd
SW Hook Rd
SW Ward Rd
SW Ward Rd
LIVING
FAITH
CHURCH
504 ft

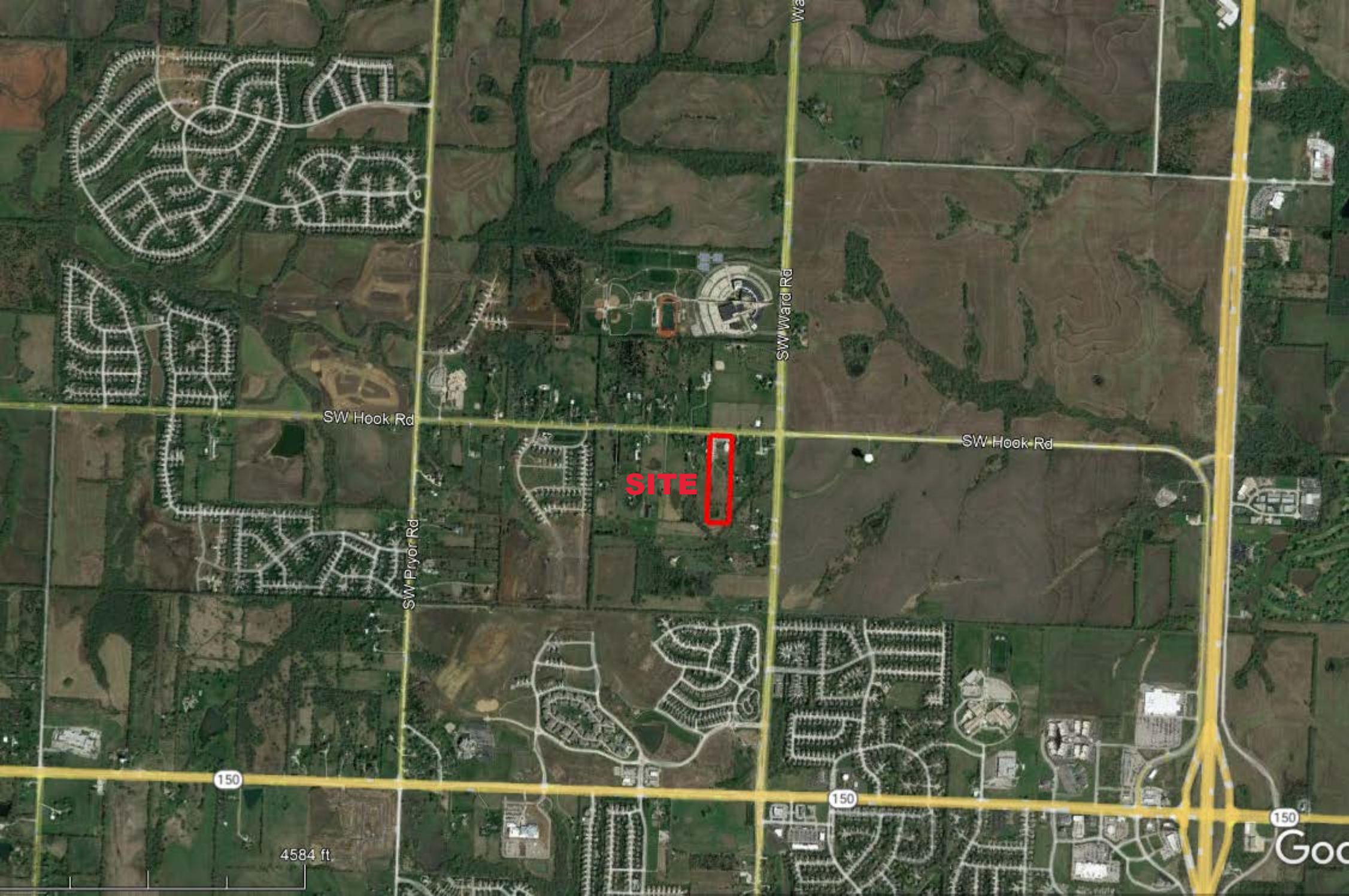

SW Hook Rd
SW Hook Rd
SW Ward Rd
SW Pryor Rd
SITE
150
150
150
4584 ft

Exhibit B

FEMA FIRMette

National Flood Hazard Layer FIRMette

FEMA

94°24'21"W 38°52'13"N

94°23'43"W 38°51'45"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/4/2022 at 3:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Exhibit C

NRCS Soil Classification Report

United States Department of Agriculture

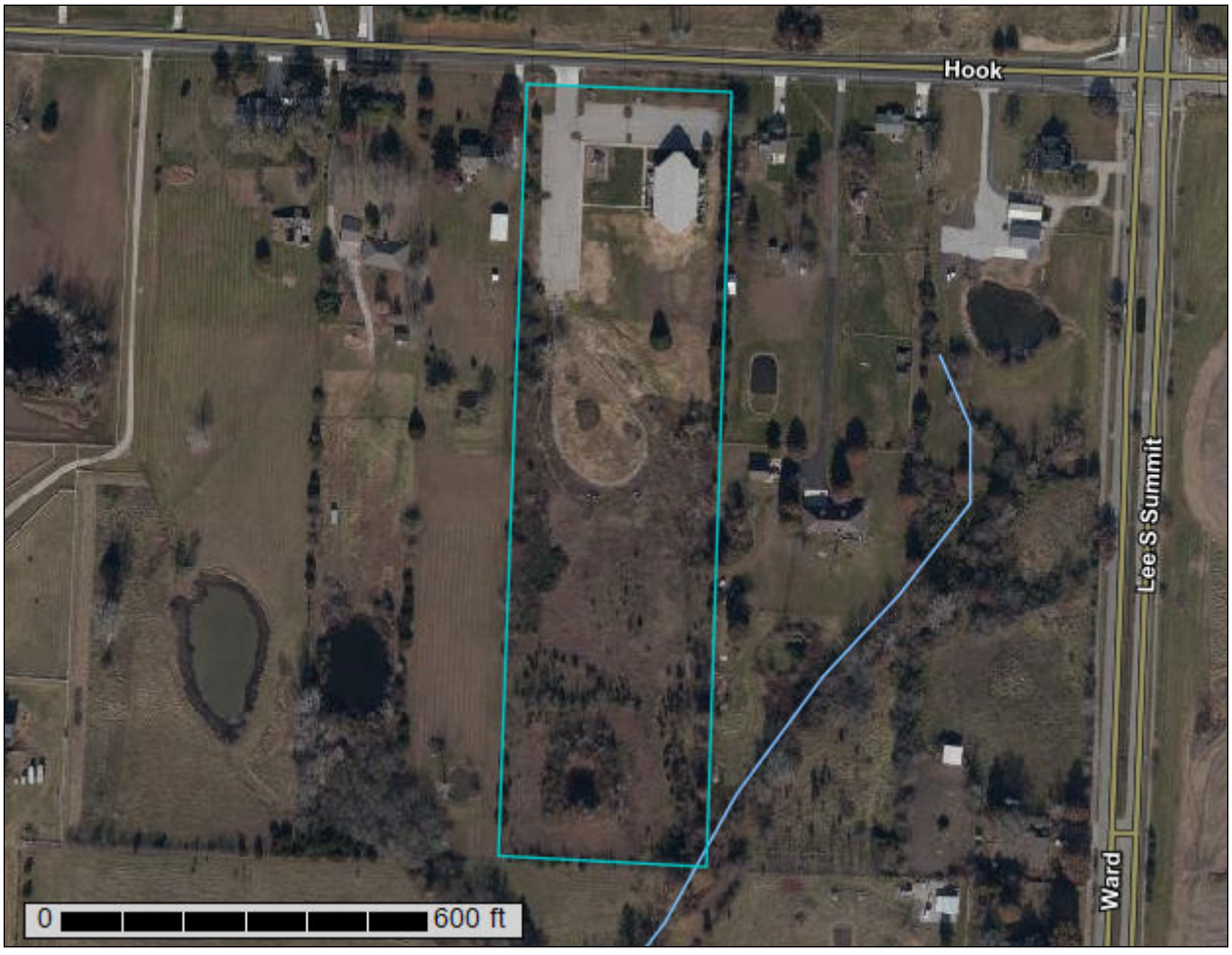
NRCS

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

LIVING FAITH CHURCH



March 4, 2022

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

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

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 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.

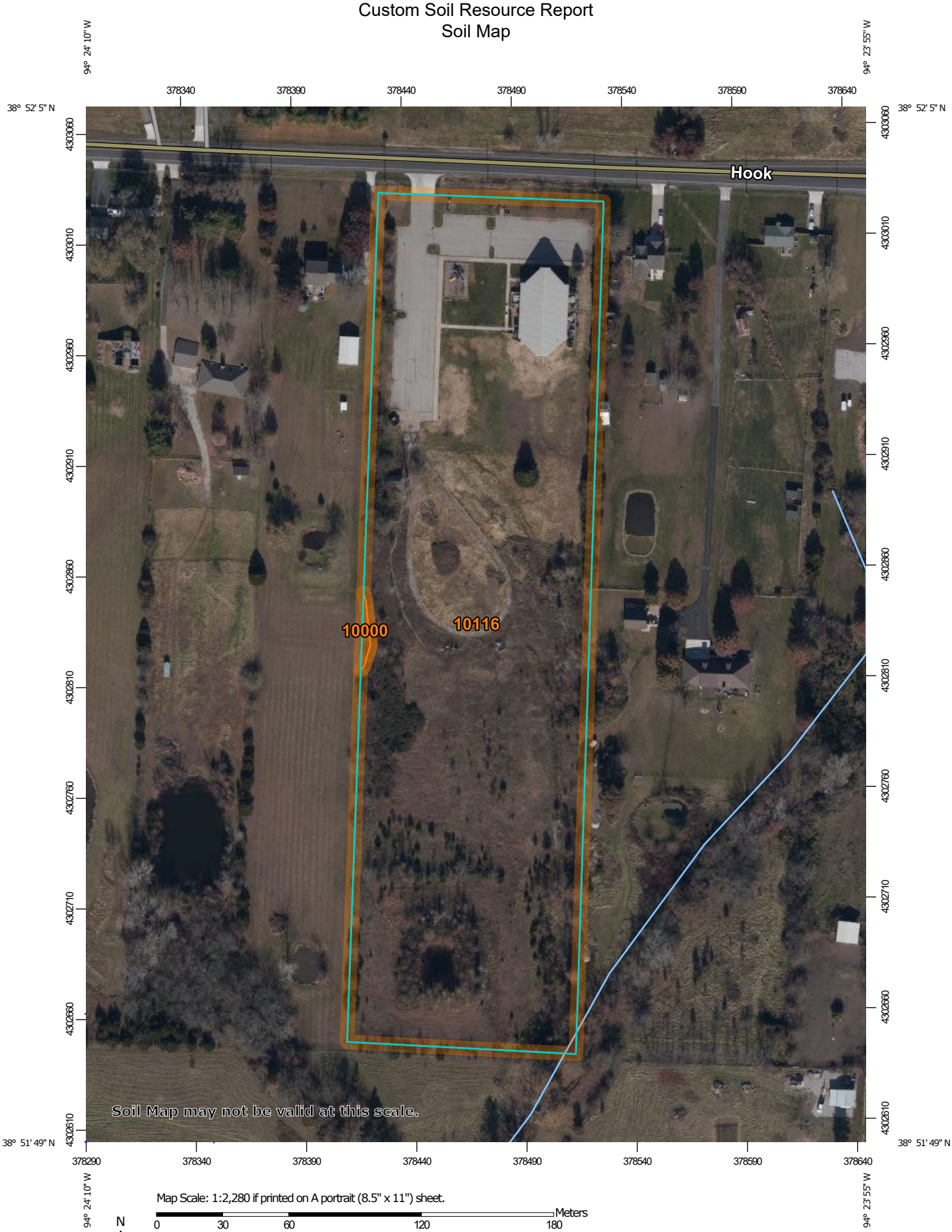
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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



Map Scale: 1:2,280 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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 23, Sep 1, 2021

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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
10000	Arisburg silt loam, 1 to 5 percent slopes	0.0	0.2%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	9.8	99.8%
Totals for Area of Interest		**9.8**	**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

10000—Arisburg silt loam, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w22b
Elevation: 610 to 1,130 feet
Mean annual precipitation: 39 to 43 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: 87 percent
Minor components: 13 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: R107BY007MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sharpsburg

Percent of map unit: 5 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

Greenton

Percent of map unit: 5 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

Haig

Percent of map unit: 3 percent
Landform: Flats
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R109XY001MO - Claypan Summit Prairie
Hydric soil rating: Yes

10116—Sampsel silty clay loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2qkzy
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Sampsel and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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, concave
Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 11 inches: silty clay loam
Bt - 11 to 80 inches: silty clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: 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 8.4 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

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Exhibit D

Existing Drainage Map

North

0 40' 80' 160'

EXISTING DRAINAGE MAP

SCALE: 1" = 80'

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005032186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

LIVING FAITH CHURCH
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Project: LIVING FAITH CHURCH-LSMO
Issue Date: January 28, 2022

Existing Drainage Map
Construction Plans for:
LIVING FAITH CHURCH
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT

Exhibit E

Composite Curve Number Calculations

LIVING FAITH CHURCH
COMPOSITE CURVE NUMBERS

A (Existing)	Area (ac.)	CN	Area x CN
IMPERVIOUS	0.88	98	86.23
PERVIOUS	4.41	74	326.35
			0.00
Total Area	5.29		412.58
Composite CN	78		

A (Proposed)	Area (ac.)	CN	Area x CN
IMPERVIOUS	1.90	98	186.20
PERVIOUS	3.39	74	250.86
			0.00
Total Area	5.29		437.06
Composite CN	83		

A (Future)	Area (ac.)	CN	Area x CN
IMPERVIOUS	2.45	98	240.10
PERVIOUS	2.84	74	210.16
			0.00
Total Area	5.29		450.26
Composite CN	85		

Exhibit F

Time of Concentration Calculations

APWA STORM DRAINAGE "TC" COMPUTATIONS FOR: LIVING FAITH CHURCH

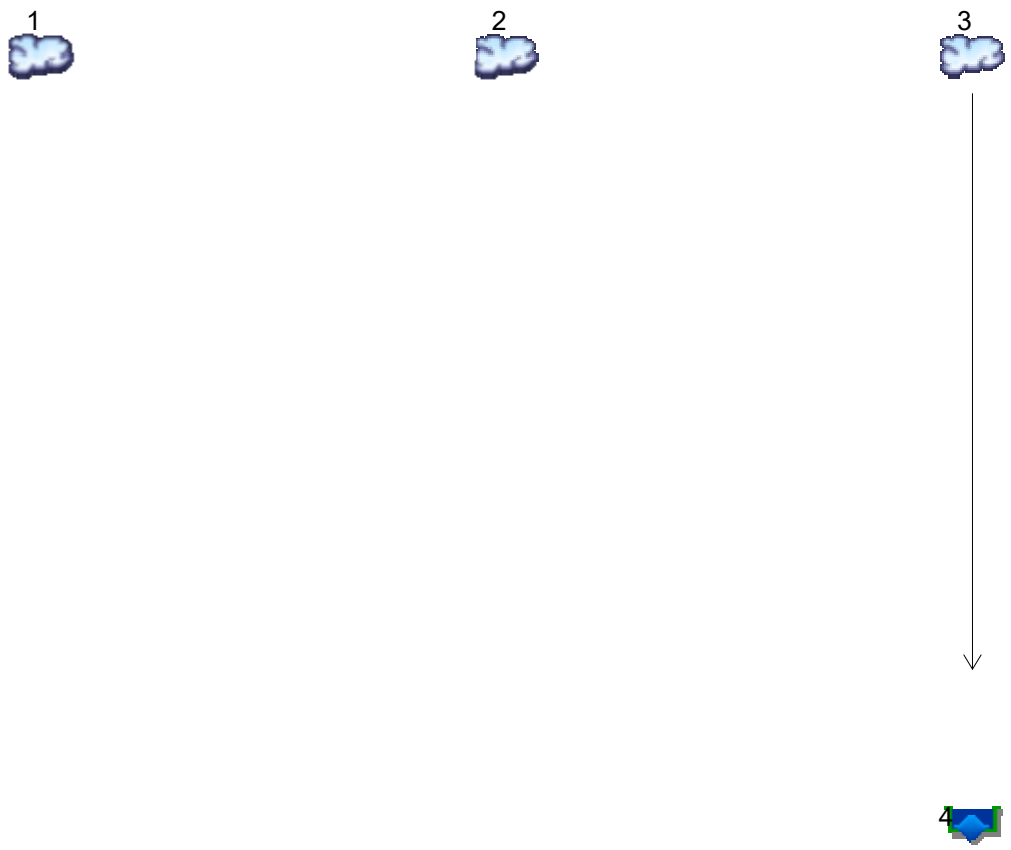
					Surface types:	Asph/Conc	Bus/Com	Dirt	Grass/Park	Lake	MultFam	SnglFam	Undev	Other							
	yellow areas are self computing				SURFACE CODES	A	B	D	G	L	M	S	U	Z							
	overwrite if necessary				"C" Values	0.90	0.87	0.60	0.30	0.90	0.66	0.51	0.3				TC COMPUTATION				
						Overwrite Length - DnElev or Slope				SURFACE	P=Paved			Overwrite Slope or Elevations							
		TOTAL WATERSHED				if necessary				CODE	U=Unpaved			if necessary		Cal	Used	Cal	Cal		
						OVERLAND FLOW - 100' MAX				P	CHANNEL FLOW - FIRST REACH					Overland	Min 5	Channel	Channel	Total	
AREA	TOTAL	WTRSHD	UP	DN	SURFACE	"C"	OVRLND	UP	DN	SLOPE	or	CHANNEL	UP	DN	SLOPE	VELOCITY	Flow	Max 15	One	Two		AREA
ID	ACRES	LENGTH	ELEV	ELEV	CODE	VALUE	LENGTH	ELEV	ELEV	%	U	LENGTH	ELEV	ELEV	%	F/S	T(I)	T(I)	T(T)	T(T)	T© 10	ID
A	5.29	1179.00	1033.00	1008.00	Z	0.40	52.0	1033.0	1031.90	2.1	P	1127.0	1031.9	1008.0	2.12	3.0	7.1	7.1	6.3	0.0	13.4	A

Exhibit G

Complete Hydraflow Report
Combination Emergency Spillway Analysis

Hydraflow Table of Contents

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX. A
2	SCS Runoff	PROP. A
3	SCS Runoff	FUTURE A
4	Reservoir	Future A Routed

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	11.15	-------	-------	21.54	-------	-------	37.62	EX. A
2	SCS Runoff	------	-------	13.90	-------	-------	24.78	-------	-------	41.04	PROP. A
3	SCS Runoff	------	-------	15.04	-------	-------	26.02	-------	-------	42.27	FUTURE A
4	Reservoir	3	-------	0.958	-------	-------	7.227	-------	-------	15.84	Future A Routed

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

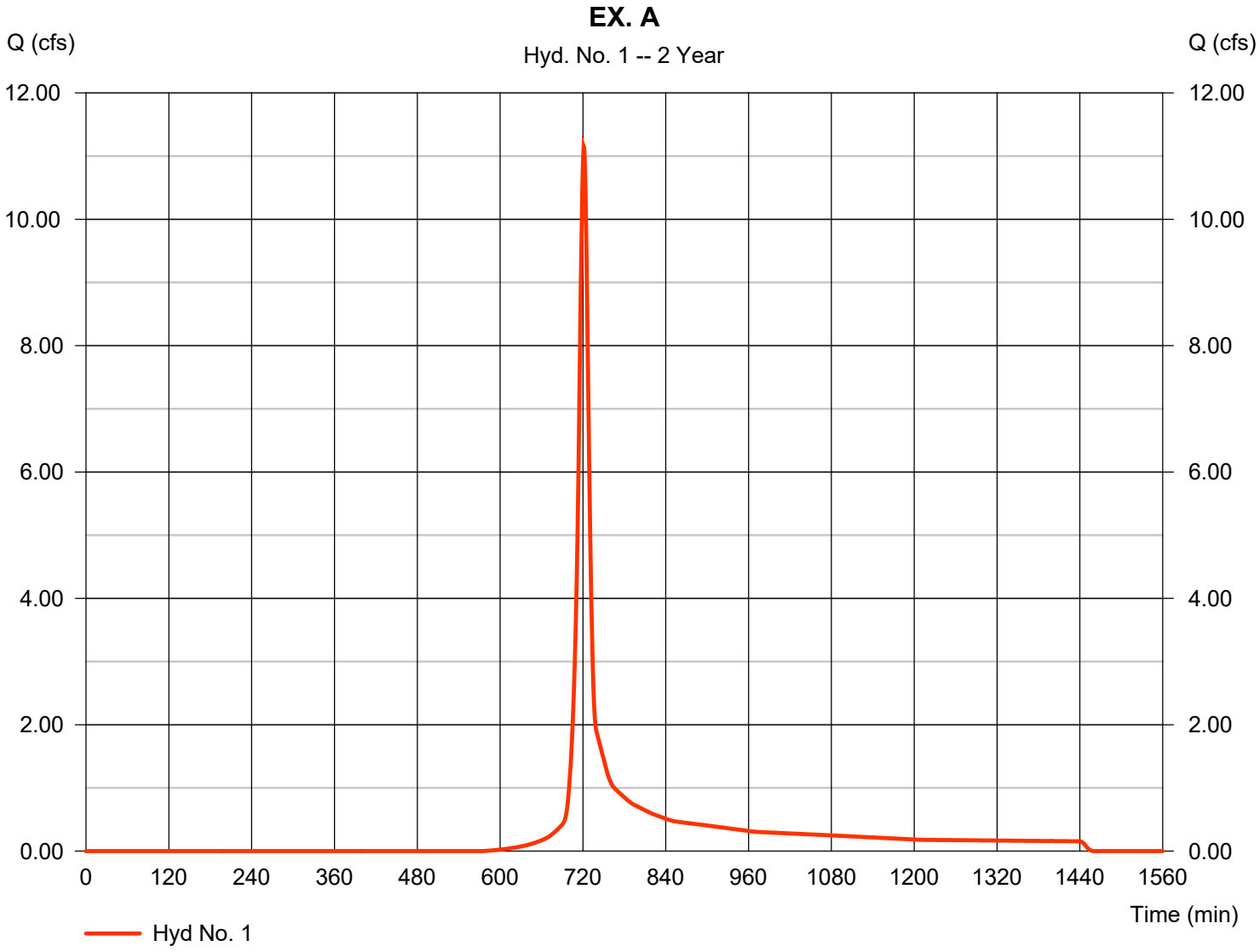
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	11.15	1	721	28,304	------	------	------	EX. A
2	SCS Runoff	13.90	1	721	35,132	------	------	------	PROP. A
3	SCS Runoff	15.04	1	721	38,115	------	------	------	FUTURE A
4	Reservoir	0.958	1	786	32,268	3	1009.16	22,256	Future A Routed

Hydrograph Report

Hyd. No. 1

EX. A

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.15 cfs
Storm frequency	=	2 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	28,304 cuft
Drainage area	=	5.290 ac	Curve number	=	78
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.40 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

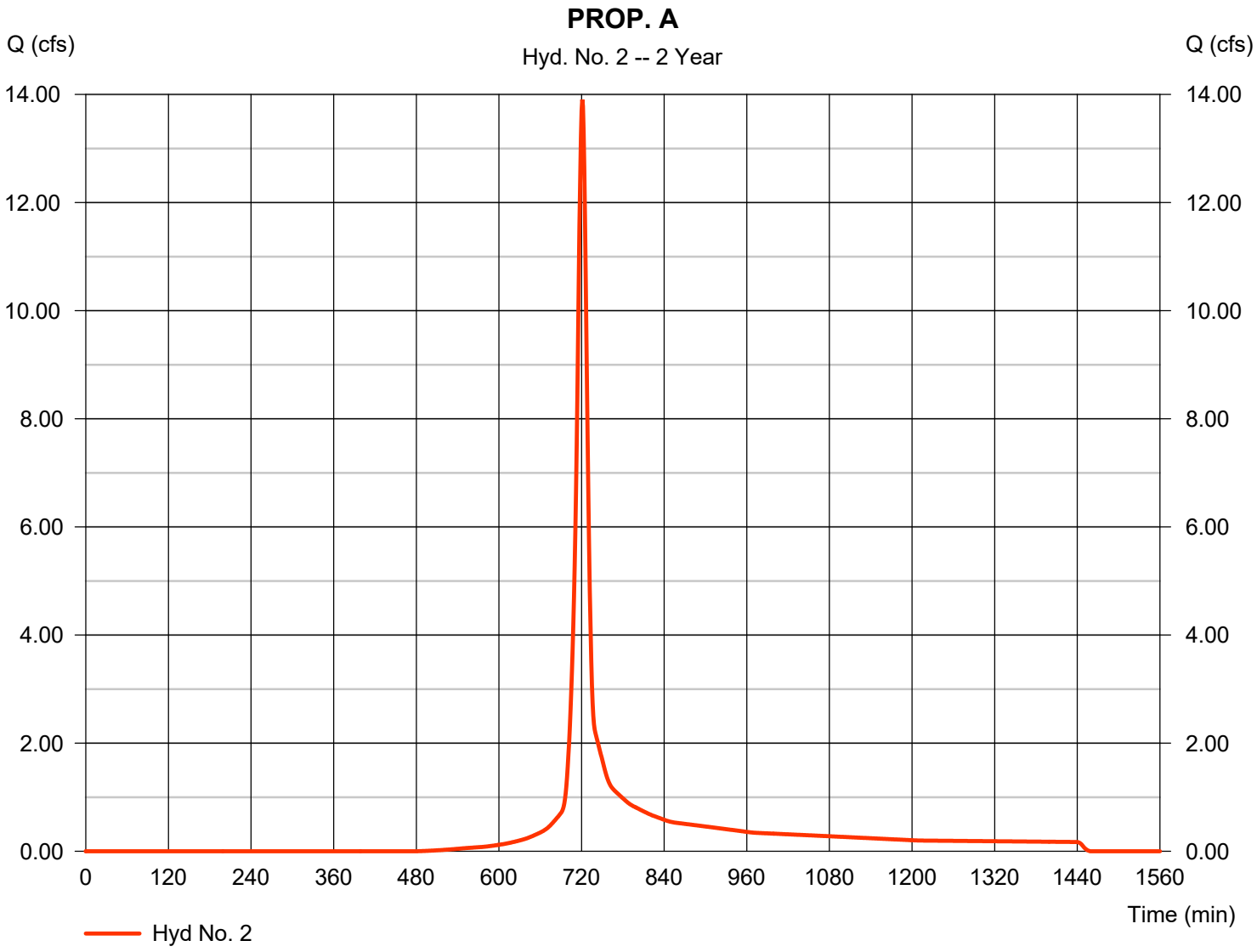


Hydrograph Report

Hyd. No. 2

PROP. A

Hydrograph type	=	SCS Runoff	Peak discharge	=	13.90 cfs
Storm frequency	=	2 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	35,132 cuft
Drainage area	=	5.290 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.40 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

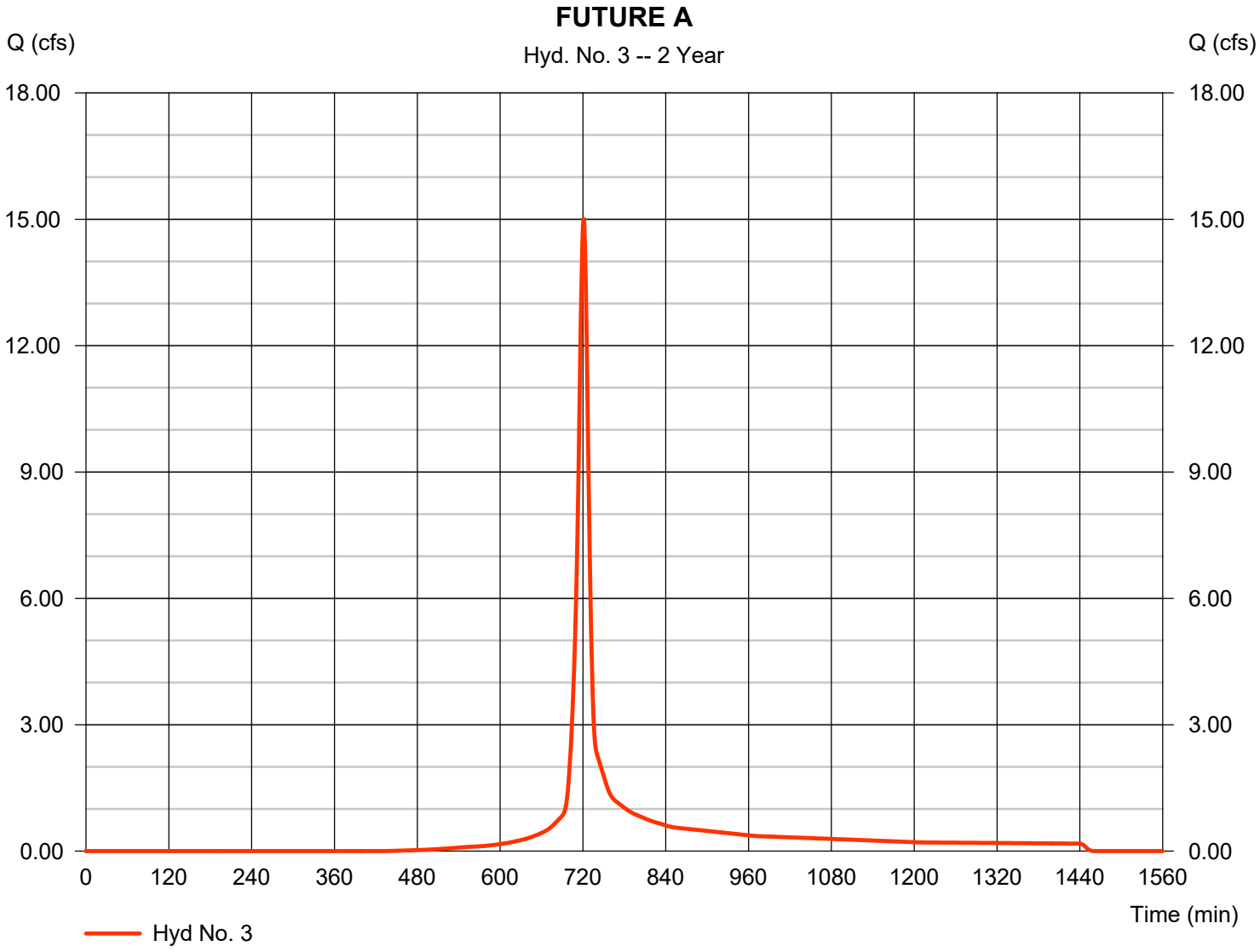


Hydrograph Report

Hyd. No. 3

FUTURE A

Hydrograph type	= SCS Runoff	Peak discharge	= 15.04 cfs
Storm frequency	= 2 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 38,115 cuft
Drainage area	= 5.290 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.40 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



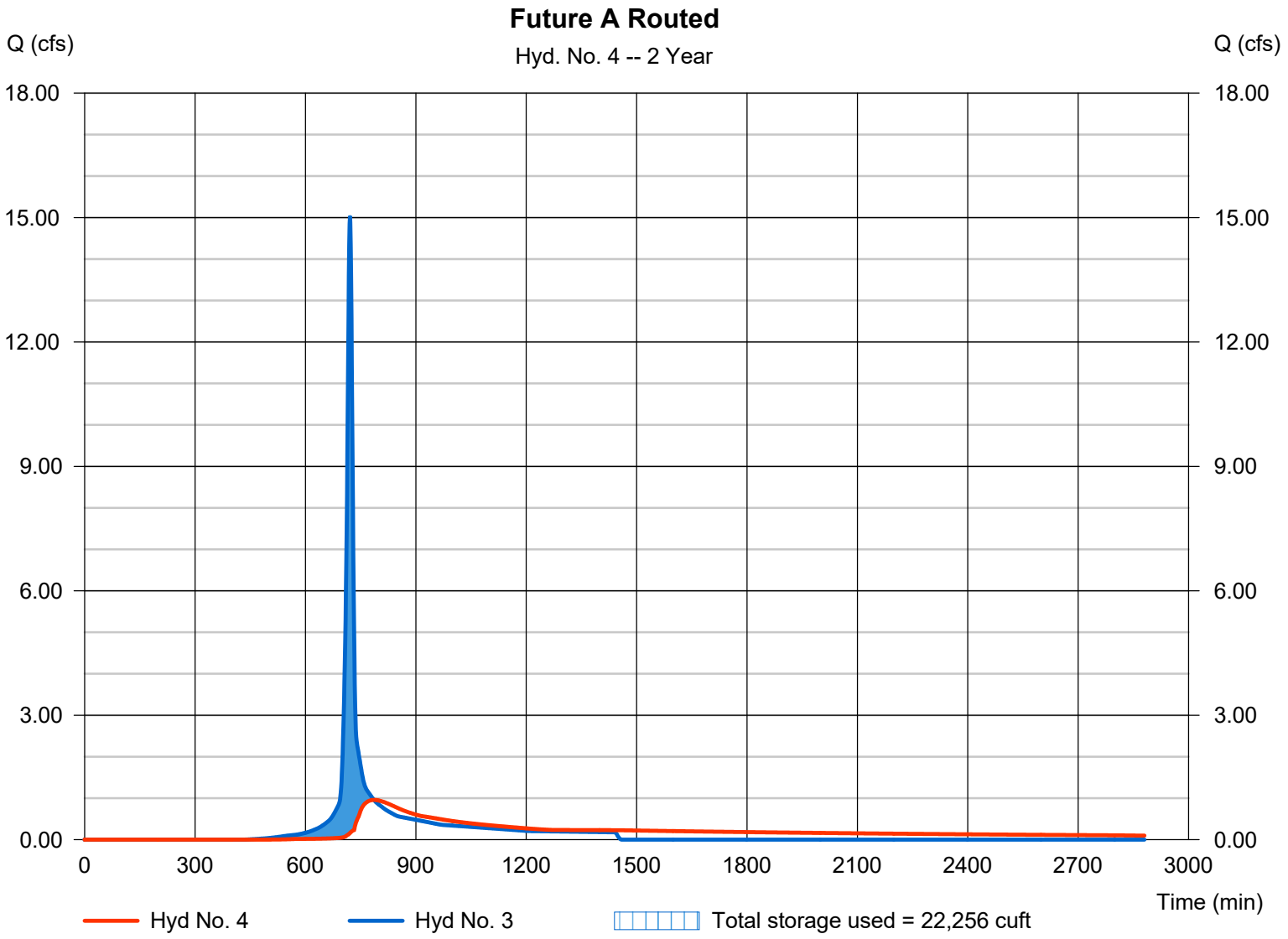
Hydrograph Report

Hyd. No. 4

Future A Routed

Hydrograph type	=	Reservoir	Peak discharge	=	0.958 cfs
Storm frequency	=	2 yrs	Time to peak	=	786 min
Time interval	=	1 min	Hyd. volume	=	32,268 cuft
Inflow hyd. No.	=	3 - FUTURE A	Max. Elevation	=	1009.16 ft
Reservoir name	=	Detention Pond	Max. Storage	=	22,256 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Detention Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 1006.60 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1006.60	00	0	0
0.40	1007.00	1,852	370	370
1.40	1008.00	9,926	5,889	6,259
2.40	1009.00	16,295	13,110	19,369
3.40	1010.00	18,751	17,523	36,892
4.40	1011.00	20,815	19,784	56,676
5.40	1012.00	22,946	21,882	78,559

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	12.00	0.00	1.00
Span (in)	= 24.00	36.00	0.00	1.00
No. Barrels	= 1	1	0	6
Invert El. (ft)	= 1006.20	1009.00	0.00	1006.30
Length (ft)	= 40.00	0.00	0.00	1.68
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .010	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	Yes

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1006.60	0.00	0.00	---	0.00	---	---	---	---	---	---	0.000
0.40	370	1007.00	1.01 ic	0.00	---	0.02	---	---	---	---	---	---	0.016
1.40	6,259	1008.00	1.01 ic	0.00	---	0.10	---	---	---	---	---	---	0.104
2.40	19,369	1009.00	1.01 ic	0.00	---	0.23	---	---	---	---	---	---	0.232
3.40	36,892	1010.00	10.35 oc	10.21 ic	---	0.14	---	---	---	---	---	---	10.35
4.40	56,676	1011.00	17.88 oc	17.69 ic	---	0.19	---	---	---	---	---	---	17.88
5.40	78,559	1012.00	23.01 ic	22.77 ic	---	0.24	---	---	---	---	---	---	23.01

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

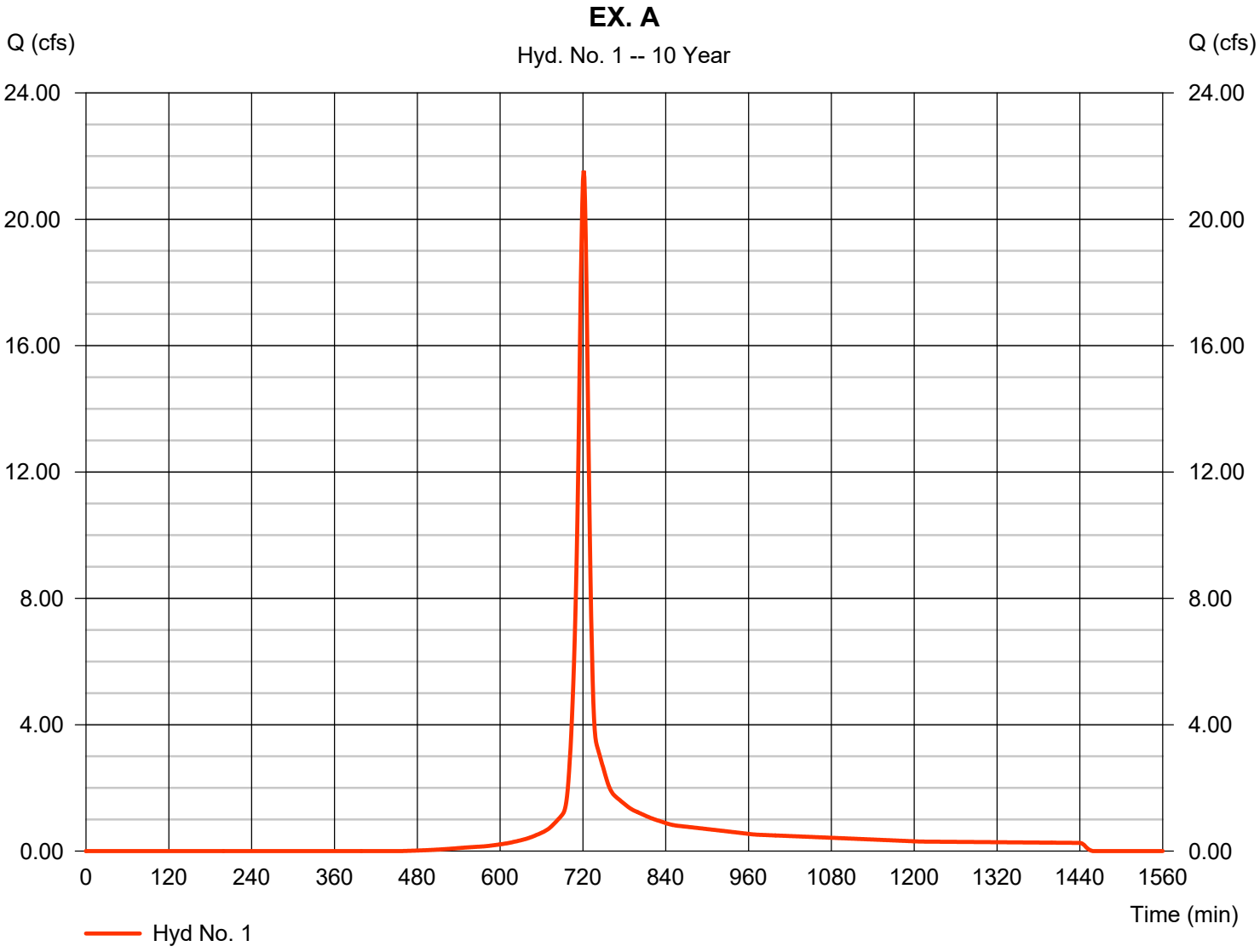
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	21.54	1	721	54,483	------	------	------	EX. A
2	SCS Runoff	24.78	1	721	63,430	------	------	------	PROP. A
3	SCS Runoff	26.02	1	721	67,168	------	------	------	FUTURE A
4	Reservoir	7.227	1	733	60,992	3	1009.78	33,049	Future A Routed

Hydrograph Report

Hyd. No. 1

EX. A

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.54 cfs
Storm frequency	=	10 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	54,483 cuft
Drainage area	=	5.290 ac	Curve number	=	78
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.40 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

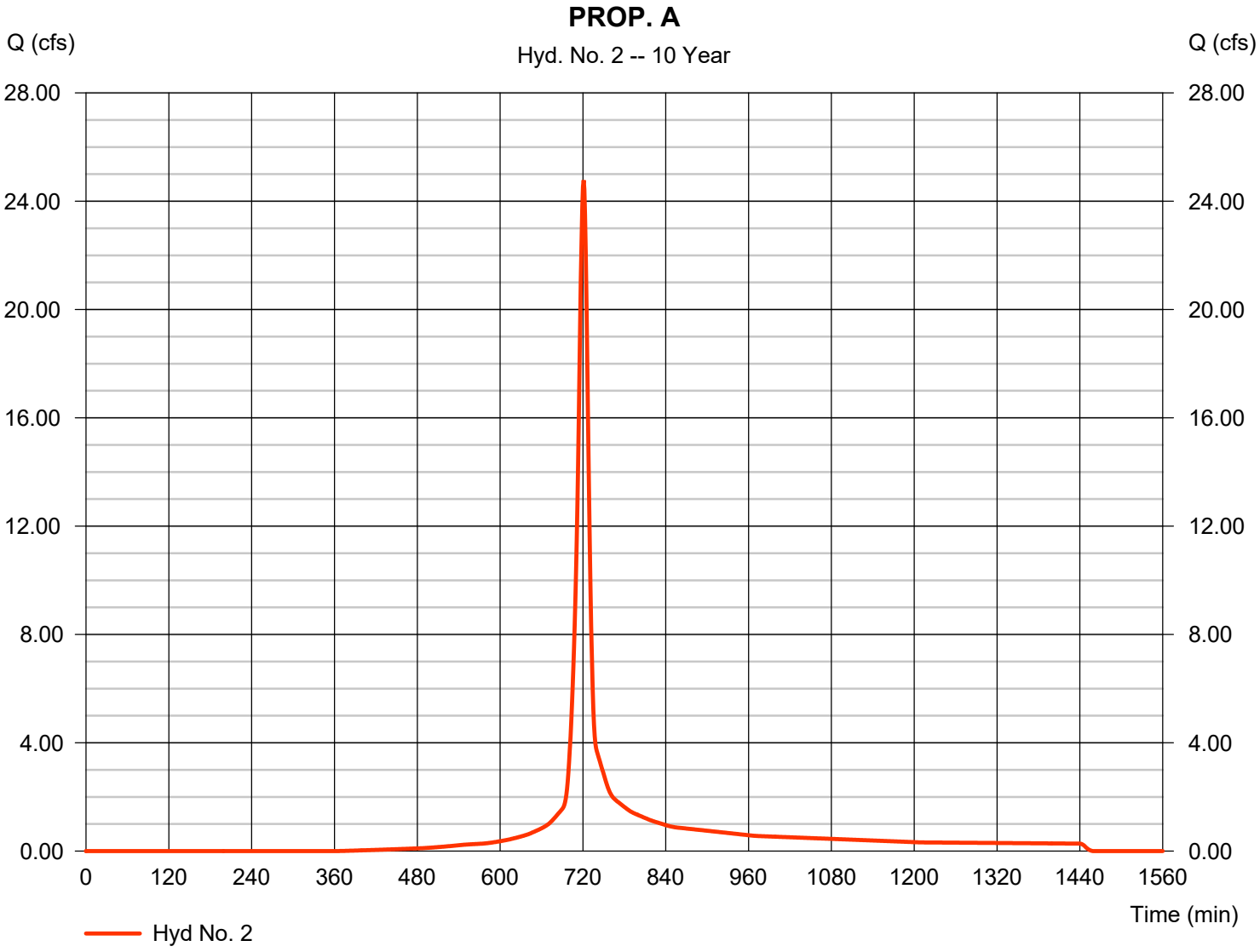


Hydrograph Report

Hyd. No. 2

PROP. A

Hydrograph type	=	SCS Runoff	Peak discharge	=	24.78 cfs
Storm frequency	=	10 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	63,430 cuft
Drainage area	=	5.290 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.40 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

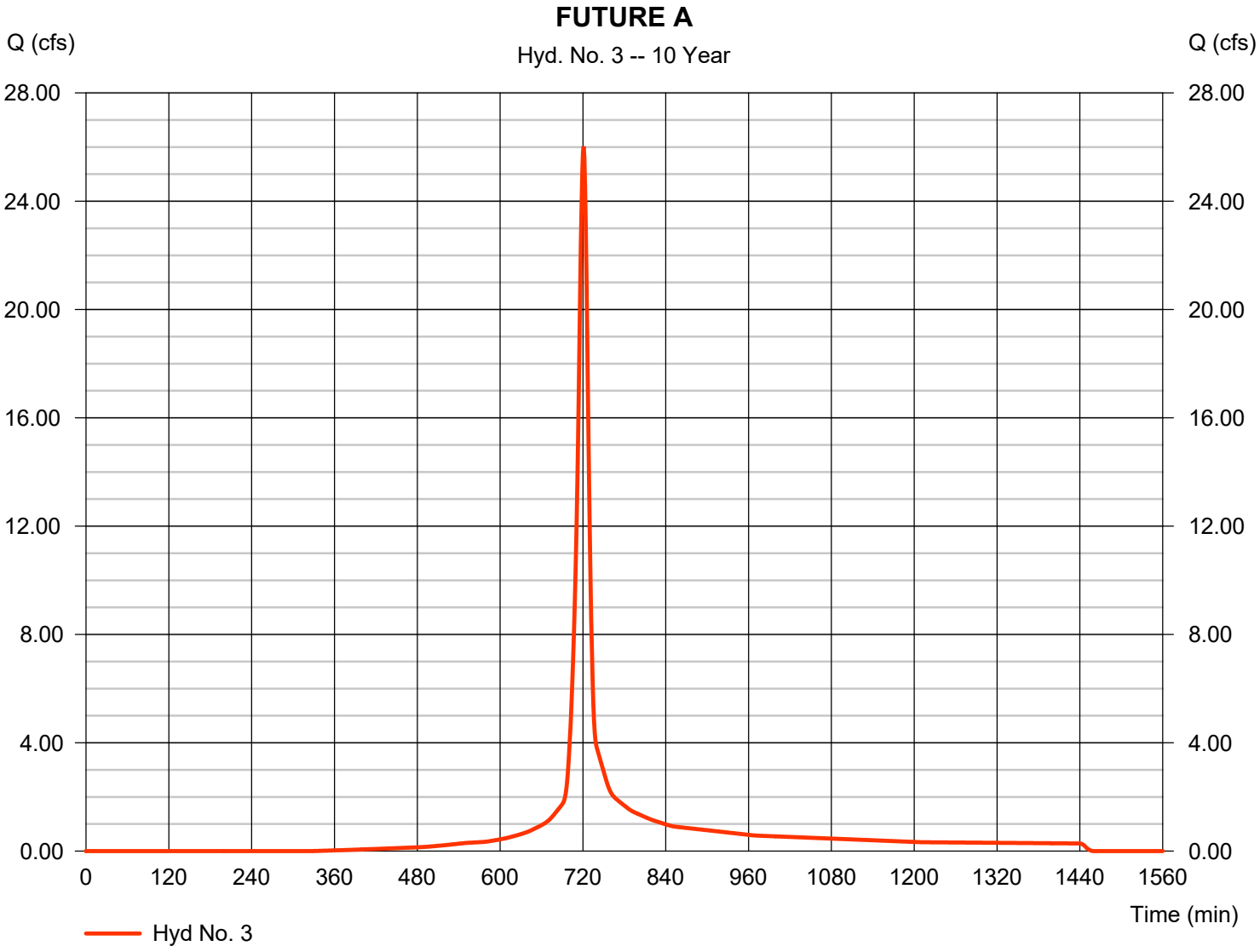


Hydrograph Report

Hyd. No. 3

FUTURE A

Hydrograph type	=	SCS Runoff	Peak discharge	=	26.02 cfs
Storm frequency	=	10 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	67,168 cuft
Drainage area	=	5.290 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.40 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



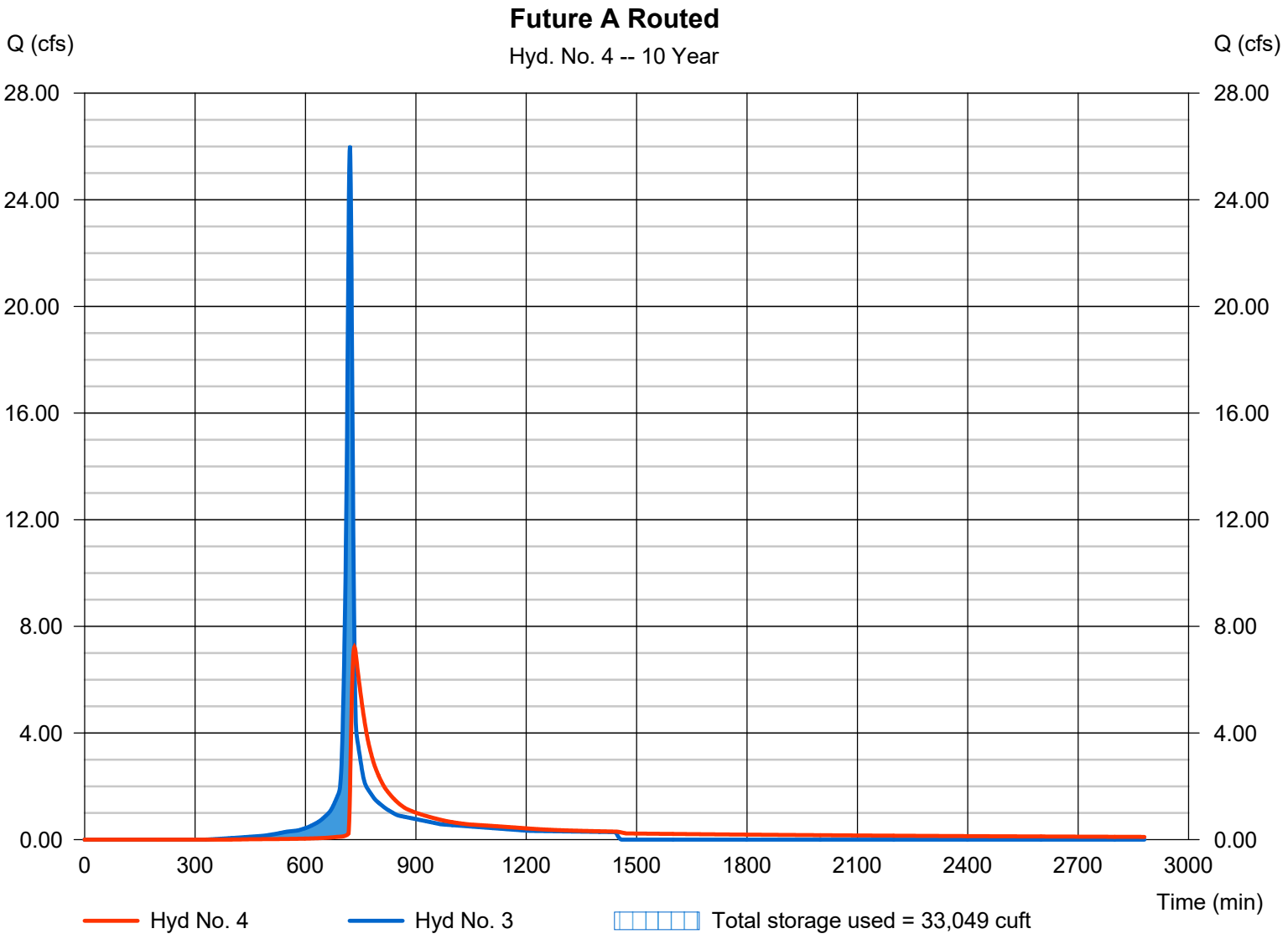
Hydrograph Report

Hyd. No. 4

Future A Routed

Hydrograph type	=	Reservoir	Peak discharge	=	7.227 cfs
Storm frequency	=	10 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	60,992 cuft
Inflow hyd. No.	=	3 - FUTURE A	Max. Elevation	=	1009.78 ft
Reservoir name	=	Detention Pond	Max. Storage	=	33,049 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

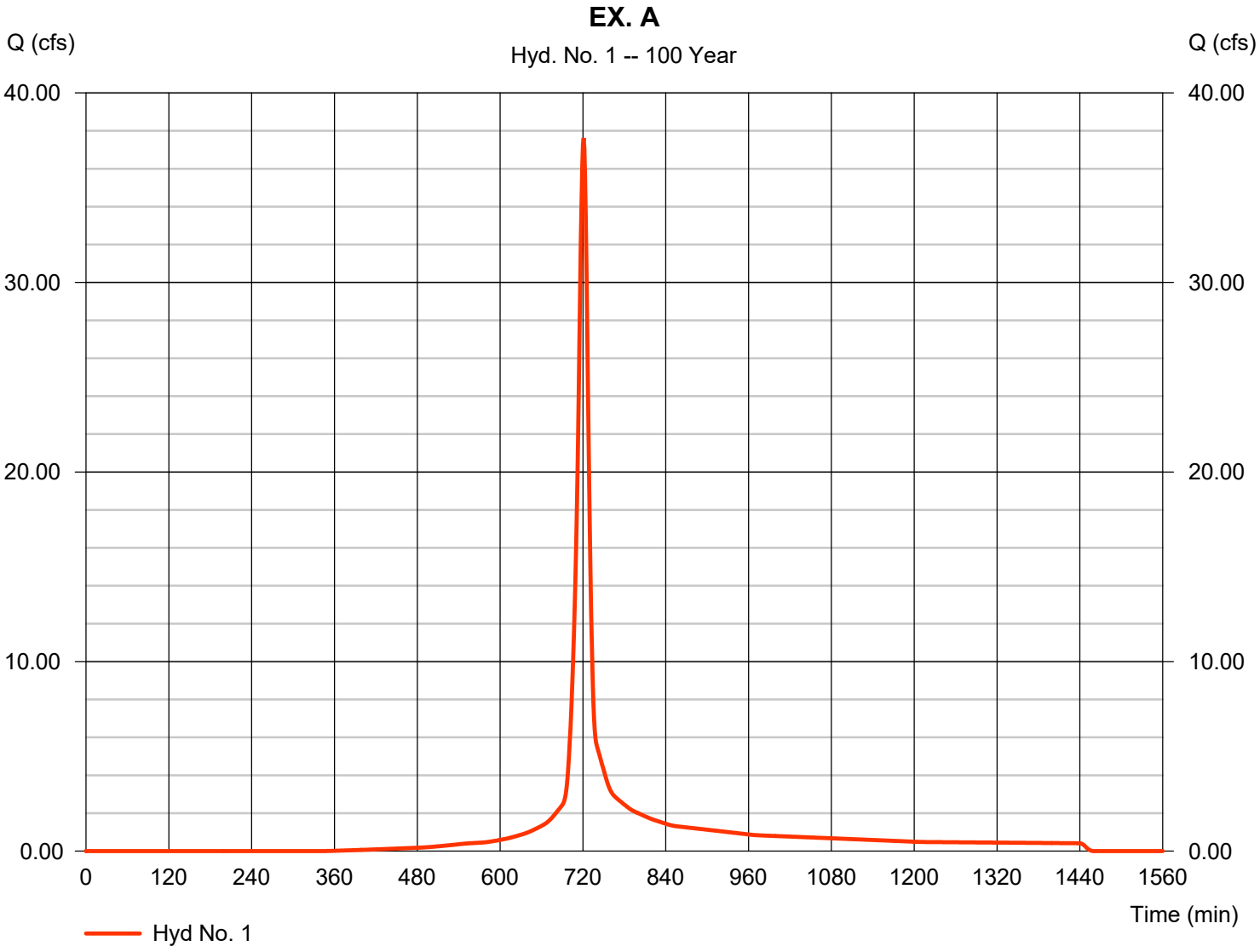
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	37.62	1	721	96,676	------	------	------	EX. A
2	SCS Runoff	41.04	1	721	107,583	------	------	------	PROP. A
3	SCS Runoff	42.27	1	721	111,982	------	------	------	FUTURE A
4	Reservoir	15.84	1	731	105,579	3	1010.68	50,265	Future A Routed

Hydrograph Report

Hyd. No. 1

EX. A

Hydrograph type	=	SCS Runoff	Peak discharge	=	37.62 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	96,676 cuft
Drainage area	=	5.290 ac	Curve number	=	78
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.40 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

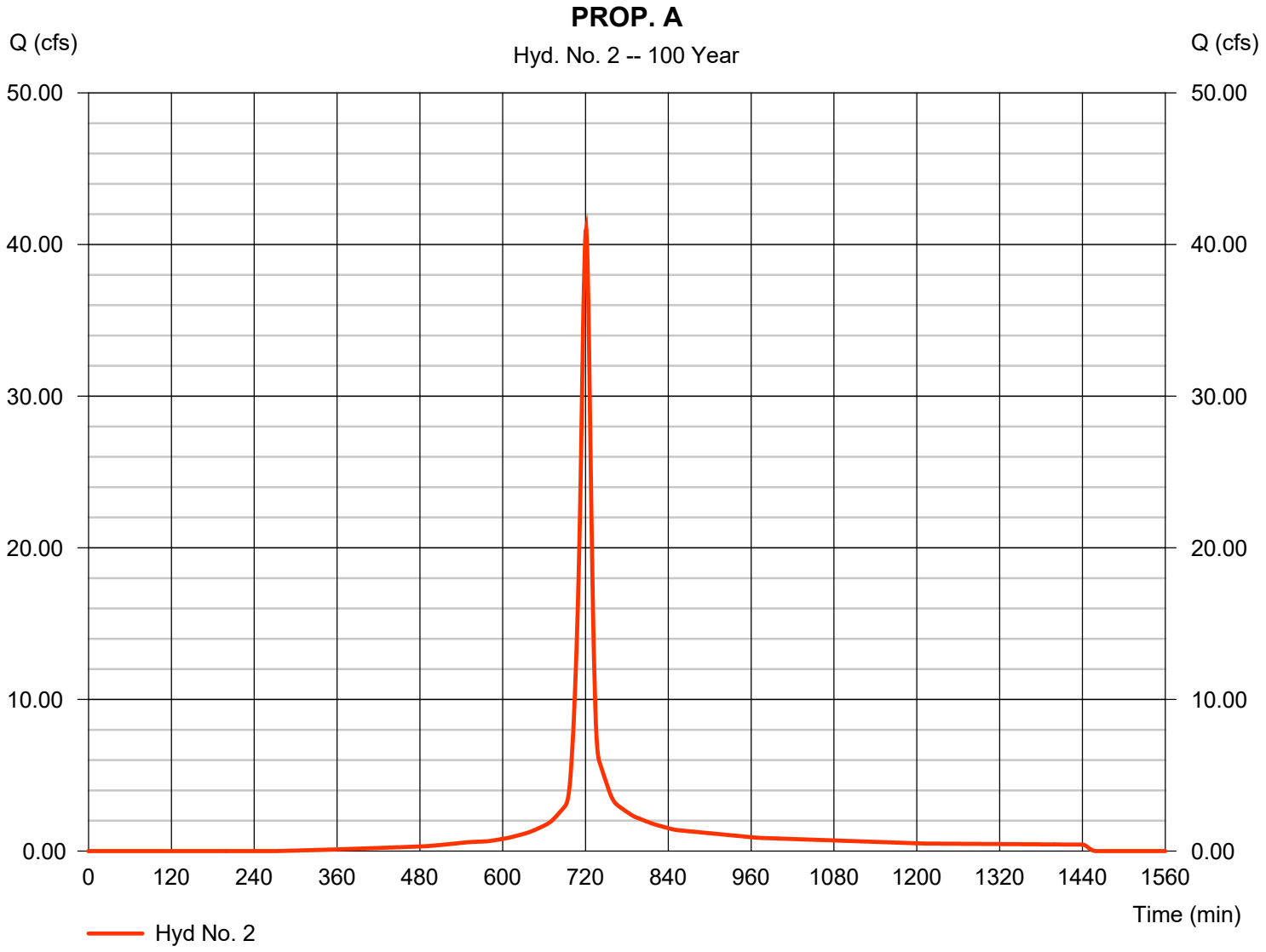


Hydrograph Report

Hyd. No. 2

PROP. A

Hydrograph type	= SCS Runoff	Peak discharge	= 41.04 cfs
Storm frequency	= 100 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 107,583 cuft
Drainage area	= 5.290 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.40 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

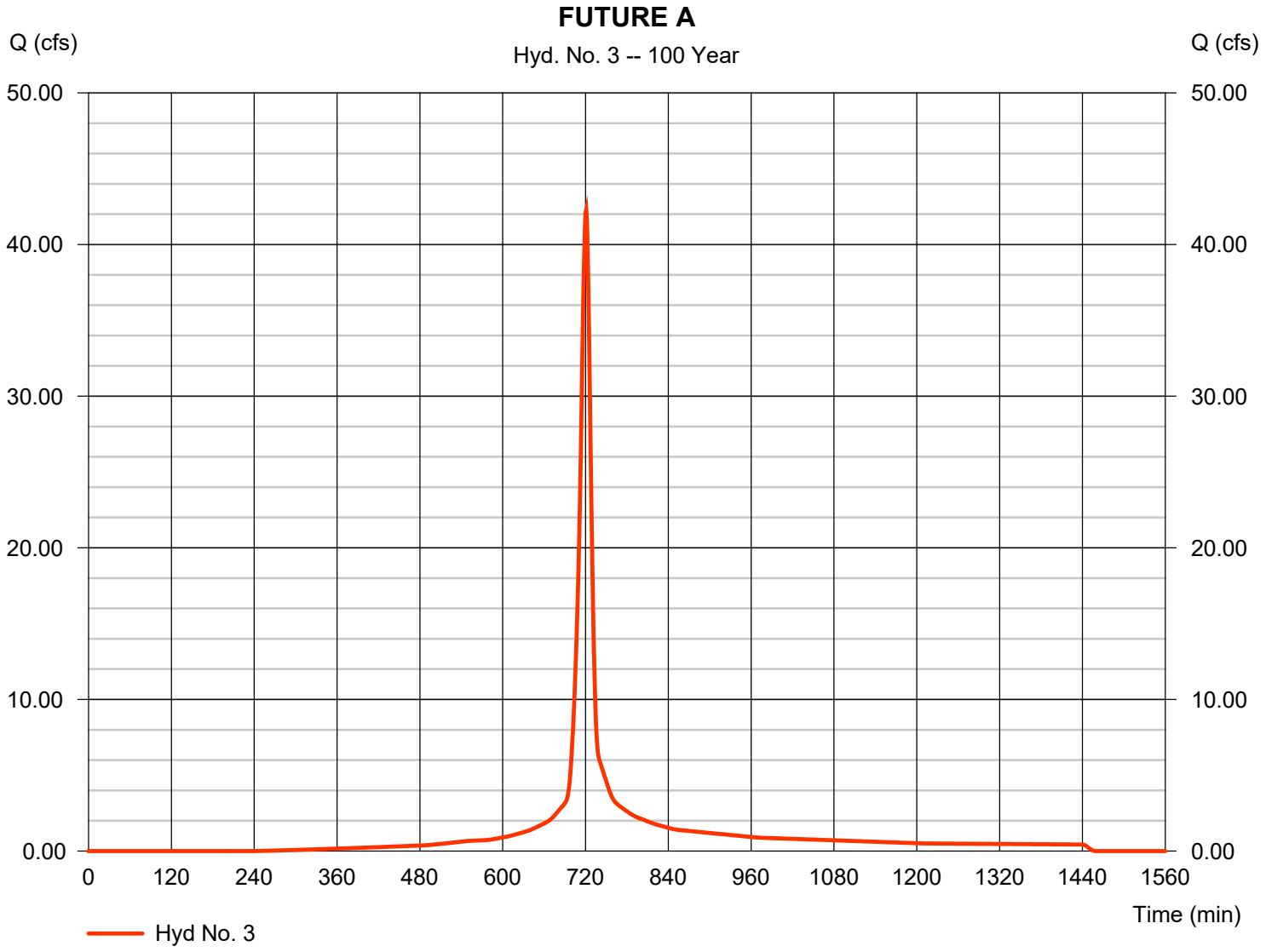


Hydrograph Report

Hyd. No. 3

FUTURE A

Hydrograph type	=	SCS Runoff	Peak discharge	=	42.27 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	111,982 cuft
Drainage area	=	5.290 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.40 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



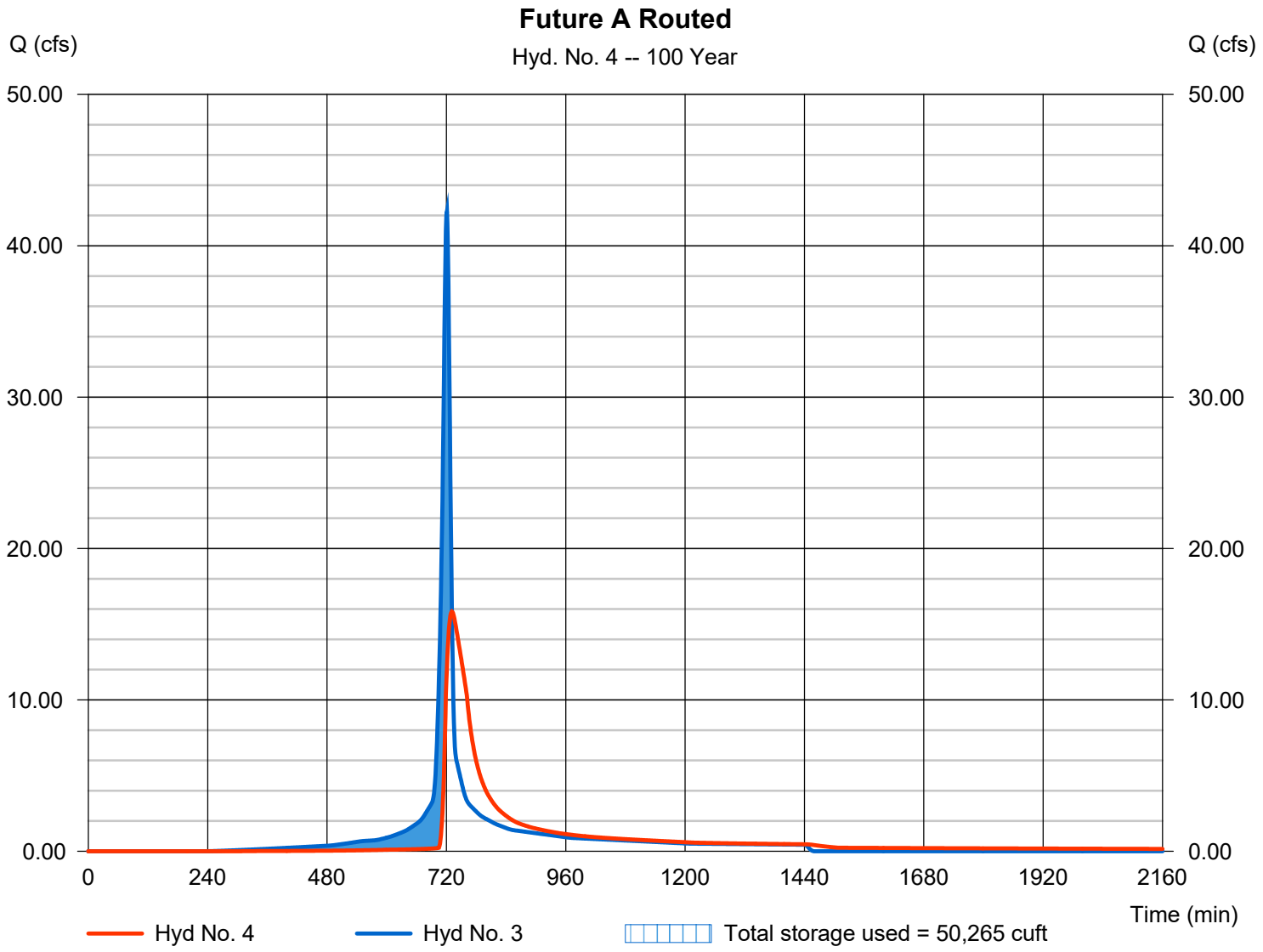
Hydrograph Report

Hyd. No. 4

Future A Routed

Hydrograph type	=	Reservoir	Peak discharge	=	15.84 cfs
Storm frequency	=	100 yrs	Time to peak	=	731 min
Time interval	=	1 min	Hyd. volume	=	105,579 cuft
Inflow hyd. No.	=	3 - FUTURE A	Max. Elevation	=	1010.68 ft
Reservoir name	=	Detention Pond	Max. Storage	=	50,265 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	64.1474	17.7000	0.8922	--------
2	95.7859	19.2000	0.9317	--------
3	0.0000	0.0000	0.0000	--------
5	118.7799	19.1000	0.9266	--------
10	125.1300	18.2000	0.9051	--------
25	158.9867	18.7000	0.9180	--------
50	171.2459	18.3000	0.9078	--------
100	187.3624	18.1000	0.9031	--------

File name: KCMO.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.96	3.31	2.86	2.52	2.25	2.04	1.87	1.72	1.60	1.49	1.40	1.32
2	4.92	4.13	3.56	3.14	2.81	2.54	2.32	2.14	1.98	1.85	1.73	1.63
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.23	5.23	4.51	3.98	3.56	3.22	2.94	2.71	2.52	2.35	2.20	2.07
10	7.27	6.09	5.26	4.63	4.14	3.75	3.43	3.16	2.93	2.74	2.57	2.42
25	8.70	7.30	6.30	5.54	4.96	4.49	4.10	3.78	3.51	3.27	3.07	2.89
50	9.83	8.24	7.11	6.26	5.60	5.07	4.64	4.27	3.97	3.70	3.47	3.27
100	11.00	9.21	7.95	7.00	6.26	5.67	5.19	4.78	4.44	4.14	3.89	3.66

Tc = time in minutes. Values may exceed 60.

Precip. file name: Z:\acad\KCMO.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	3.50	3.50	0.00	3.30	5.20	6.00	6.80	7.70
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	3.25	3.10	0.00	4.01	4.64	5.52	6.21	6.90
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, May 31 2022

Emergency Spillway

Rectangular Weir

Crest	= Broad
Bottom Length (ft)	= 90.00
Total Depth (ft)	= 1.32

Calculations

Weir Coeff. Cw	= 2.60
Compute by:	Known Q
Known Q (cfs)	= 42.27

Highlighted

Depth (ft)	= 0.32
Q (cfs)	= 42.27
Area (sqft)	= 28.74
Velocity (ft/s)	= 1.47
Top Width (ft)	= 90.00

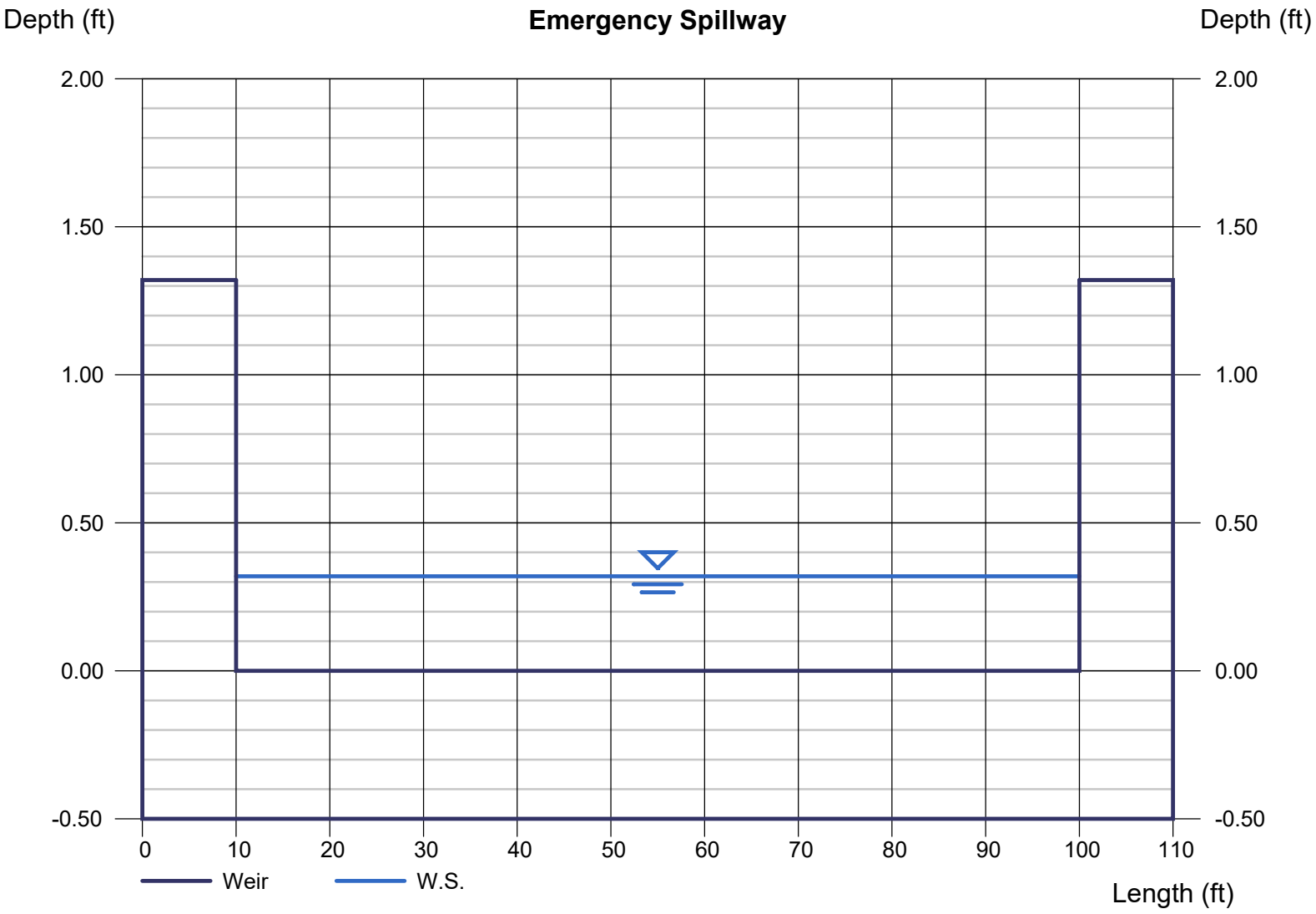
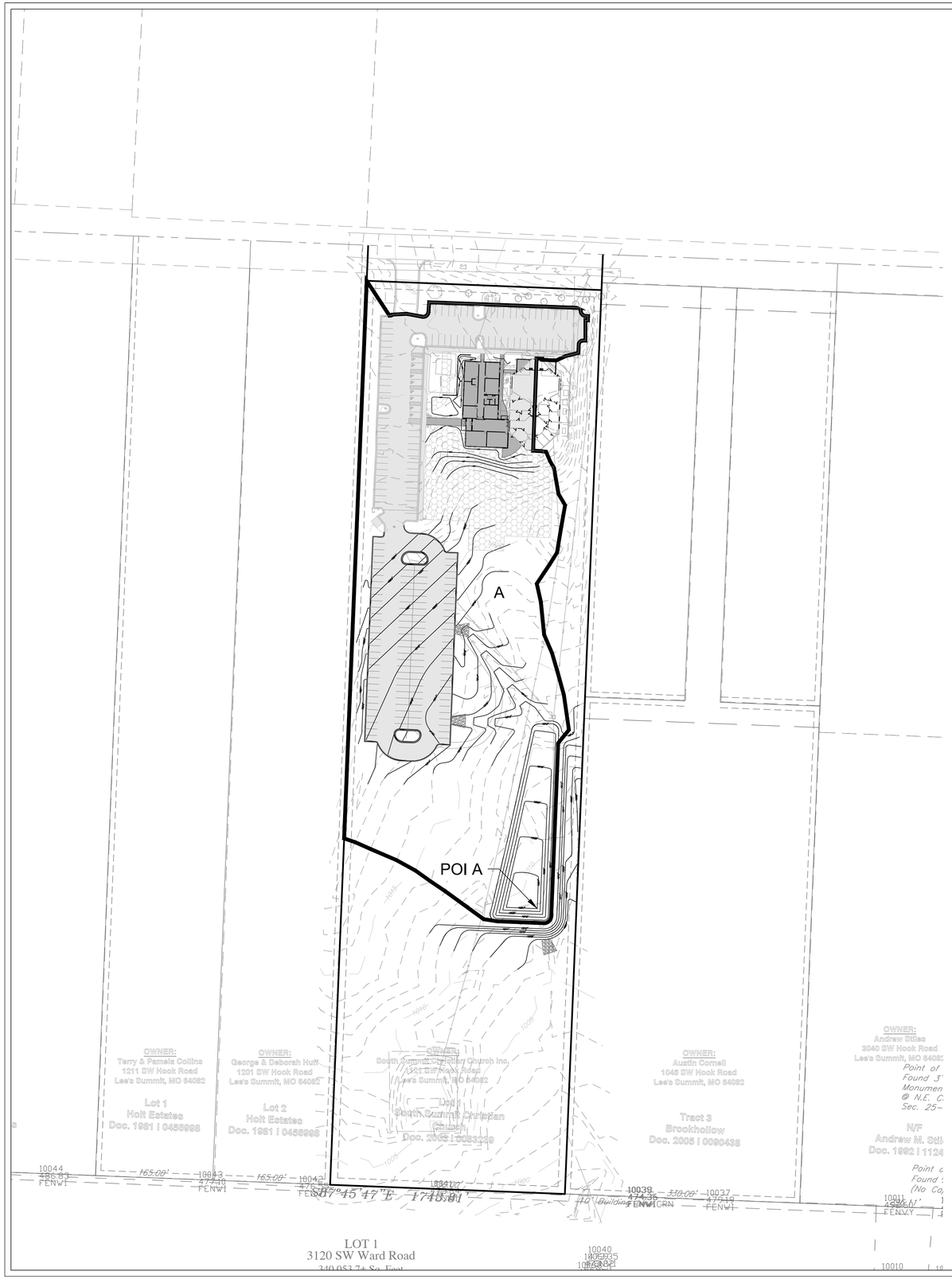


Exhibit H

Proposed Drainage Area Map



North

0 40' 80' 160'

PROPOSED DRAINAGE MAP

SCALE: 1" = 80'

EXISTING IMPERVIOUS

PROPOSED IMPERVIOUS

FUTURE IMPERVIOUS

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1895
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

LIVING FAITH CHURCH
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Project: LIVING FAITH CHURCH-113MO

Issue Date: January 28, 2022

Proposed Drainage Map
Construction Plans for:
LIVING FAITH CHURCH
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2006019708
PROFESSIONAL ENGINEER

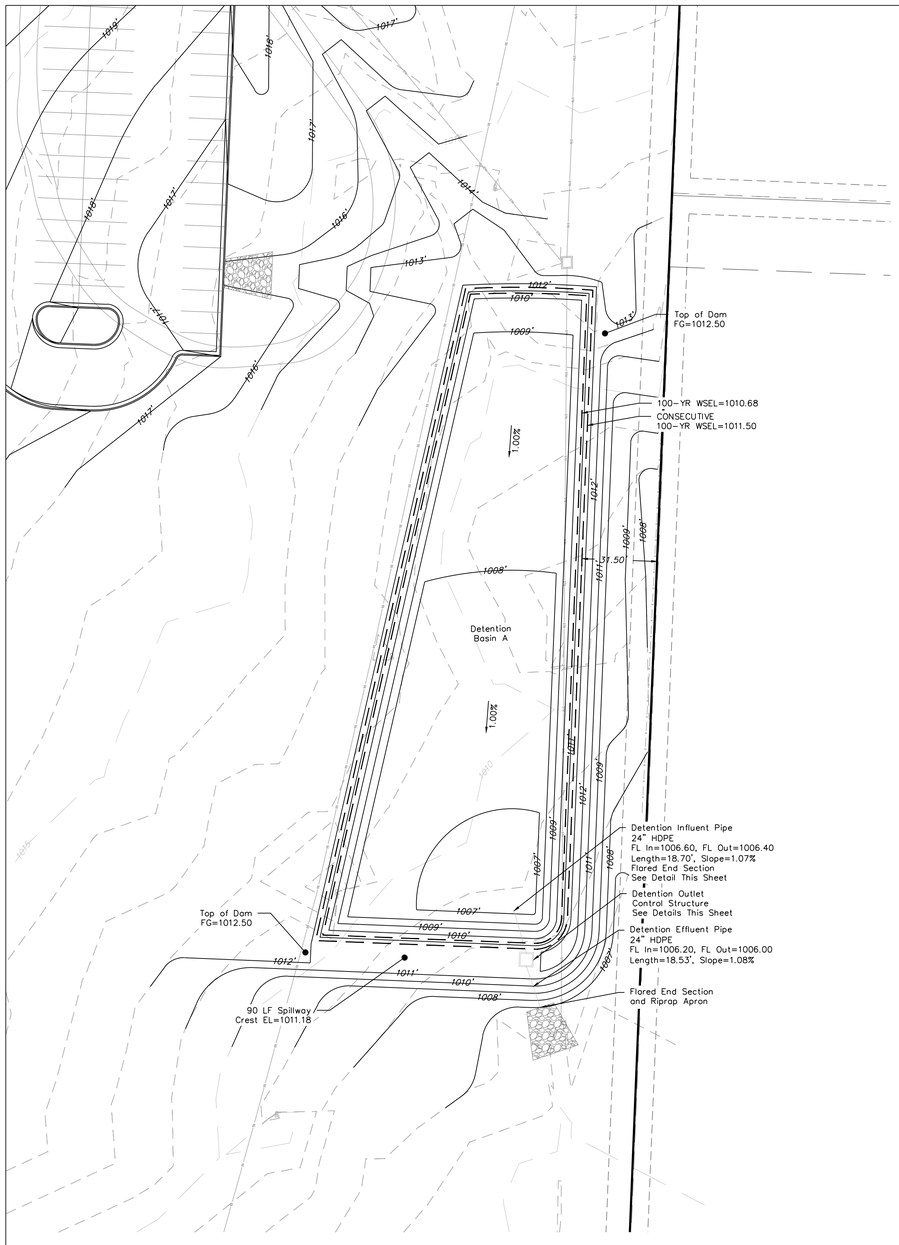
Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT

Exhibit I

Detention Basin Plan



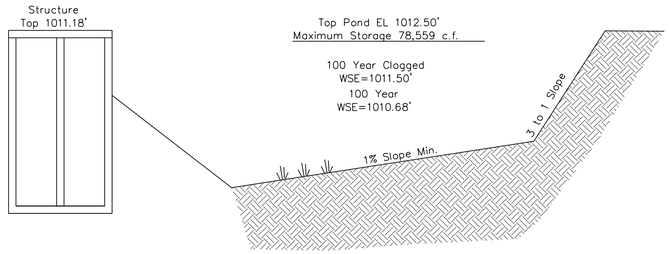
North

0 15' 30' 60'

DETENTION BASIN PLAN

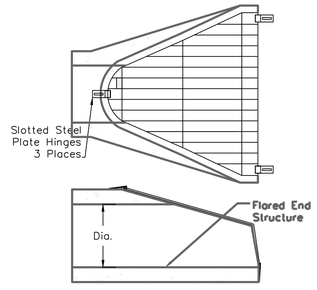
SCALE: 1" = 30'

NOTES:
1. THE BASIN SHALL BE CONSTRUCTED WITH THE EROSION AND SEDIMENT CONTROL MEASURES.
2. AN AS-BUILT DETENTION BASIN PLAN SHALL BE SUBMITTED AND ACCEPTED PRIOR TO ISSUANCE OF A CERTIFICATE OF SUBSTANTIAL COMPLETION, WITH AS-BUILT VERSUS PROPOSED STORAGE.

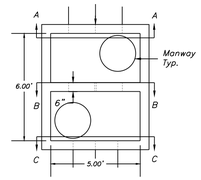


SECTION VIEW – BASIN A

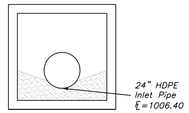
N.T.S.



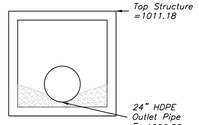
Galvanized
Trash Guard
For Influent Flared Ends



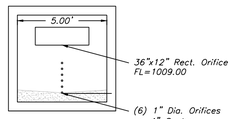
SECTION A-A



SECTION C-C



SECTION B-B



CONTROL STRUCTURE – BASIN A

1" = 1'-0"

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005032186-D
Surveying 2005008319-D
Kansas
Engineering E-1895
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

LIVING FAITH CHURCH
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Project: LIVING FAITH CHURCH-LSMO
Issue Date: January 28, 2022

Proposed Drainage Map
Construction Plans for:
LIVING FAITH CHURCH
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT

Exhibit J

40 Hour Extended Detention Calculations

Calculate Water Quality for Storm Study

Project: LIVING FAITH CHURCH Date: 3-8-22

To Calculate: WQv = P * Rv * A

P (in) =	1.37
P (ft) =	0.11
Impervious Area (sq. ft.) =	107,542.80
Total Area (sq. ft.) =	230,432.40
Impervious Area (ac) =	2.47
Total Area (acre) =	5.29
Rv = (0.05 * 0.009(I)) =	0.47
Percent Impervious (I) =	46.67
WQ_v (cu. ft.) =	12,365
WQ_v (ac. ft.) =	0.284

Enter data in these Fields

Unit Conversions
1 Acre = 43,560 Sq. Ft.

CCN = 85

Pond Volume

Elevation	Area (Sq. Ft.)	Volume (Cu. Ft.)
1,006.60	-	-
1,007.00	1,852.00	926.00
1,008.00	9,926.00	6,815.00
1,009.00	16,295.00	19,925.50
1,010.00	18,751.00	37,448.50
1,011.00	20,815.00	57,231.50
1,012.00	22,946.00	79,112.00

40 HOUR DETENTION CALC.

To Calculate: 40 Hour Detention (EDDB)

I. Basin Water Quality Storage Volume

Step 1) Tributary area To EDDB, A_t (ac) =	A_T (ac) =	5.29
Step 2) Calculate WQ_v using Sec. 6 (ac-ft) =	WQ_v (ac. ft.)=	0.284
Step 3) Add 20 Percent to Step 2.	V_{design} (ac-ft) =	0.341

II.a. Water Quality Outlet Type

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

Outlet Type = 2

Step 2) Proceed to Step IIb, IIc, or IId based on selection

To Calculate Z_{WQ} (ft) interpolate from Storm Study (Sheet 13)

Elevation 1 =	1008.00	Storage 1 =	6,815.00
Elevation X =		Storage X =	12,365.41
Elevation 2 =	1009.00	Storage 2 =	19,925.50
		Elevation X =	1008.42
Lowest Elevation of Pond =	1006.60		
Elevation X =	1008.42		
Z_{WQ} (ft) =	1.82		

IIc. Water Quality Outlet, Perforated Riser

Step 1) Depth at outlet above lowest perforation:	Z_{WQ} (ft) =	1.82
Step 2) Recommended maximum outlet area per row:	A_0 (in^2) =	0.824
Step 3) Circular perforation diameter per row assuming a single column:	D_1 (in) =	0.438
1	n_c (unitless) =	1
Step 5) Design circular perforation diameter (should be between 1 and 2 inches):	D_{perf} (in) =	1.000
Step 6) Horizontal perforation column spacing when n_c > 1, center to center:	S_c (in) =	4
Step 7) Number of rows (4" vertical spacing between perforations, center to center):	n_r (unitless) =	6

Calculates the diameter of each hole given the depth of water and the area per row. Assuming 4" spacing. If less than 1" use 1" as D_{perf}.

Note: If $D_{perf} \geq 1.0$ inch, $S_c = 4$

Recommended Method: Perforated Riser