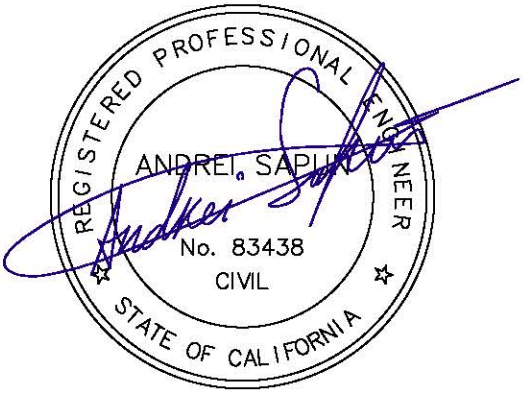
DRAINAGE STUDY
FOR
IU-MIEN-BUDDHIST TEMPLE
(LEVEL 3)

Prepared for:
Aras Design & Construction Inc.
2533 Sierra Boulevard
Sacramento, CA 95825
Contact Person: Fred Arastoo

APN:
067-0050-042

Control Number:
PLNP2023-00062



8/17/2023

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Job Number:
23028

Preparation Date:
August 2023

Last Updated On:
n/a

Watershed: Elder Creek
Vertical Datum: NGVD 29

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FIGURES

Figure 1 – Existing Swale Typical Section

1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

The purpose of this drainage study is to support the IU-Mien-Buddhist Temple Use Permit entitlement application. This study is not acceptable for design and further study will be required to complete design analysis for improvement plans approval. Current study purpose is address DWR letter dated May 22, 2023, to include the following:

1. There is existing through drainage coming from the east and north and discharging towards the southeast portion of the parcel boundary. This through drainage must be mitigated, detained, or rerouted around your project site.
2. The proposed 20-foot wide road will require a culvert crossing. Design and size to allow for a 10-year, 24-hour storm event.
3. Include a preliminary grading plan showing the following:
    a. Existing and proposed grades.
    b. Overland release path to safely convey offsite 100-year runoff through the site. Maximum depth of flow shall be limited to 1.0 foot across parking areas and driveways.
    c. The extent of the Local 100-year floodplain within the project site using current topography. Water Resources may require mitigation if fill is proposed within the Local floodplain.
4. Calculations pursuant to Improvement Standards for the necessary overland release paths.
5. Include shed maps and electronic copies of any models produced.

1.2 PROJECT DESCRIPTION

The project is located within the Vineyard Community Plan in Sacramento County. Project Vicinity Map is provided in Appendix 1. Project goal is to construct a new Buddhist temple and associated parking lot with 150-person capacity on a 9.65-acre lot in AG-20 zone. The project site lot has an existing small temple building as shown in the Proposed Site Plan in Appendix 4. Project site does not include FEMA floodplain hazard area. The closest FEMA floodplain is located 800 feet (ft) to the northwest from the project site as shown in Appendix 2.

1.3 APPLICABLE STANDARDS

The design computations shall be in conformance with Sections 9-8 through 9-11 of the Sacramento County Improvement Standards and Volume 2 of the Sacramento City/County Drainage Manual.

1.4 PREVIOUS STUDIES

No information is available on the previous studies.

2.0 REGIONAL FLOOD CONTROL

2.1 UPSTREAM IMPACTS

Based on the County LIDAR information, the Project does have some offsite drainage from the north and minor area from the east side. Schematics of the offsite watersheds are provided in Appendix 5 on the Existing Watershed Map.

The north offsite watershed (OFF-1) includes approximately 6.84 acres of adjacent developed parcel on the north. Existing 10-yr and 100-yr flow estimate, based SacCalc analysis are approximately 12 cfs and 20 cfs. SacCalc modeling reports for existing and proposed watersheds are provided in Appendix 5.

There is an existing 12" metal pipe that crosses the property line from the north and discharges the runoff in the middle of the project north boundary line as shown in Appendix 4. Based on the SacCalc modeling for 10-year event, this existing pipe cannot be extended and serve as the culvert since it is undersized. Thus, existing 12" pipe will have to be shorted closer to the property line and new culvert is proposed to be placed under the road. Two culvert alternatives are proposed:

1. 24" pipe culvert. It will provide capacity to convey 10-yr storm event flow, but at 100-year storm water level is estimated at 113.64ft. It is about 1 ft higher than existing wire fence grade along the culvert location. It might and might not affect the existing stables building which is located about 10-15ft north from the wire fence. Additional topo is required for this alternative.
2. 24" by 48" box culvert. It will provide unobstructed flow for both 10-year and 100-year event scenarios. At 100-year event, estimated high water surface elevation is estimated at 112.15 ft with is about 1.5 ft lower than at 1 alternative and no upstream impact is anticipated without doing any additional topo on the neighborhood property.

The proposed and existing culverts' locations are shown on the Preliminary Grading Plan in Appendix 4. Design reports for culverts area provided in Appendix 7.

2.2 DOWNSTREAM IMPACTS

Project site runoff will be directed towards an existing swale that directs runoff to the adjacent parcel on the south and then crosses Excelsior Road and directs water to Elder Creek. There is an existing 24" culvert at the south project boundary line at the existing 40' drain easement which is centered along the south boundary line at the west half of the project site that serves as the project discharge location. Based on the SacCalc modeling, project development will slightly increase the runoff at a 10-year event from 26.15 cubic foot per second (cfs) to 26.67 cfs. No 100-year event runoff increase is anticipated per SacCalc modeling due timing of the peak event.

To mitigate the increase of storm water runoff for 10-year event, an onsite storage is proposed to reduce peak runoff to existing conditions. Onsite bioretention storage with maximum storage of 3,500 cubic ft will reduce the peak discharge to 26.13 cfs and therefore no downstream impact is anticipated. Routing through the pond report is provided in Appendix 8.

2.3 MINIMUM FINISH FLOOR AND OVERLAND RELEASE

The project site is outside of the FEMA Flood Zone and therefore the base flood elevation was determined by running 100-year runoff data from the open channel modeling through the existing swale and compared to the high-water level at the culvert which is discussed in Section 2.1. The minimum finish floor for the proposed buildings shall be set at least 1.5 ft above the resulting highest water level.

The existing swale that runs from the existing culvert on the north towards the existing culvert on the south is approximately 350 ft long with upstream elevation of 110.49 ft and downstream elevation of 109.30 ft. The east side of the swale has a steep bank with height varies from 2 ft to 4 feet. The west side of the swale has a gentle side slope which varies from 40 to 200 ft in length. A typical section of the swale is provided below.

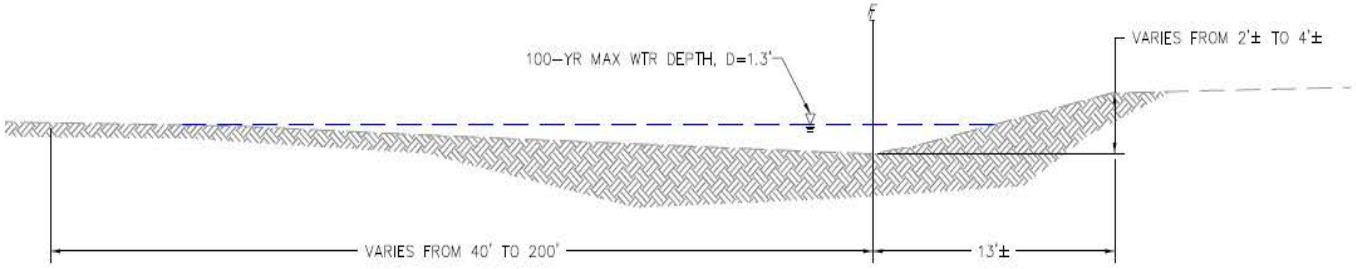


Figure 1 – Existing Swale Typical Section

Using a minimal west side slope of 40 ft, the max 100-year water depth is estimated around 1.3 ft. Upstream high-water depth for culverts under the proposed access roads are the following:

- 24" pipe culvert highest water elevation above flow line is 1.6 ft
- 24"x48" box culvert highest water elevation above flow line 1.3 ft

It is safe to assume that culvert upstream water elevation is the controlling elevation for the minimum pad and finish floor. Using the worst-case scenario, the controlling elevation is 1.6 ft with upstream HGL of 112.30 ft. Thus, the minimum pad elevation for the temple is 113.5 ft and the minimum finish floor elevation is 113.8 ft.

2.4 LOCAL FLOODPLAIN

There is an existing 100-yr floodplain on the site as shown in the Preliminary Grading Plan, but no fill is proposed in the floodplain. The proposed building and parking lot is located outside of the floodplain boundaries and no impact is anticipated.

3.0 STORMWATER QUALITY

3.1 IMPERVIOUS AREA

The proposed project has an existing structure, access road and parking area of approximately 25,100 square feet (sqft) which is about 6% of the project site. The proposed access road, additional parking area and temple building have an area of about 68,880 sqft which will increase proposed project total impervious area to about 22%.

3.2 LOW IMPACT DEVELOPMENT

Institutional/commercial projects with more than 1 acre of impervious area are required to include Low Impact Development (LID) control measures. Project impervious area including building, onsite road and parking is about 1.58 acres. Project LID credits will be obtained via the following measures:

- Interceptor trees
- Preserving pervious/natural areas such as existing trees, natural soil area and vegetation
- Bioretention pond

About 7.49 acres of the project site will remain pervious. Also, a minimum of 10 evergreen and 10 deciduous trees are assumed to be planted over the project landscape areas inside of the parking planters. At level 4 drainage study, a detailed analysis of the interceptor trees will be included along with the proposed landscape plan. Along with the trees, 2,000 square feet of bioretention area will provide the required LID credits. Copy of the LID spreadsheet calculations is provided in Appendix 9. Additional stormwater treatment will be needed. It will be provided either via vegetated swale or additional bioretention area.

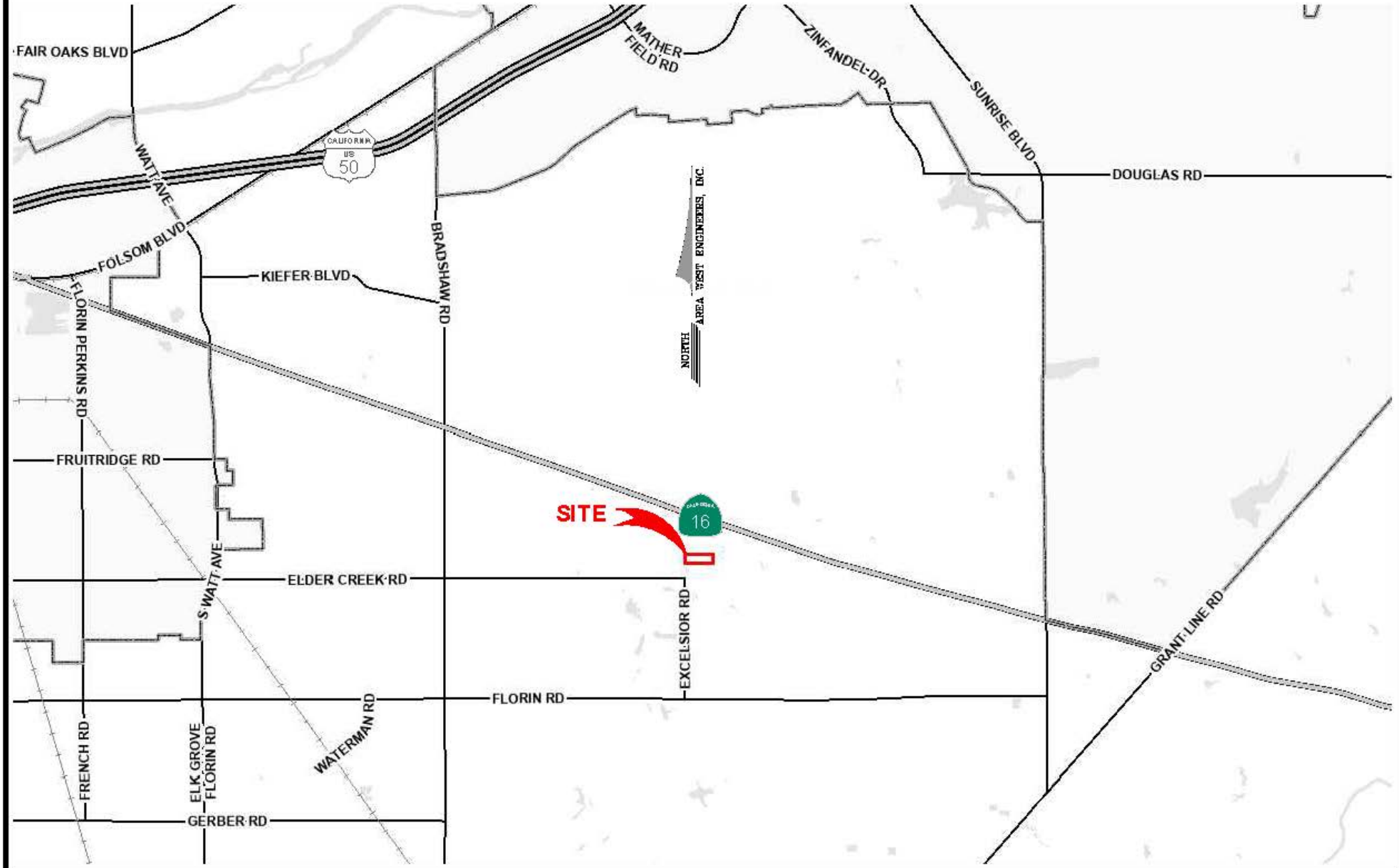
3.3 HYDROMODIFICATION

Project is located in the hydromodification requirement area for the commercial projects with impervious area above 1 acre. However, due to the active 404 permit for Elder Creek improvements and project runoff draining directly to the creek, the project is exempt from hydromodification requirement.

4.0 SUMMARY OF FINDINGS AND CONCLUSION

The purpose of this drainage study was to analyze downstream and upstream impacts to surrounding properties, size the required culvert for the proposed road to convey 10-year 24-hour storm event and show that no impact will be made to the existing local floodplain. This drainage study is not intended nor acceptable for the improvements design purposes and an additional study will be required to complete the design analysis for improvement plans approval. The proposed project will incorporate onsite detention to mitigate impacts downstream and will not disturb existing floodplain area. Recommended road culvert is 24"x48" box culvert that will convey 10-yr and 100-yr runoff without road overflow.

Appendix 1 - Project Vicinity Map



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APPENDIX 1

PROJECT VICINITY MAP EXHIBIT FOR:
8225 EXCELSIOR ROAD,
SACRAMENTO COUNTY, CALIFORNIA

SCALE	23028
HORIZ.: NONE	
VERT.: NONE	SHEET 1 OF 1
DATE: AUG 2023	

G:\LDD_2\PROJ\23028\Drainage\CAD Dwgs\23028 EXISTING SHED MAP.dwg 8/17/2023 12:56:49 PM, 1:1 AREA WEST ENGINEERS, INC.

Appendix 2 – FEMA Flood Map

National Flood Hazard Layer FIRMette



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 Cross Sections with 1% Annual Chance
- 17.5 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 8/15/2023 at 11:19 AM 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.

Appendix 3 – Soil Report

United States Department of Agriculture

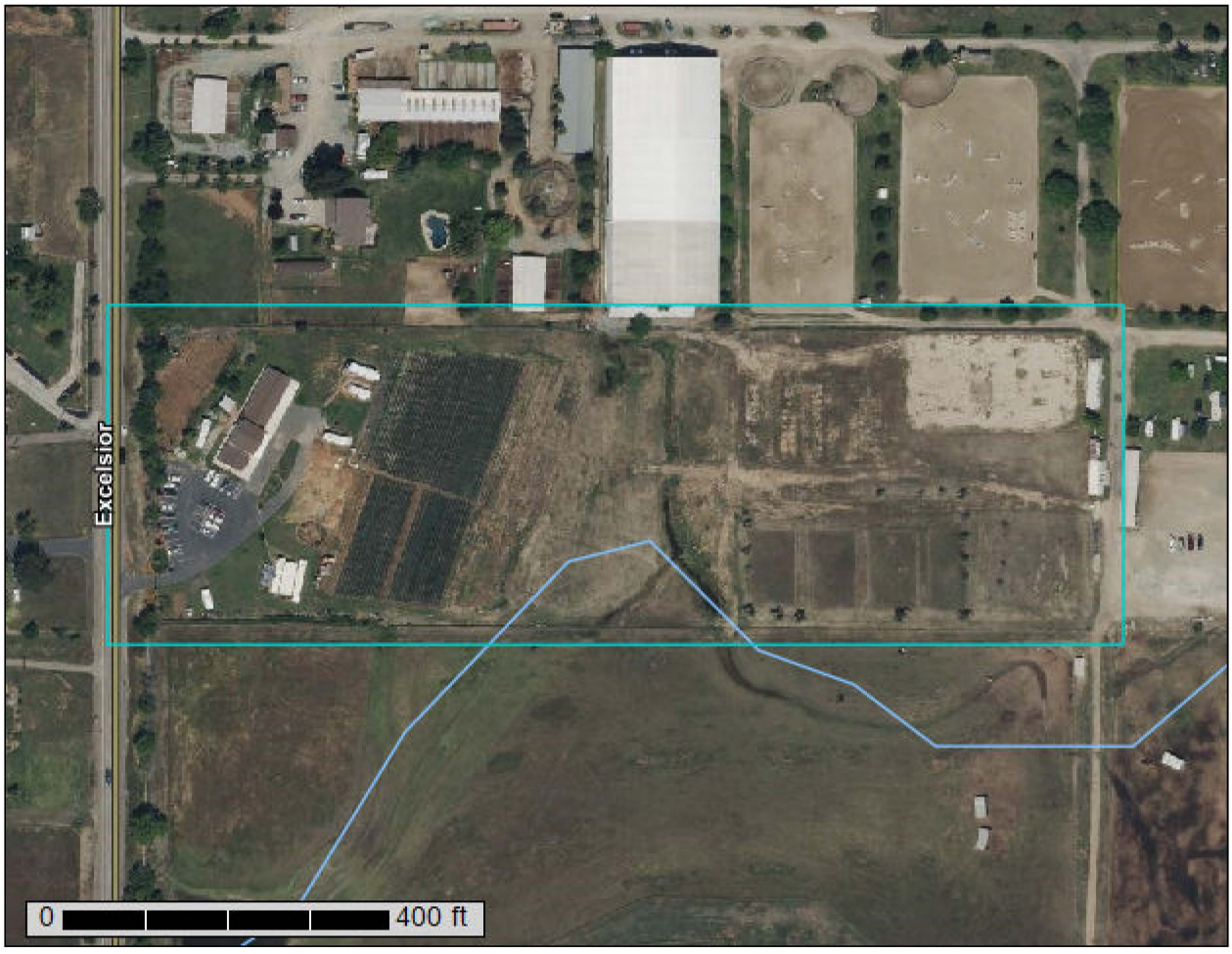
NRCS

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 Sacramento County, California

23028 - 6225 Excelsior Rd



August 15, 2023

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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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.

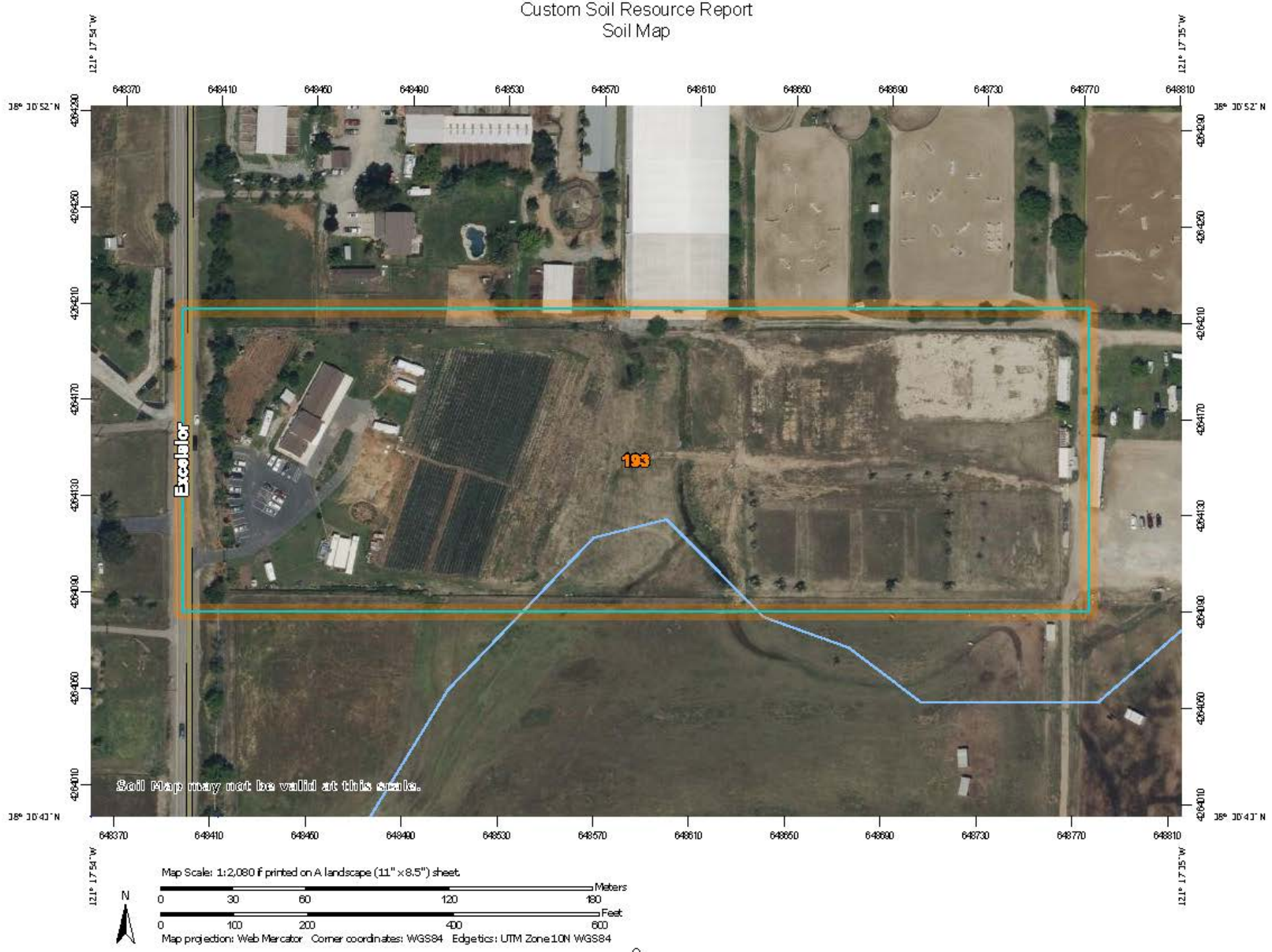
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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 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: Sacramento County, California
Survey Area Data: Version 22, Sep 1, 2022

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

Date(s) aerial images were photographed: Apr 23, 2022—Apr 24, 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
193	Red Bluff-Redding complex, 0 to 5 percent slopes	11.8	100.0%
Totals for Area of Interest		**11.8**	**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.

Sacramento County, California

193—Red Bluff-Redding complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: hhp6
Elevation: 100 to 1,500 feet
Mean annual precipitation: 14 to 30 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 230 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Red bluff and similar soils: 45 percent
Redding and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Red Bluff

Setting

Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 8 inches: loam
H2 - 8 to 25 inches: clay loam
H3 - 25 to 43 inches: clay loam
H4 - 43 to 68 inches: gravelly clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R017XD045CA - LOAMY
Hydric soil rating: No

Description of Redding

Setting

Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly alluvium

Typical profile

H1 - 0 to 7 inches: gravelly loam
H2 - 7 to 20 inches: gravelly loam
H3 - 20 to 28 inches: gravelly clay loam
H4 - 28 to 66 inches: indurated

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches; 28 to 66 inches to duripan
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: R017XD090CA - GRAVELLY LOAMY
Hydric soil rating: No

Minor Components

Corning

Percent of map unit: 5 percent
Hydric soil rating: No

Hicksville

Percent of map unit: 4 percent
Hydric soil rating: No

Xerorthents

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Unnamed, hardpan below 40 inches

Percent of map unit: 1 percent
Hydric soil rating: No

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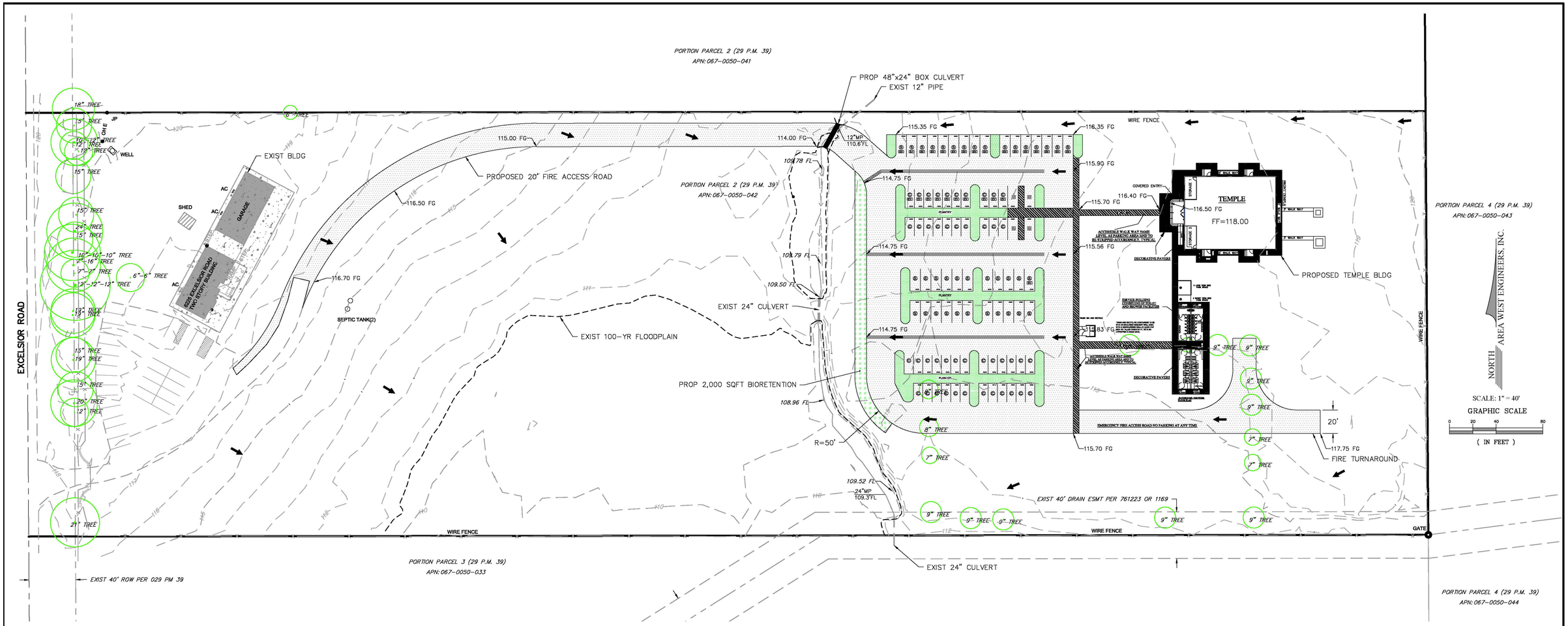
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Appendix 4 – Preliminary Grading and Drainage Plan



PREPARED UNDER THE DIRECTION OF:

REGISTERED PROFESSIONAL ENGINEER
ANDREI SAIPUN
No. 83438
CIVIL
STATE OF CALIFORNIA

NOTE: DO NOT USE FOR CONSTRUCTION UNLESS SIGNED BY THE ENGINEER

PRELIMINARY

BENCHMARK _____ ELEVATION _____

RECORD DRAWINGS

ENGR. INIT. DATE

DESIGNED BY: AS

DRAFTED BY: AS

CHECKED BY: RR

PRELIMINARY GRADING AND DRAINAGE PLAN
FOR
6225 EXCELSIOR ROAD
IU-MIEN-BUDDHIST TEMPLE
SACRAMENTO COUNTY STATE OF CALIFORNIA

AREA WEST ENGINEERS, INC.
ENGINEERING - SURVEYING - PLANNING
7478 SANDALWOOD DRIVE, SUITE 400
CITRUS HEIGHTS, CA 95621
(916) 725-5551 (916) 725-5808 (FAX)
AWE@AREAWESTENG.COM

REVISIONS #	DESCRIPTION	ENGR. INIT.	APPROVAL APPROVED BY	APPROVAL DATE

SCALE
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VERT.: N/A
DATE: AUGUST 2023

JOB NO. 23028

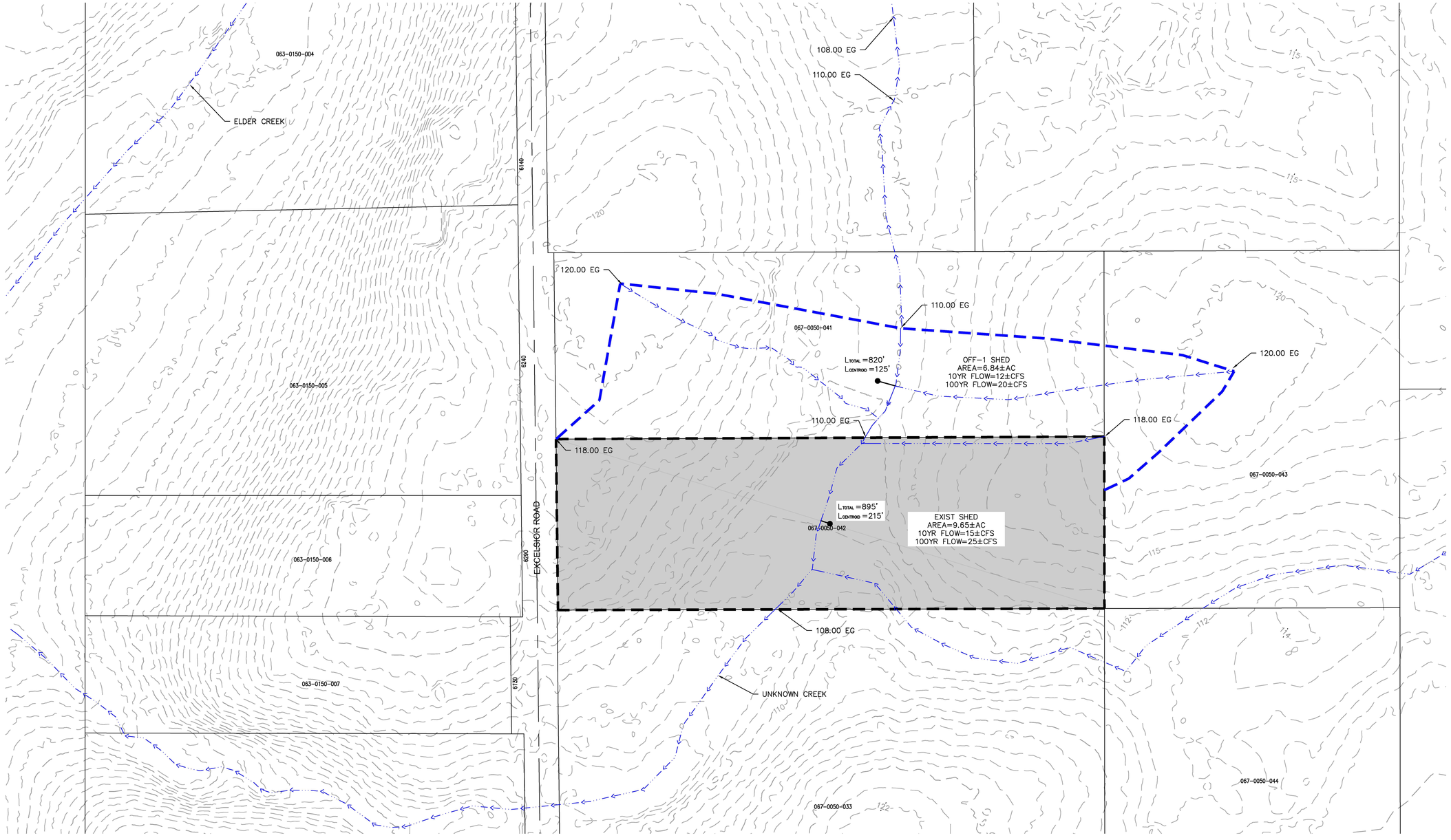
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Appendix 5 – Existing and Proposed Watershed Maps



Sacramento method results
(Project: 23028)
(10-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
SITE	16.	12:05	.02			
OFF-1	12.	12:04	.01			
CH1	11.	12:08	.01			
DL	26.	12:07	.03			

Sacramento method results
(Project: 23028)
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
SITE	25.	12:06	.02			
OFF-1	20.	12:04	.01			
CH1	19.	12:07	.01			
DL	44.	12:07	.03			

SHED MAP LEGEND

- SHED BOUNDARY
- PROJECT SITE
- LONGEST WATER PATH
- SHED CENTROID

PREPARED UNDER THE DIRECTION OF:
REGISTERED PROFESSIONAL ENGINEER
ANDREI SAPUN
No. 85438
CIVIL
STATE OF CALIFORNIA

NOTE: DO NOT USE FOR CONSTRUCTION UNLESS SIGNED BY THE ENGINEER

PRELIMINARY

BENCHMARK N/A ELEVATION N/A
SACRAMENTO COUNTY LIDAR CONTOURS.

RECORD DRAWINGS
ENGR. INIT. DATE

DESIGNED BY: AS
DRAFTED BY: AS
CHECKED BY: RR

DRAINAGE STUDY
FOR
6225 EXCELSIOR ROAD
PROPOSED SHED MAP
SACRAMENTO COUNTY STATE OF CALIFORNIA

AREA WEST ENGINEERS, INC.
ENGINEERING - SURVEYING - PLANNING
7478 SANDALWOOD DRIVE, SUITE 400
CITRUS HEIGHTS, CA 95621
(916) 725-5551 (916) 725-5808 (FAX)
AWE@AREAWESTENG.COM

REVISIONS

#	DESCRIPTION	ENGR. INIT.	APPROVAL APPROVED BY	APPROVAL DATE

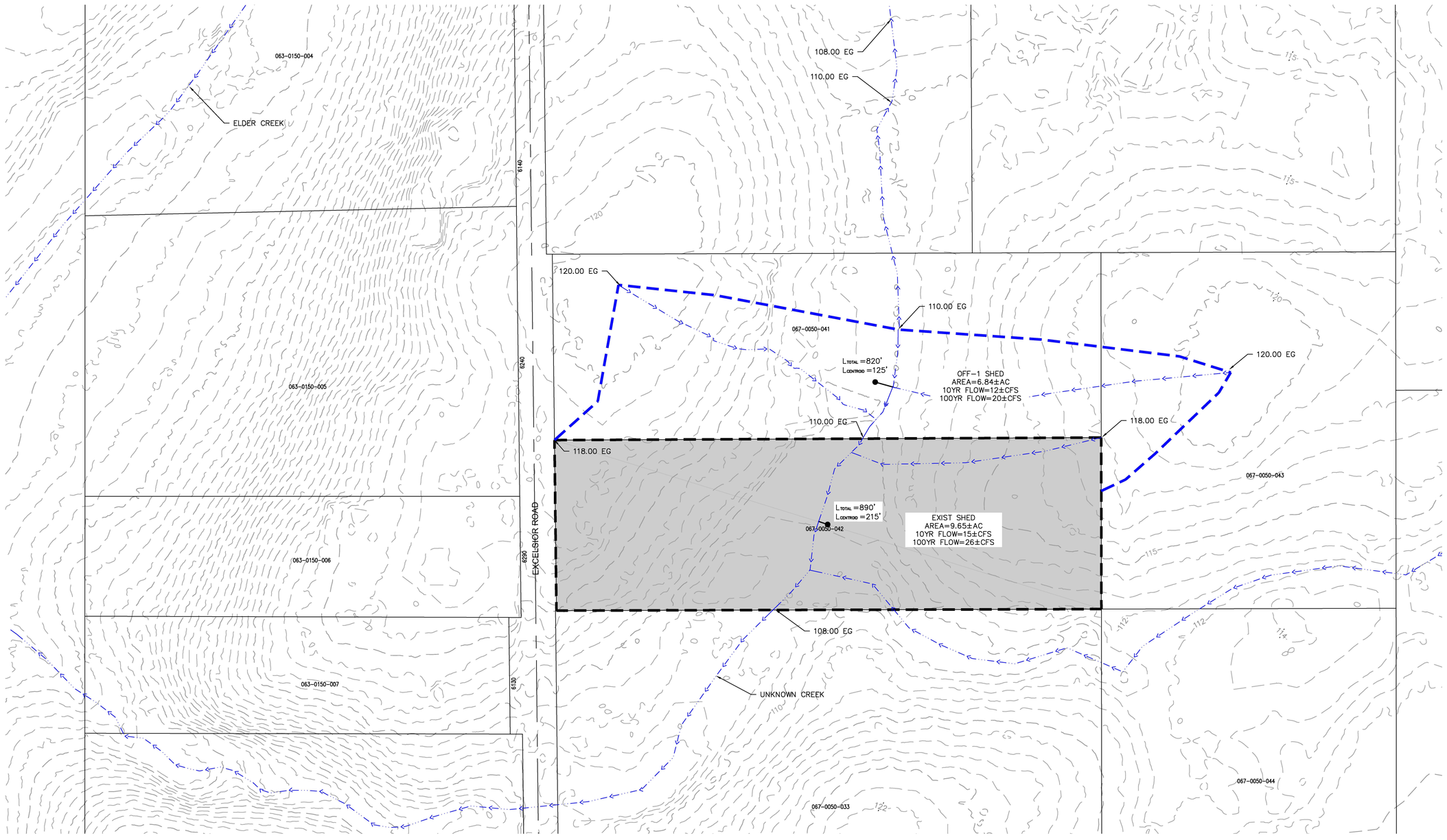
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VERT.: N/A
DATE: AUGUST 2023

JOB NO. 23028
SHEET 1 OF 1

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G:\LDD_2\PROJ\23028\Drainage\CAD Dwgs\23028 PROPOSED SHED MAP.dwg 8/17/2023 3:46:09 PM, 1:1 AREA WEST ENGINEERS, INC.



Sacramento method results
(Project: 23028)
(10-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
EXIST	15.	12:05	.02			
OFF-1	12.	12:04	.01			
CH1	11.	12:07	.01			
DL	26.	12:06	.03			

Sacramento method results
(Project: 23028)
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
EXIST	26.	12:05	.02			
OFF-1	20.	12:04	.01			
CH1	20.	12:06	.01			
DL	46.	12:06	.03			

SHED MAP LEGEND

- SHED BOUNDARY
- PROJECT SITE
- LONGEST WATER PATH
- SHED CENTROID

PREPARED UNDER THE DIRECTION OF:
REGISTERED PROFESSIONAL ENGINEER
ANDREI SAPUN
No. 85438
CIVIL
STATE OF CALIFORNIA
NOTE: DO NOT USE FOR CONSTRUCTION UNLESS SIGNED BY THE ENGINEER

PRELIMINARY

BENCHMARK N/A ELEVATION N/A
SACRAMENTO COUNTY LIDAR CONTOURS.

RECORD DRAWINGS
ENGR. INIT. DATE

DESIGNED BY: AS
DRAFTED BY: AS
CHECKED BY: RR

DRAINAGE STUDY
FOR
6225 EXCELSIOR ROAD
EXISTING SHED MAP
SACRAMENTO COUNTY STATE OF CALIFORNIA

AREA WEST ENGINEERS, INC.
ENGINEERING - SURVEYING - PLANNING
7478 SANDALWOOD DRIVE, SUITE 400
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AWE@AREAWESTENG.COM

REVISIONS

#	DESCRIPTION	ENGR. INIT.	APPROVAL APPROVED BY	APPROVAL DATE

SCALE
HORIZ.: 1"=100'
VERT.: N/A
DATE: AUGUST 2023

JOB NO. 23028
SHEET 1 OF 1

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Appendix 6 – SacCalc Reports and Results

Sacramento Hydrologic Calculator Report

August 17, 2023 14:36

Project Title: 23028
Method: Sacramento County HEC-1 method
Comments: EXISTING MODEL FOR 6225 EXCELSIOR RD. REVISION DATE - N/A
Date: 8/15/2023
Prepared by: AWE

Watershed Hydrologic Summary Data

Watershed	Area (acres)	Mean Elevation (ft)	Lag Times		Basin "n"		Loss Rates		Percent Impervious	
			Method	Lag Time (min)	Method	Basin "n"	Method	Loss Rate (in/hr)	Method	Impervious Area (%)
EXIST	9.65	113	Basin "n"	-	Computed	-	Computed	-	Specified	6
OFF-1	6.84	115	Basin "n"	-	Computed	-	Computed	-	Computed	-

Basin "n" Method Data for Lag Time Computation

Watershed	Channel Length (ft)	Centroid Length (ft)	Slope (ft/ft)	Channelization	Land Use Impervious Area Percent (% or acres)																
					95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
EXIST	800	215	0.01	Undeveloped														0				
				Developed														100				
OFF-1	740	125	0.01	Undeveloped														0				
				Developed														100				

Refer to the Drainage manual for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Infiltration Loss Rate Data

Watershed	Soil Cover Group	Land Use Impervious Area Percent (% or acres)																
		95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
EXIST	B																		
	C														100				
	D																		
OFF-1	B																		
	C														100				
	D																		

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Hydrograph Routing – Muskingum–Cunge (Standard)

Routing ID	Route From	Route To	Channel Type	Length (ft)	Slope (ft/ft)	Width or Diameter (ft)	Side Slope (H:V)	Mannings "n"
CH1	OFF-1	DL	Trapezoidal	350	0.004	40	5:1	0.040

View HEC-1 output

Sacramento method results
(Project: 23028)
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
EXIST	26.	12:05	.02			
OFF-1	20.	12:04	.01			
CH1	20.	12:06	.01			
DL	46.	12:06	.03			

(10-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
EXIST	15.	12:05	.02			
OFF-1	12.	12:04	.01			
CH1	11.	12:07	.01			
DL	26.	12:06	.03			

Sacramento Hydrologic Calculator Report

August 17, 2023 15:40

Project Title: 23028
Comments: PROPOSED MODEL FOR 6225 EXCELSIOR RD. REVISION DATE - N/A
Prepared by: AWE
Method: Sacramento County HEC-1 method
Date: 8/15/2023

Watershed Hydrologic Summary Data

Watershed	Area (acres)	Mean Elevation (ft)	Lag Times		Basin "n"		Loss Rates		Percent Impervious	
			Method	Lag Time (min)	Method	Basin "n"	Method	Loss Rate (in/hr)	Method	Impervious Area (%)
SITE	9.65	113	Basin "n"	-	Computed	-	Computed	-	Specified	22
OFF-1	6.84	115	Basin "n"	-	Computed	-	Computed	-	Computed	-

Basin "n" Method Data for Lag Time Computation

Watershed	Channel Length (ft)	Centroid Length (ft)	Slope (ft/ft)	Channelization	Land Use Impervious Area Percent (% or acres)																
					95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
SITE	805	215	0.01	Undeveloped												0						
				Developed												100						
OFF-1	740	125	0.01	Undeveloped														0				
				Developed														100				

Refer to the Drainage manual for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Infiltration Loss Rate Data

Watershed	Soil Cover Group	Land Use Impervious Area Percent (% or acres)																	
		95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
SITE	B																		
	C												100						
	D																		
OFF-1	B																		
	C														100				
	D																		

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Hydrograph Routing – Muskingum–Cunge (Standard)

Routing ID	Route From	Route To	Channel Type	Length (ft)	Slope (ft/ft)	Width or Diameter (ft)	Side Slope (H:V)	Mannings "n"
CH1	OFF-1	DL	Trapezoidal	350	0.004	40	5:1	0.04

View HEC-1 output

Sacramento method results
(Project: 23028)
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
SITE	25.	12:06	.02			
OFF-1	20.	12:04	.01			
CH1	19.	12:07	.01			
DL	44.	12:07	.03			

(10-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
SITE	16.	12:05	.02			
OFF-1	12.	12:04	.01			
CH1	11.	12:08	.01			
DL	26.	12:07	.03			

Appendix 7 – Culverts and Existing Swale Design Reports

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Aug 16 2023

10yr Runoff through 24-inch Culvert

Invert Elev Dn (ft)	=	110.49
Pipe Length (ft)	=	25.00
Slope (%)	=	0.80
Invert Elev Up (ft)	=	110.69
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

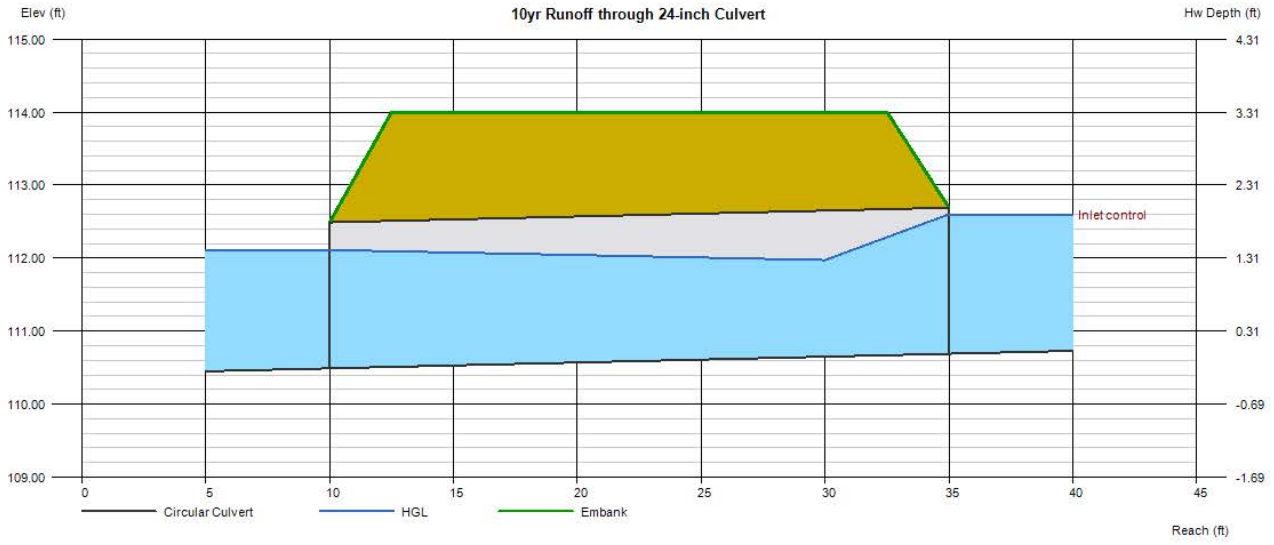
Top Elevation (ft)	=	114.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	12.00
Qmax (cfs)	=	12.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	12.00
Qpipe (cfs)	=	12.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.40
Veloc Up (ft/s)	=	5.82
HGL Dn (ft)	=	112.11
HGL Up (ft)	=	111.94
Hw Elev (ft)	=	112.60
Hw/D (ft)	=	0.95
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Aug 16 2023

10yr Runoff through 24-inch Culvert

Invert Elev Dn (ft)	=	110.49
Pipe Length (ft)	=	25.00
Slope (%)	=	0.80
Invert Elev Up (ft)	=	110.69
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

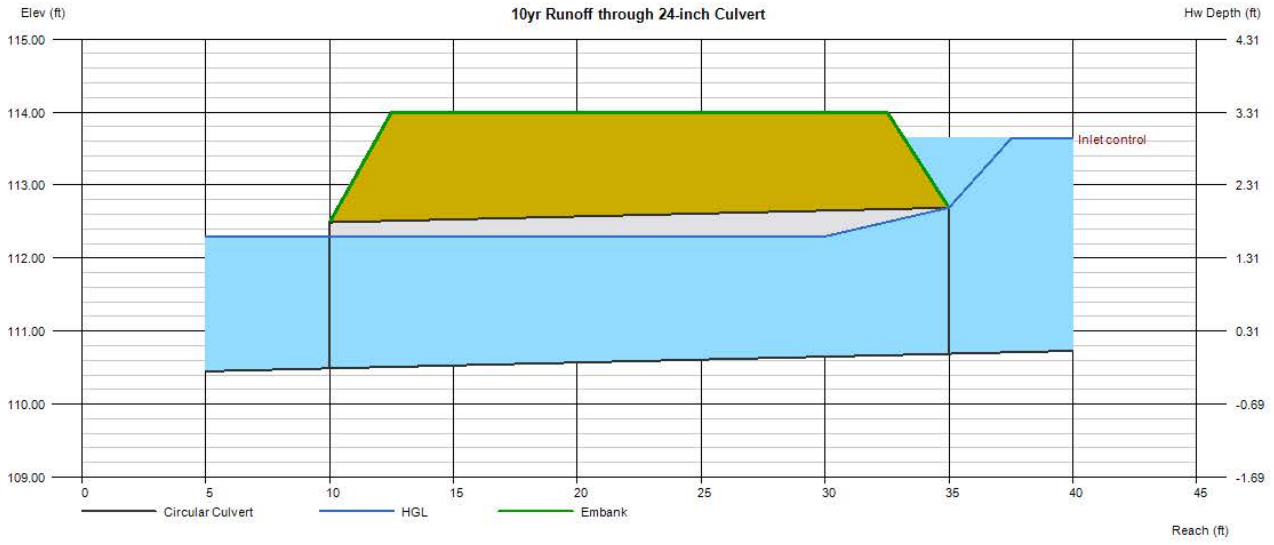
Top Elevation (ft)	=	114.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	20.00
Qmax (cfs)	=	20.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	20.00
Qpipe (cfs)	=	20.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.71
Veloc Up (ft/s)	=	7.38
HGL Dn (ft)	=	112.29
HGL Up (ft)	=	112.30
Hw Elev (ft)	=	113.64
Hw/D (ft)	=	1.47
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Aug 16 2023

10yr Runoff through 24x48-inch Box Culvert

Invert Elev Dn (ft)	=	110.49
Pipe Length (ft)	=	25.00
Slope (%)	=	0.80
Invert Elev Up (ft)	=	110.69
Rise (in)	=	24.0
Shape	=	Box
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

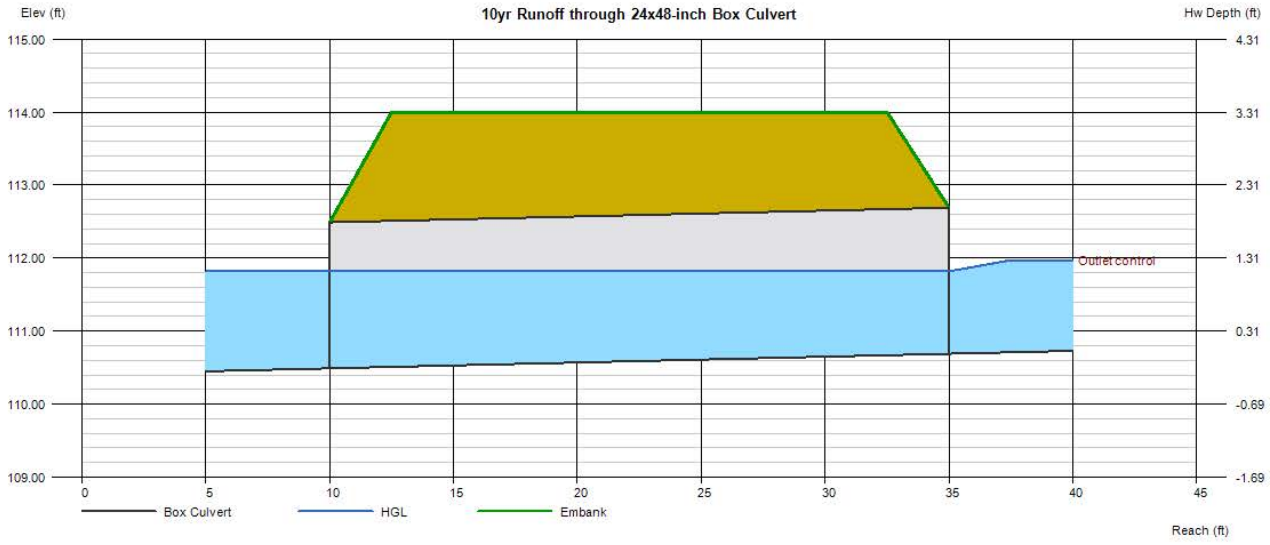
Top Elevation (ft)	=	114.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	12.00
Qmax (cfs)	=	12.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	12.00
Qpipe (cfs)	=	12.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	2.26
Veloc Up (ft/s)	=	2.66
HGL Dn (ft)	=	111.82
HGL Up (ft)	=	111.82
Hw Elev (ft)	=	111.97
Hw/D (ft)	=	0.64
Flow Regime	=	Outlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Aug 16 2023

100yr Runoff through 24x48-inch Box Culvert

Invert Elev Dn (ft)	=	110.49
Pipe Length (ft)	=	25.00
Slope (%)	=	0.80
Invert Elev Up (ft)	=	110.69
Rise (in)	=	24.0
Shape	=	Box
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

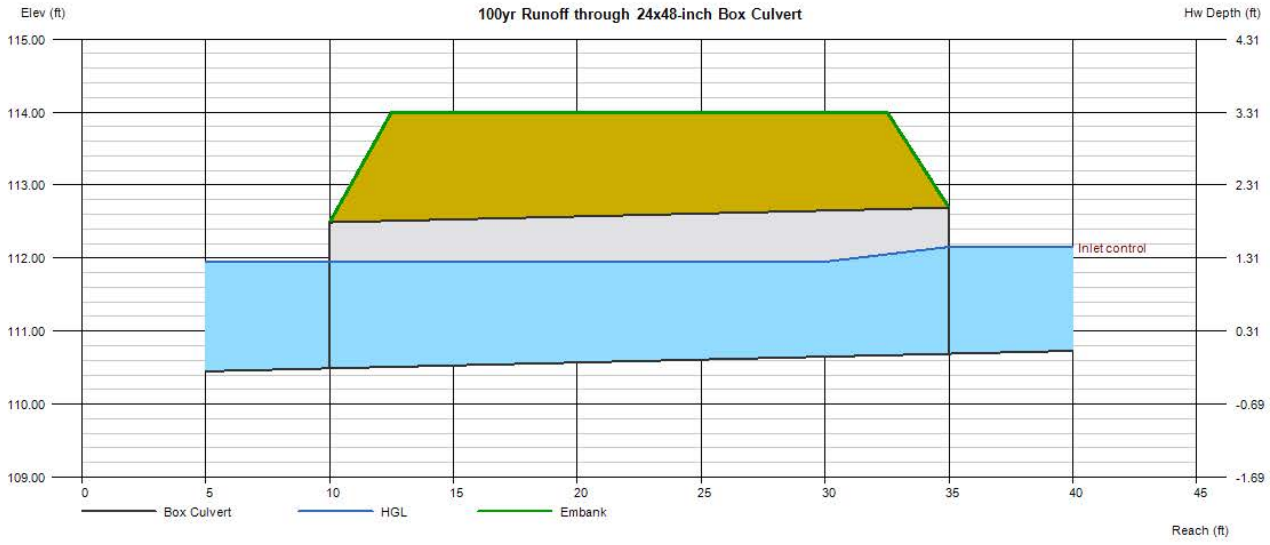
Top Elevation (ft)	=	114.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	20.00
Qmax (cfs)	=	20.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	20.00
Qpipe (cfs)	=	20.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.43
Veloc Up (ft/s)	=	3.97
HGL Dn (ft)	=	111.95
HGL Up (ft)	=	111.95
Hw Elev (ft)	=	112.15
Hw/D (ft)	=	0.73
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Aug 17 2023

100-YEAR TYPICAL SWALE SECTION

User-defined

Invert Elev (ft)	= 109.70
Slope (%)	= 0.37
N-Value	= 0.040

Calculations

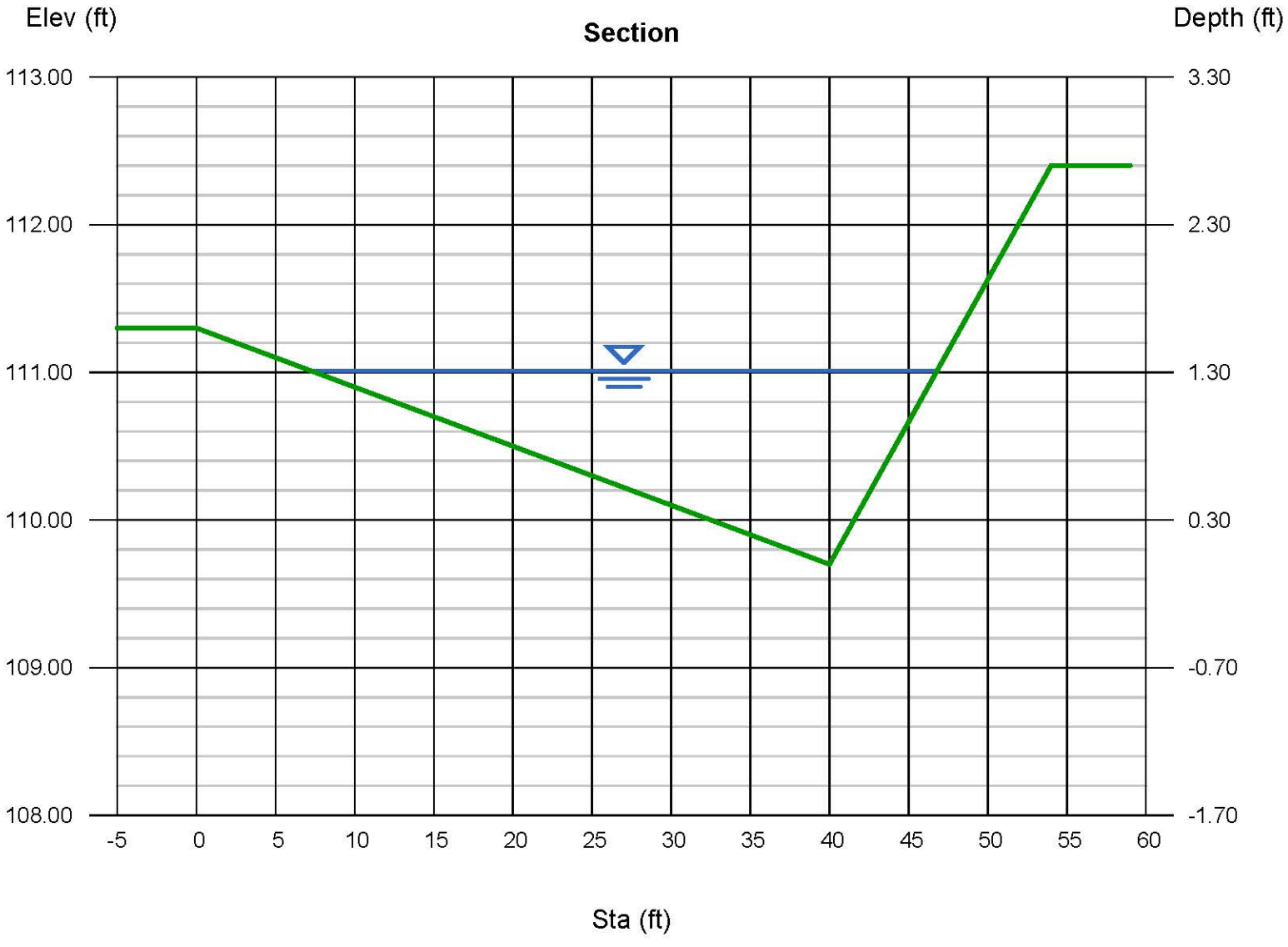
Compute by:	Known Q
Known Q (cfs)	= 44.00

(Sta, El, n)-(Sta, El, n)...

(0.00, 111.30)-(40.00, 109.70, 0.040)-(54.00, 112.40, 0.040)

Highlighted

Depth (ft)	= 1.31
Q (cfs)	= 44.00
Area (sqft)	= 25.90
Velocity (ft/s)	= 1.70
Wetted Perim (ft)	= 39.69
Crit Depth, Yc (ft)	= 0.89
Top Width (ft)	= 39.54
EGL (ft)	= 1.35



Appendix 8 – Pond Design Report

Basin Model

Hydrology Studio v 3.0.0.27

Project Name: 23028

08-17-2023



Hydrograph 10-yr Summary

Project Name: 23028

Hydrology Studio v 3.0.0.27

08-17-2023

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Manual	Pre EXIST	26.15	12.10	72,840	----		
2	Manual	Post PROPOSED	26.67	12.12	82,300	----		
3	Pond Route	BIORETENTION	26.13	12.13	81,250	2	112.65	3,451

Hydrograph Report

Project Name: 23028

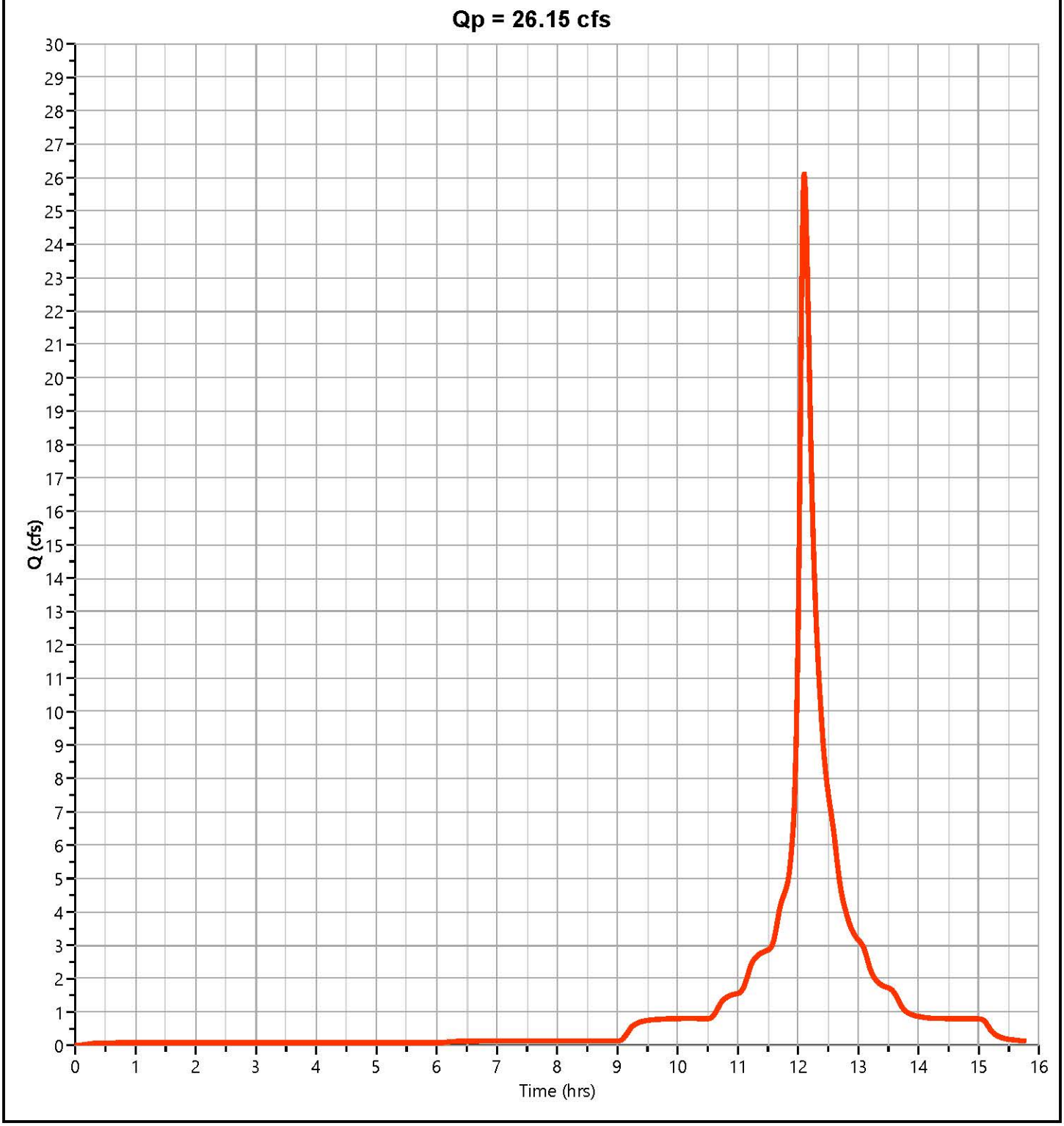
Hydrology Studio v 3.0.0.27

08-17-2023

Pre EXIST

Hyd. No. 1

Hydrograph Type	= Manual	Peak Flow	= 26.15 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.10 hrs
Time Interval	= 1 min	Hydrograph Volume	= 72,840 cuft



Hydrograph Report

Project Name: 23028

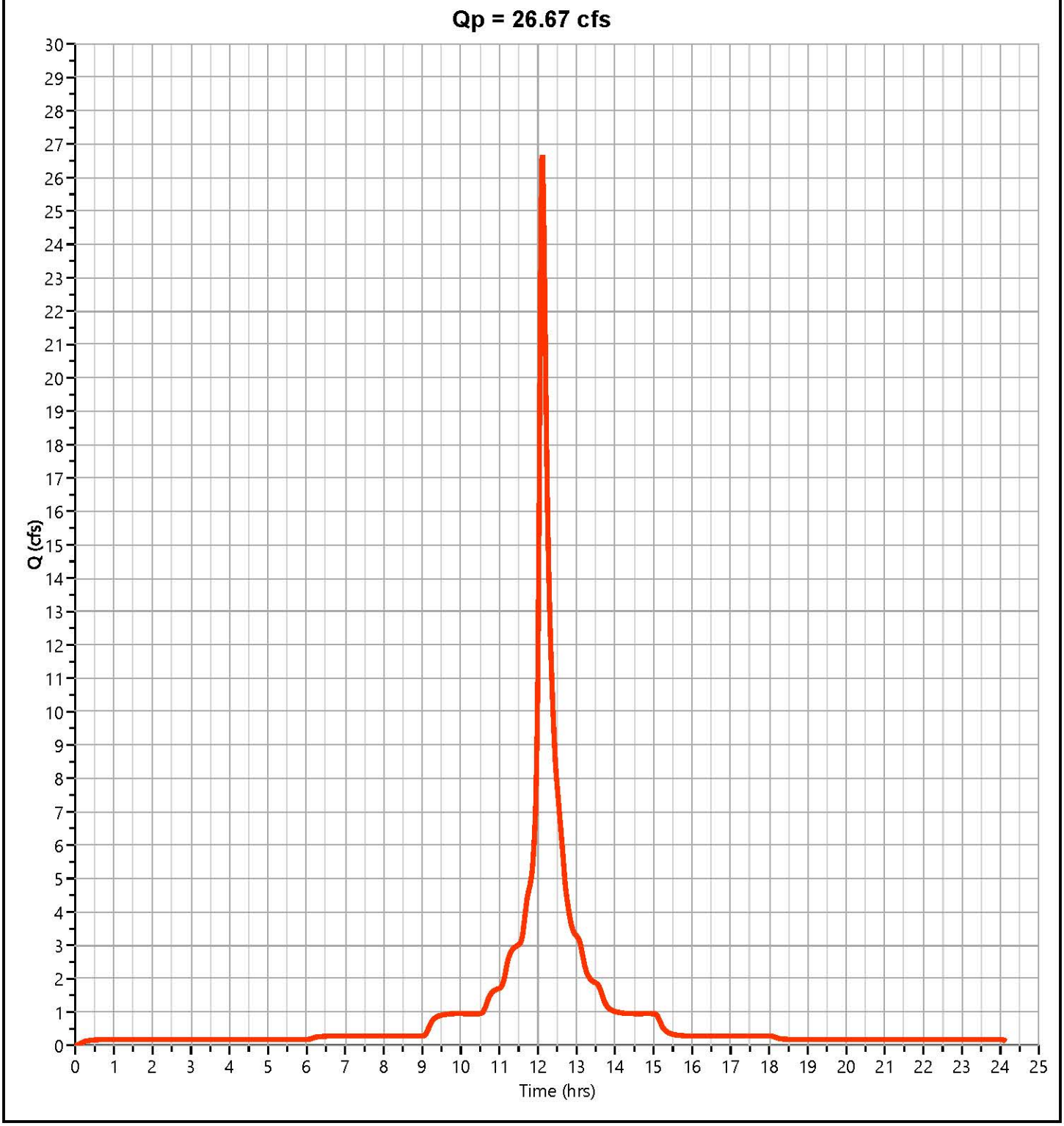
Hydrology Studio v 3.0.0.27

08-17-2023

Post PROPOSED

Hyd. No. 2

Hydrograph Type	= Manual	Peak Flow	= 26.67 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.12 hrs
Time Interval	= 1 min	Hydrograph Volume	= 82,300 cuft



Hydrograph Report

Project Name: 23028

Hydrology Studio v 3.0.0.27

08-17-2023

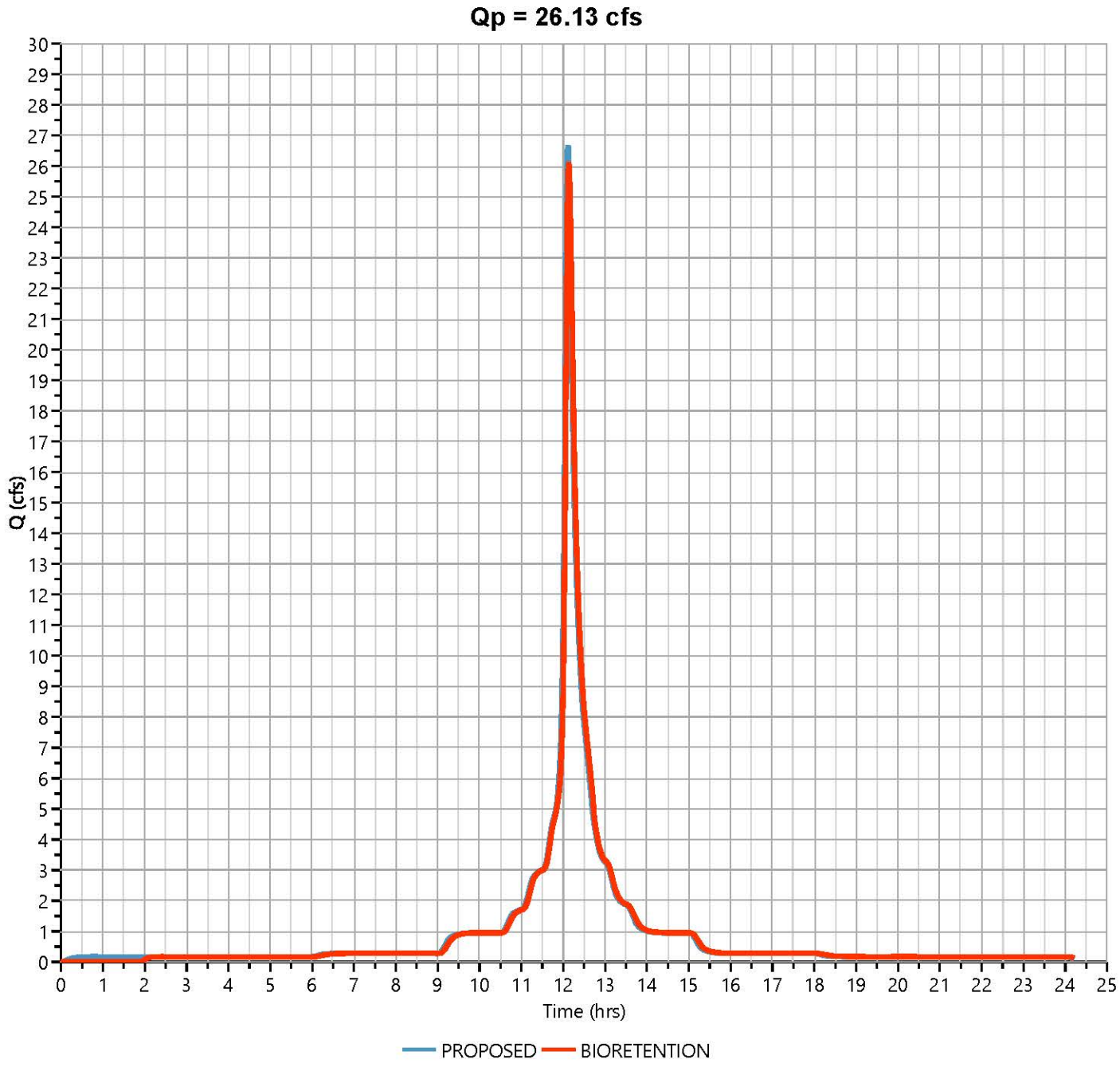
BIORETENTION

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 26.13 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.13 hrs
Time Interval	= 1 min	Hydrograph Volume	= 81,250 cuft
Inflow Hydrograph	= 2 - PROPOSED	Max. Elevation	= 112.65 ft
Pond Name	= BIORETENTION	Max. Storage	= 3,451 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 11 min



Pond Report

Project Name: 23028

Hydrology Studio v 3.0.0.27

08-17-2023

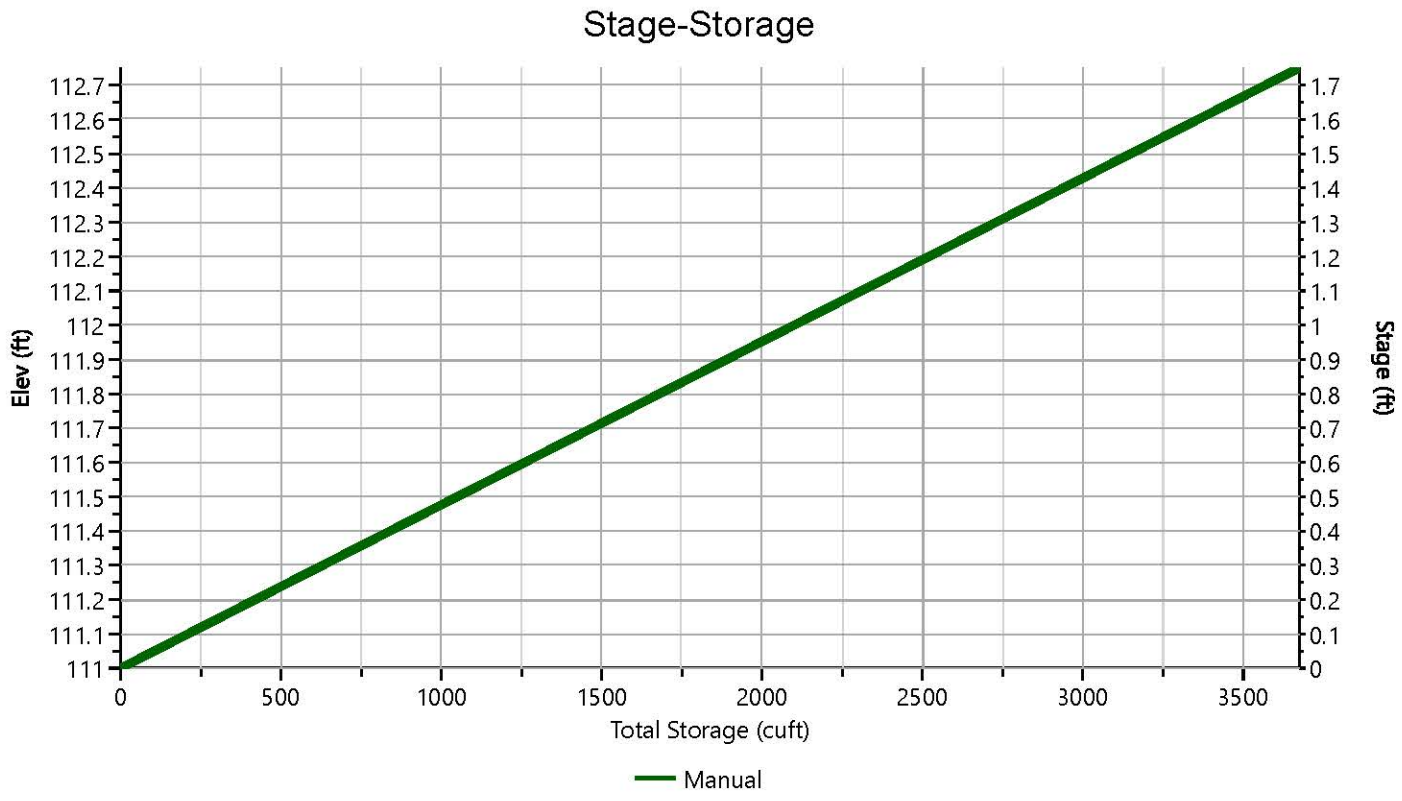
BIORETENTION

Stage-Storage

User Defined Storage	
Description	**Input**
Bottom Elevation, ft	111.00

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	111.00	n/a	0.000	0.000
0.50	111.50	n/a	1,050	1,050
1.00	112.00	n/a	1,050	2,100
1.50	112.50	n/a	1,050	3,150
1.75	112.75	n/a	525	3,675



Pond Report

Project Name: 23028

Hydrology Studio v 3.0.0.27

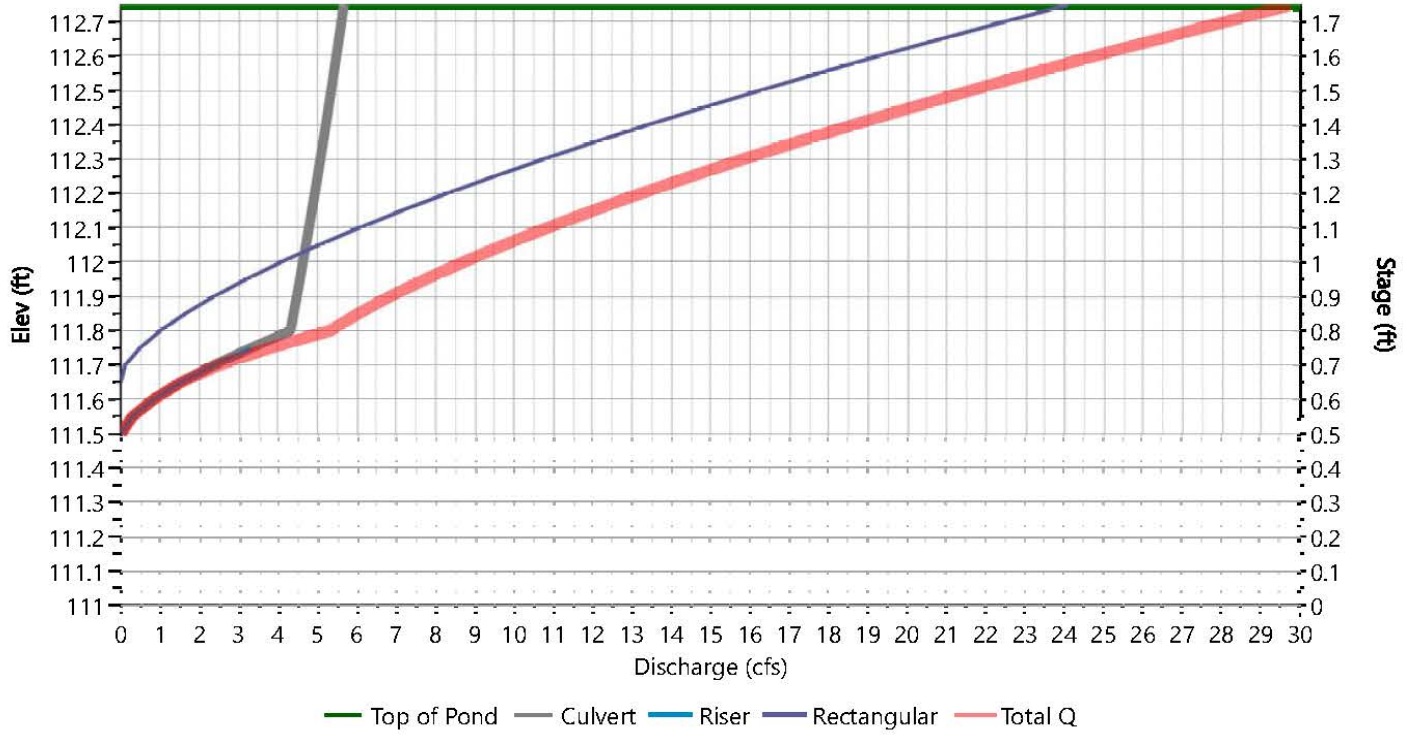
08-17-2023

BIORETENTION

Stage-Discharge

Culvert / Orifices	Culvert	Orifices			Orifice Plate	
		1	2	3		
Rise, in	12				Orifice Dia, in	
Span, in	12				No. Orifices	
No. Barrels	1				Invert Elevation, ft	
Invert Elevation, ft	110.00				Height, ft	
Orifice Coefficient, Co	0.60				Orifice Coefficient, Co	
Length, ft	20					
Barrel Slope, %	1					
N-Value, n	0.013					
Weirs	**Riser***	**Weirs**			**Ancillary**	
		1	2	3		
Shape / Type	Box	Rectangular			Exfiltration, in/hr	
Crest Elevation, ft	111.5	111.67				
Crest Length, ft	8	6.5				
Angle, deg						
Weir Coefficient, Cw	3.3	3.3				

*Routes through Culvert.



Pond Report

Project Name: 23028

Hydrology Studio v 3.0.0.27

08-17-2023

BIORETENTION

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	111.00	0.000	0.000				0.000	0.000						0.000
0.50	111.50	1,050	0.000 oc				0.000	0.000						0.000
1.00	112.00	2,100	4.631 ic				0.000	4.066						8.697
1.50	112.50	3,150	5.347 ic				0.000	16.22						21.57
1.75	112.75	3,675	5.672 ic				0.000	24.07						29.75

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

Pond Report

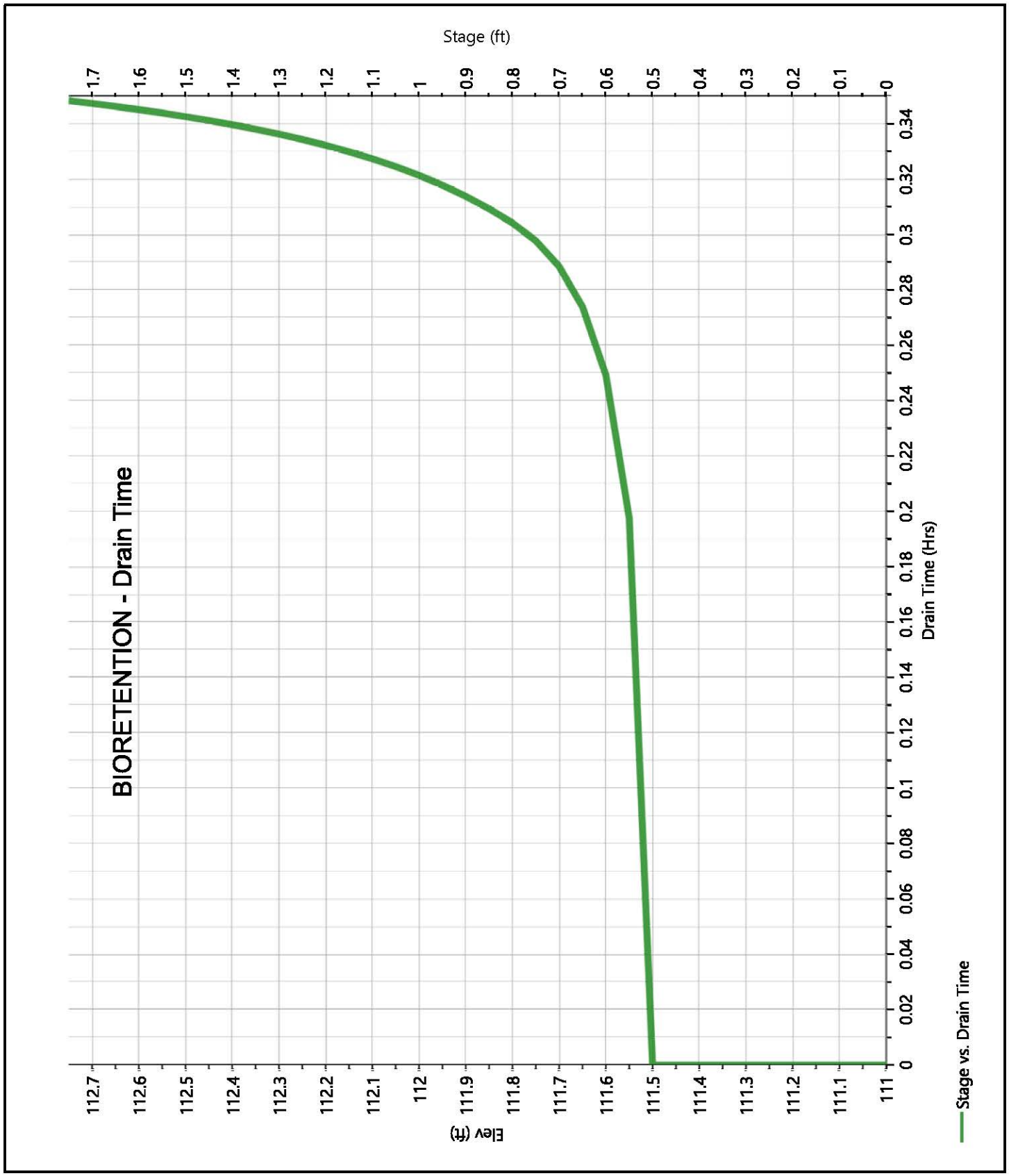
Project Name: 23028

Hydrology Studio v 3.0.0.27

08-17-2023

BIORETENTION

Pond Drawdown



Appendix 9 – LID Credits Spreadsheet

Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Proposed
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

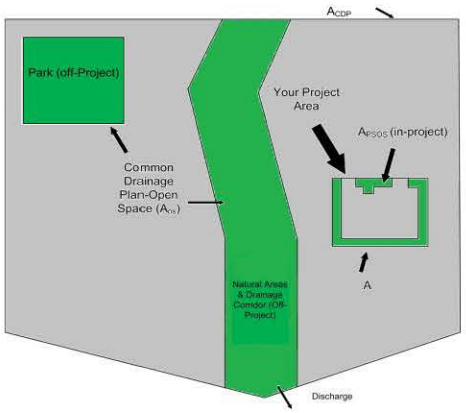
1 a. Common Drainage Plan Area	0	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	see area example below
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	9.65	acres	A	
Project-Specific Open Space (In-project, communal)**	7.49	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		see area example below
c. Natural areas including existing trees, other vegetation, and soil	7.49	acres		
d. Landscape area/park		acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	2.16	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.22		I

Open Space & Pervious Area LID Credit (Step 1)
$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 78 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.04	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.04	acres
Runoff Reduction Credit (Step 2)				$(A_C / A_T)*100$ =		2	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_E)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2			0.00 acres

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.	10	trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	2000	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.	10	trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	1000	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	10000	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	5000	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	8000	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8 This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.04	acres	Box L8

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) - enter gallons, for simple rain barrels | 0.00 acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area: 2,000 sq ft
Subdrain Elevation: 9 inches
Ponding Depth, inches: 6 inches

0.34 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs: _____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr: _____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft: 0.00 capture_vol_inf | 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft: 0 soil_surface_area | 0.00 acres

Basin or trench? _____ approximate BMP depth: 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft: _____ mulch_area | 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 0.34 A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = 31.7 pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 111.0

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = 1.78 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = 0.18 I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity): 0.18 i

Obtain A_{AT} from Step 3: 1.78 A_{AT}

Use C = 0.95: 0.95 C

Flow = 0.95 * i * A_{AT}: 0.30 cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1: 9.65 A

hrs — Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.: 0.17 P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12): 0.14 Acre-Feet

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