REALM ENGINEERING

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# Hydrology Report

Hydrology Report for APN 006-020-056 and 057
Ashby Road Campus Shasta Lake, California

July 22, 2020

## Contents

## Introduction
The purpose of this hydrology study is to assess the effect of a proposed development will have on existing stormwater runoff, and to provide design criteria to provide mitigation. This report was written to meet the requirements of Chapter 15.08 of the City of Shasta Lake Municipal Code.

## Project Description

## Site Description
The subject property consists of two parcels totaling approximately 12.86 acres of land. The site does not currently have an address, but is located on Ashby Road in The City of Shasta Lake, Shasta County, California, and is further identified by APN 006-020-057 and APN 006-020-056. The subject property is currently undeveloped. The majority of the parcels are covered in Oak trees and native grasses.

Topography at the subject site slopes from the northeast to the west and south-southwest with an approximate elevation range of 760 to 810 feet mean sea level (msl). Storm water runoff generally sheet flows as upland flow along the site to the south-southwest where it meets the north branch of Churn Creek. Approximately 0.6 acres near the western boundary of the property flows to a drainage ditch along Ashby Road, and then discharges to an unnamed creek.

## Proposed Land Use
The proposed use of this land is to construct six 5,040 sqft greenhouses, 8 other 5,040 sqft structures and an accompanying 20,000 sqft processing building. There will also be several small ancillary buildings such as 120 square foot designated pesticide/agricultural chemical storage area, refuse area, multiple draining basins, designated composting area, placement of one 10,000 gallon water storage tank, and the construction of a driveway and parking lot. See **Figure 1** for a preliminary site development plan/watershed area.

## Proposed Stormwater Management System
The proposed stormwater runoff regime will flow similar to the existing condition. Stormwater will continue to flow to the southwest. These two parcels have been divided into 4 watershed areas (West, East, Southwest, and Southeast) and analyzed separately. **Figure 1** illustrates these 4 watershed areas and the direction that storm water flows. Each parcel will have one large detention basin located on the southwest corner of the property to contain stormwater on site without affecting adjacent properties. A detailed table describing the sizing methods and calculations used for these basins is located in **Attachment C**. Stormwater from the parking area and some of the roof downspouts will be collected and routed through a series of small detention basins before entering into the large detention basin located on the southwest corner of each property. The stormwater will then enter into the North West branch of the Churn Creek Tributary.

Detention basins for the west and east watershed areas are necessary due to the large amount of impervious area that is being added (55% and 51% respectively). However, the southwest and southeast watershed areas can be managed with less invasive methods due to the small increase of impervious area (3% and 8% respectively). The majority of the impervious area added into the two southern basins is from the road. The road will have two feet of class two aggregate aligning each side followed by 4' of existing ground graded at a 1:1 slope. This will allow the stormwater to dissipate across the undeveloped site area. A cross section of the road can be found in **Figure 2**.

## Hydrology Calculations

This hydrological analysis utilizes the Modified Rational method (Q = C * I * A) to calculate the peak stormwater runoff for 10-year storm events.

Where:

Q = Runoff (cfs)

C = Runoff Coefficient

I = Rainfall Intensity (inches per hour)

A = Area (acre)

Determination of Runoff Coefficient

The runoff coefficient "C" is based on the soil group and land use of the drainage basin (See **Attachment A**). This project lies in Auburn Loam, as determined by referencing the soil survey maps (USDA Soil Survey). Soils in this area tend to retain moisture and will consequently have high runoff coefficients. Composite runoff coefficients were derived with the following formula:

$$C = \frac{(BC+DE)}{A}$$

Where:

A = Total Site Area (acres)

B = Impervious Site Area (acres)

C = Impervious Site Area Runoff Coefficient

D = Pervious Site Area (acres)

E = Pervious Site Area Runoff Coefficient

**<u>West Basin</u>**

Total Site Area: 3.90 acres

Pre-Development:

B) Impervious Site Area: 0

C) Impervious Site Runoff Coefficient: N/A

D) Pervious Site Area: 3.90 acres

E) Pervious Site Area Runoff Coefficient: 0.40

Total: 0.40

Post-Development:

B) Impervious Site Area: 2.15 acres

C) Impervious Site Area Runoff Coefficient: 0.90

D) Pervious Site Area: 1.75 acres

E) Pervious Site Area Runoff Coefficient: 0.40

Total: **0.68**

**East Basin**

Total Site Area: 4.20 acres

Pre-Development:

B) Impervious Site Area: 0

C) Impervious Site Runoff Coefficient: N/A

D) Pervious Site Area: 4.20 acres

E) Pervious Site Area Runoff Coefficient: 0.40

Total: 0.40

Post-Development:

B) Impervious Site Area: 2.15 acres

C) Impervious Site Area Runoff Coefficient: 0.90

D) Pervious Site Area: 2.05 acres

E) Pervious Site Area Runoff Coefficient: 0.40

Total: **0.66**

## Determination of Intensity

Rainfall intensity (I) is typically found from Intensity/Duration/Frequency curves for rainfall events in the geographical region of interest. The Duration is usually equivalent to the time of concentration (Tc) of the drainage area. The Modified Rational Method was used to calculate stormwater runoff for a range of storm durations since the storm producing the maximum storage requirement does not necessarily correspond the Tc. Precipitation rates were derived from the NOAA Atlas 14 (See **Attachment B**). Peak discharge was computed at the time of concentration for the pre and post conditions at the 10, 25, and 100 year storm intervals. For the purposes of this study the detention sizing was performed as a function of the Post development time of concentration. The Post development rational method calculations for the 10-yrs storm event are shown below and the detention pond calculations have been provided as an Attachment to this report as **Attachment C.** Tc is the longest time required for a particle to travel from the watershed divide to the watershed outlet. For this study, the FAA (Federal Aviation Administration) equation was used.

FAA equation: t = G (1.1 – c) L^0.5 / (100 S)^1/3

**West Basin**

c = Rational Method runoff coefficient

G = Constant. FAA: G=1.8

L = Longest watercourse length in the watershed, ft. S = Average slope of the watercourse, ft/ft.

t = Time of concentration, minutes. Length of Longest Watercourse = 758 ft

Slope of longest watercourse = (802-761)ft/758ft = .054 ft/ft or 5.4%

t = 1.8(1.1-0.68)(758ft)^0.5 / (100*.054)^1/3 = 11.98 minutes

Q = 0.68 * 3.41 in/hr * 3.90 acres = 9.04 cfs

**East Basin**

c = Rational Method runoff coefficient

G = Constant. FAA: G=1.8

L = Longest watercourse length in the watershed, ft. S = Average slope of the watercourse, ft/ft.

t = Time of concentration, minutes. Length of Longest Watercourse = 746 ft

Slope of longest watercourse = (805-786)ft/746ft = .025 ft/ft or 2.5%

t = 1.8(1.1-0.66(746ft)^0.5 / (100*.025)^1/3 = 15.99 minutes

Q = 0.66 * 2.76 in/hr *4.20acres = 7.65 cfs

## Detention Basin Sizing

Onsite stormwater detention basins will be constructed to detain runoff such that post-development discharge rates do not exceed the estimated pre-development discharge rates. The detention basins were sized using the Modified Rational Hydrograph Method (See **Attachment C**). The total volume of storage required is the area under the runoff hydrograph curve and above the basin outflow curve. The volume required for one (1) 10-year storm is 5,760 cf. Modified Rational Method was also run for the 100 and 25 year storms for reference and review. The results can be found in **Attachment C**.

## Outlet Facilities

Discharge from the detention basin will be via an outlet riser with an orifice and weir. The orifice will be sized to restrict peak flows during the 100, 25, and 10 year storm to predevelopment levels. The outlet will lead to an appropriately sized culvert which will discharge to a riprap apron above the banks of the North Branch to Churn Creek. A preliminary detention pond layout and drainage pattern layout is shown on **Figure 1.**

## Control Boards regulations

The project will comply with the California State Water Resources Control Board, the Central Valley Regional Water Quality Control Board, and/or the North Coast Regional Water Quality Control Board orders, regulations, and procedures through a formalized SWPPP. Due to the fact that disturbance exceeds 1 acre a formal report will be written, and weekly monitoring will occur on-site during construction. In the event of qualifying forecasted precipitation, a Rain Event Action Plan will be prepared by the qualified SWPPP practitioner (QSP) and implemented through the contractor and legally responsible person. All weekly reports will be uploaded to the SMARTS website and annual reports will be filed by September 1st. Prior to a notice of termination all disturbed areas will be free of temporary erosion control measures and permanent BMP’s will be installed and working.

## Storage Areas of Fertilizers and Topsoil

Cultivation operations including any topsoil, pesticides, or fertilizer storage areas are shown graphically on the site plans. The composting and topsoil area (designated by the letter “E”) is just northeast of the proposed manufacturing building. Hazardous materials including fertilizers (designated by the letter “C”) will be stored in their own separate area. It is important to note that this location is out of reach of the elements and will be monitored through the hazardous materials business plan.

### Discharge of Irrigation or Stormwater from Each Premise

The illicit discharges of irrigation or storm water from the premises, as defined in Title 40 of the Code of Federal Regulations, section 122.26, which could result in degradation of water quality of any water body will be prevented though our catchment basin.

### Shasta Lake City Maintained Drainage System

The City of Shasta Lake maintained drainage or conveyance system that the storm water is discharged into is located along Ashby Road and adjacent watercourse. In our professional opinion the storm water discharge is in compliance with the design parameters of these existing structures with our proposed basin designed to handle 10-year storms. The proposed development site will be self-sustaining and not convey additional storm flows into the existing infrastructure. Monitoring of the system will be ongoing and a backup system of a storm water catchment and leach system will be installed where all roof drains and swales catch the first flush and seep into the ground via installing bottomless inlets and pervious detention basins. The SWPPP will also require routine maintenance of the downstream existing infrastructure to keep trash and debris free from blockage.

### Existing Bridges and Roads

Public roads and bridges that are downstream of the discharge point consist of Ashby road and one small bridge just north of the intersection between Pine Grove Ave and Ashby Road. This bridge allows Nelson Creek to run under Ashby Road. Although our site does not come in direct contact with this bridge or creek the drainage system we maintain does. The best management practices described in the SWPPP will be upheld to keep all downstream drainage systems clean and functional.

### Discharge Increasing the Volume of Water Off Site

The discharge of storm water from the site will not increase the volume of water that historically has flowed onto adjacent properties. This will be accomplished through the installation of two large detention basins and seven small planter detention basins that are specifically sized to handle the pre vs. post run off for the design 10-year storm event. These basins will slow the peak flow for larger storm events but they are not designed to store the required volume to limit the peak flow to the pre-existing condition for the larger 25 and 100 year storm events. These basins will be monitored and if needed seepage pits will be installed to handle first flush of initial storm events.

### Flood Elevations Downstream

The discharge of storm water will not increase flood elevations downstream of the discharge point. This will be accomplished through the installation of the detention basins that are sized to handle the pre vs. post run off for a design 10-year storm. The site is not within the FEMA flood zone nor is the adjacent water course ordinary high-water mark affected by the proposed development. There will be a buffer of 100’ setback from this existing Class II watercourse.

### Storm Water Management Ordinance

The project follows the requirements of Chapter 15.08 of the City of Shasta Lake Municipal Code. The project is in compliance due to the fact that a proposed detention basin is designed to handle peak flows, installations of downspouts for all structures are proposed and rain collection systems will be constructed.  These measures will ensure the County Ordinance Code will be followed and maintained.

## Proposed Grading Methods

The proposed grading of the property will consist of a series of excavations for cut/fill pads to balance the site. Each structure will have a pad constructed in order for the leveling and compaction of soil beneath the building. The anticipation of grading activities will include a D5 cat dozer for initial rough grading, mid-sized excavator for trenching and the detention basins, skid steer and loader for the proposed road installation, sheep's foot roller for compaction, water truck to obtain optimum moisture of the soil and various hand tools for final grading. Protocol for grading activities will include a sequence of the following:

1. Construction staking for rough grading and scarification of the existing site
2. Rough grading using the D5 dozer and excavator.
3. Construction staking for final grades of pads and proposed roads and basin
4. Sheep's foot compactor and water truck to obtain compaction requirements
5. Final grading with the loader and skid steer.
6. Hand tools and bobcat to install erosion control and rock

## BMP's During Construction

The best management practices (BMPs) that will be used during construction include the use of gravel bags to be stored on site, straw wattles (non-plastic), jute netting and crushed rock. The wattles will be installed per the erosion control plan by digging in along contour of the slopes near the toe and staking to ensure they are not ripped out due to the weather. Gravel bags will be placed within the proposed drainage swales to act as check dams and slow down the water to reduce scarification. Jute netting shall be placed upon all disturbed sloped to reduce rilling and erosion to compacted terraces. Crushed rock shall be installed in all construction travel ways to resist pumping and rutting of access points. All stock piles shall be covered and weighted down to protect from forecasted rain and wind.

Post-construction BMP's will consist of hydro mulch and seeding of all disturbed areas with the design mix seeding as outlined within the SWPPP. Additionally, a construction entrance will be installed to ensure tracking off site to be reduced for all access points. Post-construction BMPs shall be maintained through the life of the permit with the installation of permanent erosion control measures and establishment of vegetation. The detention basin will include a rock outfall to protect against overtopping and erosion if overwhelmed from a large storm event. The basin and possible seepage pits will be the best defense against sediment migration off the site and will need to be cleaned out yearly to ensure it does not silt up

## Monitoring of BMP's

The temporary BMP's will be monitored during construction through the SWPPP and enforced with weekly reports prepared by a qualified QSP provided to the contractor. The methodology of the monitoring program will be overseeing by the state SMARTS program and must obtain a WDID number for random inspections by the state. Post construction maintenance of the permanent erosion control measures will need to be in place after the notice of termination is granted. This maintenance will include the following.

1. Cleaning out of existing downstream structures prior to major rain events and after to ensure no blockage to inlets.
2. Removing silt and debris from the detention basin.
3. Placing drainage rock stock piles on site to quickly deploy erosion to slopes and access roads.

4. Installation of seepage pits to protect against first flush rain events.
5. Upkeep of gravel check dams within proposed drainage pathways to slow down stormwater, this will be installed along the emergency outflow as an energy dissipater.

### Conclusion Statement

From the years of building these facilities and other commercial projects we have found the best way to eliminate contaminated surface and facility discharge off site is to contain as much of it as possible on site. If we contain a minimum of the 10-year storm system (5,760 cubic feet provided) we can ensure this is one more project that is not contributing to our surface water issues in California. Some developers propose less expensive drainage basins and bio swales, however these methods either fill in with sediment, are not built in the field properly, or are not adequate for water storage. If maintained properly this proposed drainage system will provide a defense against the occupant’s monthly activities, any spills that may happen can be cleaned up and contained, and first flush rains filled with heavy metals can be trapped and removed after each event. The calculated storage volume required for the entire site is 5,760 cubic feet for a 10-year event. Our proposed design will reduce the significant flooding impact downstream and our proposed drainage basins under each planter will allow water to leach back into the subsurface.

Please feel free to contact me with any questions that you might have regarding this drainage report.

Sincerely,

Jason Vine, P.E./R.C.E 67800

Figure 1: Watershed Areas

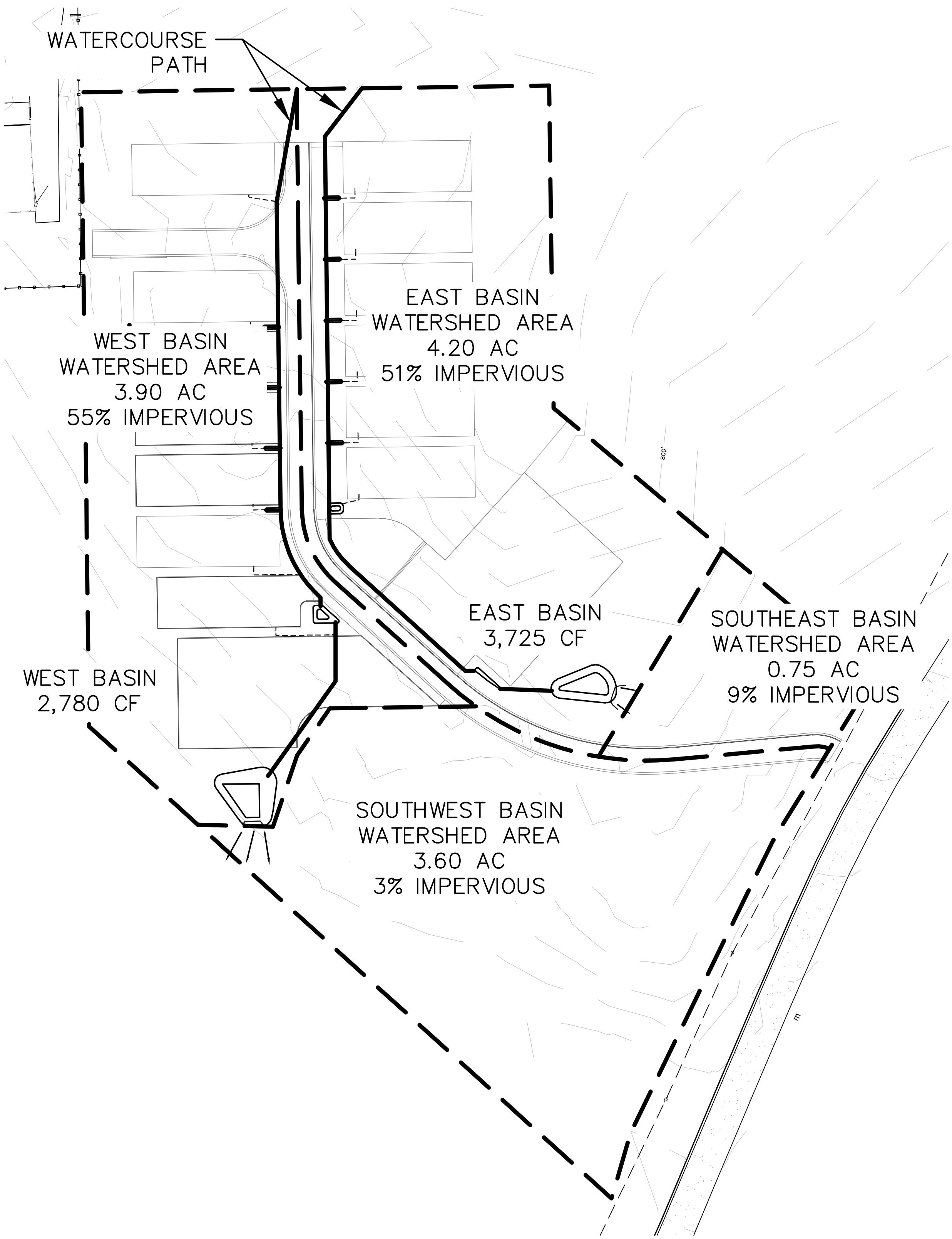


Figure 2: Typical Road Cross Section

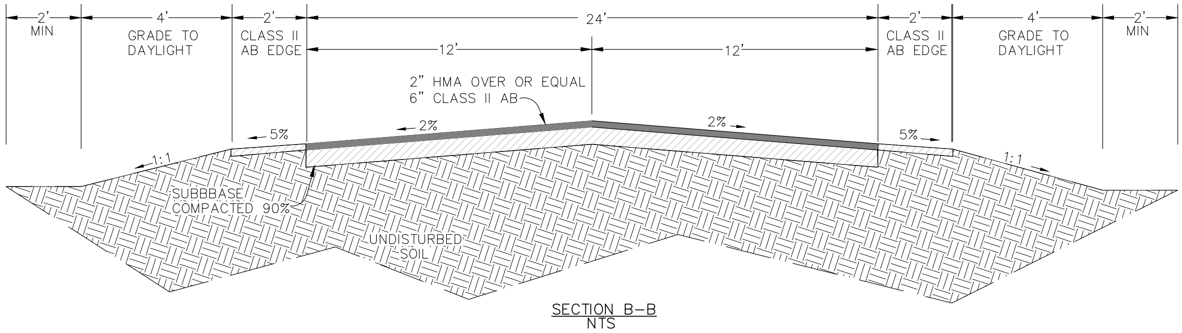
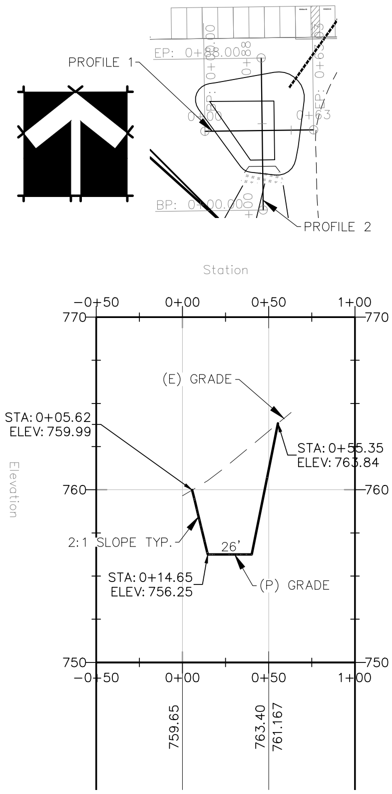
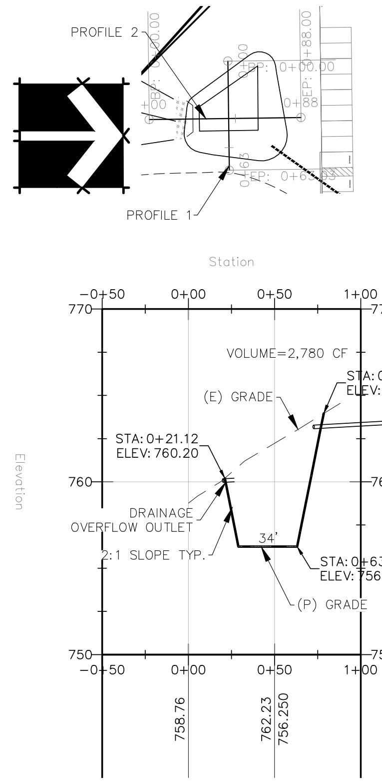


Figure 3: Detention Basin Profiles

West Basin

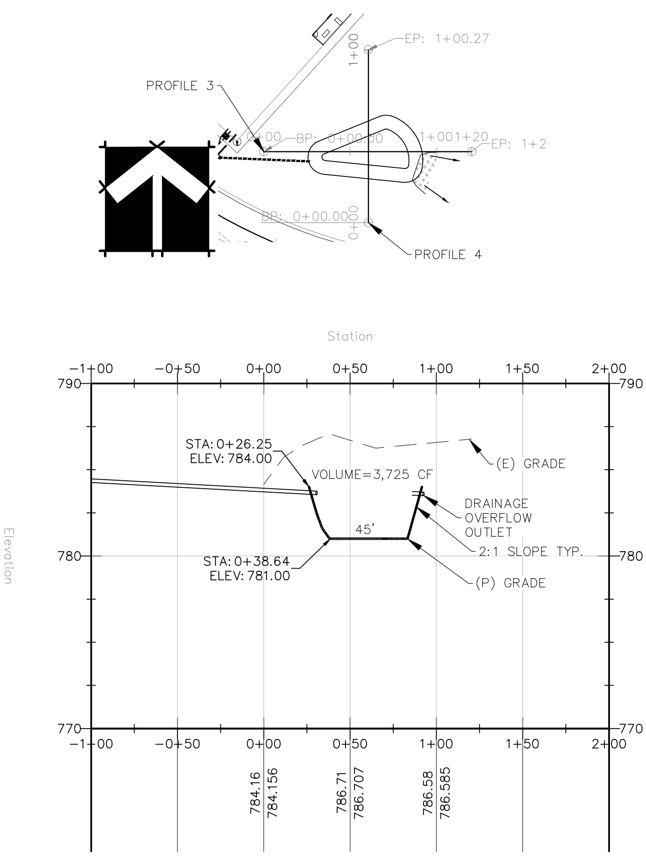



PROFILE 1

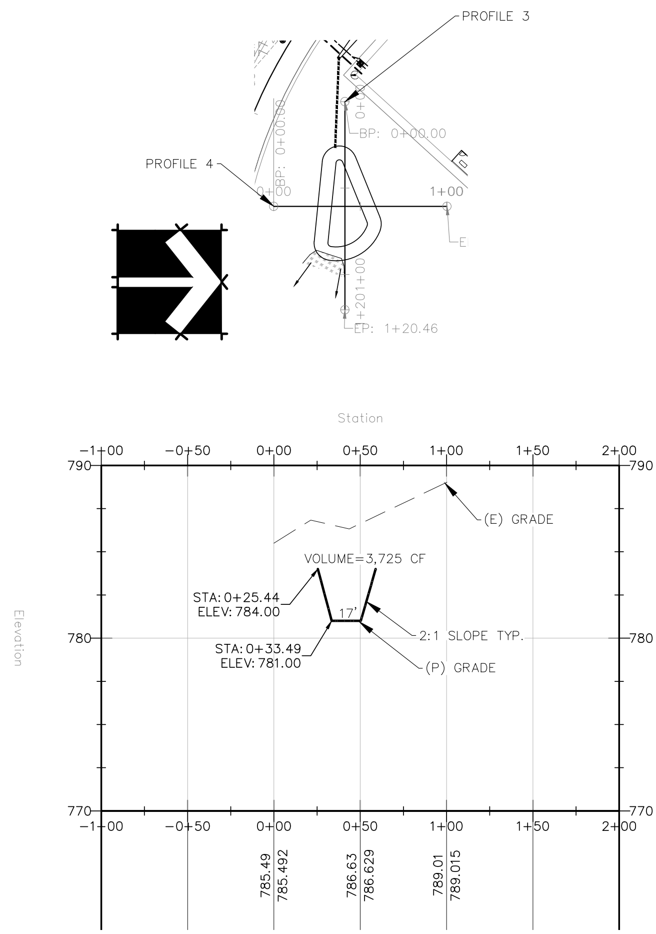



PROFILE 2

East Basin




PROFILE 3




PROFILE 4

# Attachment A

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
# Shasta County Area, California


July 22, 2019

# 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.

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# 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


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## 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 1:20,000.

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: Shasta County Area, California
Survey Area Data: Version 13, Sep 12, 2018

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

Date(s) aerial images were photographed: May 26, 2015—Jun 26, 2015

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 |
|---|---|---|---|
| AnD | Auburn loam, 8 to 30 percent slopes | 20.1 | 94.8% |
| BkD | Boomer gravelly loam, 15 to 30 percent slopes | 1.1 | 5.2% |
| **Totals for Area of Interest** | | **21.2** | **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.

# Shasta County Area, California

## AnD—Auburn loam, 8 to 30 percent slopes

### Map Unit Setting

*National map unit symbol:* hfln
*Elevation:* 120 to 3,000 feet
*Mean annual precipitation:* 20 to 40 inches
*Mean annual air temperature:* 55 to 63 degrees F
*Frost-free period:* 175 to 275 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Auburn and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Auburn

#### Setting

*Landform:* Mountains
*Landform position (two-dimensional):* Backslope, shoulder
*Landform position (three-dimensional):* Mountainflank
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Residuum weathered from metavolcanics

#### Typical profile

*H1 - 0 to 8 inches:* loam
*H2 - 8 to 24 inches:* gravelly loam
*H3 - 24 to 28 inches:* unweathered bedrock

#### Properties and qualities

*Slope:* 8 to 30 percent
*Depth to restrictive feature:* 24 to 28 inches to lithic bedrock
*Natural drainage class:* Well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Low (about 3.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* 4e
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* C
*Ecological site:* SHALLOW LOAMY (R015XD093CA)
*Hydric soil rating:* No

### Minor Components

#### Tailings and placer diggings

*Percent of map unit:* 10 percent
*Hydric soil rating:* No

**Auberry**

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

## BkD—Boomer gravelly loam, 15 to 30 percent slopes

**Map Unit Setting**

*National map unit symbol:* hfly
*Elevation:* 600 to 5,500 feet
*Mean annual precipitation:* 30 to 60 inches
*Mean annual air temperature:* 54 to 59 degrees F
*Frost-free period:* 120 to 260 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Boomer and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Boomer**

**Setting**

*Landform:* Mountains
*Landform position (two-dimensional):* Backslope, shoulder
*Landform position (three-dimensional):* Mountainflank
*Down-slope shape:* Concave
*Across-slope shape:* Convex
*Parent material:* Residuum weathered from metavolcanics

**Typical profile**

*H1 - 0 to 3 inches:* gravelly loam
*H2 - 3 to 23 inches:* gravelly sandy clay loam
*H3 - 23 to 45 inches:* clay loam
*H4 - 45 to 49 inches:* weathered bedrock

**Properties and qualities**

*Slope:* 15 to 30 percent
*Depth to restrictive feature:* 45 to 49 inches to paralithic bedrock
*Natural drainage class:* Well drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 4e
*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* C
*Hydric soil rating:* No

**Minor Components**

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

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

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

Attachment B

**NOAA Atlas 14, Volume 6, Version 2**
**Location name: Shasta Lake, California, USA***
**Latitude: 40.6804°, Longitude: -122.3725°**
**Elevation: 817.51 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 0.223 (0.192-0.261) | 0.277 (0.239-0.325) | 0.345 (0.296-0.406) | 0.397 (0.338-0.472) | 0.465 (0.380-0.575) | 0.515 (0.410-0.653) | 0.564 (0.437-0.735) | 0.612 (0.459-0.825) | 0.675 (0.482-0.954) | 0.722 (0.496-1.06) |
| 10-min | 0.320 (0.275-0.375) | 0.397 (0.342-0.466) | 0.494 (0.424-0.582) | 0.569 (0.484-0.677) | 0.667 (0.545-0.824) | 0.738 (0.588-0.935) | 0.808 (0.626-1.05) | 0.877 (0.658-1.18) | 0.968 (0.691-1.37) | 1.03 (0.711-1.52) |
| 15-min | 0.386 (0.333-0.453) | 0.481 (0.414-0.564) | 0.598 (0.513-0.704) | 0.689 (0.585-0.819) | 0.806 (0.659-0.997) | 0.893 (0.711-1.13) | 0.977 (0.757-1.27) | 1.06 (0.795-1.43) | 1.17 (0.836-1.65) | 1.25 (0.860-1.84) |
| 30-min | 0.537 (0.463-0.629) | 0.668 (0.575-0.784) | 0.831 (0.713-0.978) | 0.957 (0.813-1.14) | 1.12 (0.915-1.39) | 1.24 (0.989-1.57) | 1.36 (1.05-1.77) | 1.47 (1.11-1.99) | 1.63 (1.16-2.30) | 1.74 (1.20-2.56) |
| 60-min | 0.762 (0.657-0.894) | 0.948 (0.816-1.11) | 1.18 (1.01-1.39) | 1.36 (1.15-1.62) | 1.59 (1.30-1.97) | 1.76 (1.40-2.23) | 1.93 (1.49-2.51) | 2.09 (1.57-2.82) | 2.31 (1.65-3.26) | 2.47 (1.70-3.63) |
| 2-hr | 1.09 (0.936-1.27) | 1.33 (1.15-1.56) | 1.64 (1.41-1.93) | 1.88 (1.60-2.24) | 2.20 (1.80-2.72) | 2.44 (1.95-3.09) | 2.68 (2.07-3.49) | 2.91 (2.18-3.93) | 3.23 (2.31-4.56) | 3.47 (2.38-5.10) |
| 3-hr | 1.34 (1.15-1.57) | 1.63 (1.40-1.91) | 1.99 (1.71-2.34) | 2.28 (1.94-2.71) | 2.66 (2.18-3.29) | 2.95 (2.35-3.74) | 3.24 (2.51-4.22) | 3.52 (2.64-4.75) | 3.91 (2.79-5.52) | 4.20 (2.88-6.17) |
| 6-hr | 1.96 (1.69-2.29) | 2.35 (2.03-2.76) | 2.86 (2.45-3.36) | 3.26 (2.77-3.87) | 3.79 (3.10-4.68) | 4.19 (3.34-5.31) | 4.58 (3.55-5.98) | 4.98 (3.74-6.72) | 5.52 (3.94-7.80) | 5.93 (4.07-8.72) |
| 12-hr | 2.86 (2.47-3.36) | 3.45 (2.97-4.04) | 4.18 (3.59-4.92) | 4.75 (4.04-5.65) | 5.50 (4.50-6.80) | 6.06 (4.83-7.68) | 6.60 (5.11-8.61) | 7.14 (5.36-9.63) | 7.85 (5.61-11.1) | 8.38 (5.76-12.3) |
| 24-hr | 4.24 (3.74-4.90) | 5.14 (4.53-5.95) | 6.25 (5.50-7.26) | 7.12 (6.21-8.32) | 8.23 (6.98-9.92) | 9.05 (7.52-11.1) | 9.84 (8.00-12.3) | 10.6 (8.41-13.7) | 11.6 (8.87-15.5) | 12.4 (9.14-17.1) |
| 2-day | 5.62 (4.96-6.49) | 6.82 (6.01-7.90) | 8.35 (7.35-9.69) | 9.57 (8.36-11.2) | 11.2 (9.47-13.5) | 12.4 (10.3-15.2) | 13.6 (11.0-17.1) | 14.8 (11.7-19.0) | 16.4 (12.5-21.9) | 17.6 (13.0-24.3) |
| 3-day | 6.52 (5.76-7.54) | 7.94 (7.00-9.20) | 9.78 (8.60-11.4) | 11.3 (9.83-13.2) | 13.3 (11.2-16.0) | 14.8 (12.3-18.1) | 16.3 (13.3-20.5) | 17.9 (14.2-23.0) | 20.0 (15.2-26.7) | 21.6 (16.0-29.8) |
| 4-day | 7.30 (6.44-8.44) | 8.92 (7.87-10.3) | 11.0 (9.69-12.8) | 12.7 (11.1-14.8) | 14.9 (12.7-18.0) | 16.6 (13.8-20.4) | 18.4 (14.9-23.0) | 20.1 (15.9-25.9) | 22.4 (17.1-30.0) | 24.2 (17.9-33.4) |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **7-day** | **9.12** (8.05-10.5) | **11.3** (9.93-13.0) | **13.9** (12.3-16.2) | **16.0** (14.0-18.7) | **18.7** (15.8-22.5) | **20.7** (17.2-25.4) | **22.6** (18.4-28.4) | **24.5** (19.4-31.6) | **27.0** (20.6-36.1) | **28.8** (21.3-39.7) |
| **10-day** | **10.4** (9.19-12.0) | **12.9** (11.4-14.9) | **16.0** (14.0-18.5) | **18.3** (16.0-21.4) | **21.3** (18.1-25.7) | **23.5** (19.5-28.8) | **25.5** (20.8-32.1) | **27.6** (21.8-35.5) | **30.1** (23.0-40.3) | **32.0** (23.7-44.2) |
| **20-day** | **13.9** (12.2-16.0) | **17.2** (15.2-20.0) | **21.3** (18.7-24.7) | **24.3** (21.2-28.4) | **28.1** (23.8-33.9) | **30.8** (25.6-37.8) | **33.4** (27.1-41.9) | **35.8** (28.4-46.1) | **38.9** (29.7-51.9) | **41.0** (30.4-56.5) |
| **30-day** | **16.9** (14.9-19.5) | **20.9** (18.4-24.2) | **25.7** (22.6-29.8) | **29.2** (25.5-34.2) | **33.7** (28.5-40.6) | **36.8** (30.6-45.2) | **39.7** (32.3-49.9) | **42.5** (33.7-54.8) | **46.0** (35.1-61.5) | **48.5** (35.9-66.9) |
| **45-day** | **20.9** (18.5-24.2) | **25.7** (22.7-29.7) | **31.4** (27.6-36.4) | **35.6** (31.1-41.6) | **40.6** (34.6-49.2) | **44.5** (37.0-54.6) | **47.9** (38.9-60.1) | **51.1** (40.5-65.8) | **55.2** (42.1-73.8) | **58.0** (42.9-80.1) |
| **60-day** | **24.7** (21.8-28.5) | **30.0** (26.4-34.7) | **36.3** (31.9-42.1) | **41.0** (35.8-48.0) | **46.9** (39.7-55.4) | **50.9** (42.3-62.5) | **54.7** (44.5-68.7) | **58.4** (46.3-76.2) | **62.9** (48.0-84.1) | **66.1** (48.9-91.1) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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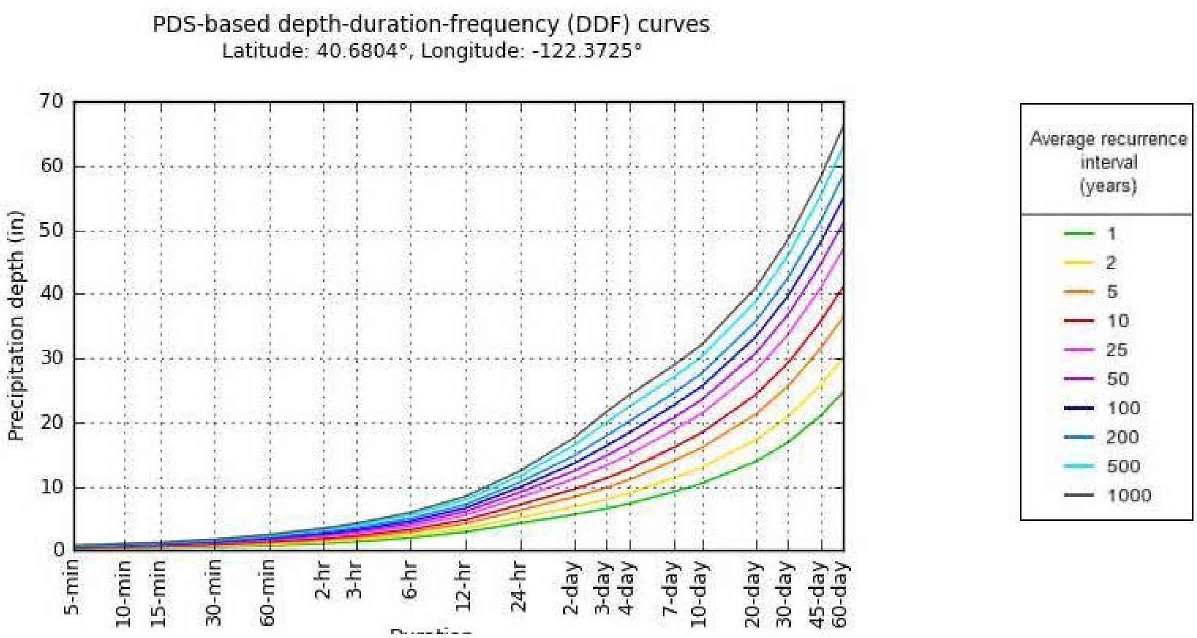
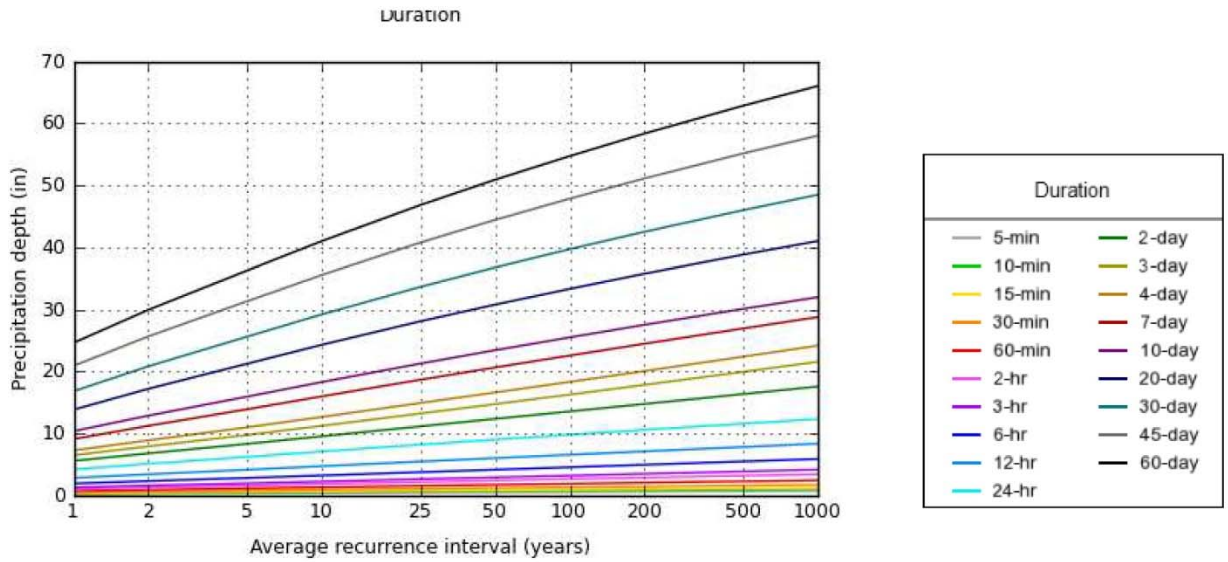
## PF graphical



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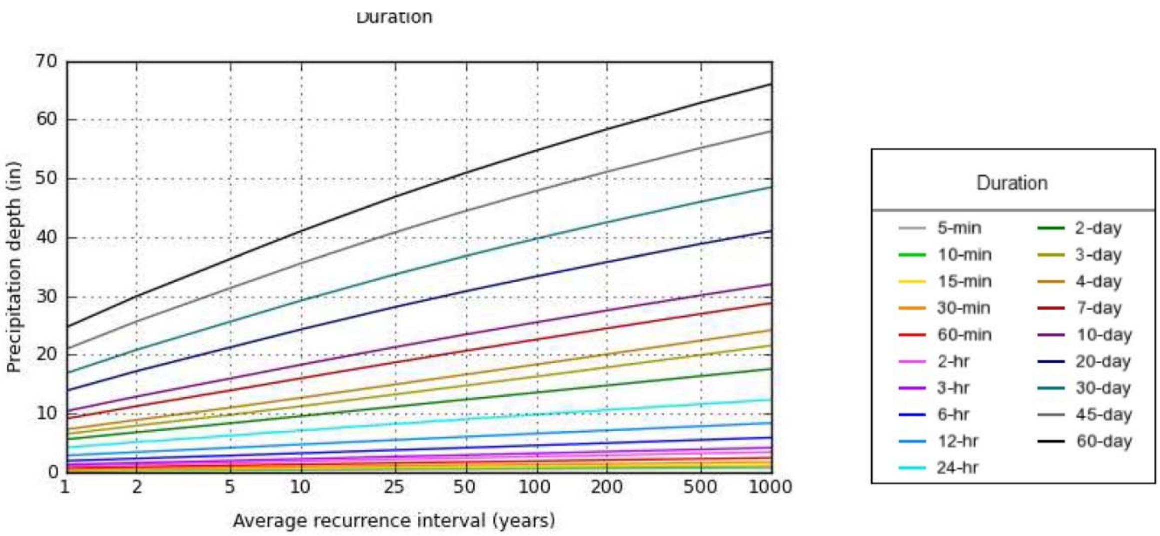
## Maps & aerials

**Small scale terrain**

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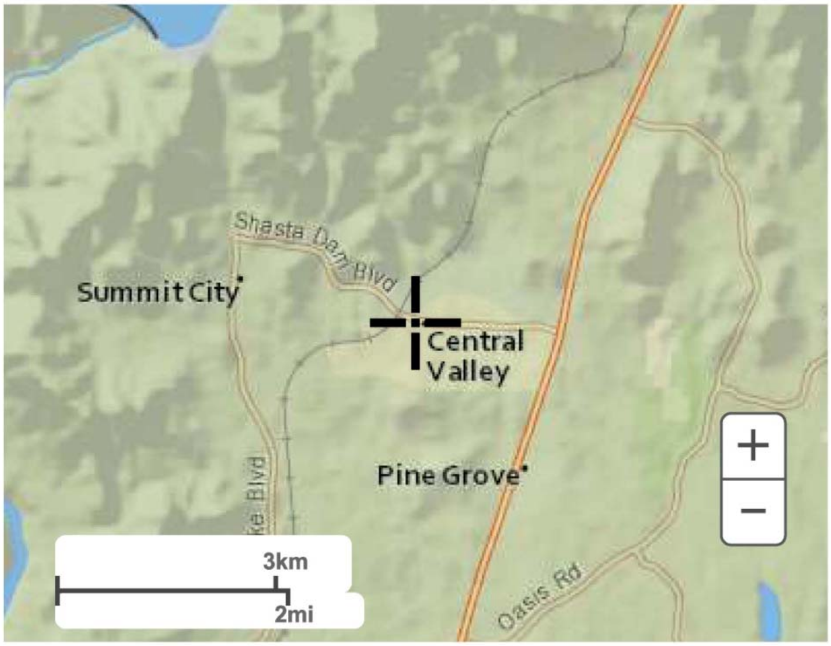
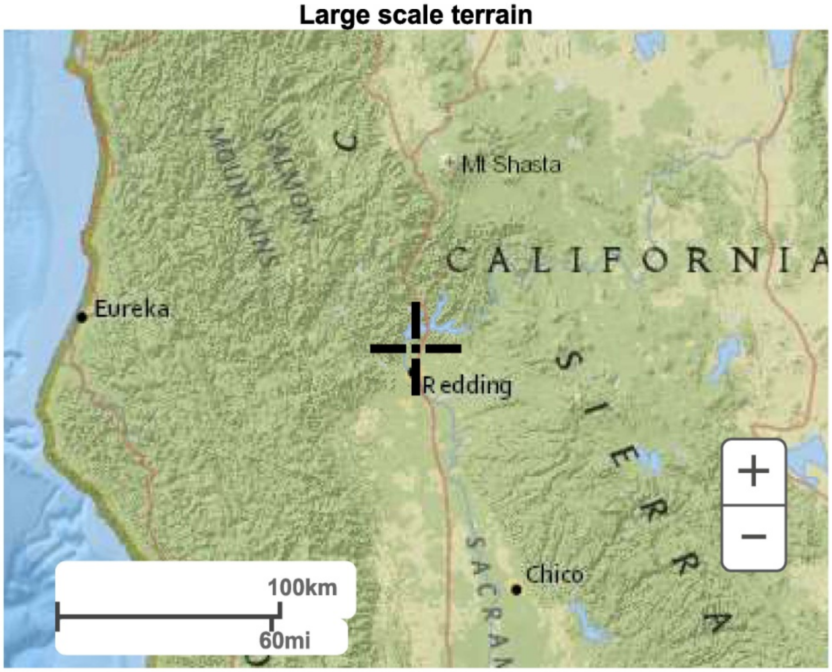
## Maps & aerials

**Small scale terrain**




Large scale terrain




Large scale map

Attachment C: Rational Method Calculations

## Modified Rational Method
## Detention Basin Sizing Tool

**West Basin**

| | | | |
|---|---|---|---|
| **Location:** | City of Shasta Lake | **Area (ac)** | 3.90 |
| **Project:** | 10-Year | **Cexist** | 0.40 |
| **Job No.:** | 19.074 | **Cproj** | 0.68 |
| **Date:** | 12/18/2019 | **Tc (min)*** | 11.98 |
| **By:** | Jason Vine | **i for Tc** | 3.41 |
| **Chk By:** | Jackie Hollmer | **Qexist (cfs)** | 5.33 |

| Storm Duration (Min) | 10 Yr Precip (in) | Intensity (i=in/hr) | Peak Runoff (cfs) | Project Runoff Volume (cfs) | Allowable Q Runoff Volume (cfs) | Required Storage (cf) |
|---|---|---|---|---|---|---|
| 5 | 0.397 | 4.76 | 12.55 | 62.77 | 45.21727268 | 1052.906 |
| 10 | 0.569 | 3.41 | 9.00 | 89.96 | 58.53187268 | 1885.622 |
| 15 | 0.689 | 2.76 | 7.26 | 108.93 | 71.84647268 | 2225.066 |
| 20 | 0.78 | 2.34 | 6.17 | 123.32 | 85.16107268 | 2289.416 |
| 30 | 0.957 | 1.91 | 5.04 | 151.30 | 111.7902727 | 2370.686 |
| 60 | 1.36 | 1.36 | 3.58 | 215.02 | 191.6778727 | 1400.288 |
| 120 | 1.88 | 0.94 | 2.48 | 297.23 | 351.4530727 | -3253.5 |
| 180 | 2.28 | 0.76 | 2.00 | 360.47 | 511.2282727 | -9045.62 |
| 360 | 3.26 | 0.54 | 1.43 | 515.41 | 990.5538727 | -28508.9 |
| 720 | 4.75 | 0.40 | 1.04 | 750.98 | 1949.205073 | -71893.8 |
| 1440 | 7.12 | 0.30 | 0.78 | 1125.67 | 3866.507473 | -164450 |

| | |
|---|---|
| **Required Storage Volume (cf)** | **2380** |
| **Required Storage Volume (acft)** | **0.05** |

**East Basin**

| | | | |
|---|---|---|---|
| **Location:** | City of Shasta Lake | **Area (ac)** | 4.20 |
| **Project:** | 10-Year | **Cexist** | 0.40 |
| **Job No.:** | 19.074 | **Cproj** | 0.66 |
| **Date:** | 12/18/2019 | **Tc (min)*** | 15.99 |
| **By:** | Jason Vine | **i for Tc** | 2.76 |
| **Chk By:** | Jackie Hollmer | **Qexist (cfs)** | 4.63 |

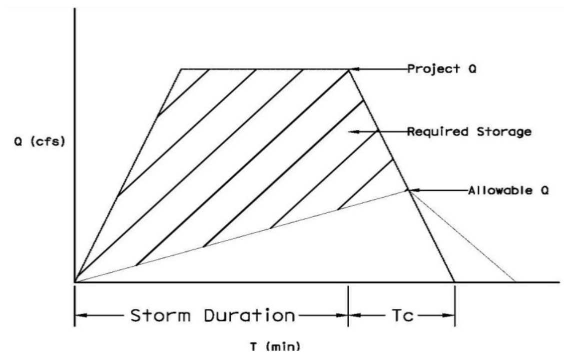
| Storm Duration (Min) | 10 Yr Precip (in) | Intensity (i=in/hr) | Peak Runoff (cfs) | Project Runoff Volume (cfs) | Allowable Q Runoff Volume (cfs) | Required Storage (cf) |
|---|---|---|---|---|---|---|
| 5 | 0.397 | 4.76 | 13.52 | 67.59 | 48.58286687 | 1140.658 |
| 10 | 0.569 | 3.41 | 9.69 | 96.88 | 60.15806687 | 2203.245 |
| 15 | 0.689 | 2.76 | 7.82 | 117.31 | 71.73326687 | 2734.616 |
| 20 | 0.78 | 2.34 | 6.64 | 132.80 | 83.30846687 | 2969.732 |
| 30 | 0.957 | 1.91 | 5.43 | 162.94 | 106.4588669 | 3388.886 |
| 60 | 1.36 | 1.36 | 3.86 | 231.56 | 175.9100669 | 3338.738 |
| 120 | 1.88 | 0.94 | 2.67 | 320.09 | 314.8124669 | 316.7535 |
| 180 | 2.28 | 0.76 | 2.16 | 388.20 | 453.7148669 | -3931.11 |
| 360 | 3.26 | 0.54 | 1.54 | 555.05 | 870.4220669 | -18922.2 |
| 720 | 4.75 | 0.40 | 1.12 | 808.74 | 1703.836467 | -53705.6 |
| 1440 | 7.12 | 0.30 | 0.84 | 1212.26 | 3370.665267 | -129504 |

| | |
|---|---|
| **Required Storage Volume (cf)** | **3390** |
| **Required Storage Volume (acft)** | **0.08** |

*Round Tc to closest Storm Duration
Q=CiA
10-Yr Precip - From NOAA Atlas 14 (attach Point Precipitation Frequency Estimate)

| | | Post-Development | |
|---|---|---|---|
| FAA EQN: | T=G(1.1-c)*L^0.5/(100S)^(1/3)) | West Basin | East Basin |
| C= Rational Method Runoff Coefficient | | 0.68 | 0.66 |
| G= FAA CONSTANT | | 1.8 | 1.8 |
| L=Longest watercourse length | | 758 | 746 |
| S= Average slope | | 0.054 | 0.025 |
| T= time of concentration (minutes) | | 11.98 | 15.99 |
| impervious area | | 2.15 | 2.15 |
| pervious area | | 1.75 | 2.05 |
| impervious area runoff Coefficient | | 0.9 | 0.9 |
| pervious area runoff coefficient | | 0.4 | 0.4 |

Project Runoff Volume = Qproj * Storm Duration
Allowable Q Runoff Volume = (Qexist * (Storm Duration + Tc))/2
Required Strage = Project Runoff Volume - Allowable Q Runoff Volume



## Modified Rational Method
## Q Calculations Pre vs Post

**West Basin**

| | | | | | |
|---|---|---|---|---|---|
| **Location:** | City of Shasta Lake | Pre | | Post | |
| **Project:** | 25-Year | **Area (ac)** | 3.90 | **Area (ac)** | 3.90 |
| **Job No.:** | 19.074 | **Cexist** | 0.40 | **Cproj** | 0.68 |
| **Date:** | 12/18/2019 | **Tc (min)*** | 19.76 | **Tc (min)*** | 11.98 |
| **By:** | Jason Vine | **i for Tc** | 3.23 | **i for Tc** | 4.00 |
| **Chk By:** | Jackie Hollmer | | | | |

| Storm Duration (Min) | 25 Yr Precip (in) | Intensity (i=in/hr) |
|---|---|---|
| 5 | 0.465 | 5.58 |
| 10 | 0.667 | 4.00 |
| 15 | 0.808 | 3.23 |
| 20 | 1.12 | 3.36 |
| 30 | 1.59 | 3.18 |
| 60 | 2.2 | 2.20 |
| 120 | 2.66 | 1.33 |
| 180 | 2.66 | 0.89 |
| 360 | 3.79 | 0.63 |
| 720 | 5.5 | 0.46 |
| 1440 | 8.23 | 0.34 |

| | |
|---|---|
| **Q(PRE) =** | **5.0 CFS** |
| **Q(POST) =** | **10.5 CFS** |

**East Basin**

| | | | | | |
|---|---|---|---|---|---|
| **Location:** | City of Shasta Lake | Pre | | Post | |
| **Project:** | 25-Year | **Area (ac)** | 4.20 | **Area (ac)** | 4.20 |
| **Job No.:** | 19.074 | **Cexist** | 0.40 | **Cproj** | 0.66 |
| **Date:** | 12/18/2019 | **Tc (min)*** | 25.20 | **Tc (min)*** | 15.99 |
| **By:** | Jason Vine | **i for Tc** | 3.36 | **i for Tc** | 3.23 |
| **Chk By:** | Jackie Hollmer | | | | |

| Storm Duration (Min) | 25 Yr Precip (in) | Intensity (i=in/hr) |
|---|---|---|
| 5 | 0.465 | 5.58 |
| 10 | 0.667 | 4.00 |
| 15 | 0.808 | 3.23 |
| 20 | 1.12 | 3.36 |
| 30 | 1.59 | 3.18 |
| 60 | 2.2 | 2.20 |
| 120 | 2.66 | 1.33 |
| 180 | 2.66 | 0.89 |
| 360 | 3.79 | 0.63 |
| 720 | 5.5 | 0.46 |
| 1440 | 8.23 | 0.34 |

| | |
|---|---|
| **Q(PRE) =** | **5.6 CFS** |
| **Q(POST) =** | **8.9 CFS** |

*Round Tc to closest Storm Duration
Q=CiA
25-Yr Precip - From NOAA Atlas 14 (attach Point Precipitation Frequency Estimate)

## Modified Rational Method
## Q Calculations Pre vs Post

**West Basin**

| | | | | | |
|---|---|---|---|---|---|
| **Location:** | City of Shasta Lake | Pre | | Post | |
| **Project:** | 100-Year | **Area (ac)** | 3.90 | **Area (ac)** | 3.90 |
| **Job No.:** | 19.074 | **Cexist** | 0.40 | **Cproj** | 0.68 |
| **Date:** | 12/18/2019 | **Tc (min)*** | 19.76 | **Tc (min)*** | 11.98 |
| **By:** | Jason Vine | **i for Tc** | 3.91 | **i for Tc** | 4.85 |
| **Chk By:** | Jackie Hollmer | | | | |

| Storm Duration (Min) | 100 Yr Precip (in) | Intensity (i=in/hr) |
|---|---|---|
| 5 | 0.564 | 6.77 |
| 10 | 0.808 | 4.85 |
| 15 | 0.977 | 3.91 |
| 20 | 1.36 | 4.08 |
| 30 | 1.93 | 3.86 |
| 60 | 2.68 | 2.68 |
| 120 | 3.24 | 1.62 |
| 180 | 4.58 | 1.53 |
| 360 | 6.6 | 1.10 |
| 720 | 9.84 | 0.82 |
| 1440 | 13.6 | 0.57 |

| | |
|---|---|
| **Q(PRE) =** | **6.1 CFS** |
| **Q(POST) =** | **12.8 CFS** |

**East Basin**

| | | | | | |
|---|---|---|---|---|---|
| **Location:** | City of Shasta Lake | Pre | | Post | |
| **Project:** | 100-Year | **Area (ac)** | 4.20 | **Area (ac)** | 4.20 |
| **Job No.:** | 19.074 | **Cexist** | 0.40 | **Cproj** | 0.66 |
| **Date:** | 12/18/2019 | **Tc (min)*** | 25.20 | **Tc (min)*** | 15.99 |
| **By:** | Jason Vine | **i for Tc** | 4.08 | **i for Tc** | 3.91 |
| **Chk By:** | Jackie Hollmer | | | | |

| Storm Duration (Min) | 100 Yr Precip (in) | Intensity (i=in/hr) |
|---|---|---|
| 5 | 0.564 | 6.77 |
| 10 | 0.808 | 4.85 |
| 15 | 0.977 | 3.91 |
| 20 | 1.36 | 4.08 |
| 30 | 1.93 | 3.86 |
| 60 | 2.68 | 2.68 |
| 120 | 3.24 | 1.62 |
| 180 | 4.58 | 1.53 |
| 360 | 6.6 | 1.10 |
| 720 | 9.84 | 0.82 |
| 1440 | 13.6 | 0.57 |

| | |
|---|---|
| **Q(PRE) =** | **6.9 CFS** |
| **Q(POST) =** | **10.8 CFS** |

*Round Tc to closest Storm Duration

Q=CiA

100-Yr Precip - From NOAA Atlas 14 (attach Point Precipitation Frequency Estimate)