Appendix H2

Hydrology and Flood Control Measures

INTRODUCTION

The Santa Clara Valley Water District (Valley Water) has developed a two dimensional hydraulic HEC-RAS model of Los Gatos Creek which represents the best available floodplain data within the watershed. The creek model identifies a deficiency of capacity in the channel that results in overbank flooding during the 100-year event that is not identified on the FEMA Flood Insurance Rate Map (FIRM). As such, this project will need to address the updated floodplain within the design to meet all local and federal requirements as well as CEQA thresholds.

Hydrology

The hydrologic inputs to the Valley Water HEC-RAS model are based on the Army Corps of Engineers HEC-HMS modeling and subsequent report[1] for the greater Guadalupe River Watershed.

The effective FEMA Flood Insurance Study (FIS) is based on hydrologic inputs from a 1977 study[2] which are input into a steady-state model to determine the effective mapping. The updated 2009 Army Corps hydrographs are input into the Valley Water 2019 unsteady hydraulic model to determine the best available mapping. The peak 100-year flows throughout the project reach for both analysis are compared in Table 1. It can be seen that the updated input flows are 4-11% higher than in the effective FIS. These flows are based on hydrologic modeling only and do not account for spills.

Table 1: 100-year Hydrology Comparison

Location	1977 FIS Flow (cfs)	2009 Army Corps Study (cfs)
Below Vasona Dam	6,950	7,730
Upstream of Confluence with Guadalupe River	7,980	8,274

Geometry

Valley Water developed the new HEC-RAS model based on survey performed between 2017-19 for channel cross sections and a two dimensional surface from 2006 LiDAR as described in their technical memorandum[3]. Channel roughness was updated based on visual inspection by Valley Water. The “n” values are compared in Table 2. It is notable that the channel roughness was determined to have increased considerably since the 1977 modeling effort, and is thought to be due to an increase in vegetation and debris. Schaaf & Wheeler performed a calibration of the channel invert “n” value based on recorded high water surface

[1] U.S. Army Corps of Engineers - San Francisco District, Guadalupe Watershed Hydrologic Assessment, November 2009
[2] FEMA, Flood Insurance Study Number 06085CV001B, Santa Clara County, California and Incorporated Areas, February 19, 2014
[3] Xu, Jack, 2D Hydraulic Model Details & Results Analysis (Update), Los Gatos Creek Modeling and Mapping, Santa Clara Valley Water District, May 23, 2019

elevations during a 2019 storm. These calibrated invert values were taken with Valley Water's bank values and composited to represent each channel cross section roughness. Details regarding this process are included in a 2019 memorandum by Schaaf & Wheeler[4].

Table 2: Average Composite Roughness Comparison

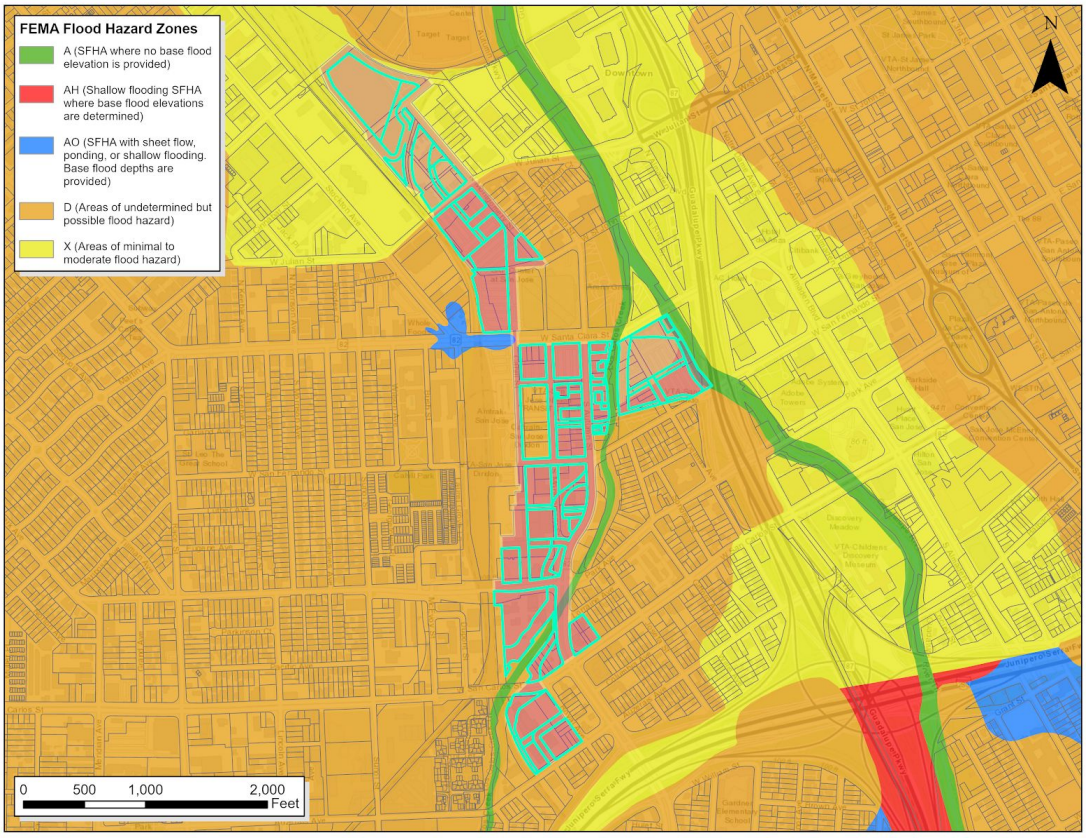
Location	1977 FIS	2019 HEC-RAS
Confluence to Highway 280	0.045	0.05-0.07

100-year Floodplain Mapping

FEMA FIRM

The effective FIRM[5] depicts all of the flow contained within Los Gatos Creek and Guadalupe River as shown in the map below. The development parcels outlined are located within Zone X (yellow) and Zone D (orange) which have no development requirements.

Figure 1: Effective FEMA 100-year Floodplain Map



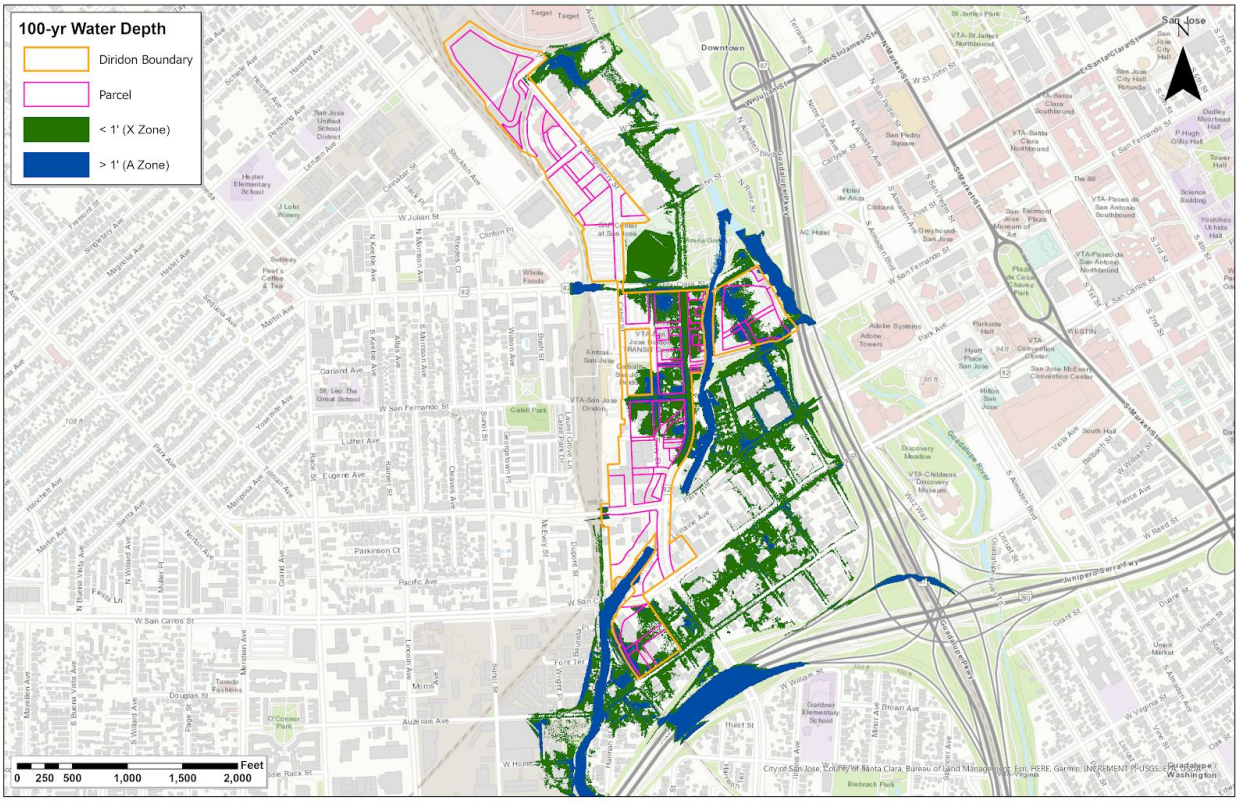
[4] Gilmore, Caitlin, Los Gatos Creek Independent QC and Revisions to FINAL HEC-RAS model, Letter to Jack Xu, December 20, 2019

[5] FEMA, Flood Insurance Rate Map Number 06085C0234H, May 18, 2009

Valley Water Model

The results of the Valley Water hydraulic model are shown below in Figure 2 for the 100-year floodplain extent. The Project parcels are also depicted for reference. Where water depths exceed one foot an A Zone designation is shown in dark blue, whereas depths less than one foot are classified as X Zone and shown in green. FEMA and the City require the elevation or floodproofing of structures within A Zones as described below.

Figure 2: Valley Water Best Available 100-year Floodplain Map



Regulatory Framework

The Project is subject to several agency and local government regulations regarding development with a 100-year floodplain. Below is a summary of those requirements.

City of San Jose

As the floodplain administrator and member of the National Flood Insurance Program (NFIP), the City of San Jose is tasked with reviewing and approving projects located within the FEMA, or best available, 100-year floodplain A Zone designations. With that aim, the City's Municipal Code Chapter 17.08 requires that structures be elevated such that the finish floor is located above, or protected to, the base flood elevation (BFE). Additionally, the Project cannot cause a cumulative rise in BFE of more than one foot. The City has also adopted the 2019 California

Building Code (CBC) which incorporates a freeboard requirement that project finish floors must be elevated or flood proofed to one foot above the BFE.

FEMA

FEMA produces a Flood Insurance Manual that describes the requirements of developing in the floodplain with A Zone designation. Projects must be elevated or protected to the BFE. In order for a project (structure) to be removed from the floodplain, the lowest adjacent grade to the structure must be at or above the BFE. However, as the effective FEMA FIRM does not show the proposed structures within the effective 100-year floodplain, no applications to FEMA are required for removal. The Valley Water best available floodplain mapping will be used to determine minimum elevations will be met and that the project is protected from 100-year flood waters.

Valley Water

As the owner of the Creek, project elements such as bridges or in-channel work must be reviewed and accepted by Valley Water to meet their priorities of restoring wildlife habitat and providing flood protection.

CEQA

CEQA requires projects to be reviewed to determine if it will significantly impede or redirect flood flows.

DESIGN ALTERNATIVES

There are two design concepts considered to reduce the flood hazard to the proposed development and surrounding area. Portions of the first option are located outside of the project boundary as shown in the ADEIR-1 Site Plan, but would be considered a project improvement.

1. Channel Rehabilitation, Reconstruct W San Fernando St Bridge, and Elevating or floodproofing structures remaining in floodplain
2. Elevate or flood proof structures in the floodplain
3. Reconstruction W San Fernando Street Bridge, and elevate or floodproof structures remaining in the floodplain (no channel rehabilitation)

These project elements are described in more detail herein.

Channel Rehabilitation

An in-channel rehabilitation project would both improve Creek ecology and improve user experience adjacent to the Creek as well as lessen impediments to flow and improve channel hydraulics thereby reducing overbank flooding.

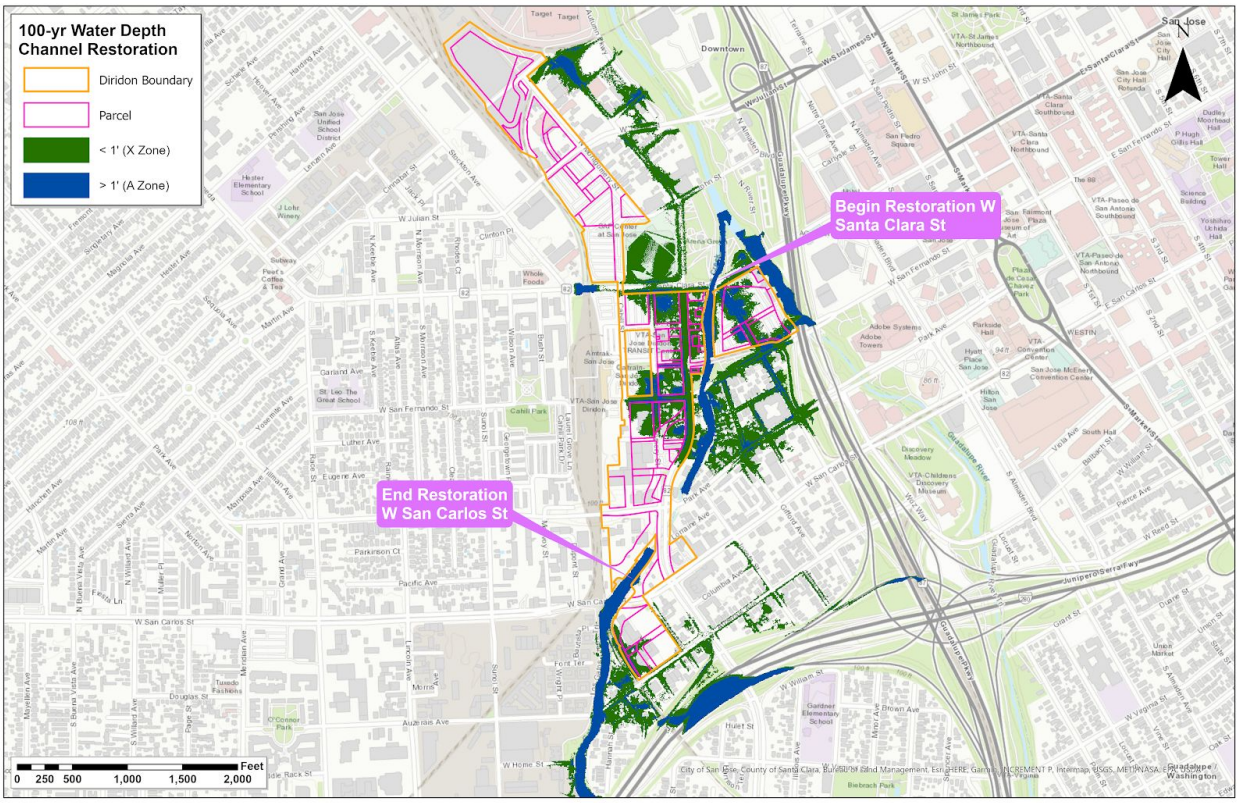
The existing channel has a high roughness coefficient due to the presence of large invasive tree and shrub species near the channel invert, log jams, large dead trees, and other debris. These serve to slow flow and reduce capacity and results in the mapped overbank flooding. Existing

condition roughness coefficients vary from about 0.05 to 0.07 between the confluence with Guadalupe River and Highway 280. These values could be reduced by approximately 0.01 through a capital improvement project and ongoing maintenance.

A capital improvement project would intend to improve Los Gatos creek ecology through removal of trash and debris, dead trees and invasive tree species in the creek bed and banks, focusing on those located in strategic hydraulic locations such as the creek invert. The channel will need to have ongoing maintenance in perpetuity to prevent the accumulation of additional debris and re-growth of non-native species. This ongoing maintenance will allow for a continued lowered baseline channel roughness for hydraulic calculations and generally improve flow conveyance with a lower risk of flow obstruction.

The rehabilitation project could extend from the West Santa Clara Street bridge to the West San Carlos Street bridge and occur on both banks. The project would lower floodplain base flood elevations by an average of 0.1 feet.

Figure 3: 100-year Floodplain After Channel Rehabilitation



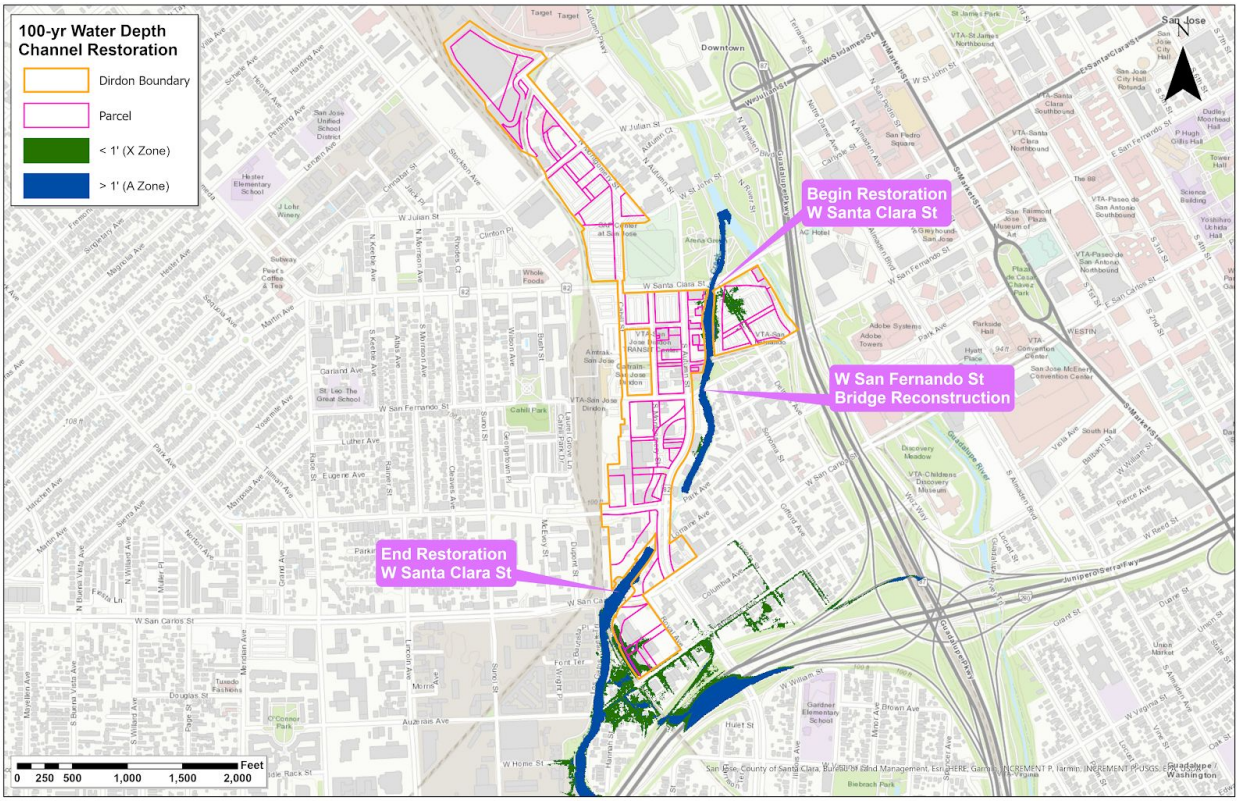
Reconstruction of San Fernando Bridge

The existing West San Fernando Street bridge represents an impediment to flow due to columns and abutments within the channel and a low bridge deck. In conjunction with the channel rehabilitation project, reconstructing San Fernando bridge to a clear span would significantly reduce overbank flooding during a 100-year event. In order to accomplish this, the bridge would need to be reconstructed so that the abutments are located outside of the channel with no supports within the channel. This requires an approximate 100 foot free span with a minimum soffit elevation of 91.8 feet.

With Channel Rehabilitation

With channel rehabilitation and bridge reconstruction, portions of five (5) parcels would remain in a Zone A designation and would require elevating or flood protection measures.

Figure 4: 100-year Floodplain After Channel Rehabilitation and Bridge Reconstruction



Without Channel Rehabilitation

With bridge reconstruction only, portions of thirteen (13) parcels would remain in a Zone A designation and would require elevating or flood protection measures.

Figure 5: 100-year Floodplain After Bridge Reconstruction Only

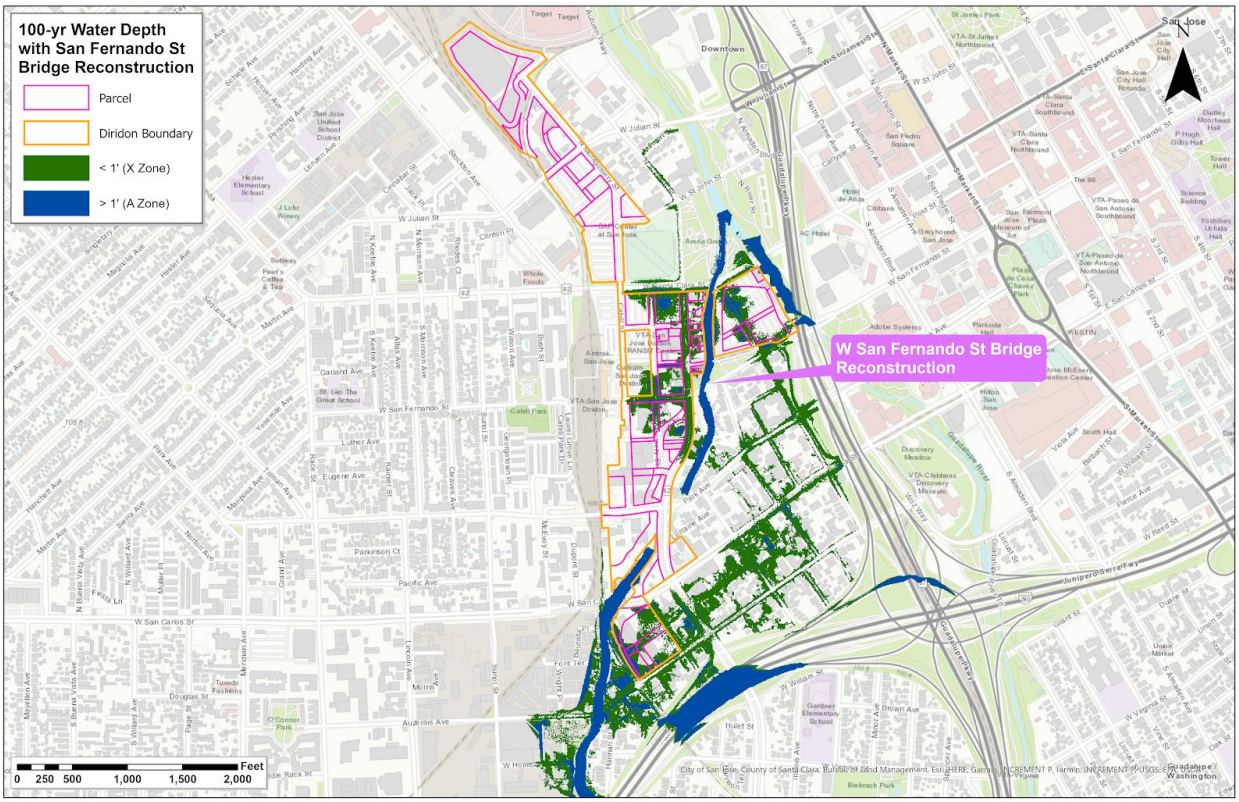
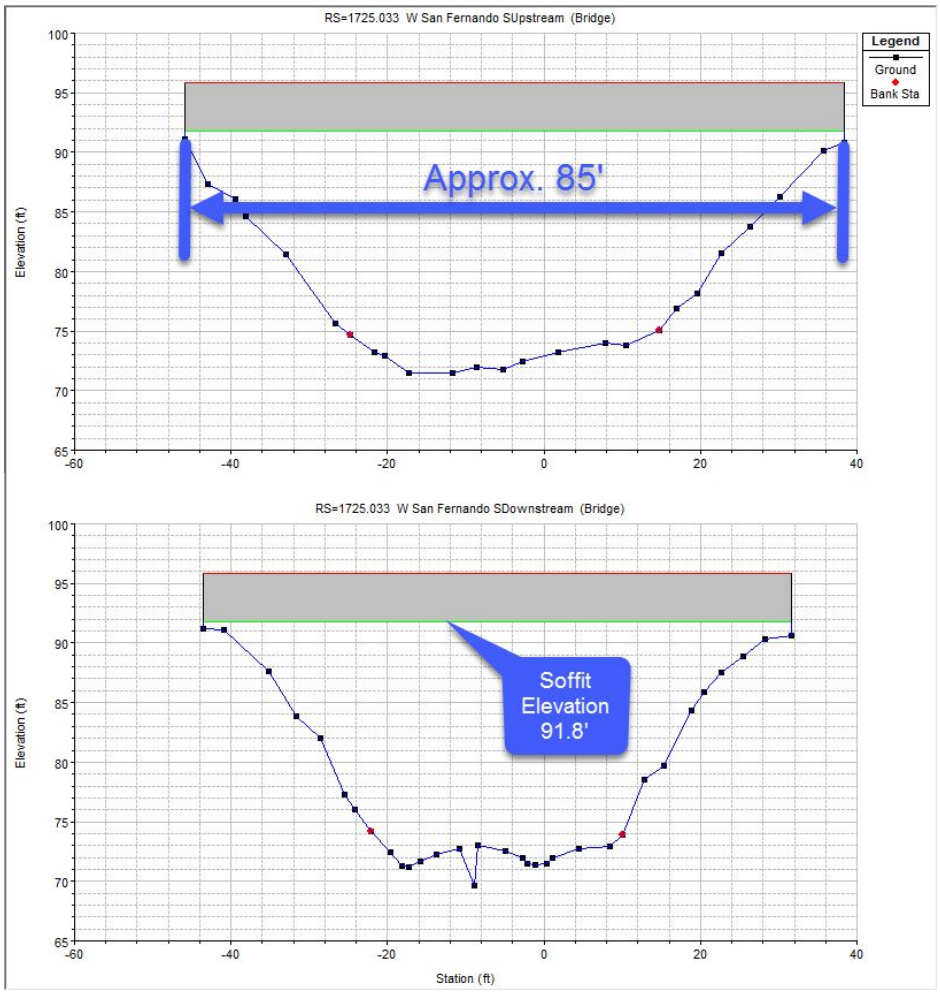


Figure 6: Existing Bridge and model Cross Section



Raising Finish Floors

Per San Jose Building Code, the lowest floor of development (FFE) within Flood Zone A must be elevated at or above the base flood elevations. Per ASCE 24-12, recommends the minimum FFE be one foot above the design flood elevation (100-year water surface values based on the best available data model).

Based on the proposed creek remediation and bridge reconstruction solution (Design Alternative 1), portions of five (5) parcels will need to be raised above existing grade for flood protection.

For Design Alternative 2 with no bridge or channel work, portions of fourteen (14) parcels will need to be raised or floodproofed.

Based on bridge reconstruction only (Design Alternative 3), a portion of thirteen (13) parcels will need to be raised above existing grade for flood protection.

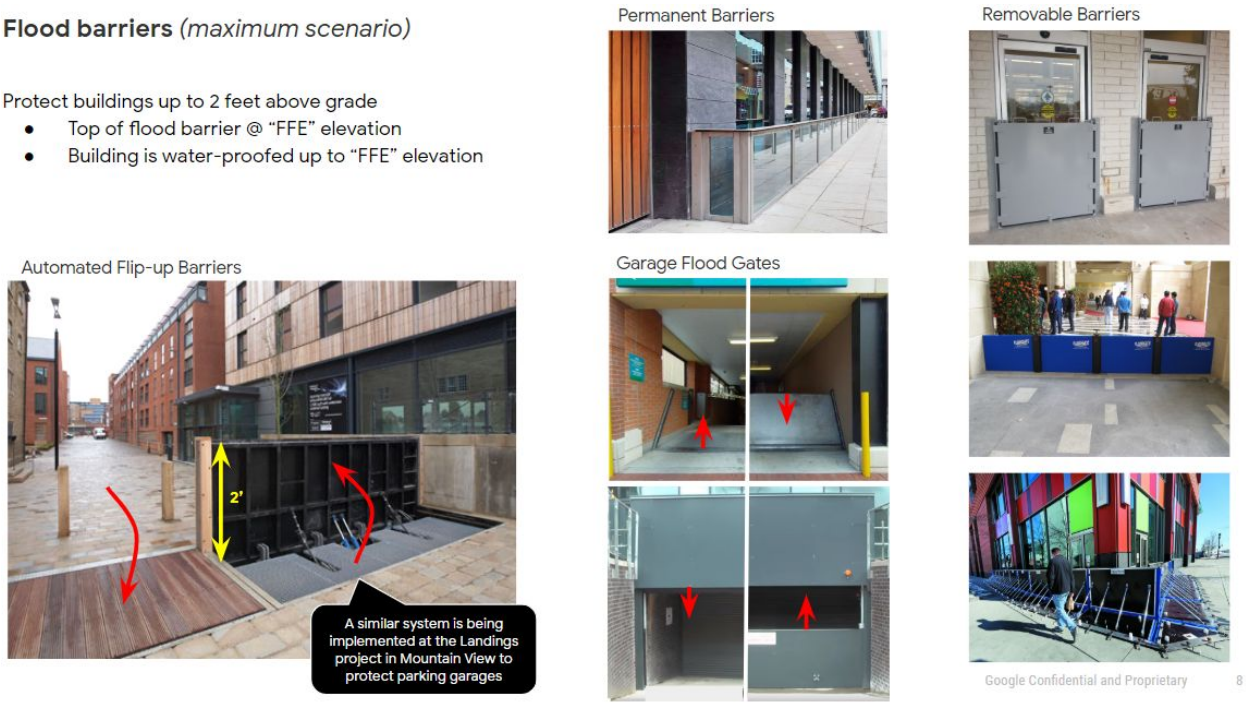
Raising of grades can be done with either fill or by raising a subgrade parking garage to partially expose the exterior structure. Additionally, any building with a raised FFE will require fill, ramps, and/or stairs to ensure there are accessible paths from the existing streets to entrances which meet ADA standards.

Flood Barrier Design Option

As an alternative to elevating structures by fill, flood barriers and waterproofing may be used. Buildings within Flood Zone A should be externally waterproofed up to the minimum FFE. The top elevation of any proposed floodgates must also reach the minimum FFE.

Flood barrier design can be flexible to meet building design, spatial and aesthetic requirements. Barriers that may be considered include (but are not limited to) permanent standing barriers, automated barriers integrated into the ground or building walls, or removable barriers.

Figure 7: Flood Barrier Alternatives



Summary of Regulatory Requirements

The three (3) design alternatives under consideration both offer means of meeting the multijurisdictional requirements of developments within the 100-yr floodplain for the project. Design Alternative 1 seeks to ameliorate the extent and magnitude of flooding from Los Gatos Creek through channel rehabilitation and the reconstruction of the West San Fernando Street

bridge; structures remaining impacted within the A-zone floodplain would be elevated or floodproofed. Design Alternative 2 does not seek to reduce the extent and magnitude of flooding from Los Gatos Creek and seeks to meet regulatory requirements solely through elevating or floodproofing structures in the A zone floodplain for the project. Alternative 3 looks to reconstruct W San Fernando Street Bridge to relieve some flooding depths and extents, but not to the extent of Alternative 1.

City of San Jose

For all of the design alternatives, all proposed structures located within the Valley Water modeled special flood hazard zone A will be elevated or floodproofed to, at minimum, one foot above BFE. Design Alternative 1 reduces the extent of the floodplain through improved channel hydraulics and requires that portions of five (5) parcels be elevated or floodproofed; Design Alternative 2 does not alter channel hydraulics and requires that portions of fourteen (14) parcels be elevated or floodproofed, and Design Alternative 3 requires portions of thirteen (13) parcels be elevated or floodproofed.

FEMA

The effective FEMA FIRM does not show the locations of the proposed development parcel areas as being located within a special flood hazard area A-zone; therefore, the proposed parcels are not subject to FEMA requirements of developments within A-zone designations for any of the three design alternatives.

Valley Water

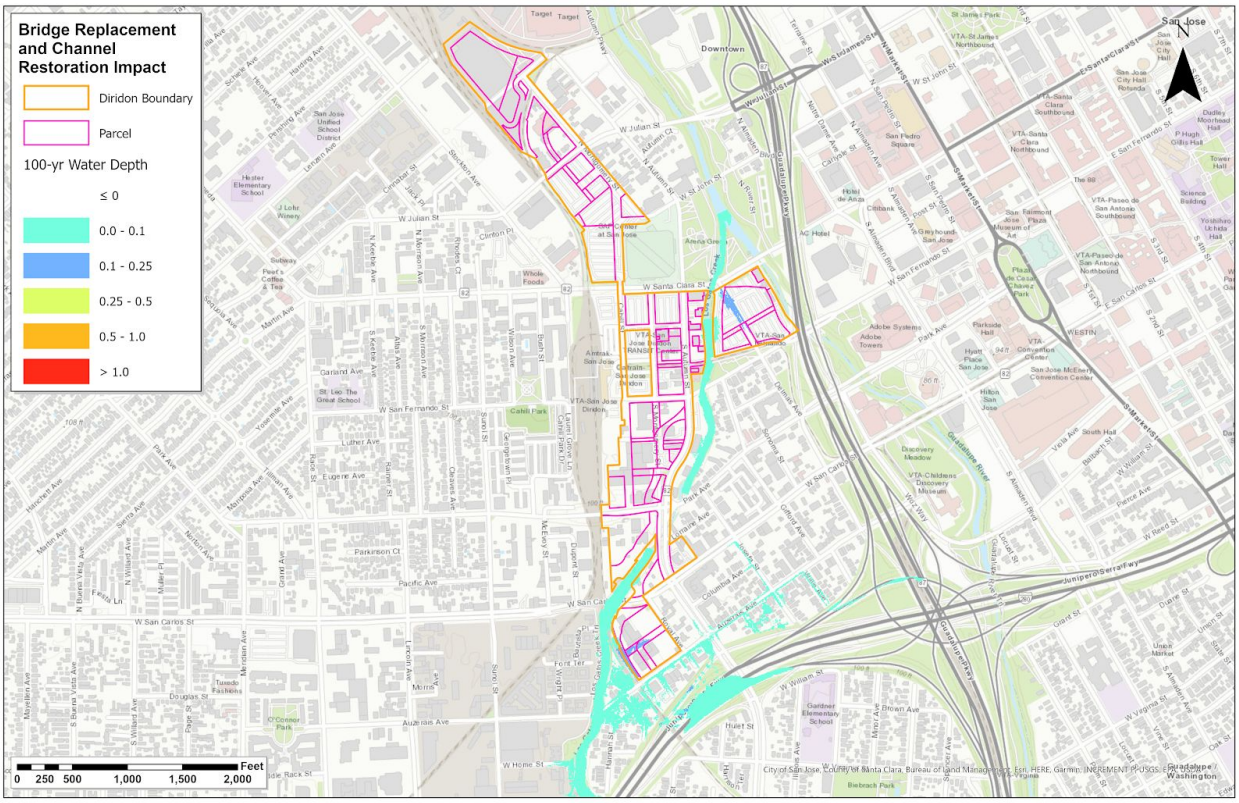
Design Alternatives 1 and 3 are dependent on either channel rehabilitation and the reconstruction of the West San Fernando Street bridge for improved channel hydraulics that reduce the extent of the floodplain and the number of proposed parcels impacted by floodwaters greater than one (1) foot in depth. As the owner of the Los Gatos Creek channel, Valley Water will review the project design drawings in order to ensure that the project alternative aligns with their goals of ecological and flood protection benefit requirements for in-channel work. Ongoing coordination with Valley Water has indicated their preliminary acceptance of the Design Alternative 1 concept. Design Alternative 2 does not involve in-channel work or Valley Water permitting. Design Alternative 3 is limited to permitting for bridge reconstruction.

CEQA

CEQA requires projects to be reviewed to determine if it will significantly impede or redirect flood flows. Each alternative is reviewed herein for impacts to water surface elevation pre- and post-project.

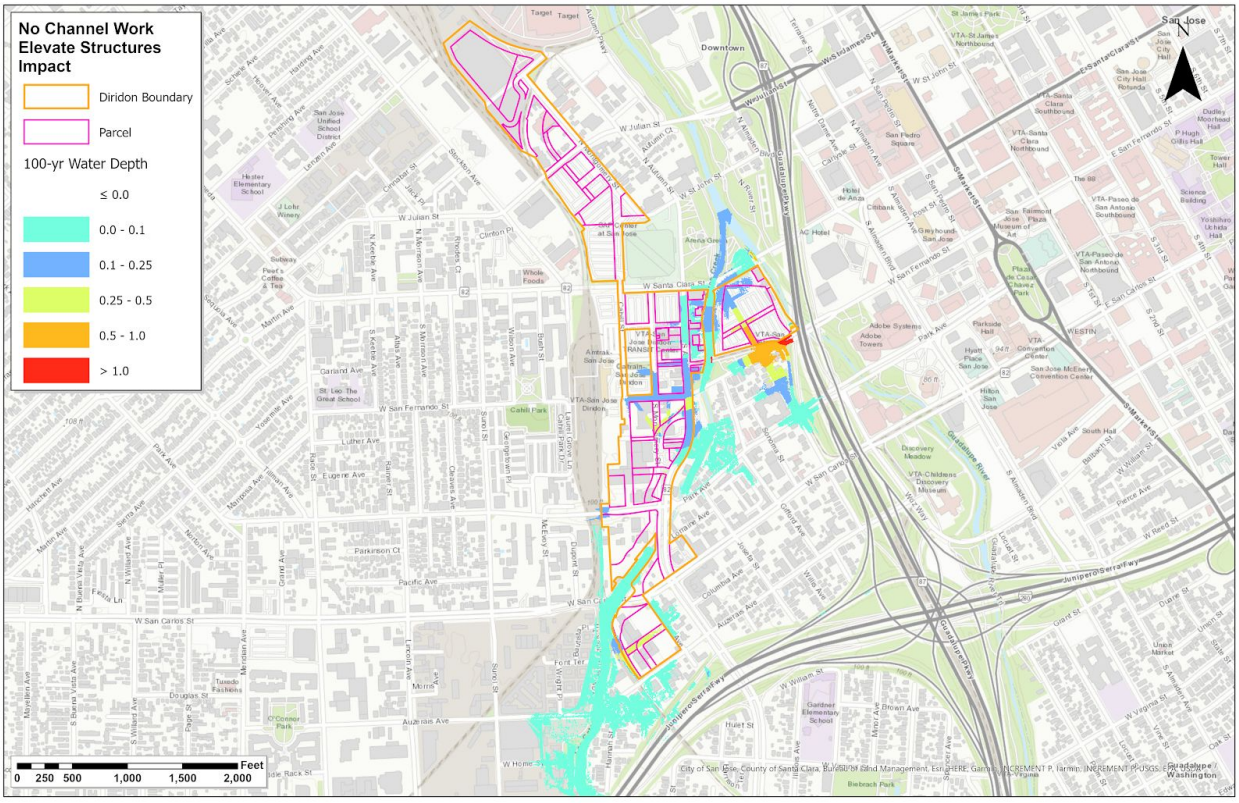
Design Alternative 1 (bridge reconstruction, channel restoration and building elevation or floodproofing) reduces the magnitude and extent of flooding throughout the project and is, therefore, not considered to impede or redirect flood flows to cause negative impact. There is only a small (less than 0.25') impact to the water surface elevation within two proposed interior streets within the development itself and the alternative causes no impact to adjacent parcels.

Figure 8: Design Alternative 1 Overland Flow Impacts (feet)



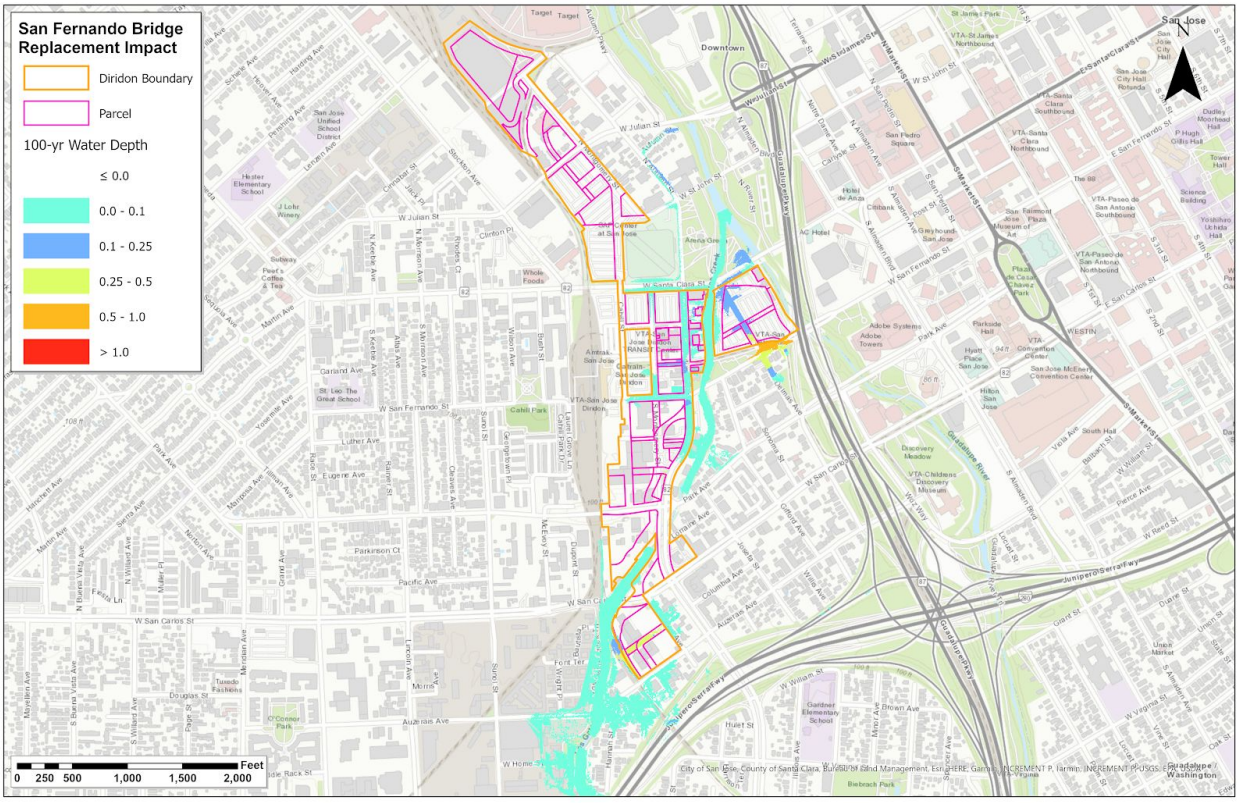
The effects of Design Alternative 2 (no in-channel projects, elevate or floodproof structures) are limited to a maximum isolated 1.1 ft rise in overland flow base flood elevation within the City right of way and are not considered substantial impacts. Cumulative impacts to properties and structures are a maximum of less than one foot as regulated by the City's Municipal Code. This increase in BFE is isolated to a section of San Fernando Street near Highway 87 where overland flow enters Guadalupe River from south to north. Most impacts throughout the project area are less than 0.4 feet cumulatively.

Figure 9: Design Alternative 2 Overland Flow Impacts (feet)



The effects of Design Alternative 3 (reconstruct bridge and elevate or floodproof structures) are limited to a maximum isolated 0.4 ft rise in overland flow base flood elevation and are not considered substantial impacts. Cumulative impacts to properties and structures are a maximum of less than one foot as regulated by the City's Municipal Code. Design Alternative 3 generally reduces the magnitude of flooding throughout the project. There is a small increase in BFE with the City right of way on the east overbank of the channel associated with the new building construction, but impacts are less than one foot cumulatively.

Figure 10: Design Alternative 3 Overland Flow Impacts (feet)



Downstream Impacts of Design Alternatives

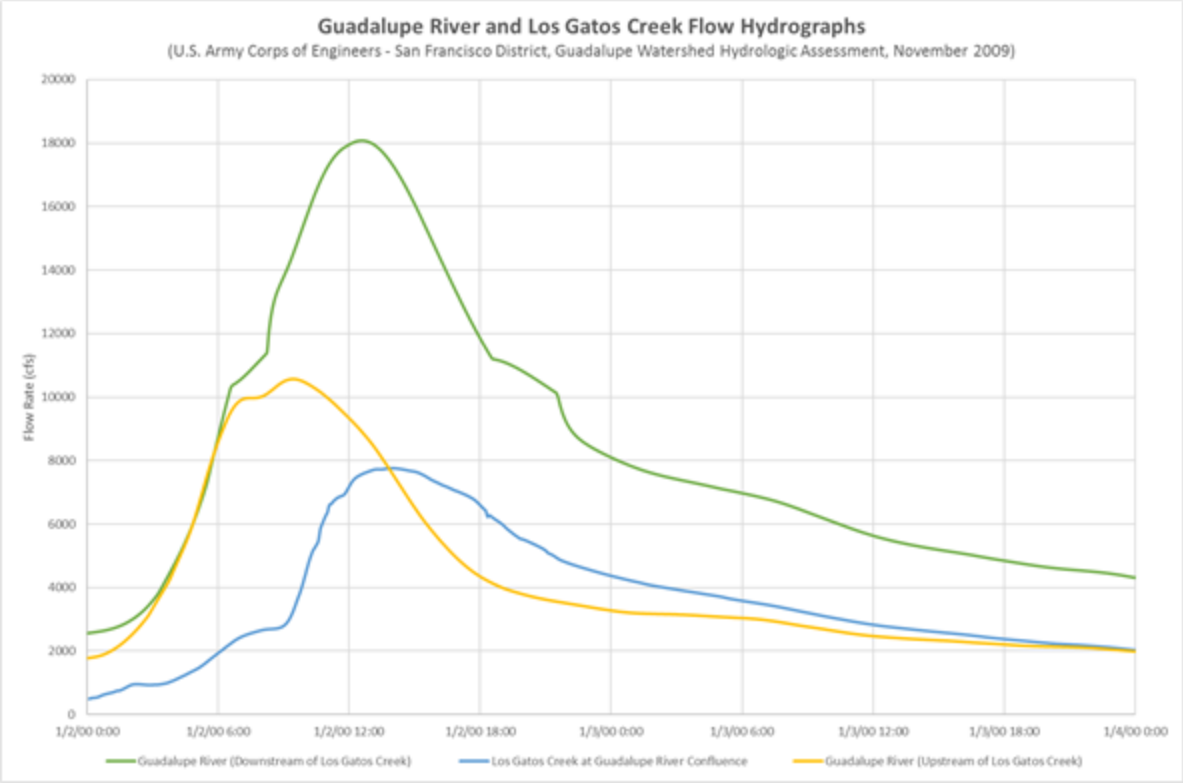
The USACE HEC-HMS model[1] was developed with the assumption that all design discharges remained within the channel. These same flow rates were subsequently utilized by Valley Water to develop the two dimensional hydraulic HEC-RAS model for Los Gatos Creek which identified 100-year flooding not shown on the 1977 FEMA FIRM. These flows were also used for the designs of the upper (future), downtown (constructed), and lower (constructed) Guadalupe improvement projects. Therefore, by implementing design alternatives which reduce overbank flooding from Los Gatos Creek, there is no anticipated change in design flow or increase in modeled spills from the Guadalupe River downstream of the confluence with Los Gatos Creek as this condition more closely aligns with the assumptions in the model and designs.

Valley Water further describes this methodology as appropriate in their memorandum[6] as follows:

“The downstream boundary condition was assumed to be a normal depth slope equal to the average channel bed slope for Guadalupe River. The resulting model WSEL at the downstream end of Los Gatos Creek was compared to the 100-yr run for Guadalupe River at the confluence, and found to be higher, verifying the use of this method.”

Additionally, using flow data from the USACE HEC-HMS model[7], it can be observed that Guadalupe River and Los Gatos Creek produce hydrographs that do not peak simultaneously; Guadalupe River peaks at approximately 10,600 cfs approximately four-and-one-half (4.5) hours prior to Los Gatos Creek peaking at approximately 7,800 cfs. At the time Los Gatos Creek is experiencing peak flows, the flow rate in Guadalupe River has decreased to approximately 7,700 cfs. This variation in peak flow timing provides ample capacity in Guadalupe River to convey the full design flows from Los Gatos Creek and is illustrated below in Figure 11.

Figure 11: Peak Flows at Guadalupe River Confluence



[6] Xu, Jack, 2D Hydraulic Model Details & Results Analysis (Update), Los Gatos Creek Modeling and Mapping, Santa Clara Valley Water District, May 23, 2019

[7] U.S. Army Corps of Engineers - San Francisco District, Guadalupe Watershed Hydrologic Assessment, November 2009