04-Ala-680, 04-CC-680
Ala PM R20.1/R21.9
CC PM R0.0/R14.0
EA 04-3G9501

Regional Express Lane Network Phase 1: I-680 Project
Alameda and Contra Costa Counties, California

Drainage Report

Prepared for:

Caltrans URS

Prepared by:

WRECO

March 2015

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Drainage Report

Submitted to:
California Department of Transportation
Metropolitan Transportation Commission

This report has been prepared by or under the supervision of the following Registered Engineer. The Registered Civil Engineer attests to the technical information contained herein and has judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

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Executive Summary

Bay Area Infrastructure Financing Authority (BAIFA) and the California Department of Transportation (Caltrans) are pursuing development of an integrated Bay Area express lane network to enhance mobility and afford greater user flexibility of the transportation system within the San Francisco Bay Area. Express lanes will allow single occupancy vehicles to use high occupancy vehicle (HOV) lanes by paying a toll that is adjusted dynamically based on congestion. The proposed regional express lane network has been divided into 33 specific segments for implementation. At this time, BAIFA and Caltrans have selected the following five segments to advance as the first phase of the express lane network (Phase 1 Project): (1) San Francisco-Oakland Bay Bridge westbound approach from I-80, I-580, and I-880, (2) San Mateo Bridge westbound approach on SR-92, (3) Dumbarton Bridge westbound approach on SR 84, (4) Interstate 680 (I-680) between Alcosta Road and Livorna Road, and (5) Interstate 880 (I-880) between Hegenberger/Lewelling and State Route 237 (SR 237). The five segments would convert existing HOV lanes to approximately 85 miles of the regional express lanes network.

Within the I-680 corridor project limits the express lanes would be contiguous/non-separated from the general purpose lanes and would be designed with no designated ingress and egress locations. The express lane width would be 12 feet wide where feasible and designated using a skip stripe pavement marking. The I-680 segment includes the addition of electronic toll technologies and overhead sign structures that would be constructed within the proposed median area.

The purpose of this Drainage Report is to evaluate the hydrologic and hydraulic conditions of the existing highway drainage systems within the Project limits, and analyze the proposed drainage system design developed to accommodate the proposed roadway improvements. The report documents the hydrologic and hydraulic design criteria used for the drainage design.

The Project is within Caltrans' right-of-way; therefore, the drainage design for the Project is based on procedures presented in the updated sixth edition of the Caltrans *Highway Design Manual* and in the *Hydraulic Engineering Circular No. 22*, a publication for highway pavement drainage from the Federal Highway Administration. The overall drainage pattern of the area would be maintained and the proposed drainage facilities meet design standards.

The Project includes drainage improvements along I-680. The proposed improvements include longitudinal systems that go around the proposed sign foundations. The overall drainage pattern of the area will be maintained.

As part of the drainage analyses, the hydraulic spread width for the existing condition in the vicinity of the improvements was evaluated. It was determined that there were problem areas at the northbound median's drainage inlet "M" Line 973+70, the southbound median's drainage inlet "M" Line 1177+00, and the southbound median's

drainage inlet "M" Line 1177+60, which are out of the Project's scope and should be addressed in future projects.

The Project would not be required to install permanent treatment best management practices because the added impervious area would be 0.16 ac and the reworked impervious area would be 0.02 ac, which is 0.18 ac and less than 1 ac. The reworked impervious area of 0.02 ac is based on the area of the excavation in the median due to sign installation.

Acronyms

ac	acres
AC	Asphalt concrete
Ala	Alameda County
APC	Alternative Pipe Culvert
BMP	Best Management Practices
Caltrans	California Department of Transportation
CC	Contra Costa County
CCTA	Contra Costa Transportation Authority
cfs	cubic feet per second
CSP	Corrugated steel pipe
DQ	Drainage quantity
DSA	Disturbed soil area
EA	Expenditure authorization
FEMA	Federal Emergency Management Agency
FES	Flared end section
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
ft	feet
HDM	Highway Design Manual
HDS	Hydraulic Design Series
HEC	Hydraulic Engineering Circular
HOT	High occupancy toll
HOV	High occupancy vehicle
I-	Interstate
MTC	Metropolitan Transportation Commission
NAVD	North American Vertical Datum
PM	Post mile
PSA	Project Study Area
PSR	Project Study Report
RCB	Reinforced concrete box
RCP	Reinforced concrete pipe
RSP	Rock slope protection
SR	State Route
SWDR	Storm Water Data Report
USGS	United States Geological Survey

1 GENERAL DESCRIPTION

1.1 Project Description

Bay Area Infrastructure Financing Authority (BAIFA) and the California Department of Transportation (Caltrans) are pursuing development of an integrated Bay Area express lane network to enhance mobility and afford greater user flexibility of the transportation system within the San Francisco Bay Area. Express lanes will allow single occupancy vehicles to use high occupancy vehicle (HOV) lanes by paying a toll that is adjusted dynamically based on congestion. The proposed regional express lane network has been divided into 33 specific segments for implementation. At this time, BAIFA and Caltrans have selected the following five segments to advance as the first phase of the express lane network (Phase 1 Project): (1) San Francisco-Oakland Bay Bridge westbound approach from I-80, I-580, and I-880, (2) San Mateo Bridge westbound approach on SR-92, (3) Dumbarton Bridge westbound approach on SR 84, (4) Interstate 680 (I-680) between Alcosta Road and Livorna Road, and (5) Interstate 880 (I-880) between Hegenberger/Lewelling and State Route 237 (SR 237). The five segments would convert existing HOV lanes to approximately 85 miles of the regional express lanes network.

Within the I-680 corridor project limits the express lanes would be contiguous/non-separated from the general purpose lanes and would be designed with no designated ingress and egress locations. The express lane width would be 12 feet wide where feasible and designated using a skip stripe pavement marking. The I-680 segment includes the addition of electronic toll technologies and overhead sign structures that would be constructed within the proposed median area.

The I-680 segment proposes converting the existing HOV lanes to express lanes in the northbound and southbound directions (Project), within the existing limits of the HOV lane (see Figure 1 and Figure 2). Table 1 identifies the locations and lengths of existing HOV lanes that would be converted to tolled express lanes on I-680.

Table 1. I-680 Existing HOV Lanes to be converted to Express Lanes

Segment Limits (PM)	Limits of HOV Conversion (PM)	HOV Conversion Length (Directional Miles)	Conversion Description
Ala 680 R20.1 – R21.9 CC 680 R0.0 – 14.0	NB: ALA 680 R20.8 - R21.9 CC 680 R0.0 – R14.0	15.1	Alcosta Boulevard to Livorna Road
	SB: CC 680 R0.4 – R12.8	12.4	Rudgear Road to Alcosta Boulevard

Within the Project limits, the express lanes would be contiguous/non-separated from the general purpose lanes and designed with no designated ingress and egress locations. The express lane would be 12 feet wide where feasible and designated using a skip-stripe

pavement marking. The Project includes the addition of electronic toll technologies and overhead sign structures that would be constructed within the proposed median area.

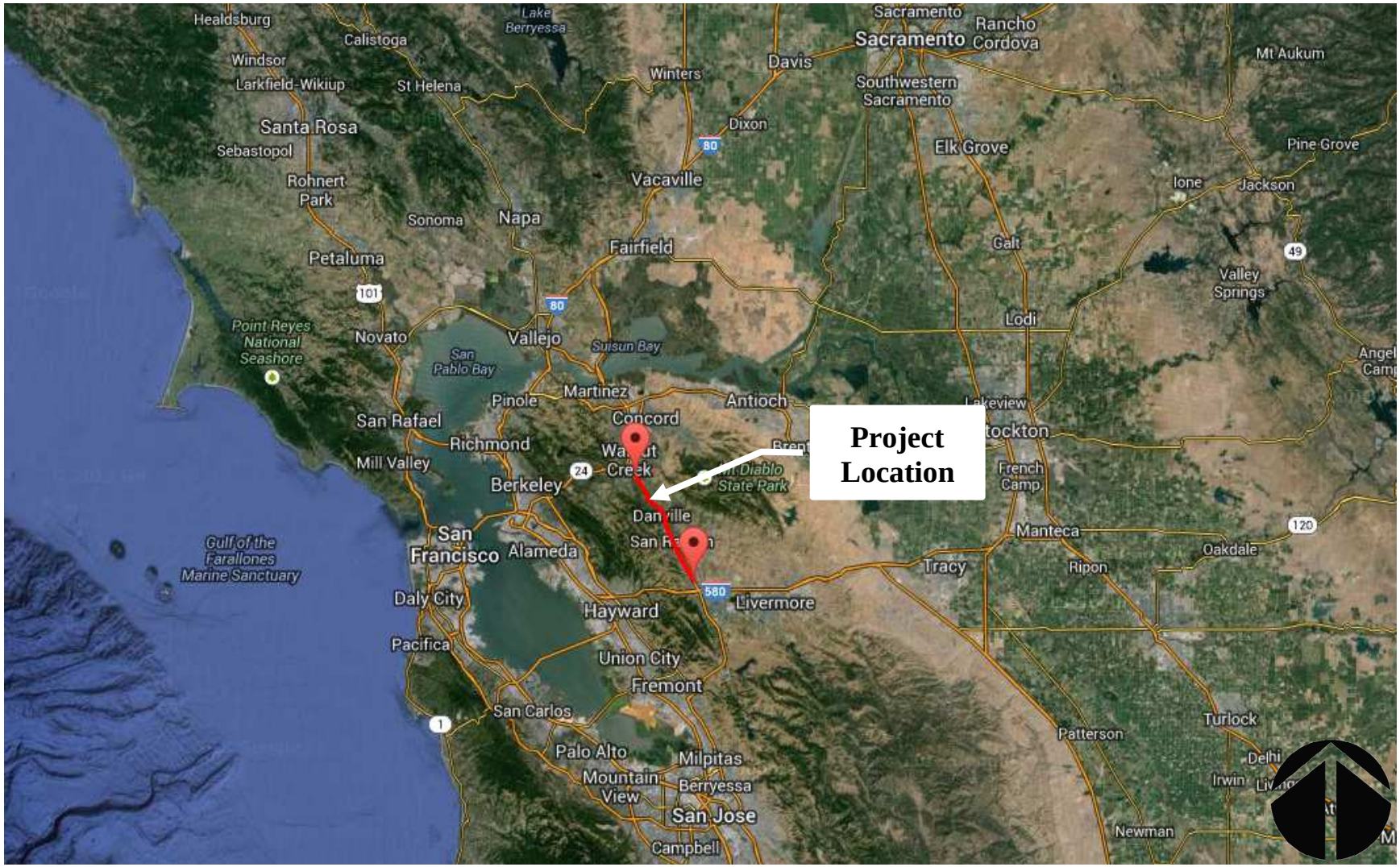


Figure 1. Location Map

Source: Caltrans

Figure 2. Vicinity Map

Source: Caltrans

1.2 Need for Project

The purpose and need for the Project according to the *Project Study Report* (PSR) *to Support the Bay Area Express Lane Backbone Network on Various Bay Area Routes in Alameda, Contra Costa, Napa, San Mateo, Santa Clara, and Solano Counties* (Caltrans 2011) are as follows:

Need:

- Significant congestion currently exists in the general purpose lanes during peak hours on Bay Area freeway corridors within the backbone network. This level of congestion would continue to get worse as traffic demand increases in the future.
- The existing HOV lane system is characterized by gaps, limiting travel time savings and trip reliability.
- Available unused capacity in the existing HOV lane system needs to be utilized to enhance transportation system efficiency.
- There is limited funding available to close gaps in the existing HOV lane system. The purpose of this Project is to reduce congestion and improve mobility along I-680.

Purpose:

- Optimize capacity in the existing Bay Area freeway corridors to better meet current and future traffic demands.
- Close the gaps within the existing HOV lane system to increase travel time savings and reliability for HOVs and buses. Maximize the efficiency of freeway facilities by better utilizing available unused capacity in the existing HOV lane system.
- Provide a funding mechanism to accelerate closure of gaps in HOV lanes and to complete the network sooner.

1.3 Project History

According to the PSR, prominent among previous studies and reports is the *Transportation 2035 Plan*, which puts forth a comprehensive 25-year, multi-modal transportation plan for the MTC's nine-county planning area, including the recommendation of an ultimate 800-mile express lane network. Concurrent with preparation of the *Transportation 2035 Plan*, MTC sponsored a Regional High Occupancy Toll (HOT) Lanes Network Feasibility Study that was completed in February 2009. Two other reports of particular significance include the *2002 High-Occupancy-Vehicle (HOV) Lane Master Plan Update for the San Francisco Bay Area* and the *I-680 Investment Options Study*, 2003, which was prepared under the auspices of the Contra Costa Transportation Authority (CCTA).

1.4 Reference Documents

- *Draft Drainage Impact Study Report, Regional Express Lane Network Project, Alameda and Contra Costa Counties* was prepared by WRECO, February 2014.
- *Natural Environment Study for Regional Express Lanes Network Phase 1 Project Interstate 680 Project Segment* was prepared by HDR Engineering, Inc., August 2013.
- *Paleontological Identification Report for the MTC Express Lanes Phase 1 Project* was prepared by Cogstone Resource Management, Inc., August 2013.

1.4.1 As-Built Record Documents

Electronic copies of Caltrans as-built plans were provided by URS Corporation.

1.4.2 Final Drainage Plans

Final Drainage sheets for the Project were provided by URS.

1.4.3 Geographical References

The following geographical references were used:

- United States Geological Survey (USGS) Topographic CD-ROM
- USGS Digital Elevation Model
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) for Alameda and Contra Costa Counties, California and Unincorporated Areas
- Topographical survey provided by URS Corporation in April 2014

The survey and design files for this Project are based on the North American Vertical Datum of 1988 (NAVD88).

1.5 Soil Characteristics

According to the *Geotechnical Design Report, Overhead Sign Structures I-680 Express Lanes Project* (URS 2014), beneath the pavement sections, the borings encountered embankment fills underlain by native alluvial soils and formational materials. The fills, where encountered, typically consisted of stiff to hard lean and sandy lean clays and medium dense to very dense sands and gravels. The native alluvial soils typically consisted of medium to hard lean clays, sandy lean clays and silts with interbedded medium dense to very dense poorly graded silty and clayey sands. The underlying formational materials, where encountered below the alluvium, generally consisted of highly weathered siltstone and claystone.

In the northern half of the project alignment, portions of I-680 cross the westernmost toe of the foothills along the east side of the San Ramon Valley. From several hundred yards north of Stone Valley Road northward to about ¾ mile north of Livorna Road most of the alignment is constructed on Pliocene age (2.6 to 5.3 million years) Green Valley and

Tassajara Formations, Tgvt, non-marine sandstone, siltstone, and conglomerate. Between Crow Canyon Road and Sycamore Valley Road, the project alignment crosses the toe of a low hill on the west side of San Ramon Valley that is underlain by Miocene age (5.3 to 23 million years) Briones Formation, Tbr, composed of marine sandstone, siltstone and conglomerate, locally with abundant shell fossils. Farther south near Alcosta Boulevard a cut was made into an east-facing hillslope for the construction of I-680. This hill is underlain by Green Valley and Tassajara Formations.

1.6 Land Use

Pavement occupies the majority of the Project area with vegetated shoulders and interchange areas of varying sizes. Land use in the Project region consists primarily of residential and commercial development, with a few small open space preserves and private ranches (HDR 2013).

Most of the land areas adjacent to I-680 in Contra Costa County are zoned as single family residential-very low to medium uses. Large areas of commercial and public/semi-public land and multiple family residential-high uses also exist in the municipalities of Walnut Creek, Alamo, Danville, and San Ramon in the vicinity of I-680. The Project action area is almost completely surrounded by urban development and bordered by two heavily used arterial roads, Camino Ramon in the east and San Ramon Valley Boulevard in the west; limited areas of undeveloped land are also present. The entire Project limits are either surrounded by existing development or active construction (Caltrans 2011). Most of the land areas adjacent to the I-680 segment in the City of Dublin (in Alameda County) are zoned as low-density residential uses (0-6 dwelling units/acre) north of Amador Valley Boulevard and south to downtown Dublin (City of Dublin 2011).

1.7 Creeks, Streams, and River Crossings

Table 2 lists the identified creek and stream crossings of the Project from north to south.

Table 2. Drainage Facilities at Major Crossings of the I-680 Segment

Waterway	PM at I-680	Drainage Facility
Las Trampas Creek	CC 13.72	Bridge
Tice Creek	CC 13.53	Culvert
San Ramon Creek	CC R12.64	Bridge
A tributary to San Ramon Creek	CC R11.33	18-inch RCP
Miranda Creek	CC R10.70	Culvert
Stone Valley Creek	CC R10.60	Culvert
A tributary to San Ramon Creek	CC R9.25	18-inch RCP
A tributary to San Ramon Creek	CC R9.00	36-inch RCP
Green Valley Creek	CC R7.64	Concrete Arch Culvert
San Ramon Creek	CC R7.43	Bridge
A tributary to San Ramon Creek	CC R5.14	42-inch RCP
San Ramon Creek	CC R4.46	Double 12 ft x 16 ft RCB

Table 2 (Cont'd)

Waterway	PM at I-680	Drainage Facility
A tributary to South San Ramon Creek	CC R1.54	Double 6 ft x 5 ft Box
Oak Creek	CC R0.94	8 ft x 7 ft RCB
Line J	ALA R20.46	Concrete Trapezoidal Culvert
Dublin Creek	ALA R20.19	Double 8 ft x 12 ft RCB

Source: Caltrans, FEMA, Oakland Museum of California, USGS

Notes:
RCB = Reinforced Concrete Box, RCP = Reinforced Concrete Pipe

1.8 Existing Drainage and Drainage Design Issues

The existing drainage system within the Project limits comprises mostly longitudinal systems connecting cross culverts that drain toward major creek and stream crossings. On tangent sections, stormwater is collected at the outside shoulders along asphalt concrete (AC) dikes before discharging into inlets or overside drains. On curved sections, there are inlets along the outside shoulders to collect stormwater at the shoulders and from hillsides. There are also inlets along the concrete barrier at the median to collect stormwater from the freeway traffic lanes.

The principal features of this Project, which would impact existing drainage facilities, are the addition of overhead signs within the median barrier along I-680. At these locations, impacted existing longitudinal drainage systems would be replaced to avoid these new sign structures and their foundations.

Stormwater runoff from the Project corridor drains directly into creek crossings and to nearby storm drain systems, which ultimately discharge into lined and unlined channels. The increased runoff is insignificant compared to the overall watershed of the receiving water bodies of the Project. The Project design goal is to maintain the existing flow patterns.

At locations where the permanent improvements are in the super-elevated section of the roadway, the allowable spread width of runoff is calculated to ensure that it can be maintained within the proposed shoulder width.

1.9 Drainage Design Criteria

The drainage design for the Project is based on procedures presented in the updated sixth edition of the Caltrans *Highway Design Manual* (HDM) and those presented in the Federal Highway Administration's (FHWA's) *Hydraulic Engineering Circular No. 22* (HEC-22).
Table 3 and Table 4 list the selected relevant HDM criteria pertinent to the hydrology and hydraulics of the drainage design and the sections that mention the criteria.

Table 3. Selected HDM Hydrology Criteria

Criteria	Section
Table 819.5A Summary of Methods for Estimating Design Discharge	819
Estimating Design Discharge - Empirical Methods	819.2

Source: Caltrans

Table 4. Selected HDM Hydraulics Criteria

Criteria	Section
Maximum allowable flow spread width (shoulder or parking lane width)	831.3
Minimum allowable pipe diameter under a roadbed (18 in.)	838.4
Manning's coefficient estimation method	851.2

Source: Caltrans

1.10 Special Circumstances

The drainage design specifies in the contract documents that all new culverts and existing culverts would be replaced as alternative pipe culverts (APC) rather than specifying particular pipe materials. This would leave the Construction Contractor the ability to choose the appropriate material from a list of allowable materials recommended by the Project geotechnical engineer. The acceptable APC materials for the Project are specified on Project plan sheet DQ-1, the first page of the Project drainage quantity sheets, prepared by URS. Corrugated steel pipe (CSP) would be proposed for pipes with slopes greater than 10%. All pipe joint types would be standard unless otherwise noted on the Project plans. Slotted corrugated steel pipe (SCSP)) was also proposed in some locations where the median shoulder widths were constricted by proposed barriers protecting signs.

1.11 Agencies Impacting Design

The Project is located in Alameda and Contra Costa Counties, California. Any drainage improvements proposed for the local roads and any off-site drainage systems impacted by the Project would conform to the local agency's requirements. The drainage design would also be based on Caltrans' design criteria.

Based on the Storm Water Data Report ([SWDR], WRECO 2014) developed for this Project, incorporation of permanent treatment best management practices (BMPs) and hydromodification mitigation would not be required for this Project.

2 OFF-SITE HYDROLOGY

Because the proposed Project would not significantly impact any cross-drainage facilities, no detailed analyses of off-site watersheds tributary to cross drainage has been performed.

3 OFF-SITE HYDRAULICS

Because the proposed Project would not significantly impact any cross-drainage facilities, no detailed analyses of cross-drainage has been performed.

4 ON-SITE ROADWAY DRAINAGE

On-site roadway drainage analysis included calculation of flows over impervious pavement areas, estimations of spread flow widths at proposed inlets, designs of on-site drainage pipe systems connecting to inlets, and designs of roadside ditches. Drainage design of gutter conveyance capacity followed the procedures in the Caltrans HDM and the FHWA's Hydraulic Engineering Circular No. 22, Third Edition (HEC-22) (September 2009).

Capacity analysis for the inlet and pipe systems were performed using Hydraflow.

4.1 Recurrence Interval

Per Table 831.3 of the HDM, roadway drainage systems for through traffic lanes, branch connections, and other major ramp connections were designed using the 25-year design discharge with permissible water spread based on the shoulder width.

4.2 Time of Concentration

The time of concentration follows procedures in Section 816.6 in the Caltrans HDM. The HDM also recommends a minimum time of concentration of five minutes for paved areas and steep unpaved areas, and ten minutes for rural or undeveloped areas. All of the on-site drainage systems in the Project have relatively short flow path lengths; therefore, the calculated times of concentration for those catchments would be shorter than the suggested minimums. Consequently, a 5-minute time of concentration is used for all on-site paved catchments in the Project that drain directly to inlets. For all other locations, the estimated times of concentration follow the procedures in the HDM.

4.3 Points of Concentration

Stormwater flows are conveyed in drainage ditches, roadside gutters, and along dikes, barriers, or retaining walls. The points of concentration for the on-site roadway drainage systems also include drainage inlets, manholes, and outfalls.

4.4 System Controls

The upstream and downstream invert elevations for the proposed culverts are generally based on Caltrans design procedures. For proposed systems connecting to existing drainage systems, the upstream and/or downstream invert elevations of the existing systems govern the proposed invert elevations. For systems that discharge to open channels, the topography at the channel controls the proposed culvert invert elevations.

Drainage systems that convey flows to ditches or biofiltration swales downstream would have a downstream control that is the hydraulic grade line of the swale or ditch for the design storm. For Drainage Systems not conveying into a ditch or biofiltration swale, a normal depth slope would be used as the downstream boundary condition.

4.5 Grate Interception and Gutter Capacity

Grate interception, bypass, gutter spread, and inlet capacity calculations were based on formulas and procedures from HEC-22. According to Table 831.3 of the HDM, the design water spread should remain outside of the traveled way at ramp areas. According to Table 831.4 of the HDM, no more than 0.1 cubic feet per second (cfs) of concentrated flow should flow across the roadway during the design storm.

Cross-slopes and longitudinal slopes were calculated based on the project topo, which is general. Cross-slopes were assumed to be 5%, except near flips where cross-slopes were at least 0.9%. The results show that the spread widths adhered to Caltrans requirements of staying within the shoulder. However, at 0% flips additional drainage inlets would be required to comply with the Caltrans requirement of 0.1 cfs or less of bypass.

As part of the drainage analyses, the hydraulic spread width for the existing condition in the vicinity of the improvements was evaluated. It was determined that there were problem areas at the northbound median's drainage inlet "M" Line 973+70, the southbound median's drainage inlet "M" Line 1177+00, and the southbound median's drainage inlet "M" Line 1177+60, which are out of the Project's scope and should be addressed in future projects.

4.6 Hydraulic Grade Line Calculations

Analysis of hydraulic grade line for on-site systems was done using Hydraflow. A pipe size was assigned for each drainage culvert, with a minimum diameter of 18 in. for culverts wholly or partly under the roadbed within Caltrans' right-of-way, per Table 838.4 of the HDM. For proposed systems that connect to existing upstream drainage systems, the size of the proposed downstream system would be at least the size of the upstream culvert.

Because the Project is only anticipated to increase the impervious area by 0.18 ac, downstream systems are not anticipated to experience any issues as a result of increased peak runoff.

4.7 Storm Water Best Management Practices

The consideration for BMPs, including temporary construction site, design pollution prevention, and treatment BMPs, are found in the SWDR.

Standard temporary construction site BMPs for the Project would be required for any construction activity to reduce pollutants in stormwater discharges throughout construction. The SWDR for the Project details Project-specific temporary construction site BMPs considered.

4.8 Permanent Soil Stabilization Systems

Permanent design pollution prevention BMPs or soil stabilization systems that reduce erosion, such as erosion control, would be specified for all disturbed soil areas (DSAs)

that would remain unpaved after construction; these areas will be specified in the Project's contract documents and SWDR.

Rock slope protection (RSP) and flared end sections (FES) would be specified at all new and reconstructed outfalls to minimize erosion potential. The *California Bank and Shore Rock Slope Protection Design* (Caltrans 2000) would be used to design the RSP.

4.9 Permanent Treatment BMPs

The Project would not be required to install permanent treatment best management practices because the added impervious area would be 0.16 ac and the reworked impervious area would be 0.02 ac, which is 0.18 ac and less than 1 ac. The reworked impervious area of 0.02 ac is based on the area of the excavation in the median due to sign installation.

5 TEMPORARY DRAINAGE SYSTEMS

Drainage work is anticipated to be performed during the dry weather season and temporary drainage systems are not anticipated to be required.

6 FLOODPLAIN INFORMATION

FEMA has designated floodplains in the Project area. Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's FIRM or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area. Zone A corresponds to the 1% annual chance floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. No base flood elevations or depths are shown within this zone because detailed hydraulic analyses are not performed for such areas. Zone AO corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 ft. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Zone AE corresponds to the base floodplain where base flood elevations are provided. Refer to the *Draft Location Hydraulic Study* (WRECO 2013) prepared for the Project for FEMA FIRMs and floodplain details.

Floodplains are associated with individual creek crossings underneath the I-680 segment. FEMA Map No. 06013C0289F, 06013C0293F, 06013C0431F, 06013C0432F, 06013C0434F, 06013C0453F, 06013C0461F, 06013C0463F, 06013C0464F, 06013C0577F, and 06001C0308G cover the I-680 segment from north to south. Eleven FEMA floodplains were identified within the Project limits. These floodplains are listed in Table 5.

Table 5. Floodplain Information

Location	PM at I-680	FIRM Panel(s)	Nearby Flood Zone(s) along I-680	Overtops Freeway
Las Trampas Creek	CC 13.72	06013C0289F	AE, X	No
Tice Creek	CC 13.53	06013C0293F	AE, X	No
San Ramon Creek	CC R12.64	06013C0293F	A, AE, X	Yes
San Ramon Creek (L)	CC R12.64 - R12.47	06013C0293F	A, AE, X	No
San Ramon Creek (L)	CC R11.28 - R11.03	06013C0431F	AE, X	No
Miranda Creek	CC R10.70	06013C0432F	AE, X	No
Stone Valley Creek	CC R10.60	06013C0432F	AE, X	No
Green Valley Creek	CC R7.64	06013C0453F	A, AE, X	No
San Ramon Creek	CC R7.43	06013C0453F	A, X	No
San Ramon Creek	CC R4.46	06013C0461F 06013C0463F	A, AE, X	No
Line J (L)	ALA R21.78 - R20.16	06001C0308G	AE, AO (1'), AO (2'), X	No
Dublin Creek	ALA R20.19	06001C0308G	AE, AH, X	No

Source: FEMA

7 COST ESTIMATE

According to URS, the cost estimate for drainage work is $600,000.

8 REFERENCES

California Department of Transportation. (2011). *Project Study Report* (PSR) *to Support the Bay Area Express Lane Backbone Network on Various Bay Area Routes in Alameda, Contra Costa, Napa, San Mateo, Santa Clara, and Solano Counties.*

California Department of Transportation. (2010). *Project Planning and Design Guide*.

California Department of Transportation. (2006). *Highway Design Manual, Sixth Edition*.

California Department of Transportation. (2000). *California Bank and Shore Rock Slope Protection Design – Practitioner's Guide and Field Evaluations of Riprap Methods Manual* (FHWA-CA-TL-95-10, October 2000).

Contra Costa County Flood Control & Water Conservation District. (2010). *Storm Depth Estimation for Frequent Return Intervals for Contra Costa County, California.*

City of Dublin. (March 2011). *Dublin General Plan Land Use Map.*

Cogstone Resource Management Inc. (August 2013). *Paleontological Identification Report for the MTC Express Lanes Phase 1 Project.*

Dibblee, T.W. Jr. (2005). *Geologic map of the Diablo quadrangle Contra Costa and Alameda Counties, California*. Dibblee Geology Center Map #DF-162, scale 1:24,000.

Federal Emergency Management Agency (August 2009). *Flood Insurance Study for Alameda County, California AND Incorporated Areas (Number 06001CV001A).*

Federal Emergency Management Agency (June 2009). *Flood Insurance Study for Contra Costa County, California and Incorporated Areas (Number 06013CV001A).*

Federal Highway Administration. (2012). *Hydraulic Design of Highway Culverts, Third Edition* (HDS No. 5)

Federal Highway Administration. (August 2001). *Urban Drainage Design Manual*. Hydraulic Engineering Circular No. 22, Second Edition. Publication No. FHWA-NHI-01-021.

Graymer, R.W. (2000). Geologic map and map database of the Oakland metropolitan area, Alameda, Contra Costa, and San Francisco Counties, California., scale 1:50,000. *USGS Miscellaneous Field Studies* MF-2342, version 1.

HDR Engineering, Inc. (August 2013). *Natural Environment Study for Regional Express Lanes Network Phase 1 Project Interstate 680 Project Segment.*

Parikh Consultants, Inc. (July 2013). *Phase I Initial Site Assessment, MTC Express Lanes Network Phase 1 PA/ED, Interstate 680 (I-680) Segment, Alameda County, California*.

United States Geological Survey. (2001). *California: Seamless U.S.G.S. Topographic Maps*. CDROM, Version 2.6.8, 2001, Part Number: 113-100-004. National Geographic Holdings, Inc.

URS. (2014). *Geotechnical Design Report, Overhead Sign Structures, I-680 Express Lanes.*

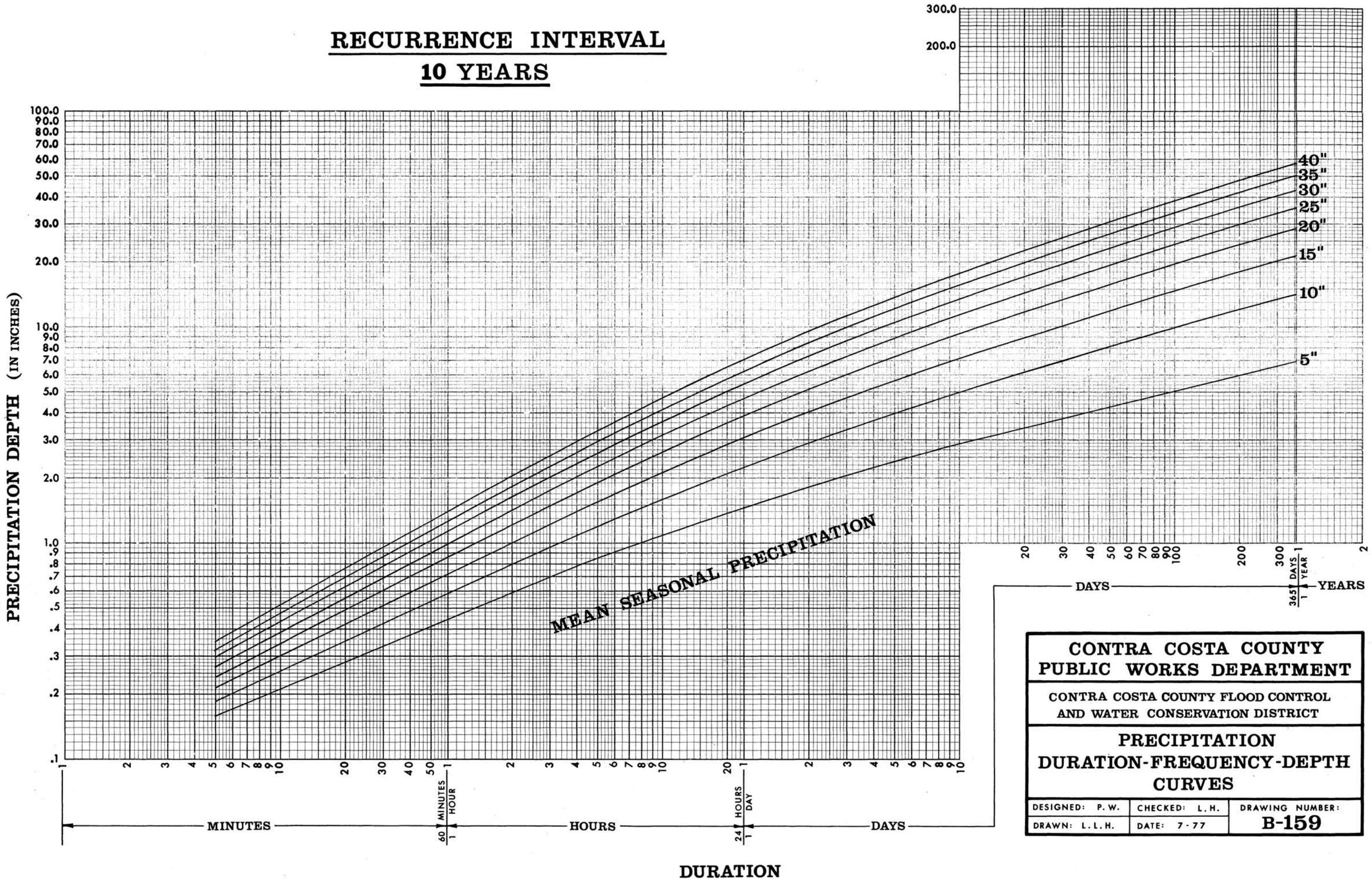
WRECO. (2014). *Draft Drainage Impact Study Report, Regional Express Lane Network Project, Alameda and Contra Costa Counties*

WRECO. (2015). *Storm Water Data Report.*

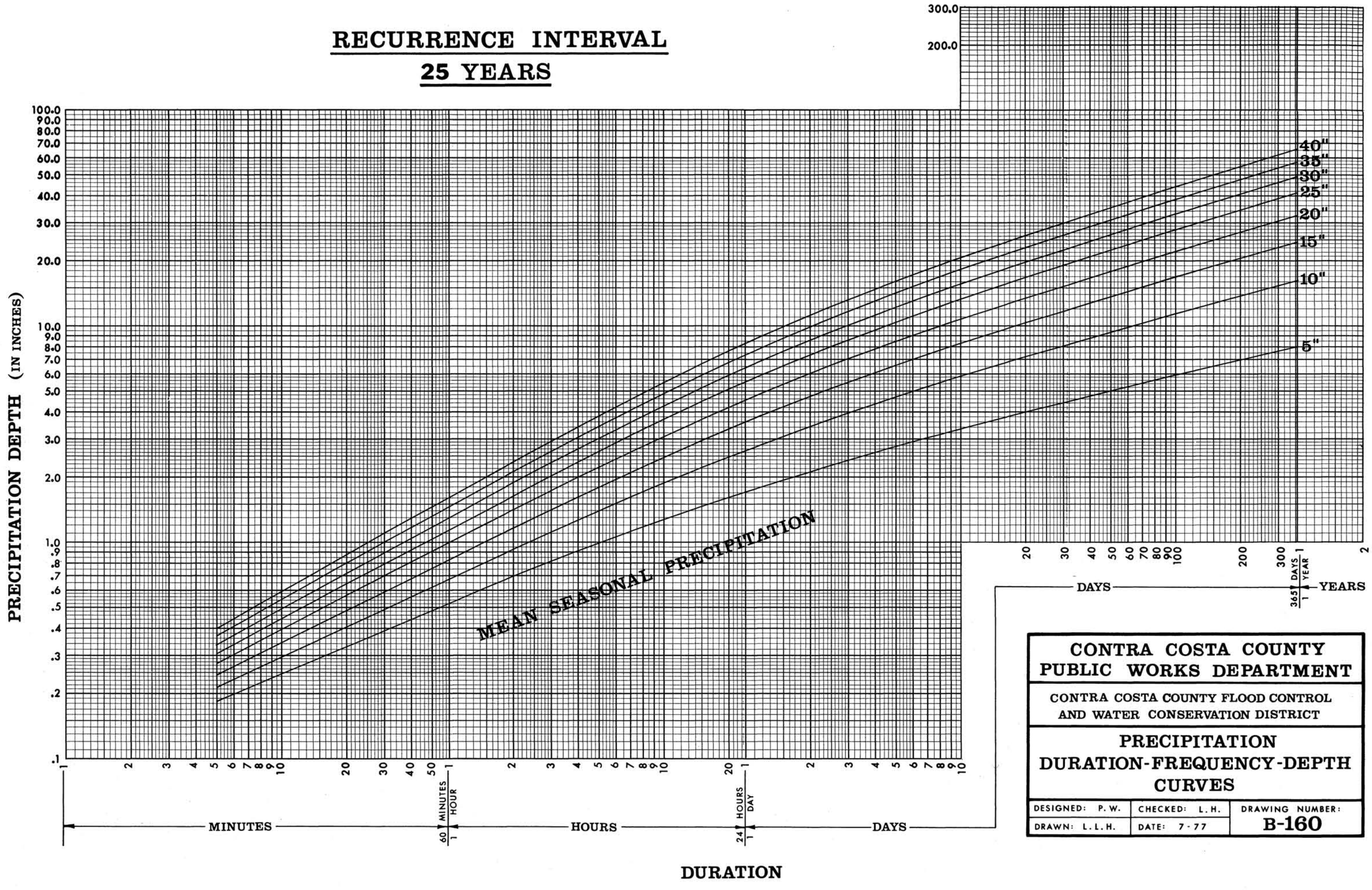
WRECO. (2013). *Draft Location Hydraulic Study.*

Appendix A Hydrologic Data

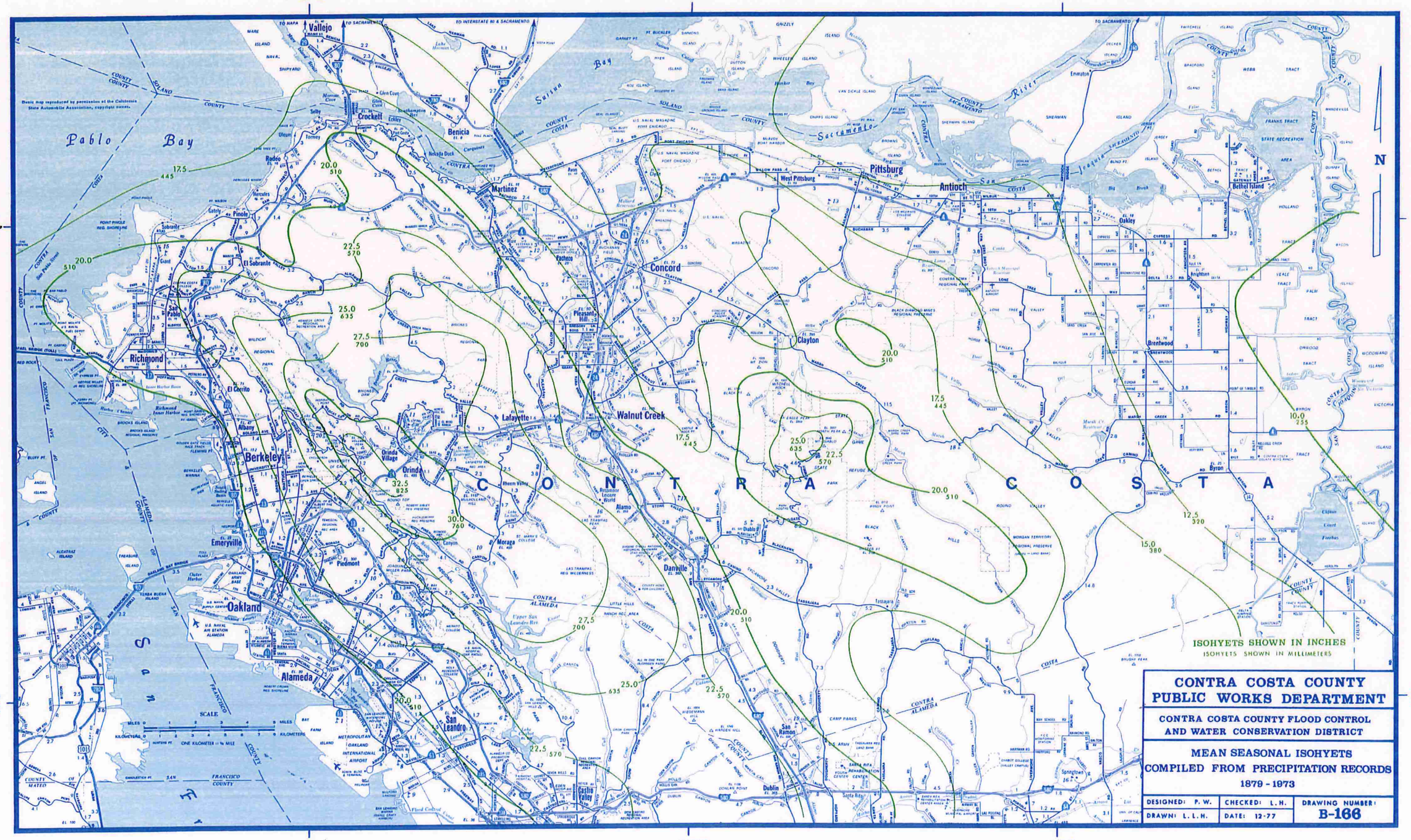
Appendix A.1 Precipitation Duration-Frequency-Depth Curves



CONTRA COSTA COUNTY PUBLIC WORKS DEPARTMENT		
CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT		
PRECIPITATION DURATION-FREQUENCY-DEPTH CURVES		
DESIGNED: P. W.	CHECKED: L. H.	DRAWING NUMBER:
DRAWN: L. L. H.	DATE: 7-77	B-159


RECURRENCE INTERVAL
25 YEARS
PRECIPITATION DEPTH (IN INCHES)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
300.0
200.0
40"
35"
30"
25"
20"
15"
10"
5"
MEAN SEASONAL PRECIPITATION
MINUTES
60 MINUTES 1 HOUR
HOURS
24 HOURS 1 DAY
DAYS
365 DAYS 1 YEAR
YEARS
DURATION
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
PRECIPITATION
DURATION-FREQUENCY-DEPTH
CURVES
DESIGNED: P. W.
CHECKED: L. H.
DRAWING NUMBER:
DRAWN: L.L.H.
DATE: 7-77
B-160

Appendix A.2 Isohyetal Map



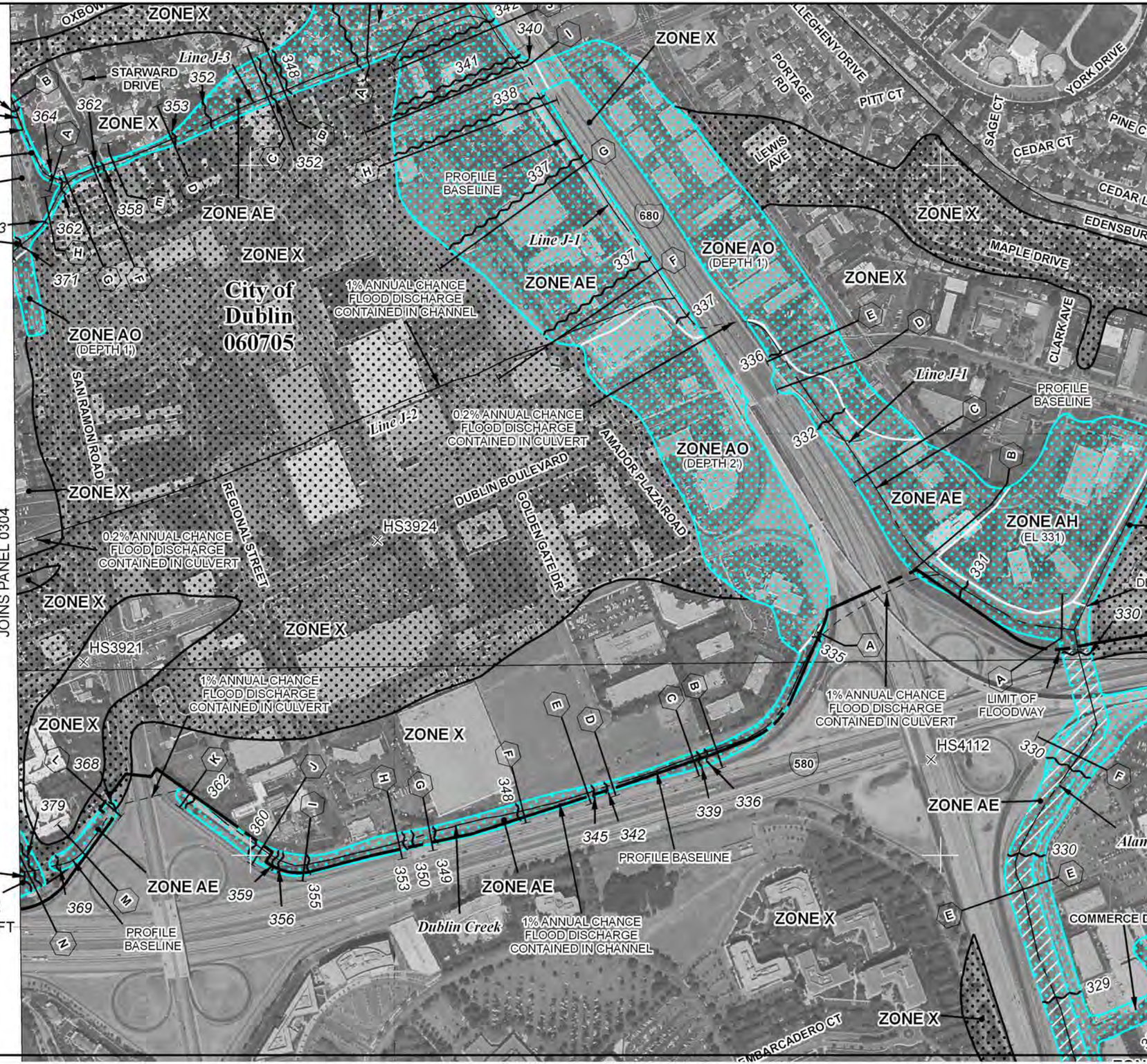
CONTRA COSTA COUNTY PUBLIC WORKS DEPARTMENT

CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

MEAN SEASONAL ISOHYETS COMPILED FROM PRECIPITATION RECORDS 1879 - 1973

DESIGNED: P. W.	CHECKED: L. H.	DRAWING NUMBER:
DRAWN: L. L. H.	DATE: 12-77	B-166

Appendix B Flood Insurance Rate Maps



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0308G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 308 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DUBLIN, CITY OF	060705	0308	G
PLEASANTON, CITY OF	060012	0308	G

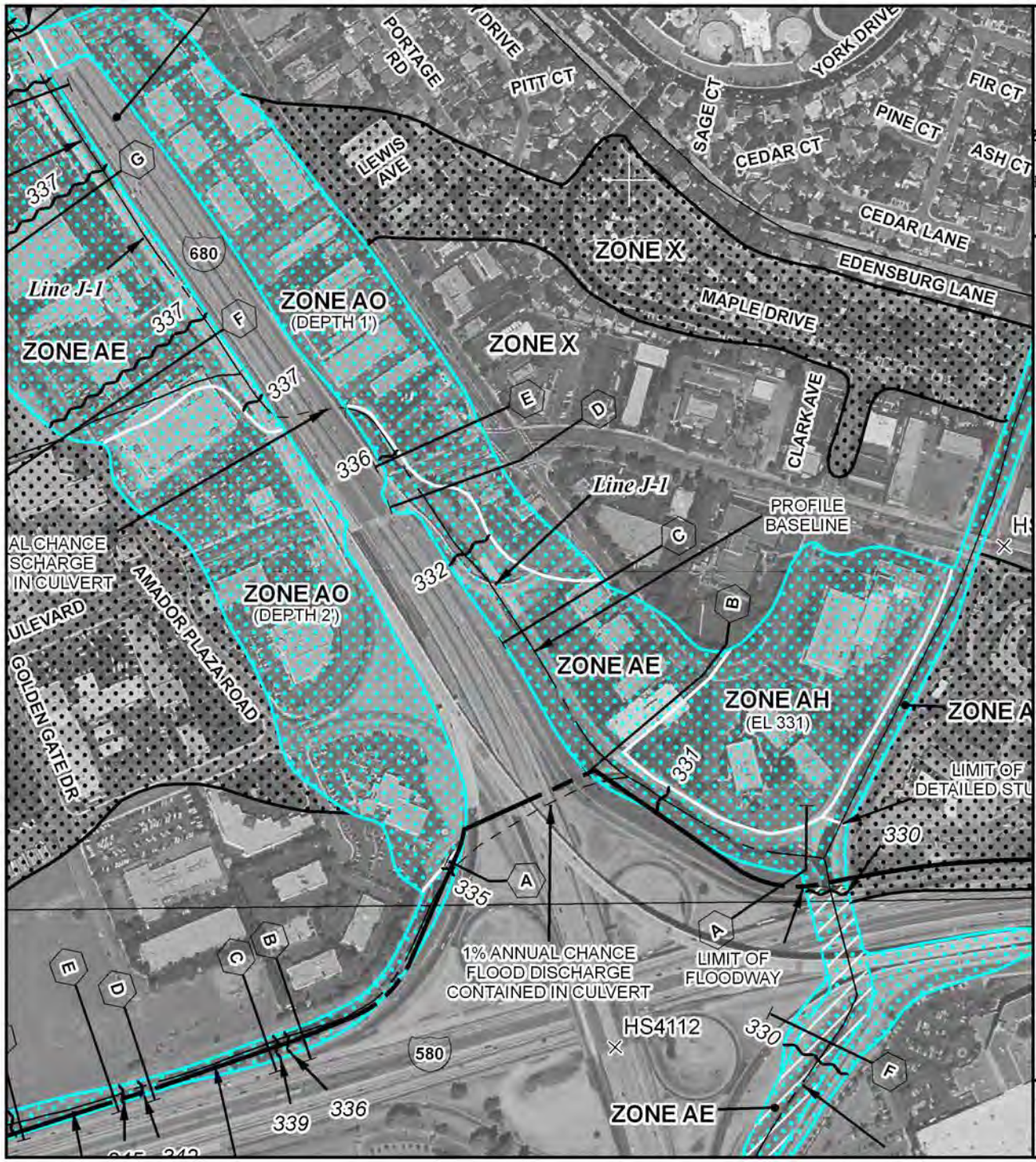
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06001C0308G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0308G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 308 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DUBLIN, CITY OF	060705	0308	G
PLEASANTON, CITY OF	060012	0308	G

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MAP NUMBER
06001C0308G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency

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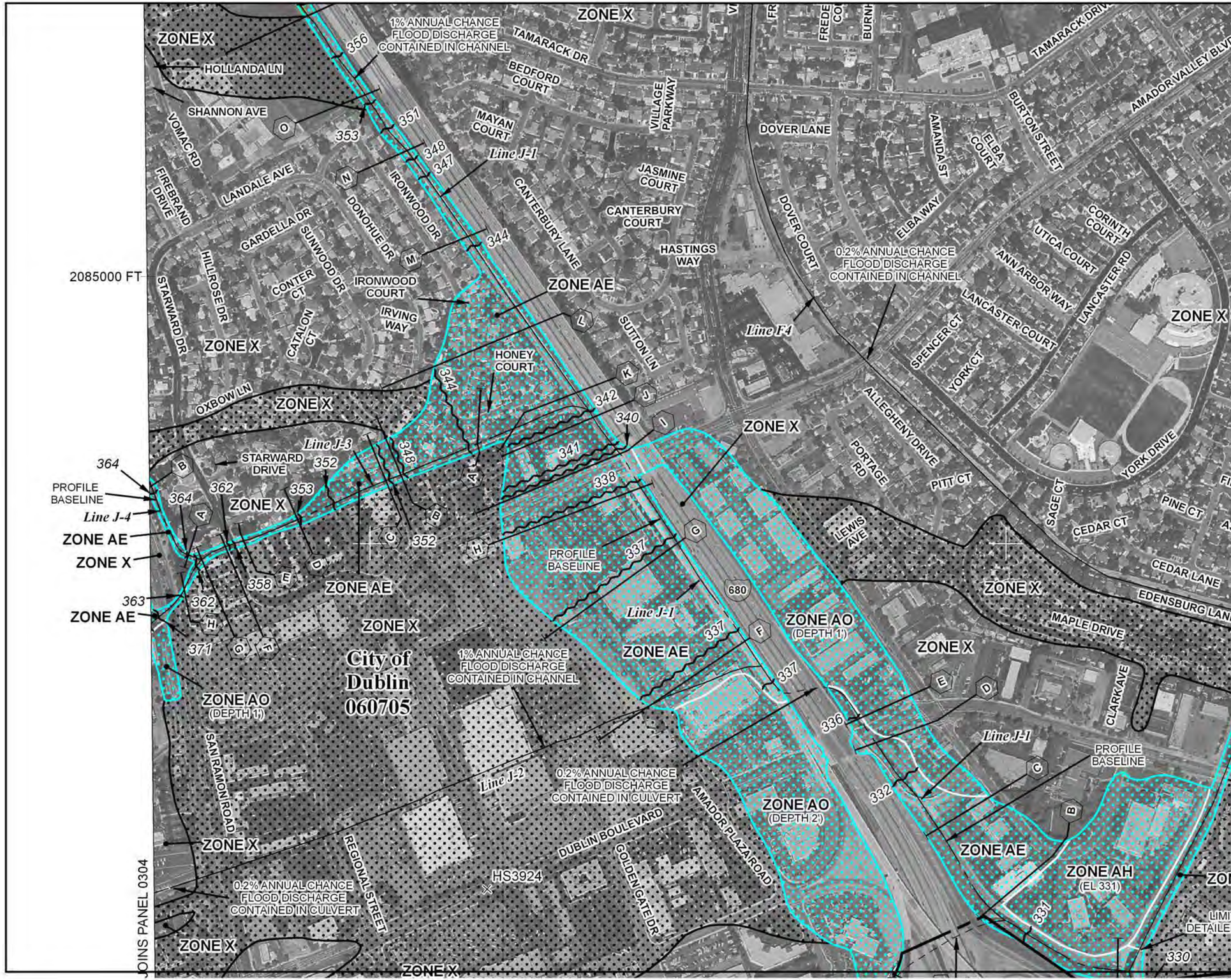

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0308G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 308 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DUBLIN, CITY OF	060705	0308	G
PLEASANTON, CITY OF	060012	0308	G

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

MAP NUMBER
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AUGUST 3, 2009

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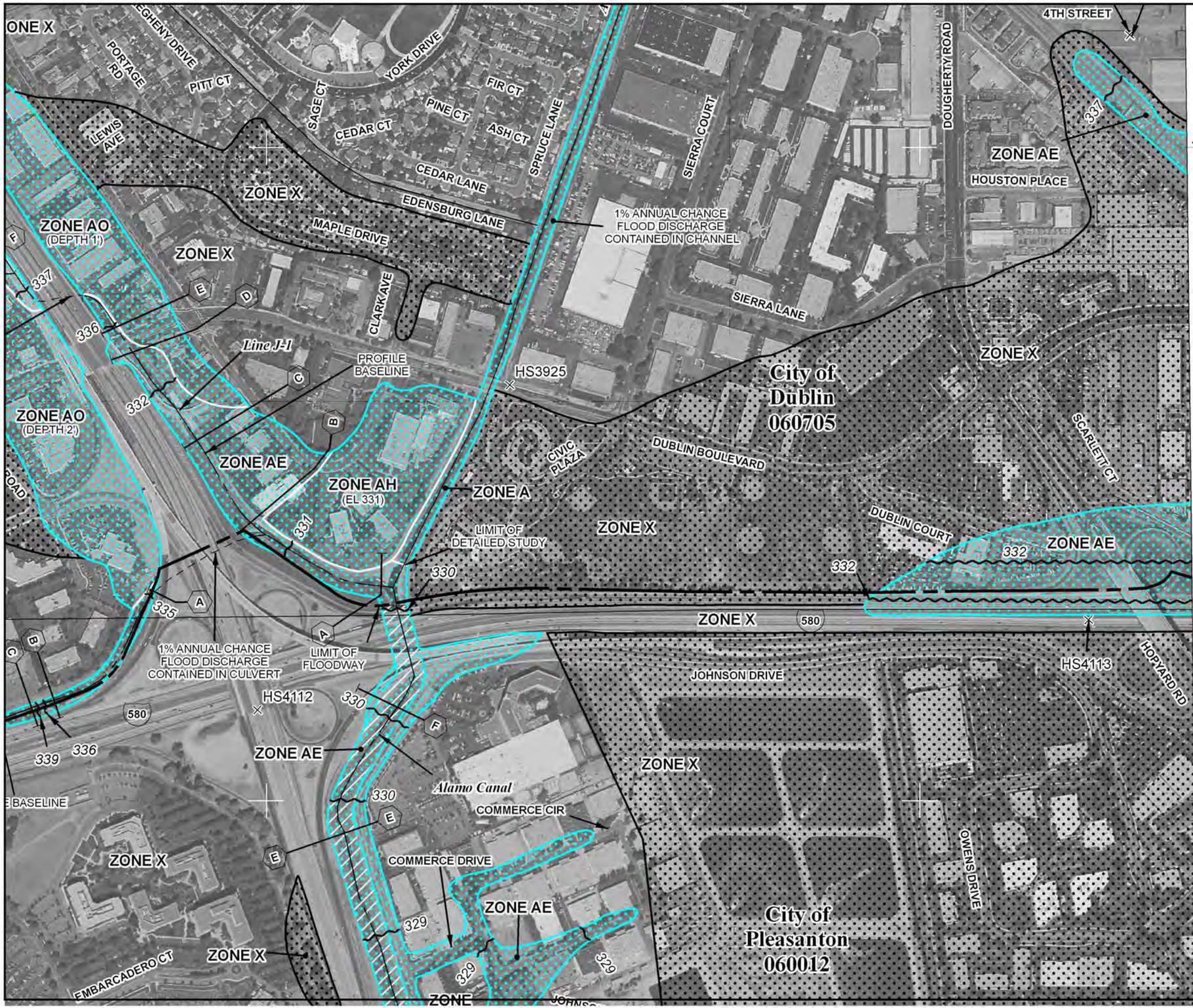

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0308G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 308 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DUBLIN, CITY OF	060705	0308	G
PLEASANTON, CITY OF	060012	0308	G

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

MAP NUMBER
06001C0308G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency

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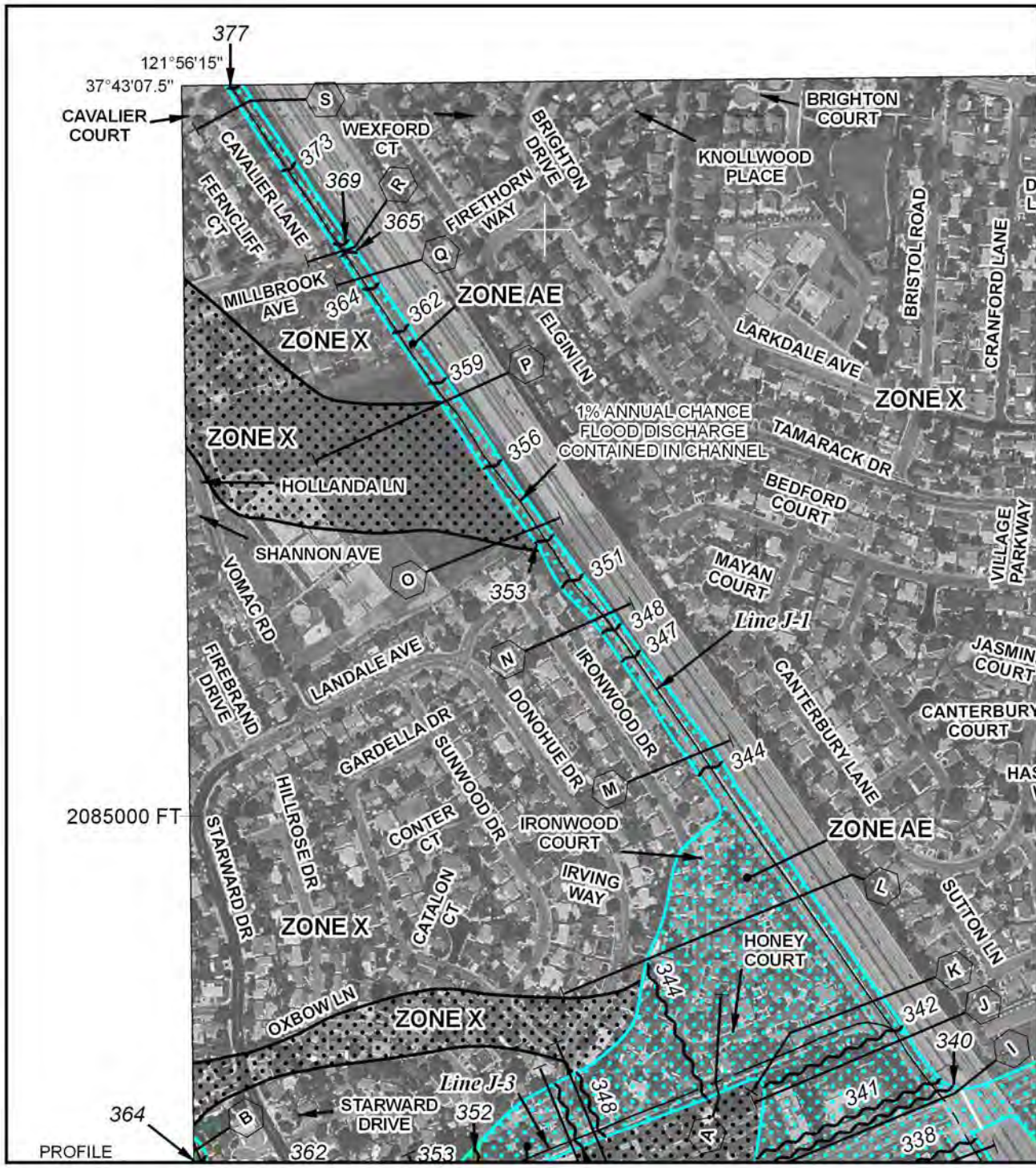

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0308G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 308 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DUBLIN, CITY OF	060705	0308	G
PLEASANTON, CITY OF	060012	0308	G

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

MAP NUMBER
06001C0308G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency

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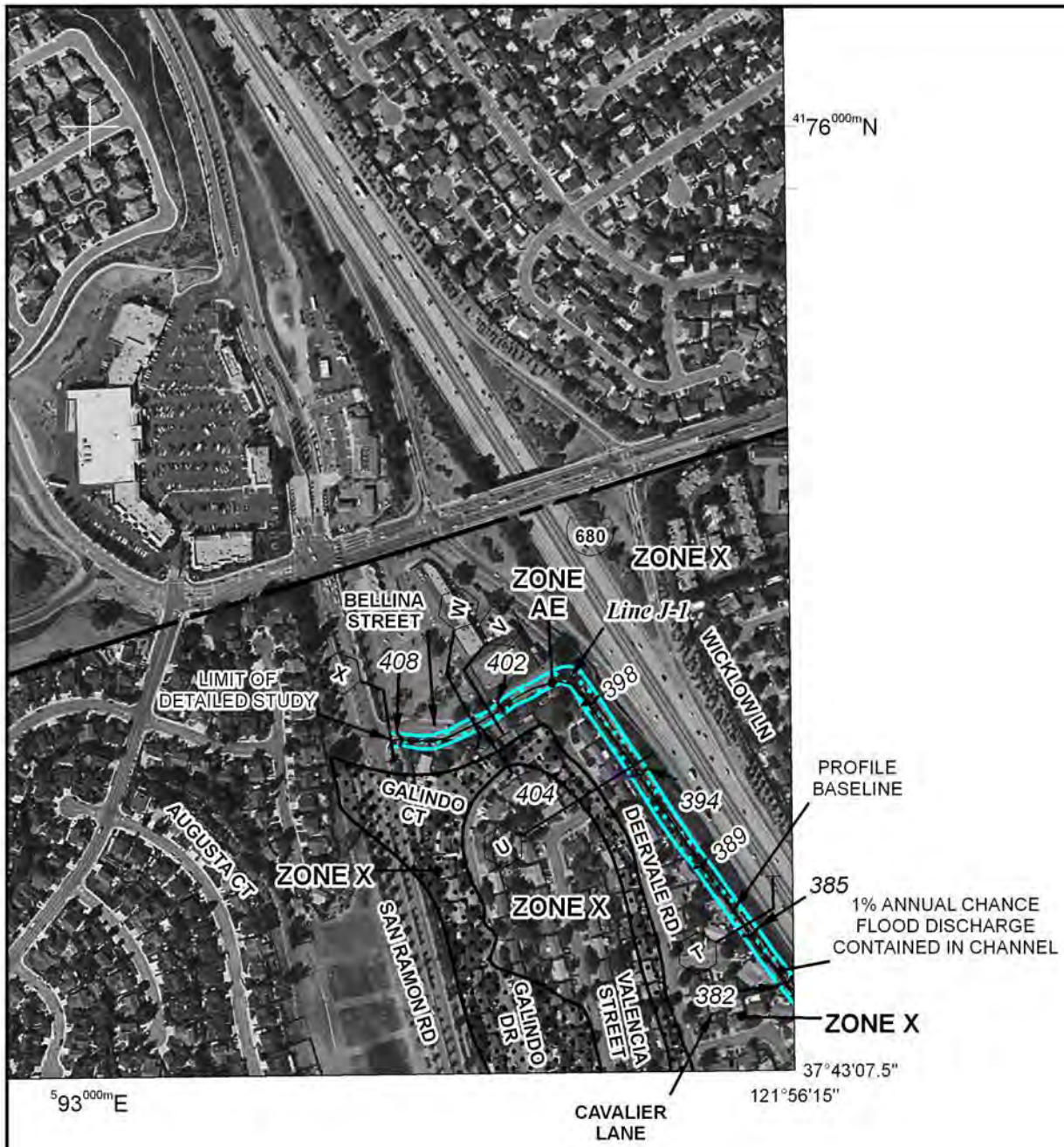


MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0302G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 302 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ALAMEDA COUNTY	060001	0302	G
DUBLIN, CITY OF	060705	0302	G

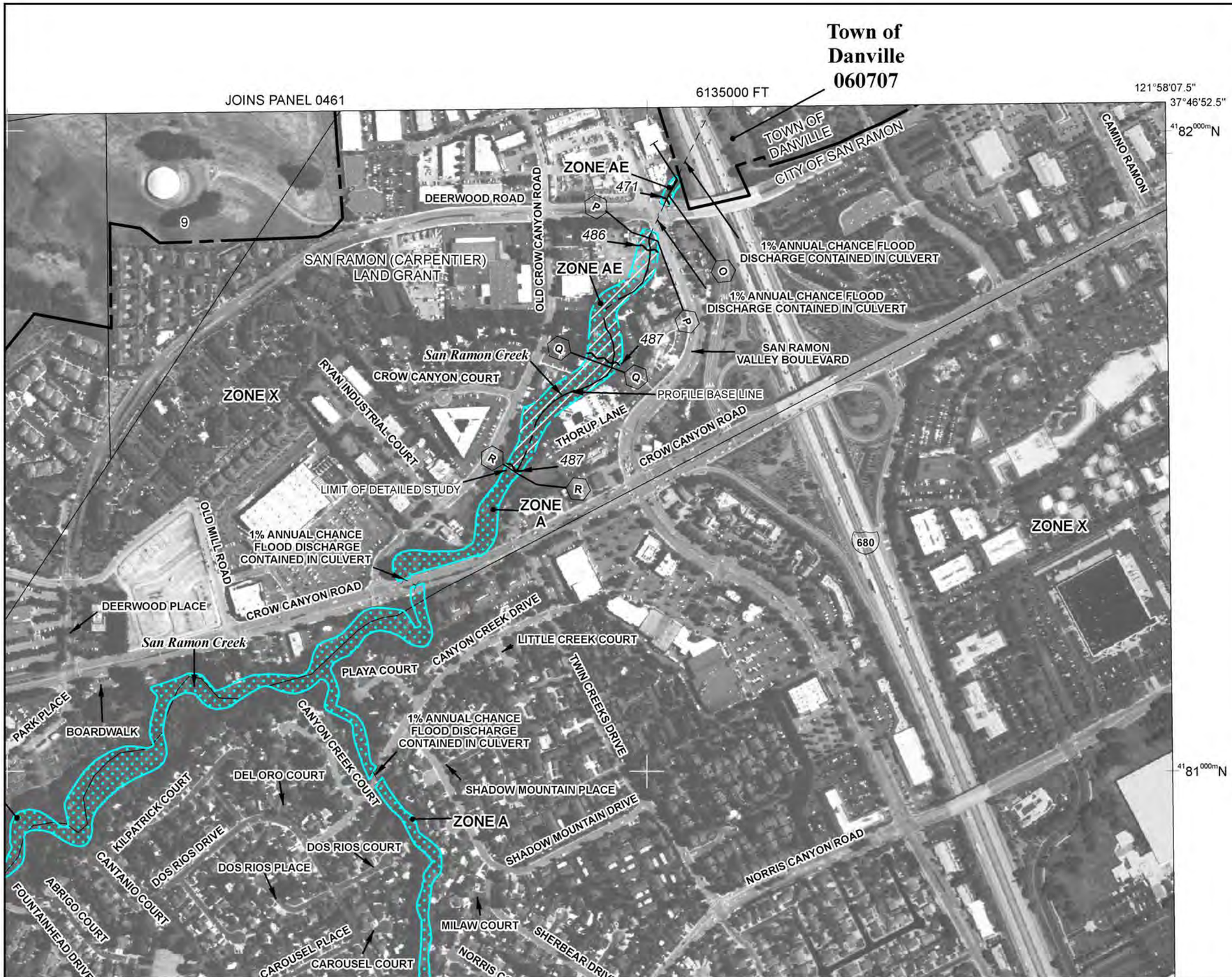
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06001C0302G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0463F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 463 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0463	F
DANVILLE, TOWN OF	060707	0463	F
SAN RAMON, CITY OF	060710	0463	F

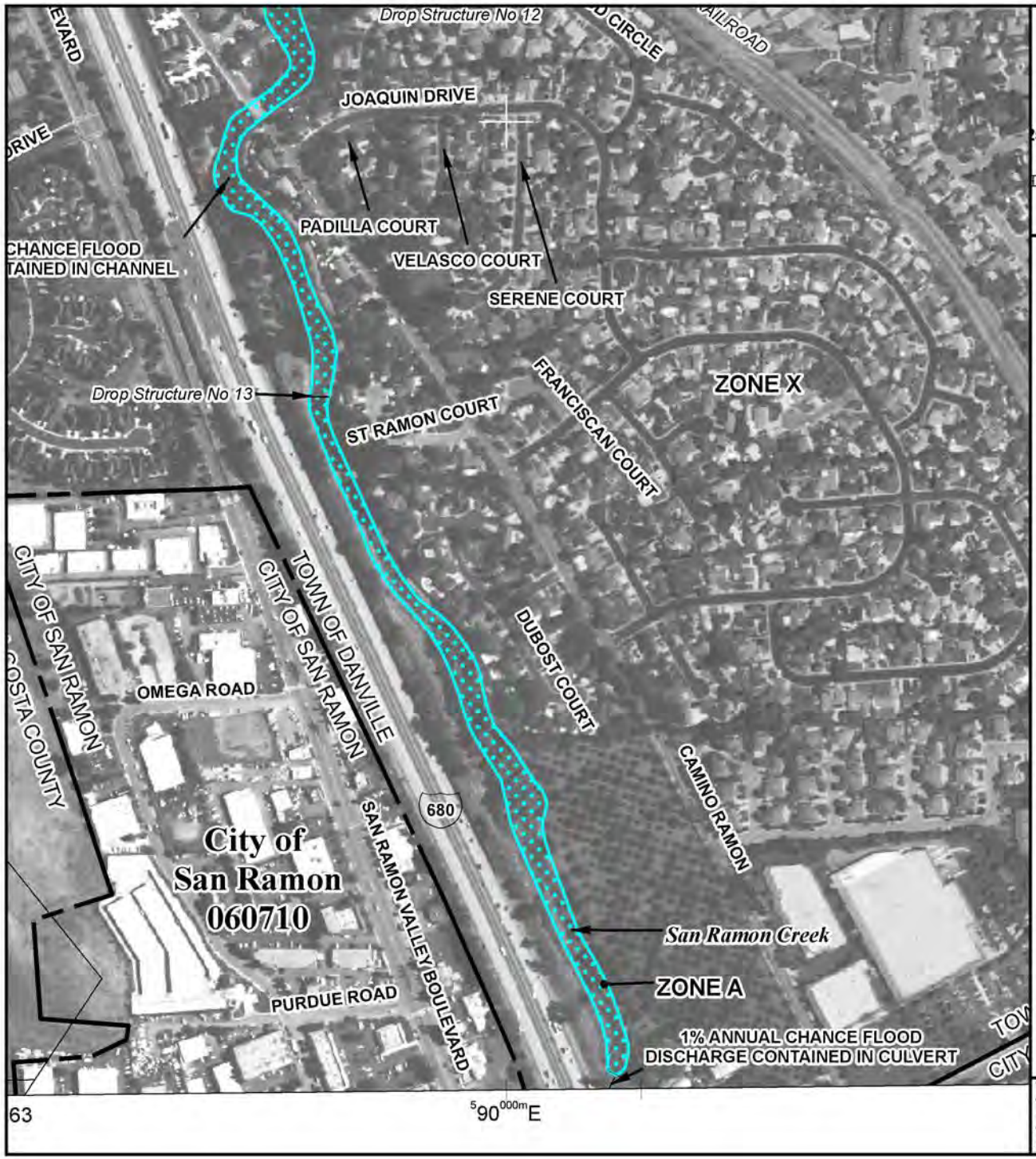
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0463F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0461F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 461 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0461	F
DANVILLE, TOWN OF	060707	0461	F
SAN RAMON, CITY OF	060710	0461	F

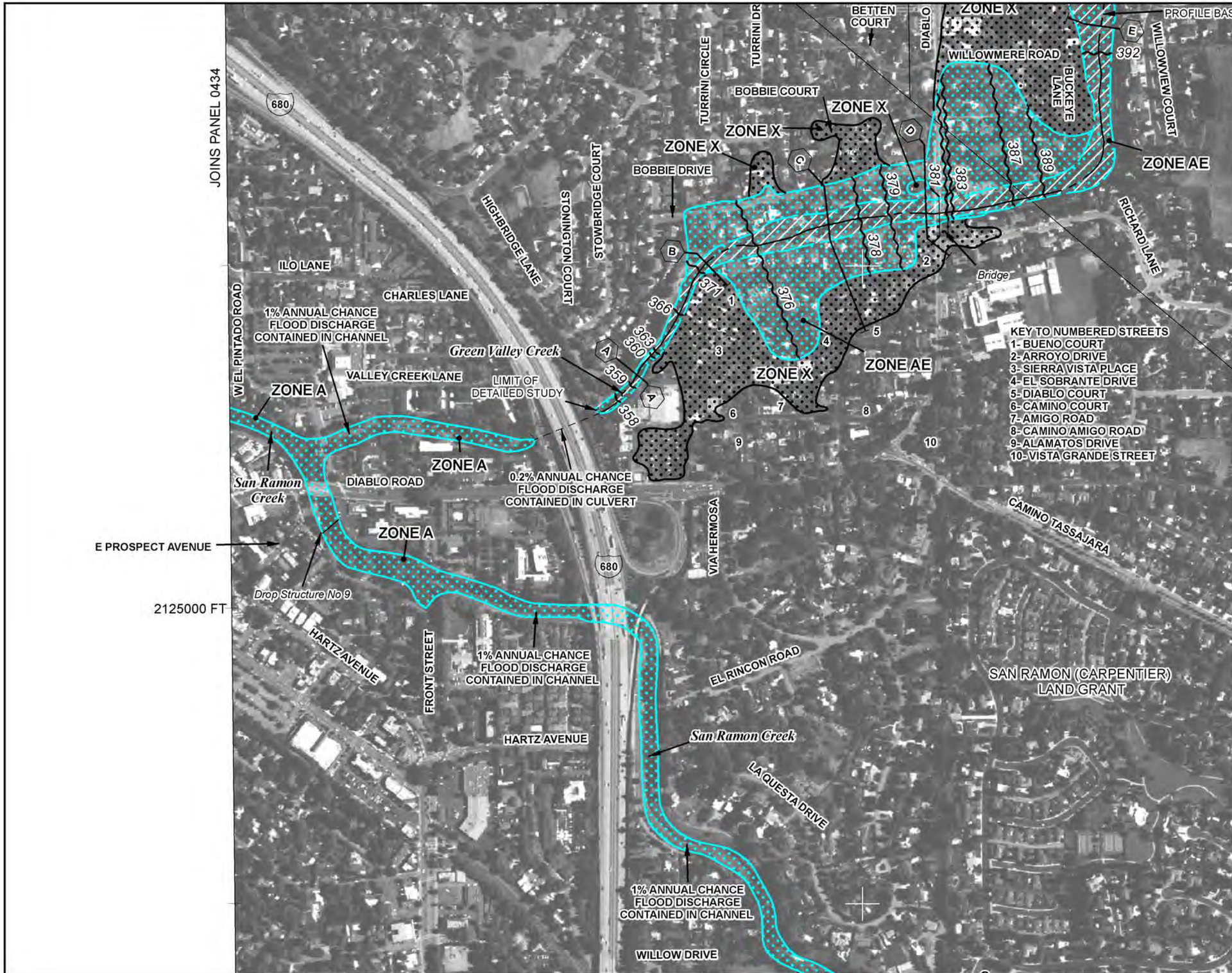
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0461F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0453F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 453 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0453	F
DANVILLE, TOWN OF	060707	0453	F

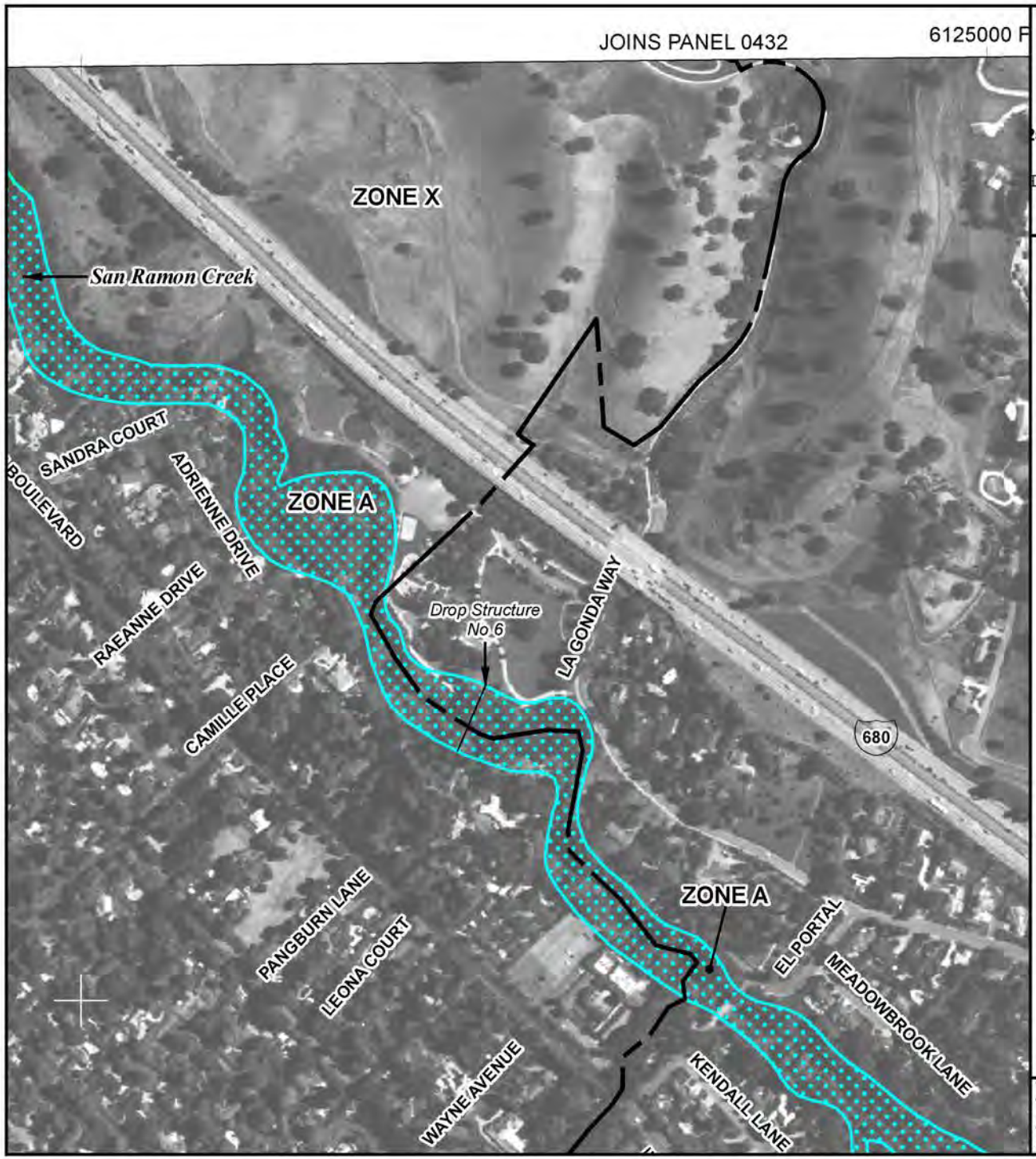
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0453F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0434F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 434 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0434	F
DANVILLE, TOWN OF	060707	0434	F

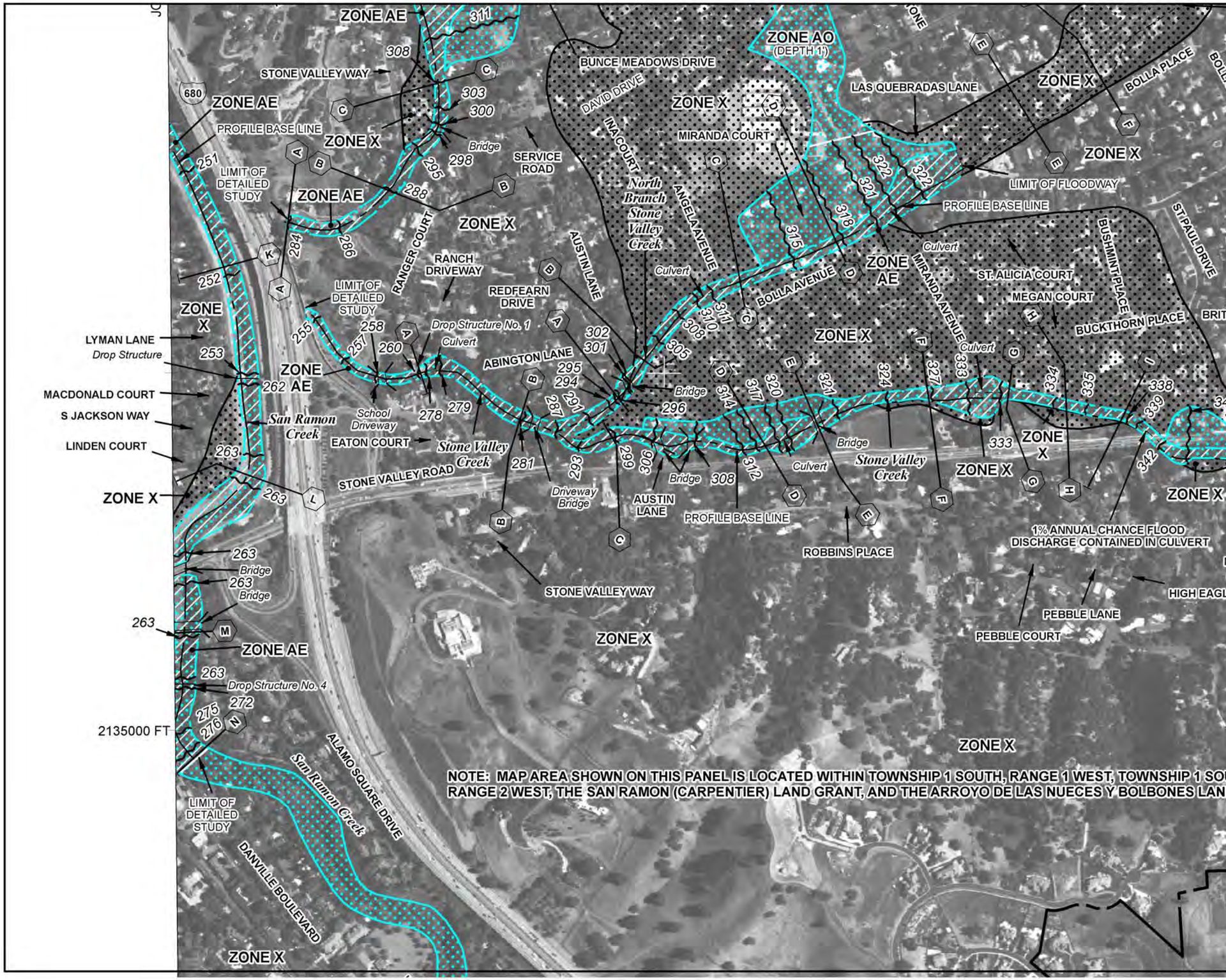
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0434F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0432F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 432 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0432	F
DANVILLE, TOWN OF	060707	0432	F
WALNUT CREEK, CITY OF	065070	0432	F

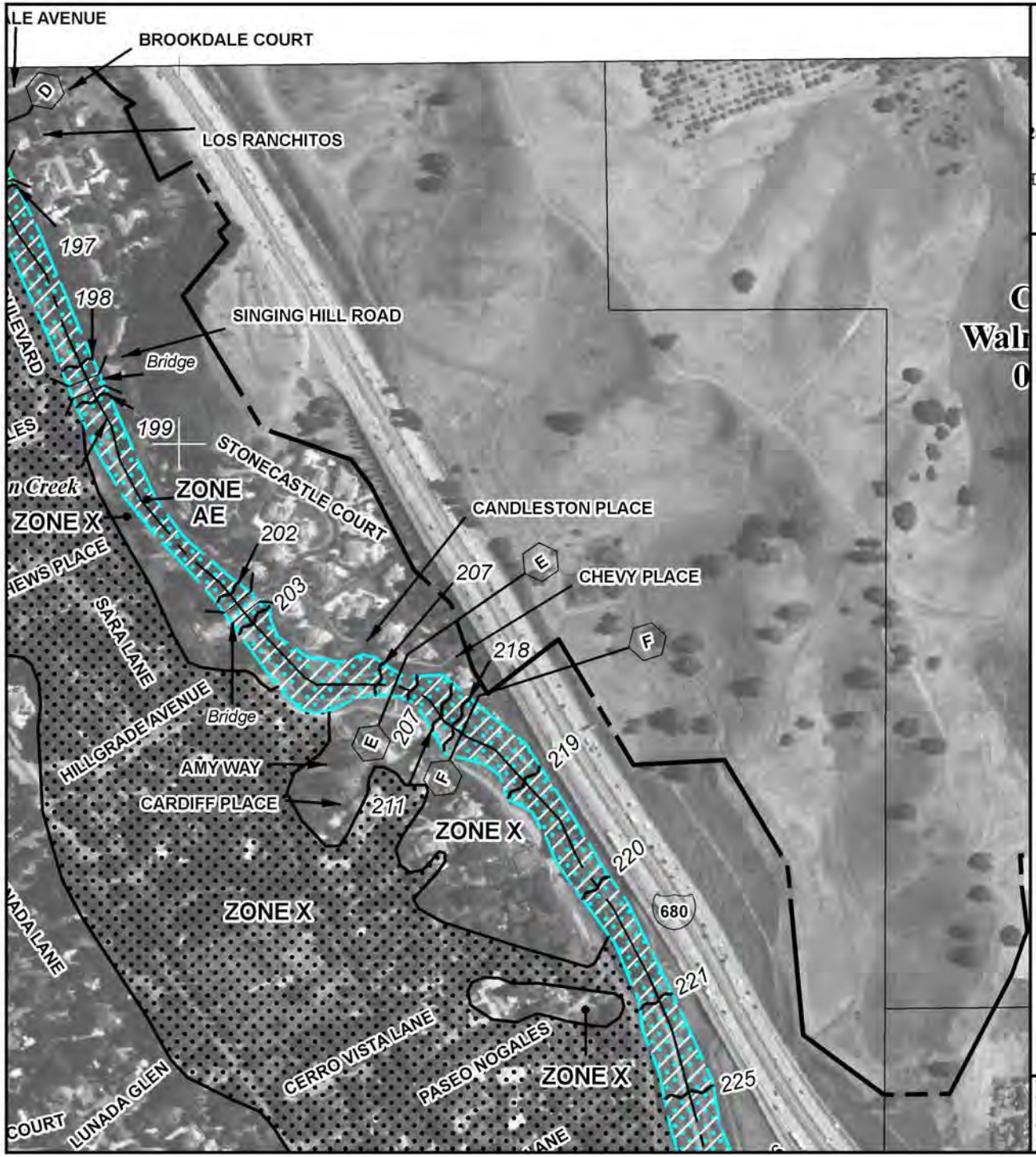
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0432F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0431F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 431 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0431	F
WALNUT CREEK, CITY OF	065070	0431	F

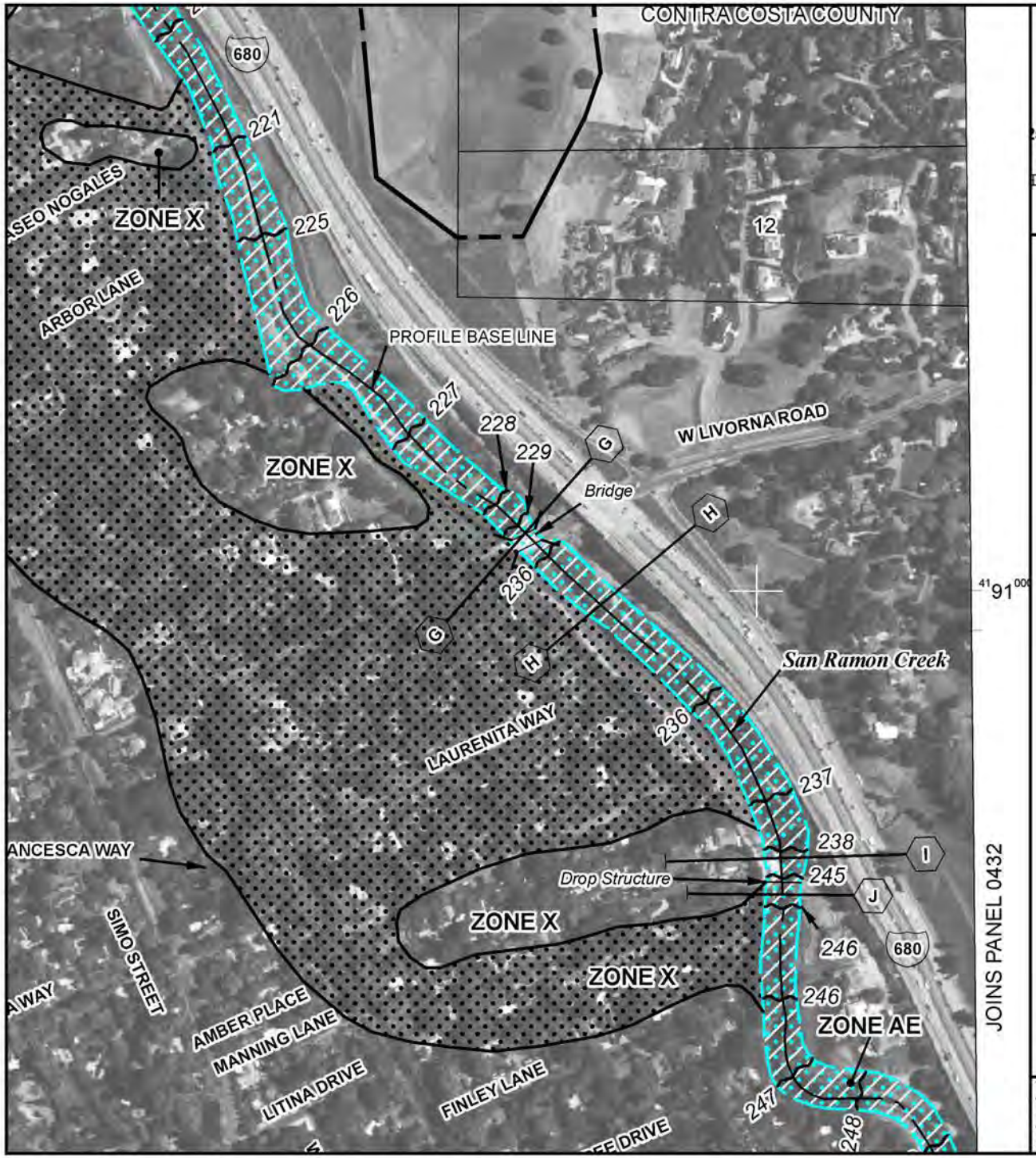
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0431F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0431F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 431 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0431	F
WALNUT CREEK, CITY OF	065070	0431	F

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

MAP NUMBER
06013C0431F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

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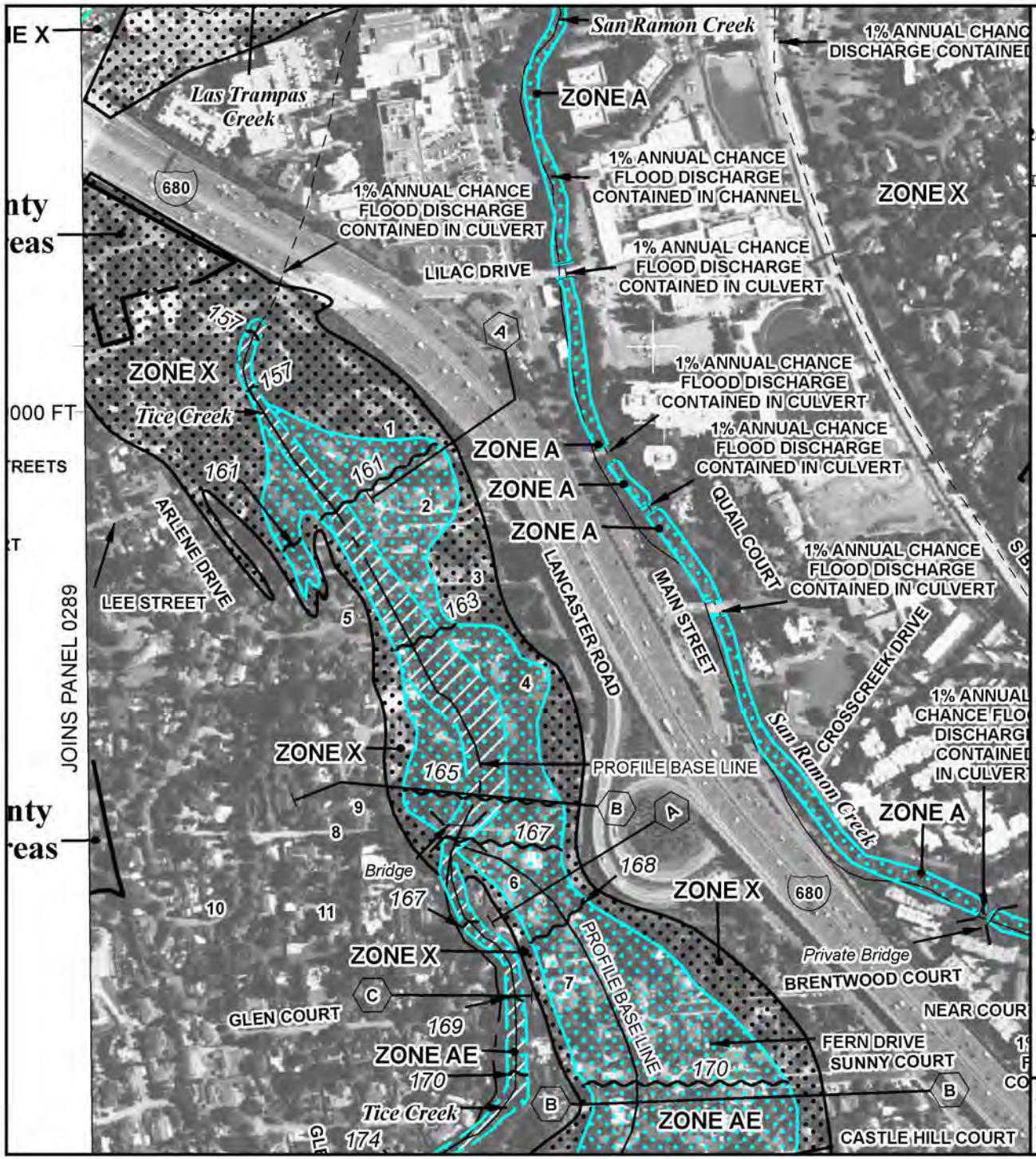

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0293F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 293 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0293	F
WALNUT CREEK, CITY OF	065070	0293	F

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

MAP NUMBER
06013C0293F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

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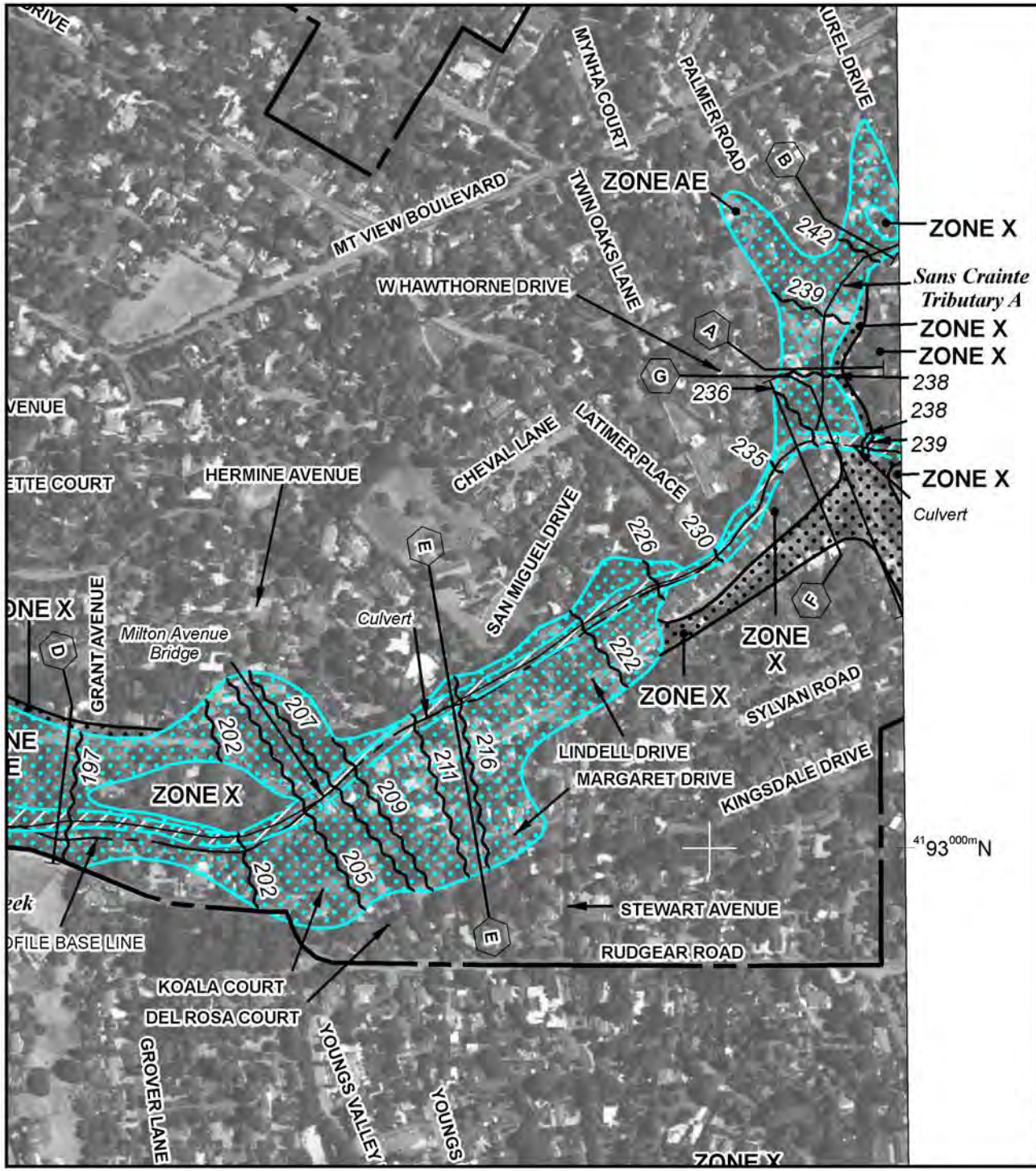

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0293F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 293 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0293	F
WALNUT CREEK, CITY OF	065070	0293	F

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

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06013C0293F

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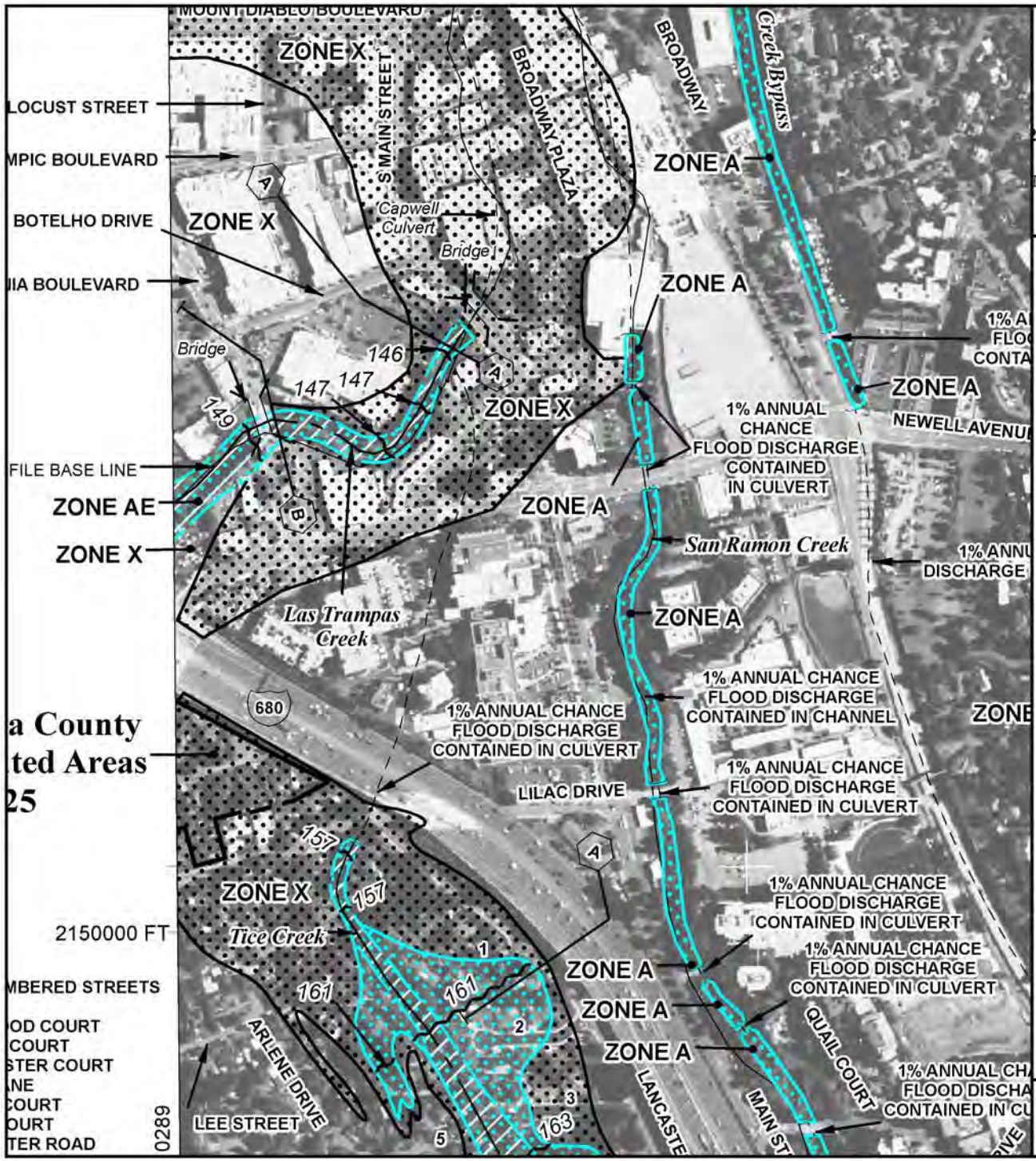


MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0293F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 293 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0293	F
WALNUT CREEK, CITY OF	065070	0293	F

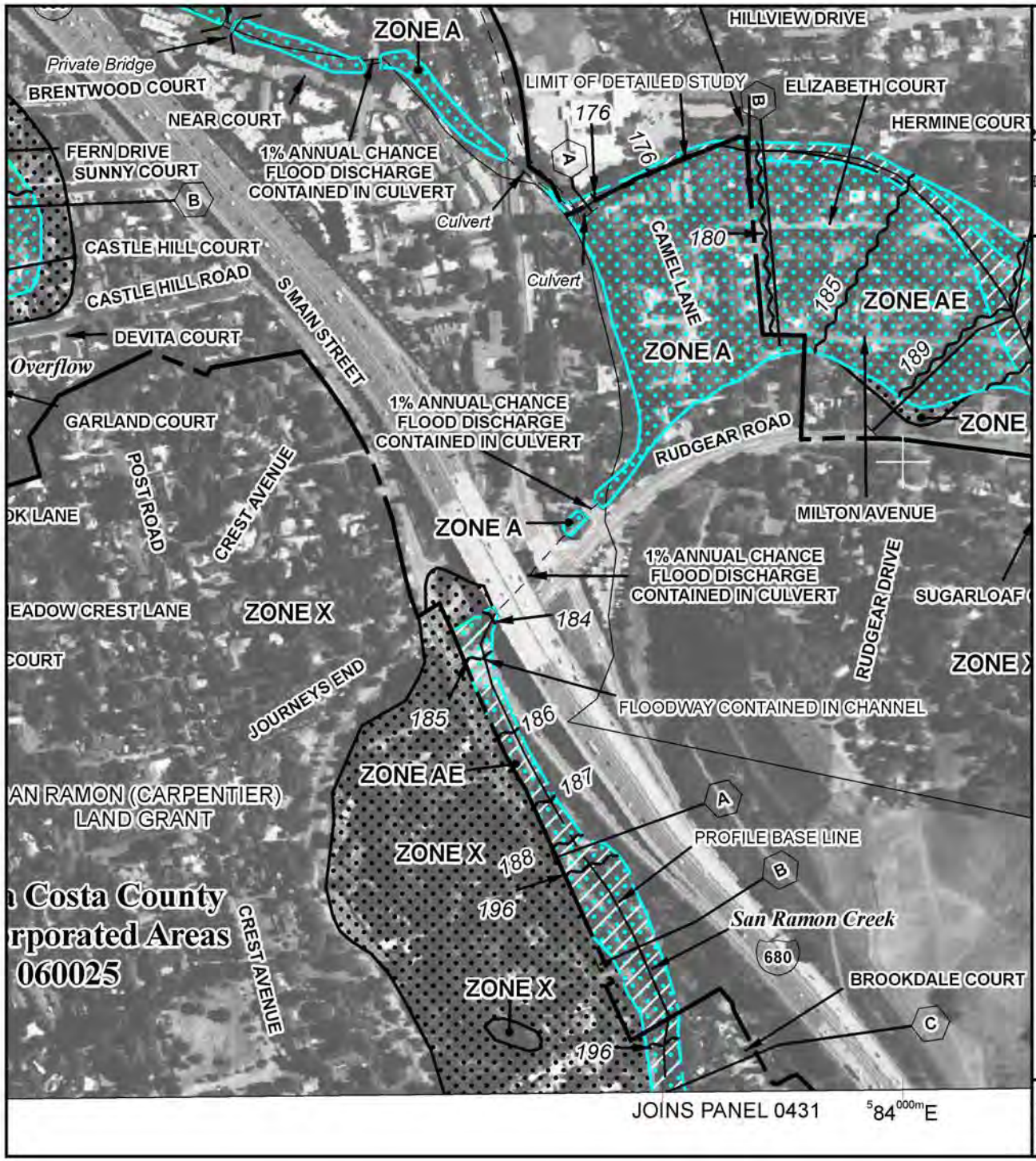
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0293F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0293F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 293 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0293	F
WALNUT CREEK, CITY OF	065070	0293	F

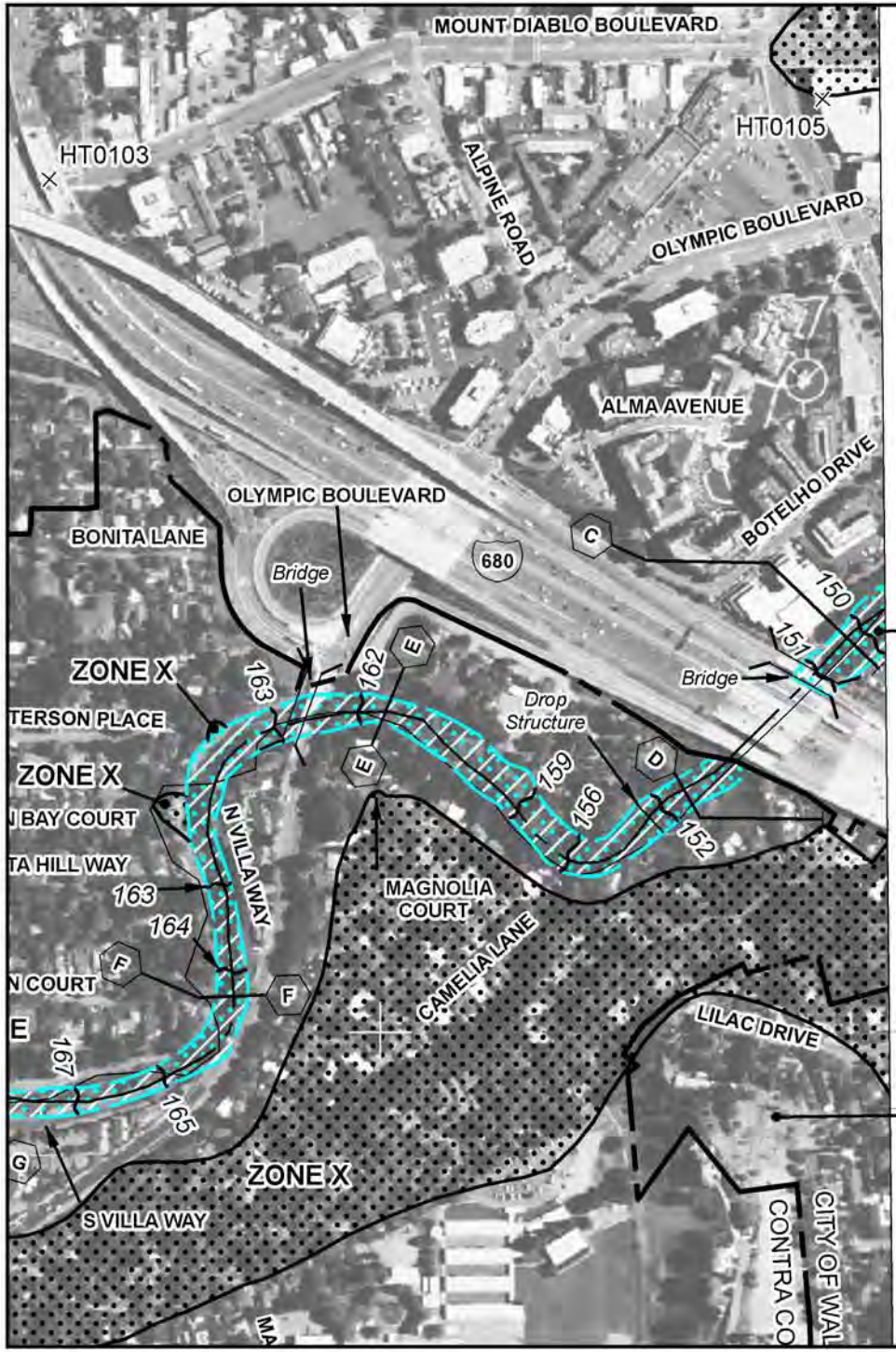
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06013C0293F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



City of Walnut Creek 065070

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0289F

FIRM

FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 289 OF 602

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0289	F
LAFAYETTE, CITY OF	065037	0289	F
WALNUT CREEK, CITY OF	065070	0289	F

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

MAP NUMBER
06013C0289F

EFFECTIVE DATE
JUNE 16, 2009

Federal Emergency Management Agency

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Appendix C Watershed Maps

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

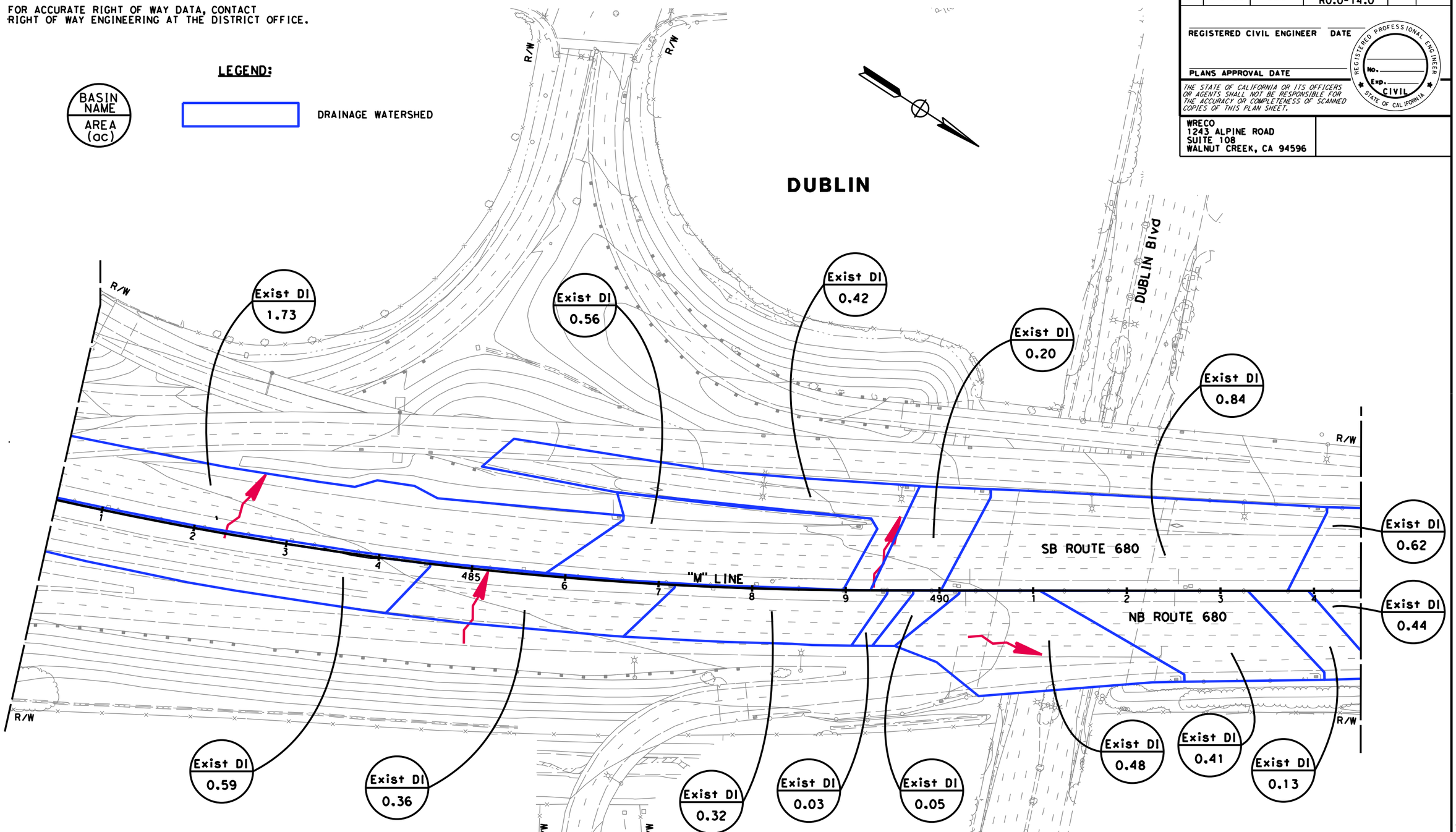
NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

BASIN NAME / AREA (ac)

DRAINAGE WATERSHED



WATERSHED MAP

SCALE: 1" = 50'

WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

CALCULATED-DESIGNED BY: JEFF TUDD

CHECKED BY: HONG CHAO YU

REVISED BY / DATE REVISED

LAST REVISION 4-30-14

DATE PLOTTED => 1/19/2015
TIME PLOTTED => 2:40:36 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

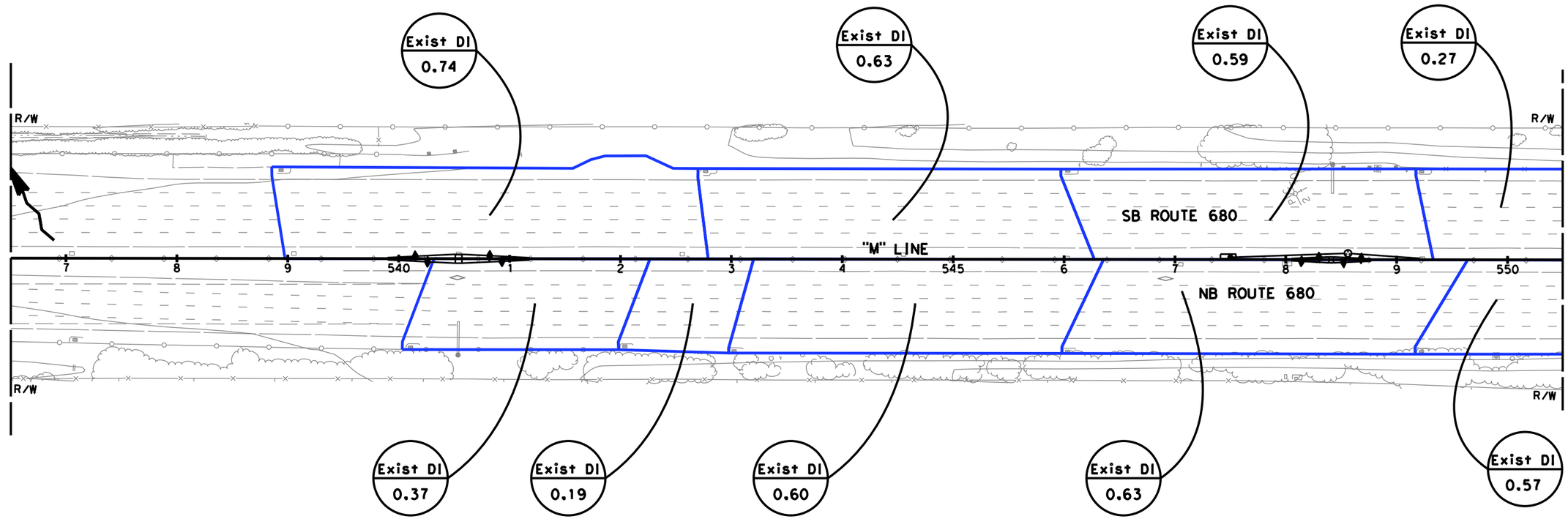
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM-2

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	CHECKED BY
JEFF TUDD	HONG CHAO YU

CONSULTANT FUNCTIONAL SUPERVISOR
CHRIS SEWELL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 4-30-14 | DATE PLOTTED => 1/19/2015 TIME PLOTTED => 2:42:35 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

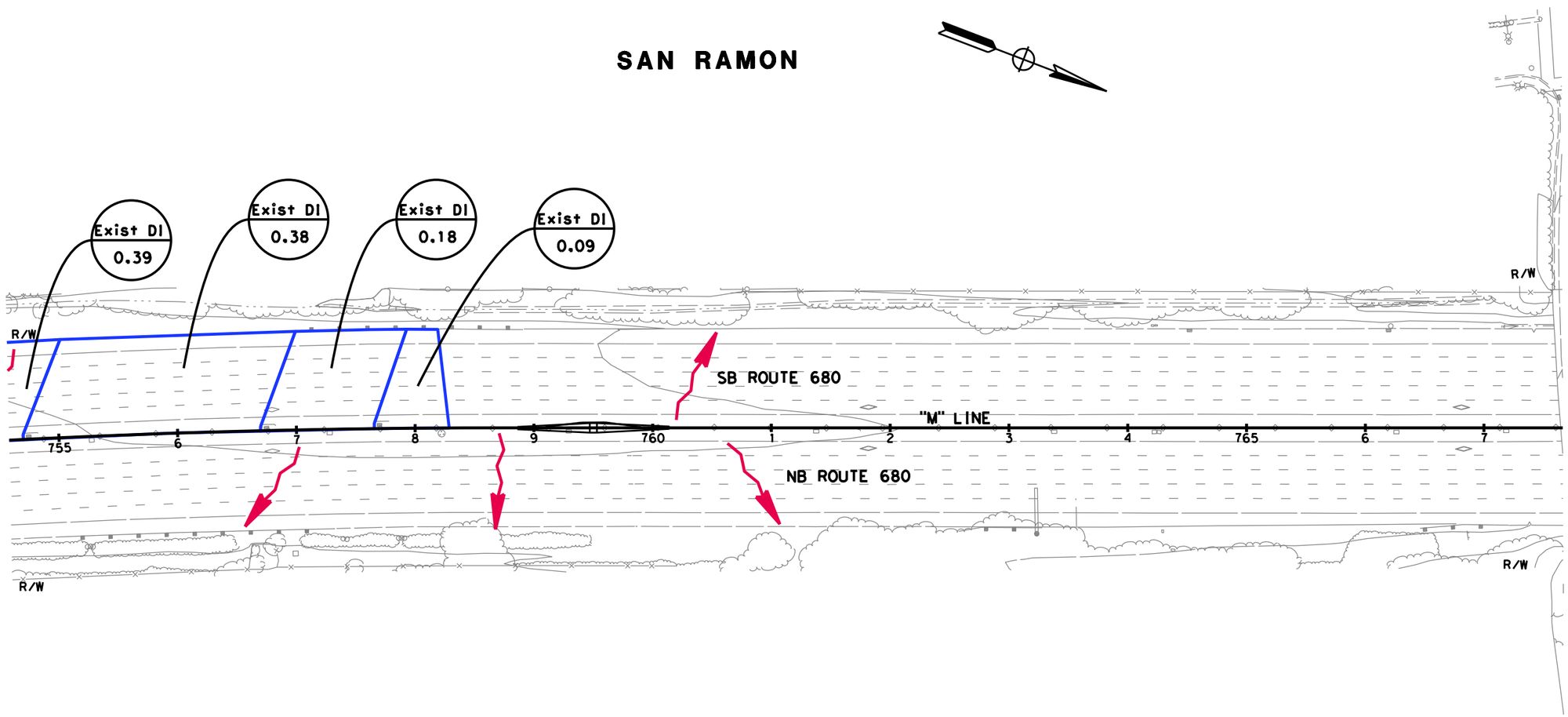
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

CALCULATED-DESIGNED BY: JEFF TUDD

CHECKED BY: HONG CHAO YU

REVISED BY

DATE REVISED

LAST REVISION 4-30-14

DATE PLOTTED => 1/19/2015
TIME PLOTTED => 2:43:27 PM

BORDER LAST REVISED 7/2/2010

USERNAME => jeff_tudd
DGN FILE => ...\Dwg\ws\WS-03.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04140004819

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

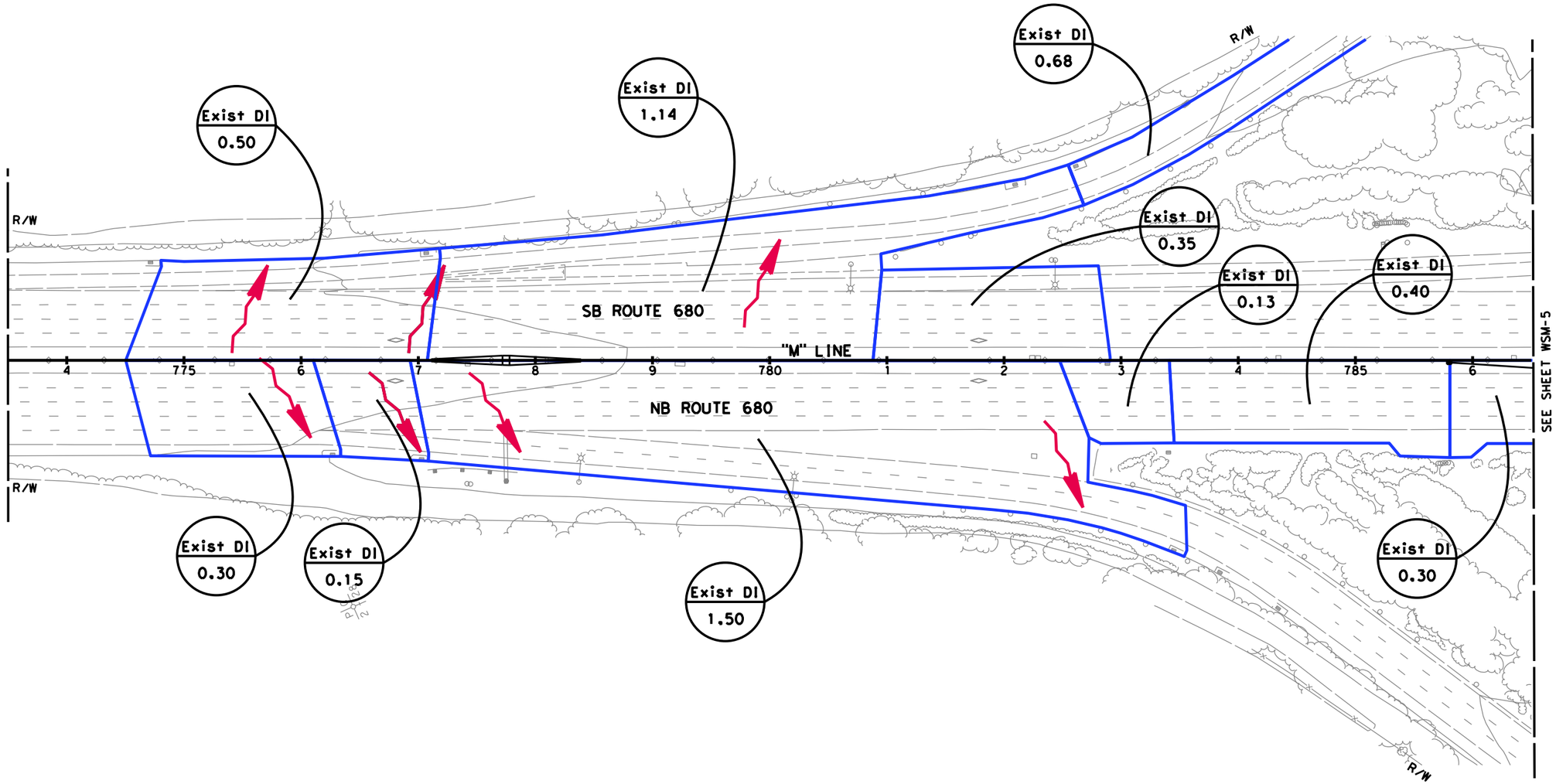
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

SAN RAMON



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM- 4

REVISED BY	DATE REVISED
JEFF TUDD	HONG CHAO YU

CALCULATED-DESIGNED BY / CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 4-30-14 DATE PLOTTED => 1/19/2015 TIME PLOTTED => 2:44:16 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

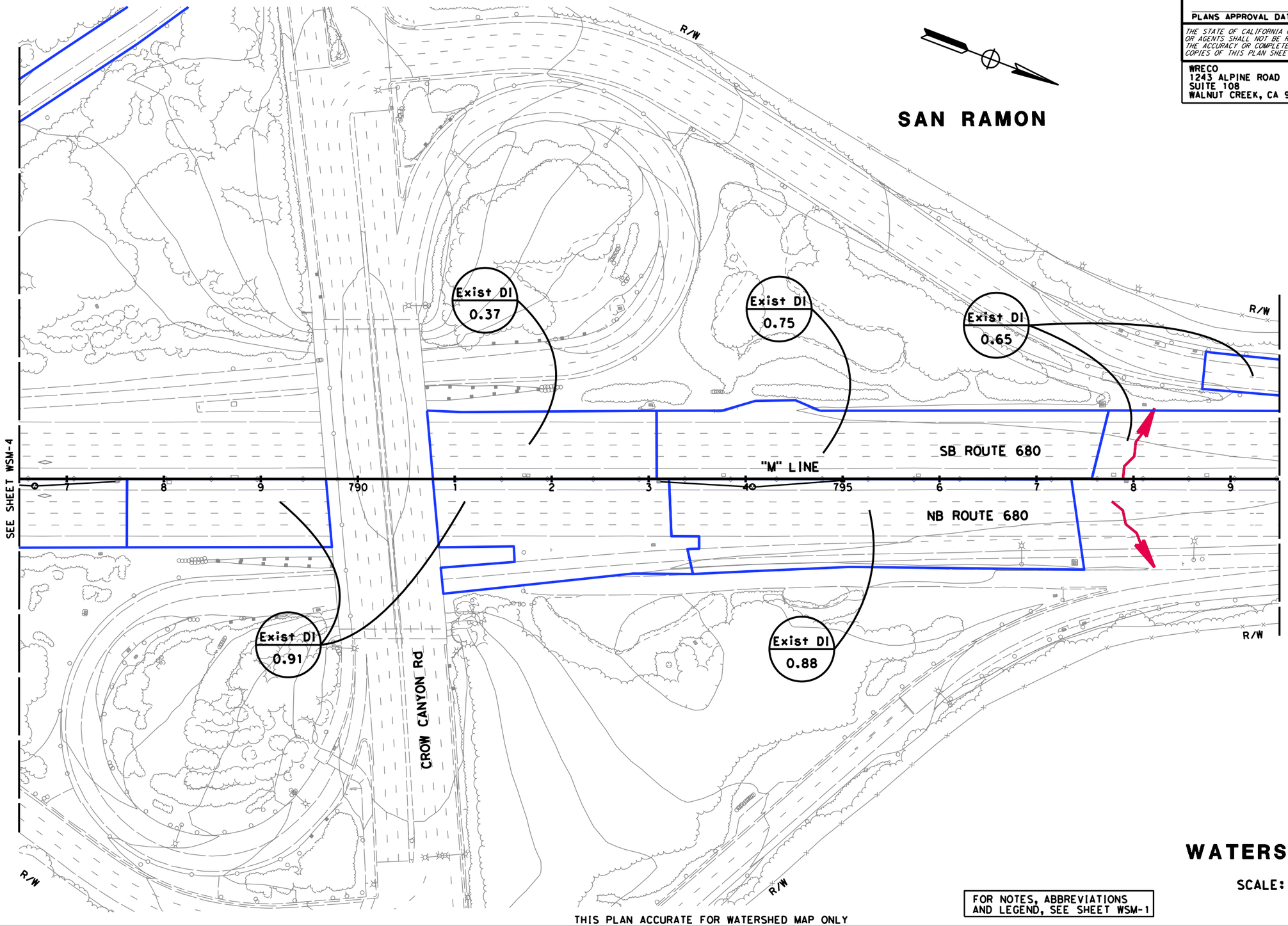
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

WATERSHED MAP

SCALE: 1" = 50'

WSM-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

CALCULATED-DESIGNED BY: JEFF TUDD

CHECKED BY: HONG CHAO YU

REVISED BY

DATE REVISED

LAST REVISION 4-30-14

DATE PLOTTED => 1/19/2015
TIME PLOTTED => 2:45:01 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

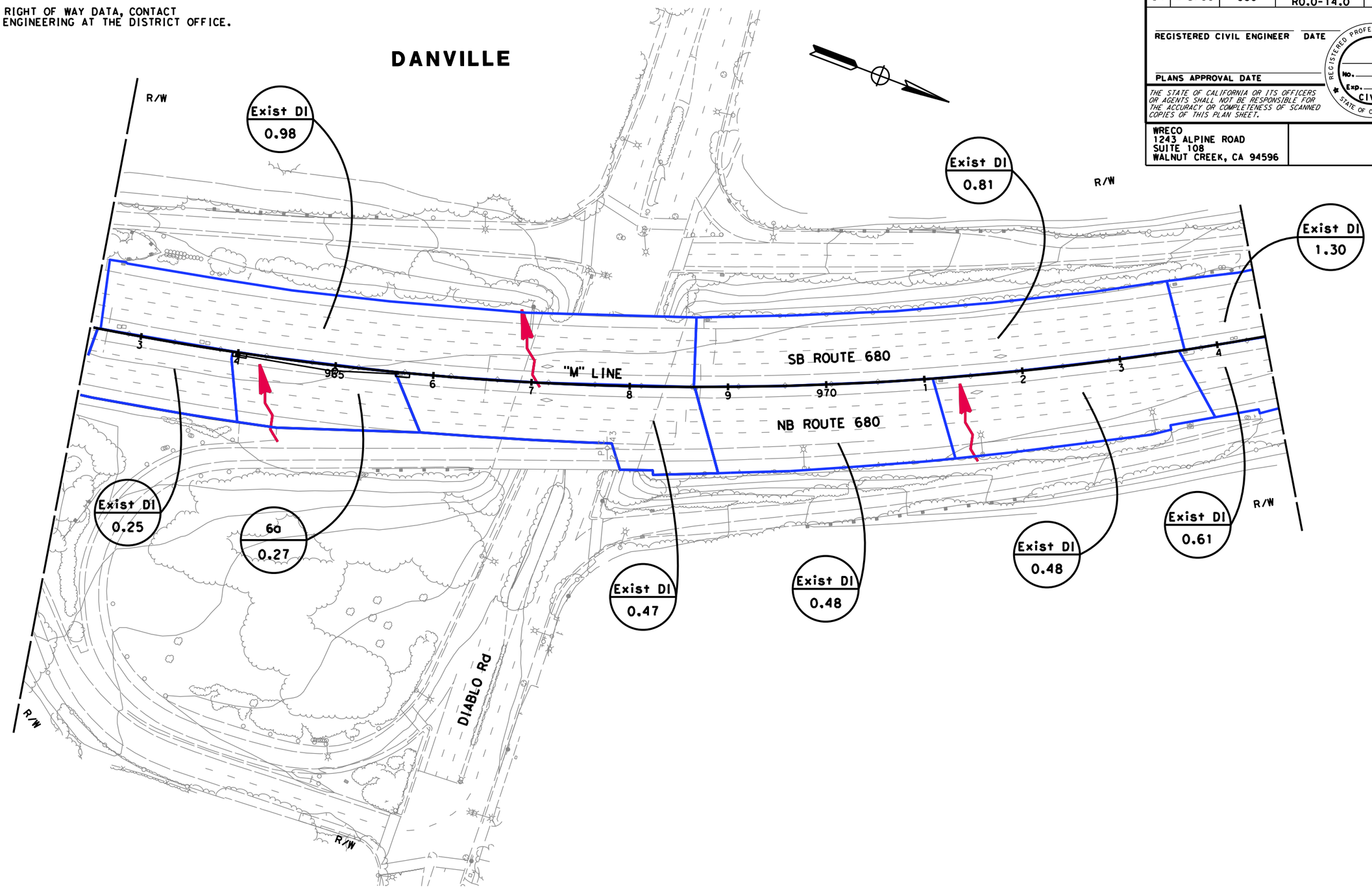
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

CALCULATED-DESIGNED BY: JEFF TUDD

CHECKED BY: HONG CHAO YU

REVISED BY

DATE REVISED

LAST REVISION 4-30-14

DATE PLOTTED => 1/19/2015
TIME PLOTTED => 2:45:40 PM

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

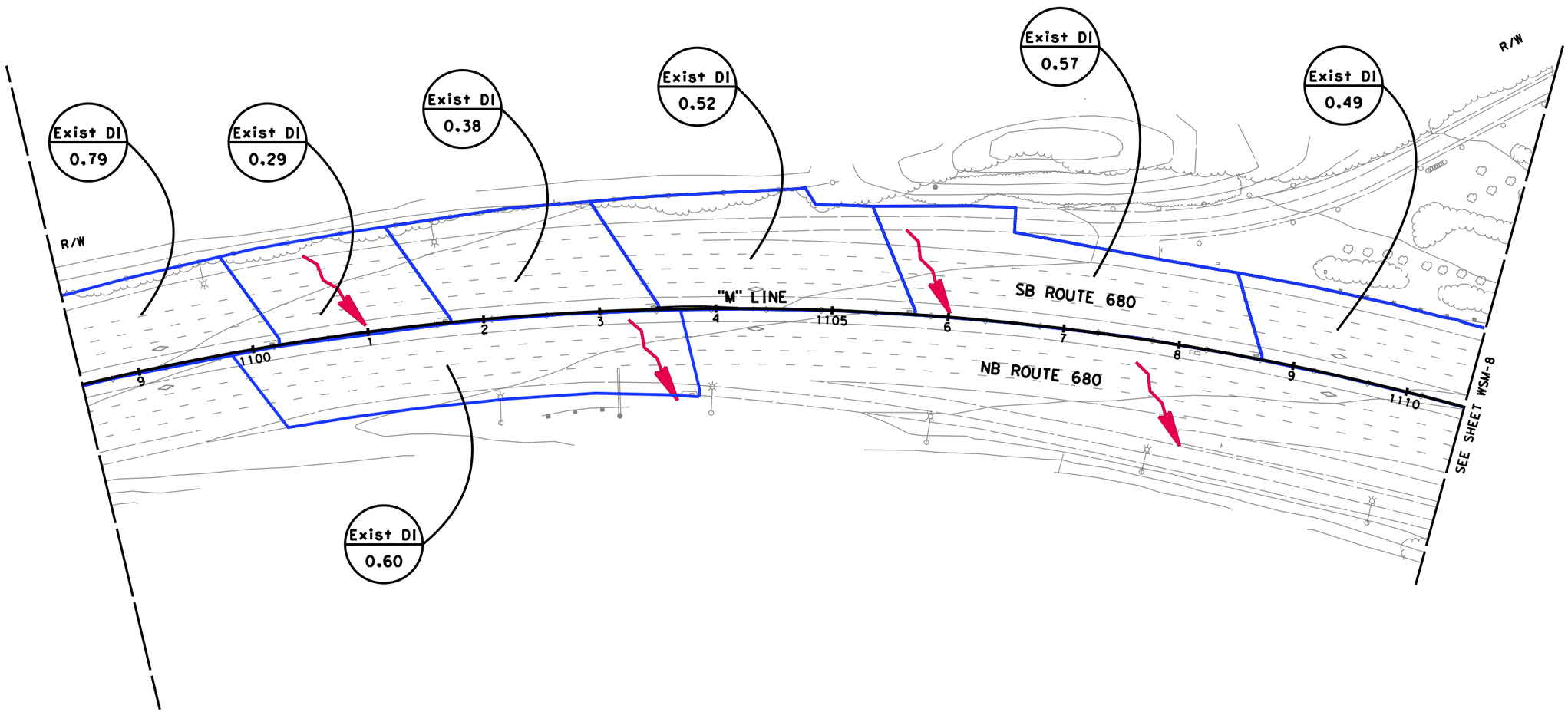
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

ALAMO



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

WSM-7

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

REVISED BY	DATE REVISED
JEFF TUDD	HONG CHAO YU
CALCULATED-DESIGNED BY	CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR	CHRIS SEWELL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 4-30-14 DATE PLOTTED => 1/19/2015 TIME PLOTTED => 2:46:34 PM

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

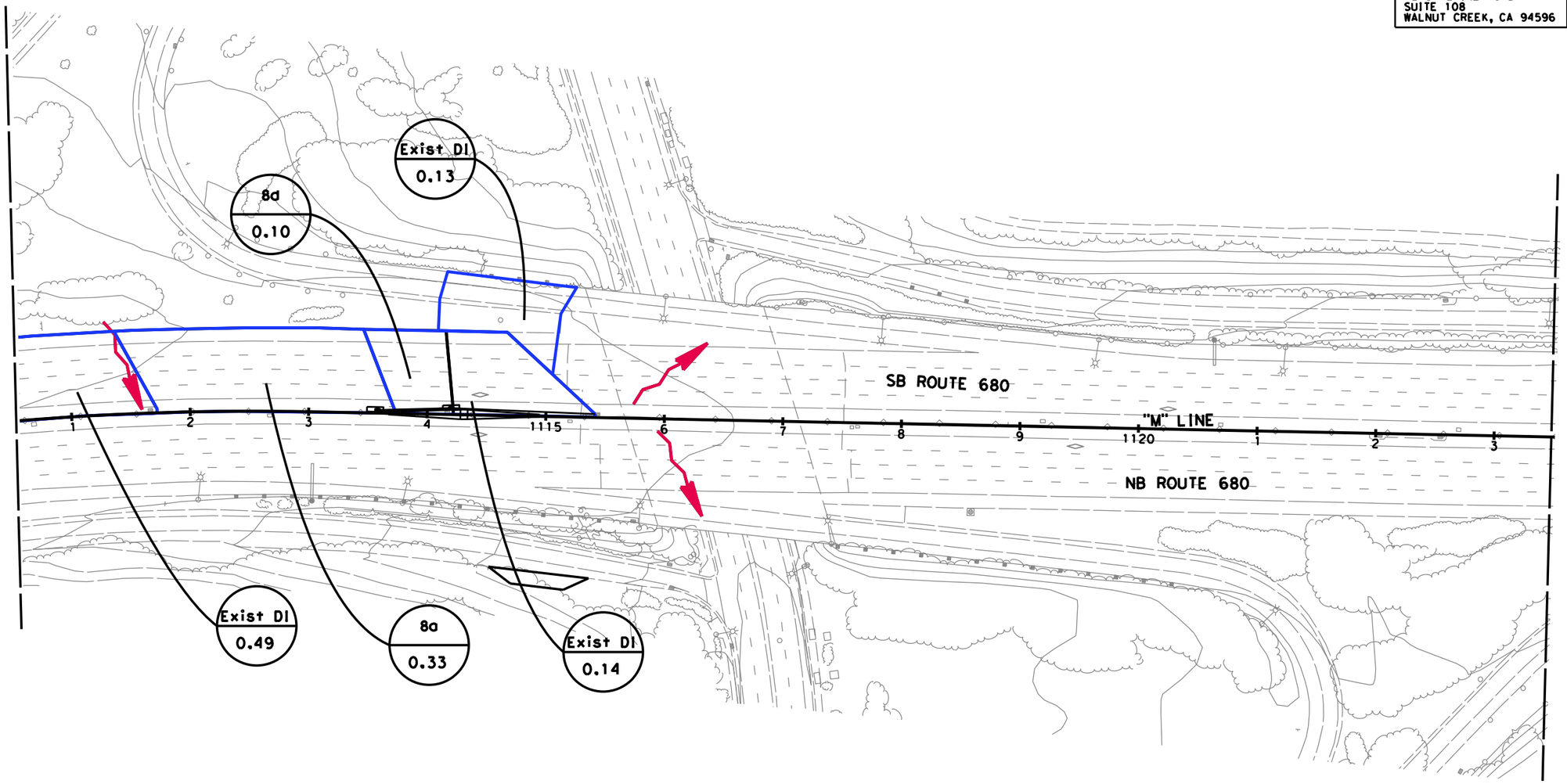
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

WSM-8

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

REVISED BY	DATE REVISED
JEFF TUDD	HONG CHAO YU

CALCULATED-DESIGNED BY: JEFF TUDD
CHECKED BY: HONG CHAO YU

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 4-30-14
DATE PLOTTED => 1/19/2015
TIME PLOTTED => 2:47:14 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

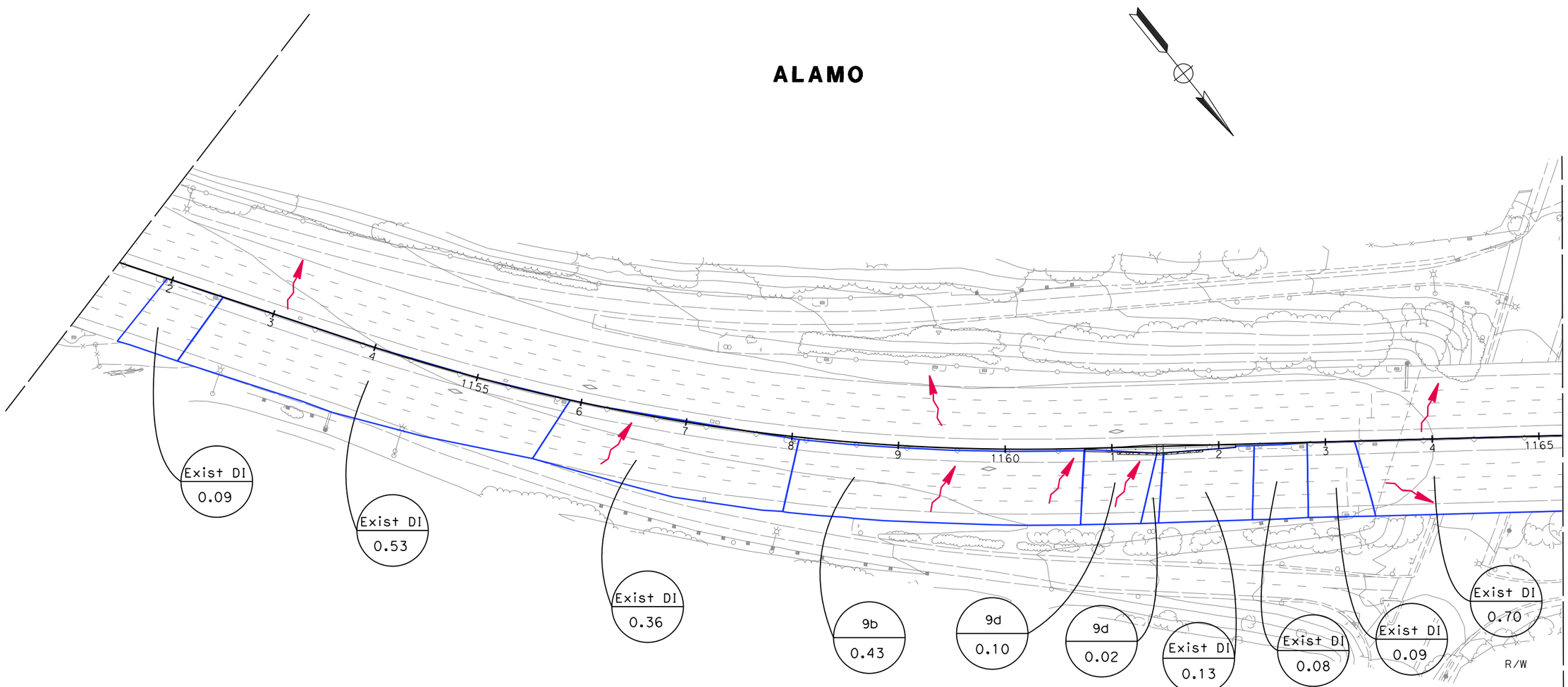
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

ALAMO



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

CALCULATED-DESIGNED BY: JEFF TUDD

CHECKED BY: HONG CHAO YU

REVISED BY

DATE REVISED

LAST REVISION 4-30-14

DATE PLOTTED => 3/26/2015
TIME PLOTTED => 5:10:10 PM

BORDER LAST REVISED 7/2/2010

USERNAME => mei_du
DGN FILE => ...\Dwg\ws\WS-09.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04140004819

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
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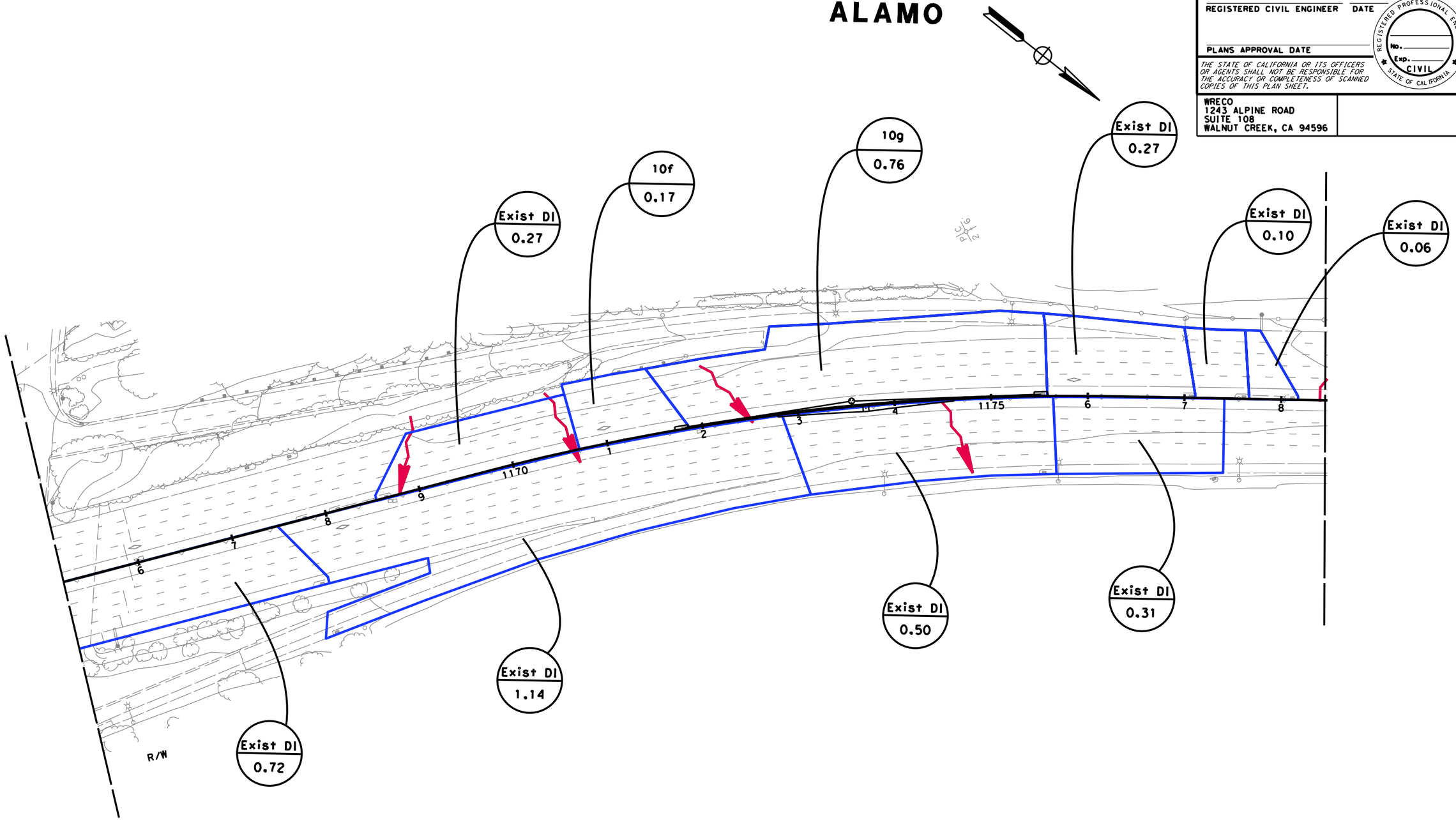
SUITE 108
WALNUT CREEK, CA 94596



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM-10

REVISED BY	DATE REVISED
JEFF TUDD	HONG CHAO YU
CALCULATED-DESIGNED BY	CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR	CHRIS SEWELL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 4-30-14 DATE PLOTTED => 1/19/2015 TIME PLOTTED => 2:48:50 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

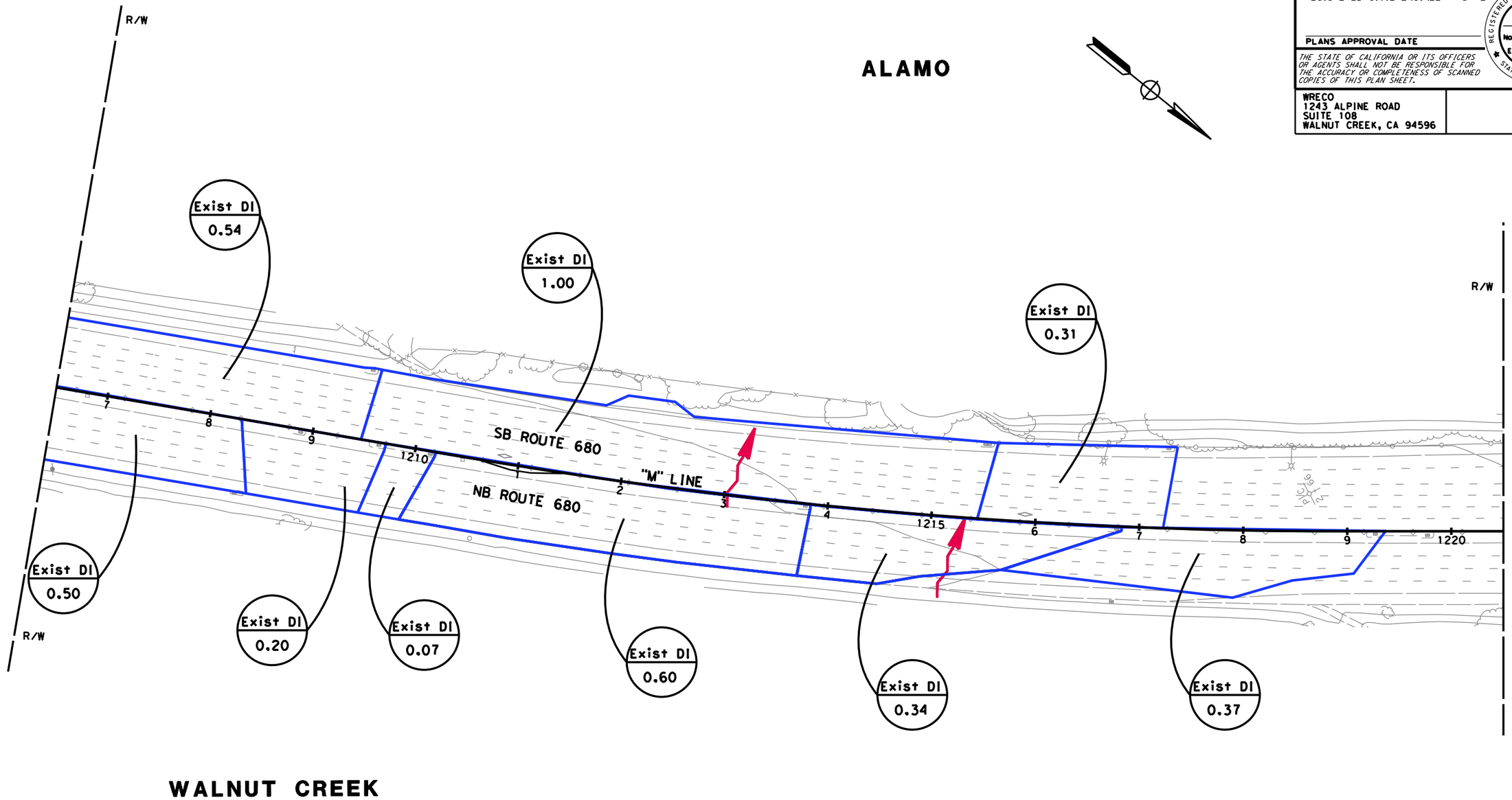
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM-11

REVISED BY	DATE REVISED
JEFF TUDD	HONG CHAO YU

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 4-30-14 | DATE PLOTTED => 1/19/2015 | TIME PLOTTED => 2:49:36 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala/CC	680	R21.0-R21.9/ R0.0-14.0		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

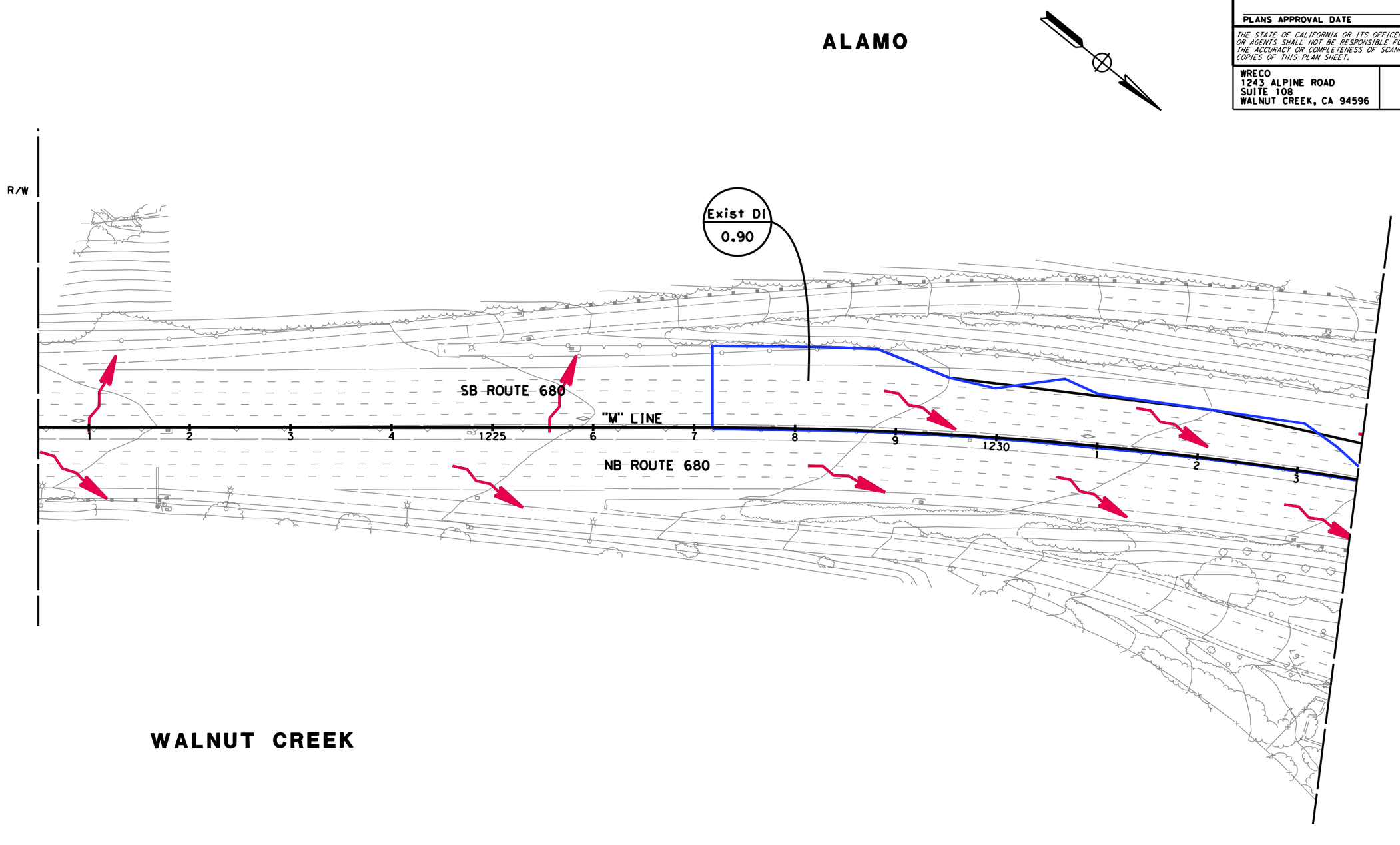
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



WATERSHED MAP

SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR WATERSHED MAP ONLY

WSM-12

REVISED BY | DATE REVISED

JEFF TUDD | HONG CHAO YU

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: CHRIS SEWELL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 4-30-14 | DATE PLOTTED => 1/19/2015 | TIME PLOTTED => 2:50:17 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jeff_tudd | DGN FILE => ...\Dwg\ws\WS-12.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0000 | PROJECT NUMBER & PHASE 04140004819

Appendix D Hydraulic Analysis of On-site Drainage Design

Appendix D.1 Assuming 0.75 ft below FG for downstream control

BAIFA 680 DS-2 (.75' below TG)

Project File: Drainage System 2.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	360.40	0.00	360.40	42	Cir	0.013	0.50	368.79	Exist 42-in
2	1	106.000	-3.000	MH	0.00	0.00	0.00	0.0	360.40	0.19	360.60	42	Cir	0.025	0.21	368.92	c
3	2	66.000	10.000	Grate	0.01	0.00	0.00	0.0	360.60	0.18	360.72	42	Cir	0.025	1.00	369.20	a

BAIFA 680 DS-2 (.75' below TG) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

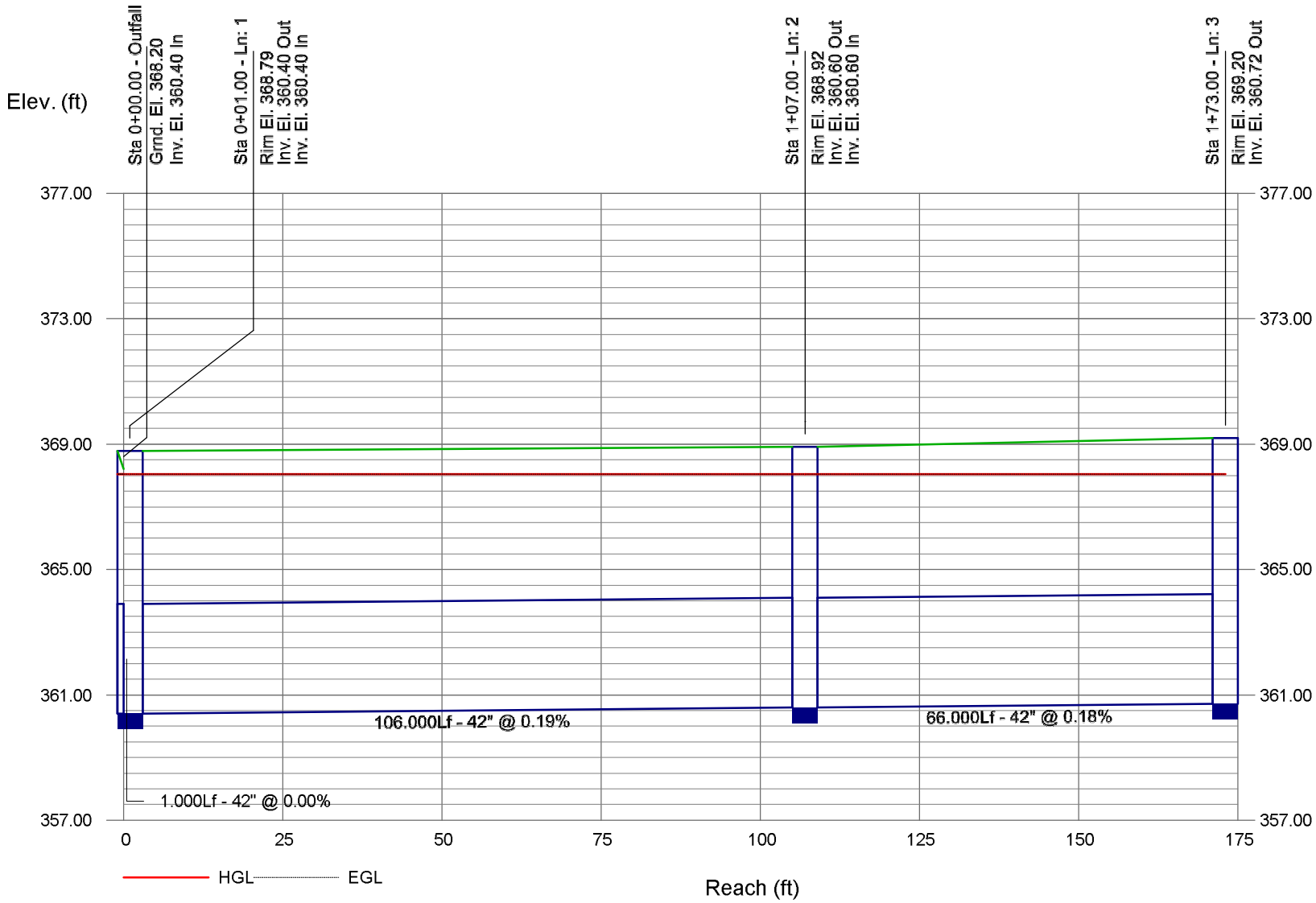
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	2757.8	0.0	0.02	0.00	0.00	42	0.00	360.40	360.40	368.04	368.04	368.20	368.79	Exist 42-in
2	1	106.000	0.00	0.00	0.00	0.00	0.00	0.0	1058.2	0.0	0.01	22.73	0.00	42	0.19	360.40	360.60	368.04	368.04	368.79	368.92	c
3	2	66.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	22.31	0.00	42	0.18	360.60	360.72	368.04	368.04	368.92	369.20	a

BAIFA 680 DS-2 (.75' below TG) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 2.stm



BAIFA 680 DS-4 (.75' below TG)

Project File: Drainage System 4.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	473.90	0.00	473.90	36	Cir	0.013	0.50	483.10	Exist 36-in
2	1	85.000	3.000	MH	0.00	0.00	0.00	0.0	473.90	0.24	474.10	30	Cir	0.025	0.15	483.31	d
3	2	87.000	-6.000	Grate	0.01	0.00	0.00	0.0	474.10	0.34	474.40	30	Cir	0.025	1.00	483.62	b

BAIFA 680 DS-4 (.75' below TG) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

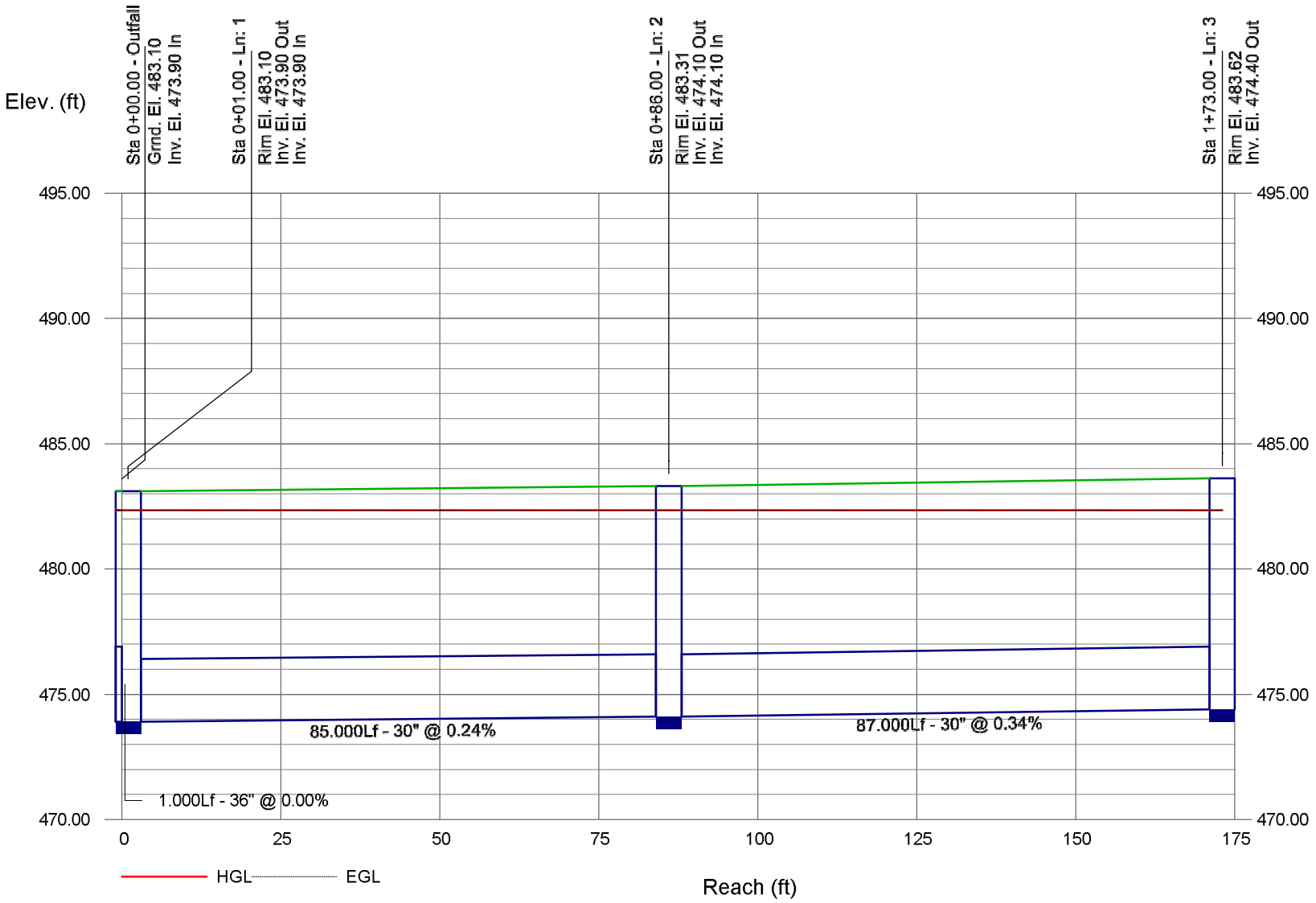
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	1407.0	0.0	0.02	0.00	0.00	36	0.00	473.90	473.90	482.35	482.35	483.10	483.10	Exist 36-in
2	1	85.000	0.00	0.00	0.00	0.00	0.00	0.0	711.7	0.0	0.01	10.35	0.00	30	0.24	473.90	474.10	482.35	482.35	483.10	483.31	d
3	2	87.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	12.52	0.00	30	0.34	474.10	474.40	482.35	482.35	483.31	483.62	b

BAIFA 680 DS-4 (.75' below TG) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 4.stm



BAIFA 680 DS-5 (.75' below TG)

Project File: Drainage System 5.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	471.30	0.00	471.30	42	Cir	0.013	0.50	481.43	Exist 42-in
2	1	93.000	3.000	MH	0.00	0.00	0.00	0.0	471.30	0.22	471.50	42	Cir	0.025	0.15	481.61	b
3	2	97.000	-6.000	Grate	0.01	0.00	0.00	0.0	471.50	0.10	471.60	42	Cir	0.025	1.00	481.90	d

BAIFA 680 DS-5 (.75' below TG) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

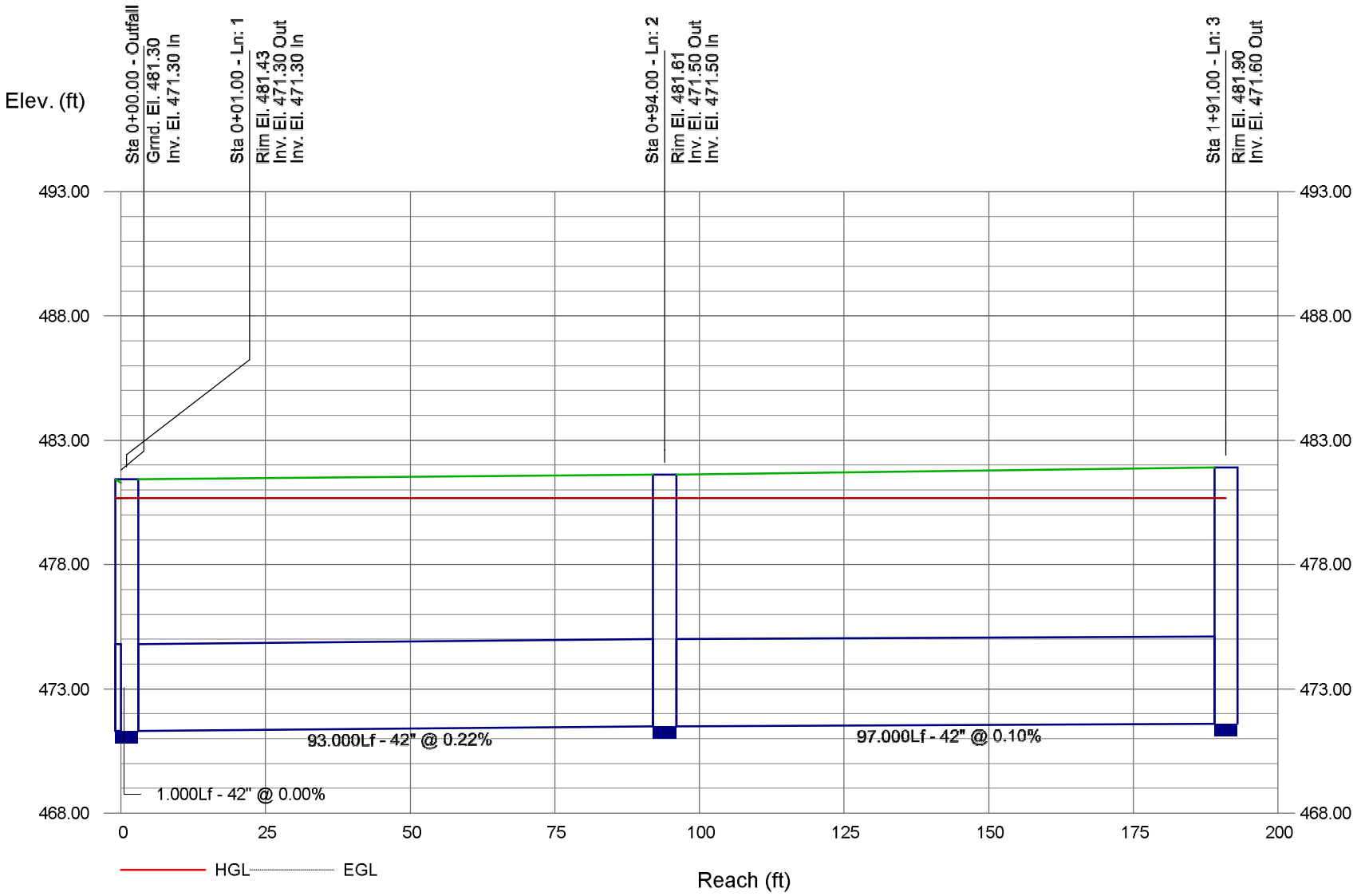
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	3046.4	0.0	0.02	0.00	0.00	42	0.00	471.30	471.30	480.68	480.68	481.30	481.43	Exist 42-in
2	1	93.000	0.00	0.00	0.00	0.00	0.00	0.0	1555.3	0.0	0.01	24.26	0.00	42	0.22	471.30	471.50	480.68	480.68	481.43	481.61	b
3	2	97.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	16.80	0.00	42	0.10	471.50	471.60	480.68	480.68	481.61	481.90	d

BAIFA 680 DS-5 (.75' below TG) | Number of lines: 3 | Run Date: 1/19/2015

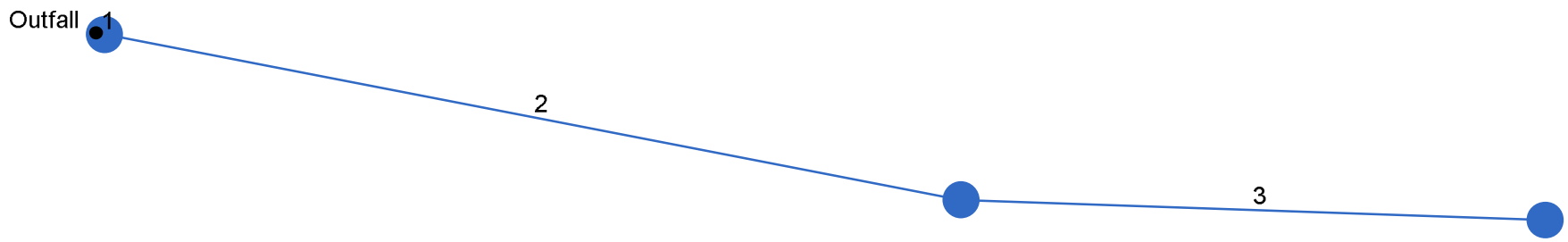
NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 5.stm



BAIFA 680 DS-6 (.75' below TG)



Project File: Drainage System 6.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	10.000	Grate	0.01	0.00	0.00	0.0	384.79	1.00	384.80	18	Cir	0.025	0.50	389.47	Exist 18-in
2	1	100.000	1.000	MH	0.00	0.00	0.00	0.0	384.80	1.10	385.90	18	Cir	0.025	0.19	389.94	b
3	2	67.000	-9.000	Grate	0.01	0.00	0.00	0.0	385.90	0.90	386.50	18	Cir	0.025	1.00	390.41	d

BAIFA 680 DS-6 (.75' below TG) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	491.8	0.0	0.02	5.45	0.01	18	1.00	384.79	384.80	388.72	388.72	389.69	389.47	Exist 18-in
2	1	100.000	0.00	0.00	0.00	0.00	0.00	0.0	197.3	0.0	0.01	5.73	0.01	18	1.10	384.80	385.90	388.72	388.72	389.47	389.94	b
3	2	67.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	5.17	0.01	18	0.90	385.90	386.50	388.72	388.72	389.94	390.41	d

BAIFA 680 DS-6 (.75' below TG)

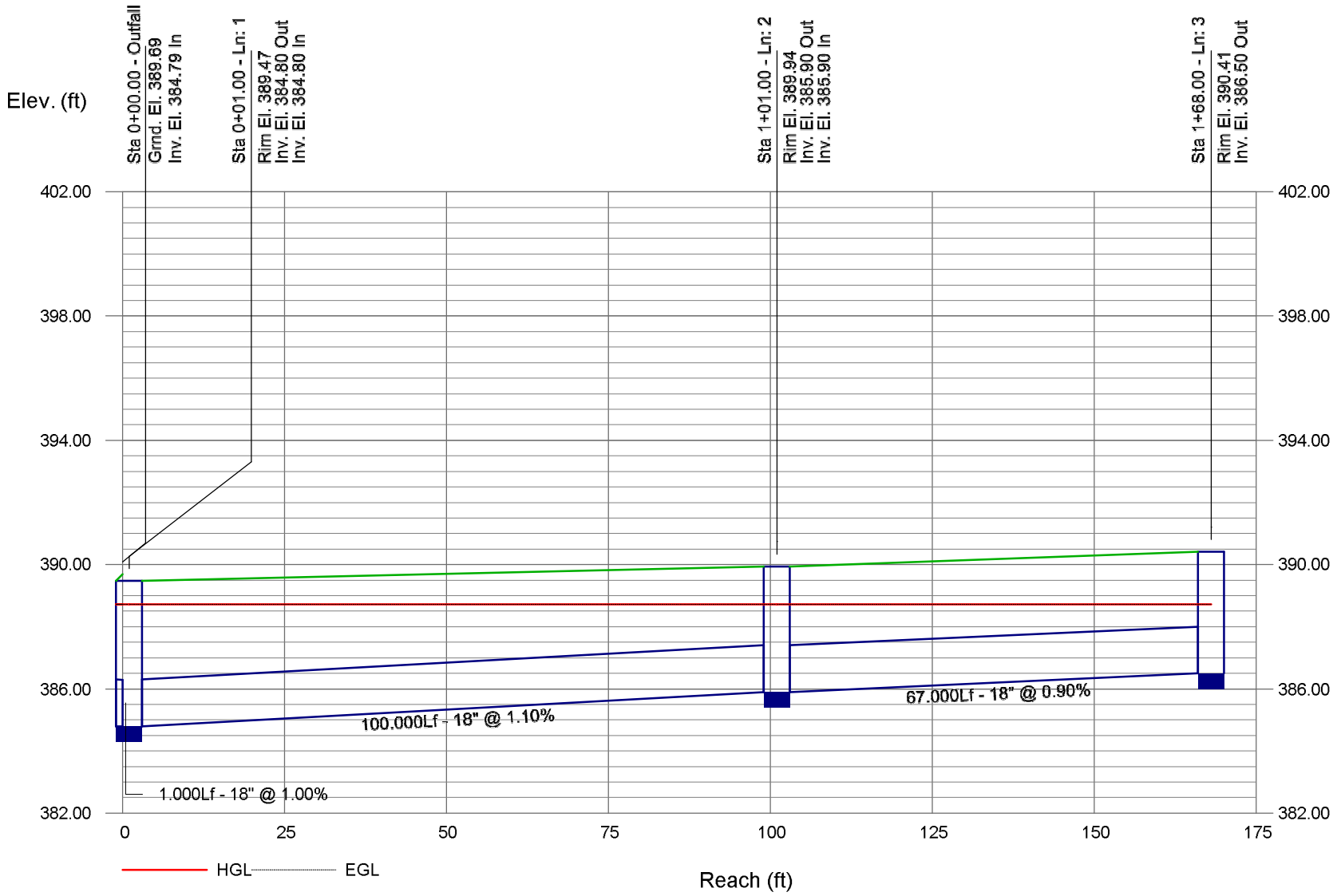
Number of lines: 3

Run Date: 1/19/2015

NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 6.stm



BAIFA 680 DS-8 (.75' below TG)

Project File: Drainage System 8.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	-180.000	Grate	0.01	0.00	0.00	0.0	293.59	1.00	293.60	18	Cir	0.013	0.50	301.50	Exist 18-in
2	1	124.000	3.000	MH	0.00	0.00	0.00	0.0	293.60	1.05	294.90	18	Cir	0.025	0.15	302.04	e
3	2	62.000	-6.000	Grate	0.01	0.00	0.00	0.0	294.90	0.81	295.40	18	Cir	0.025	1.00	302.28	c

BAIFA 680 DS-8 (.75' below TG) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

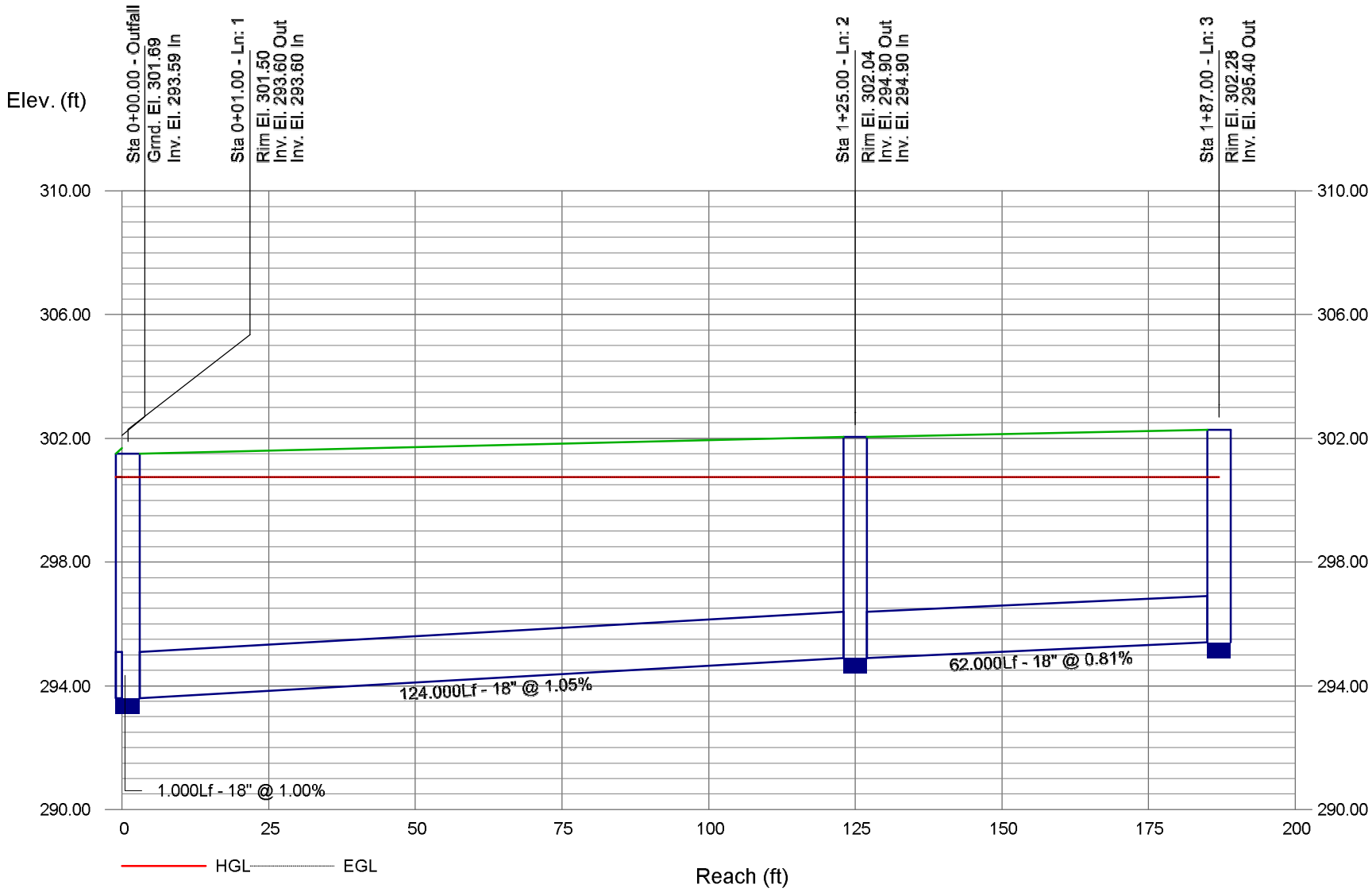
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	547.8	0.0	0.02	10.51	0.01	18	1.00	293.59	293.60	300.75	300.75	301.69	301.50	Exist 18-in
2	1	124.000	0.00	0.00	0.00	0.00	0.00	0.0	182.6	0.0	0.01	5.59	0.01	18	1.05	293.60	294.90	300.75	300.75	301.50	302.04	e
3	2	62.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	4.90	0.01	18	0.81	294.90	295.40	300.75	300.75	302.04	302.28	c

BAIFA 680 DS-8 (.75' below TG) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.92 / (Inlet time + 0.10) ^ 0.50 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 8.stm



BAIFA 680 DS-10 (.75' BLW TG)

Project File: Drainage System 10.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	267.29	1.00	267.30	18	Cir	0.013	0.50	276.30	Exist 18-in
2	1	198.000	-3.000	MH	0.00	0.00	0.00	0.0	267.30	0.56	268.40	18	Cir	0.025	0.15	277.29	d
3	2	176.000	6.000	Grate	0.01	0.00	0.00	0.0	268.40	0.68	269.60	18	Cir	0.025	1.00	277.80	a

BAIFA 680 DS-10 (.75' BLW TG) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

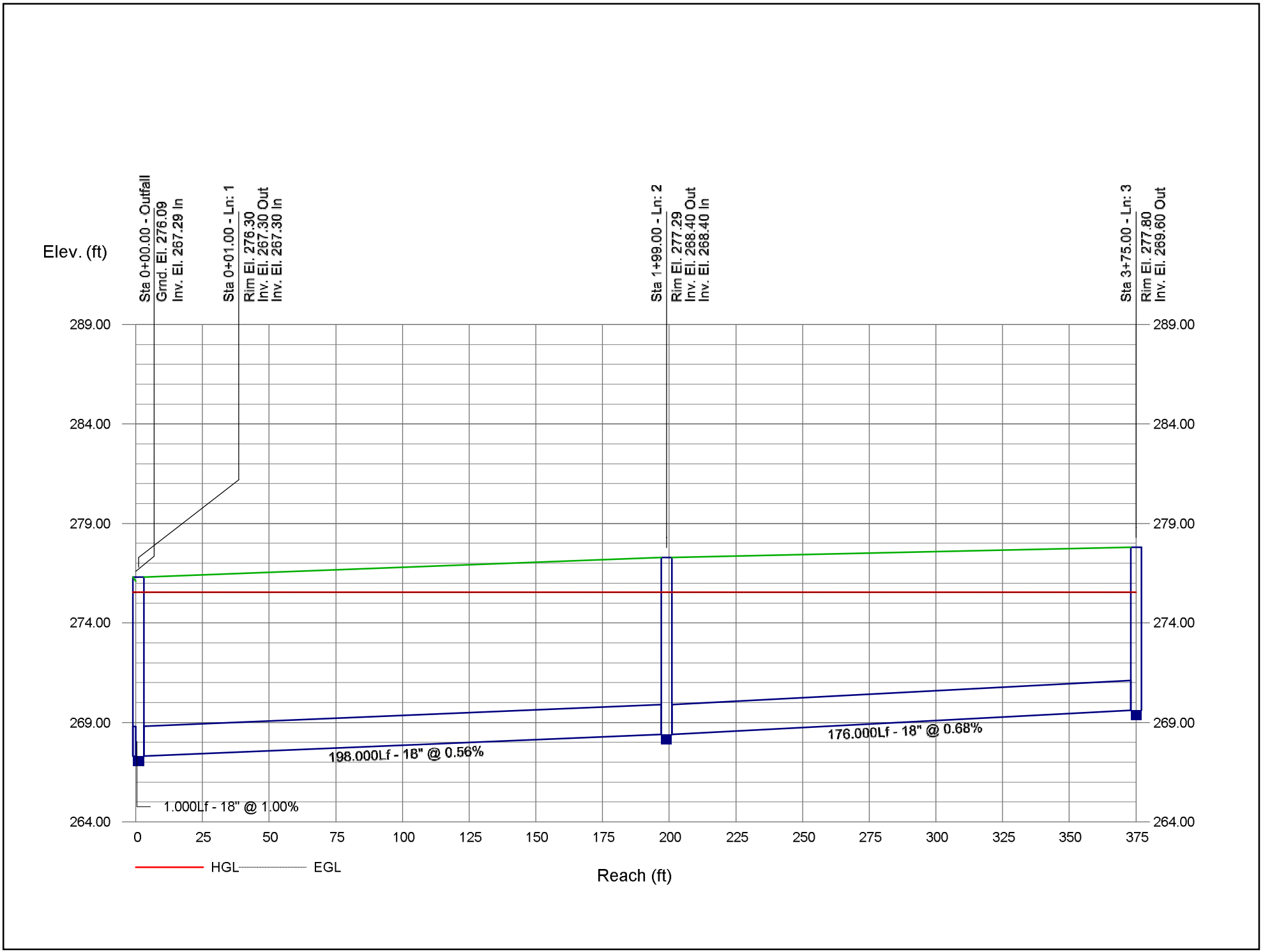
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	1101.4	0.0	0.02	10.49	0.01	18	1.00	267.29	267.30	275.55	275.55	276.09	276.30	Exist 18-in
2	1	198.000	0.00	0.00	0.00	0.00	0.00	0.0	518.3	0.0	0.01	4.07	0.01	18	0.56	267.30	268.40	275.55	275.55	276.30	277.29	d
3	2	176.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	4.51	0.01	18	0.68	268.40	269.60	275.55	275.55	277.29	277.80	a

BAIFA 680 DS-10 (.75' BLW TG) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.92 / (Inlet time + 0.10) ^ 0.50 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 10.stm



Appendix D.2 Assuming pipe crown for downstream control

BAIFA 680 DS-2 (crown)

Project File: Drainage System 2.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	360.40	0.00	360.40	42	Cir	0.013	0.50	368.79	Exist 42-in
2	1	106.000	-3.000	MH	0.00	0.00	0.00	0.0	360.40	0.19	360.60	42	Cir	0.025	0.21	368.92	c
3	2	66.000	10.000	Grate	0.01	0.00	0.00	0.0	360.60	0.18	360.72	42	Cir	0.025	1.00	369.20	a

BAIFA 680 DS-2 (crown) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

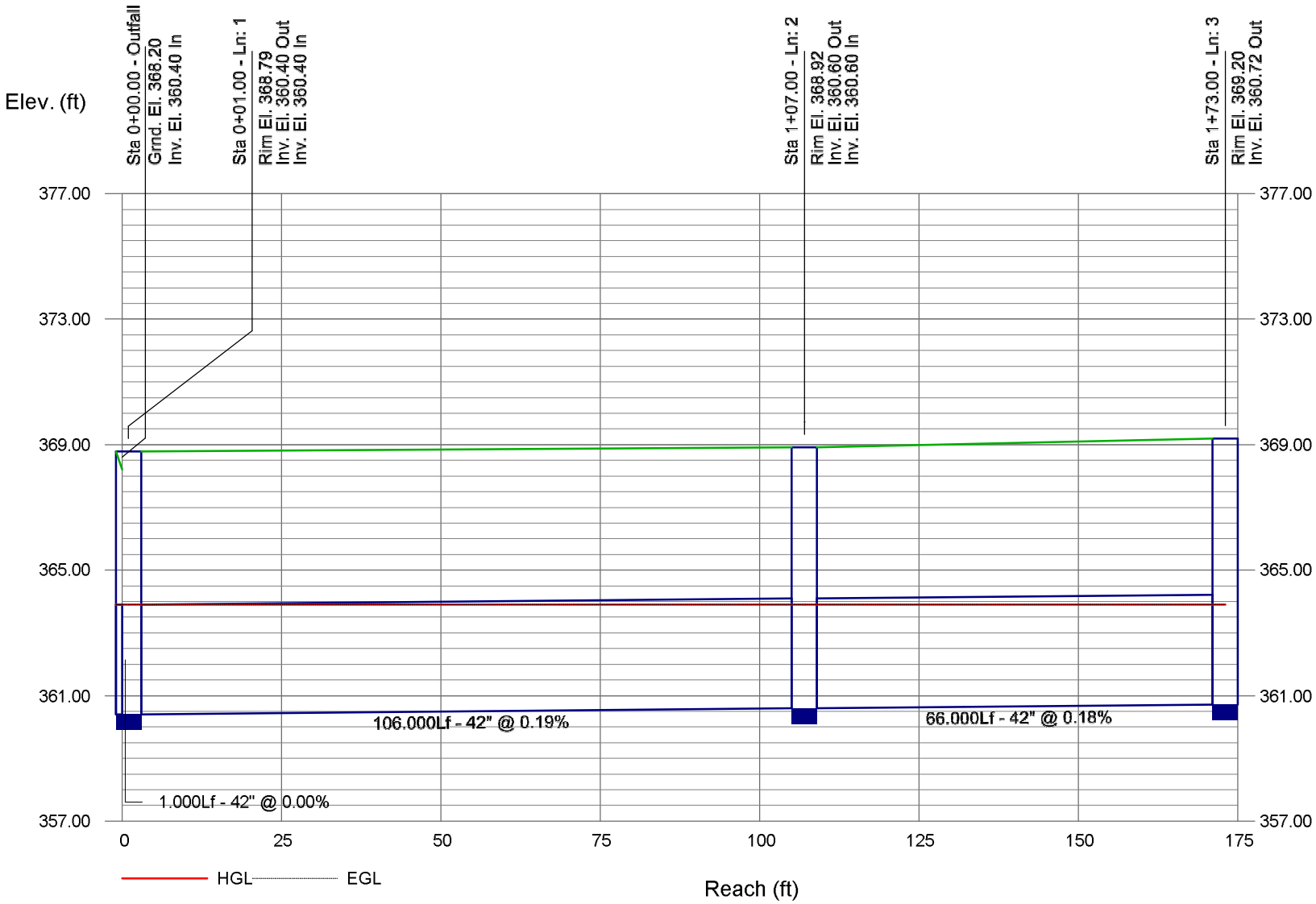
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	2701.7	0.0	0.02	0.00	0.00	42	0.00	360.40	360.40	363.90	363.90	368.20	368.79	Exist 42-in
2	1	106.000	0.00	0.00	0.00	0.00	0.00	0.0	1021.9	0.0	0.01	22.73	0.00	42	0.19	360.40	360.60	363.90	363.90	368.79	368.92	c
3	2	66.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	22.31	0.00	42	0.18	360.60	360.72	363.90	363.90	368.92	369.20	a

BAIFA 680 DS-2 (crown) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 2.stm



BAIFA 680 DS-4 (crown)

Project File: Drainage System 4.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	473.90	0.00	473.90	36	Cir	0.013	0.50	483.10	Exist 36-in
2	1	85.000	3.000	MH	0.00	0.00	0.00	0.0	473.90	0.24	474.10	30	Cir	0.025	0.15	483.31	d
3	2	87.000	-6.000	Grate	0.01	0.00	0.00	0.0	474.10	0.34	474.40	30	Cir	0.025	1.00	483.62	b

BAIFA 680 DS-4 (crown) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

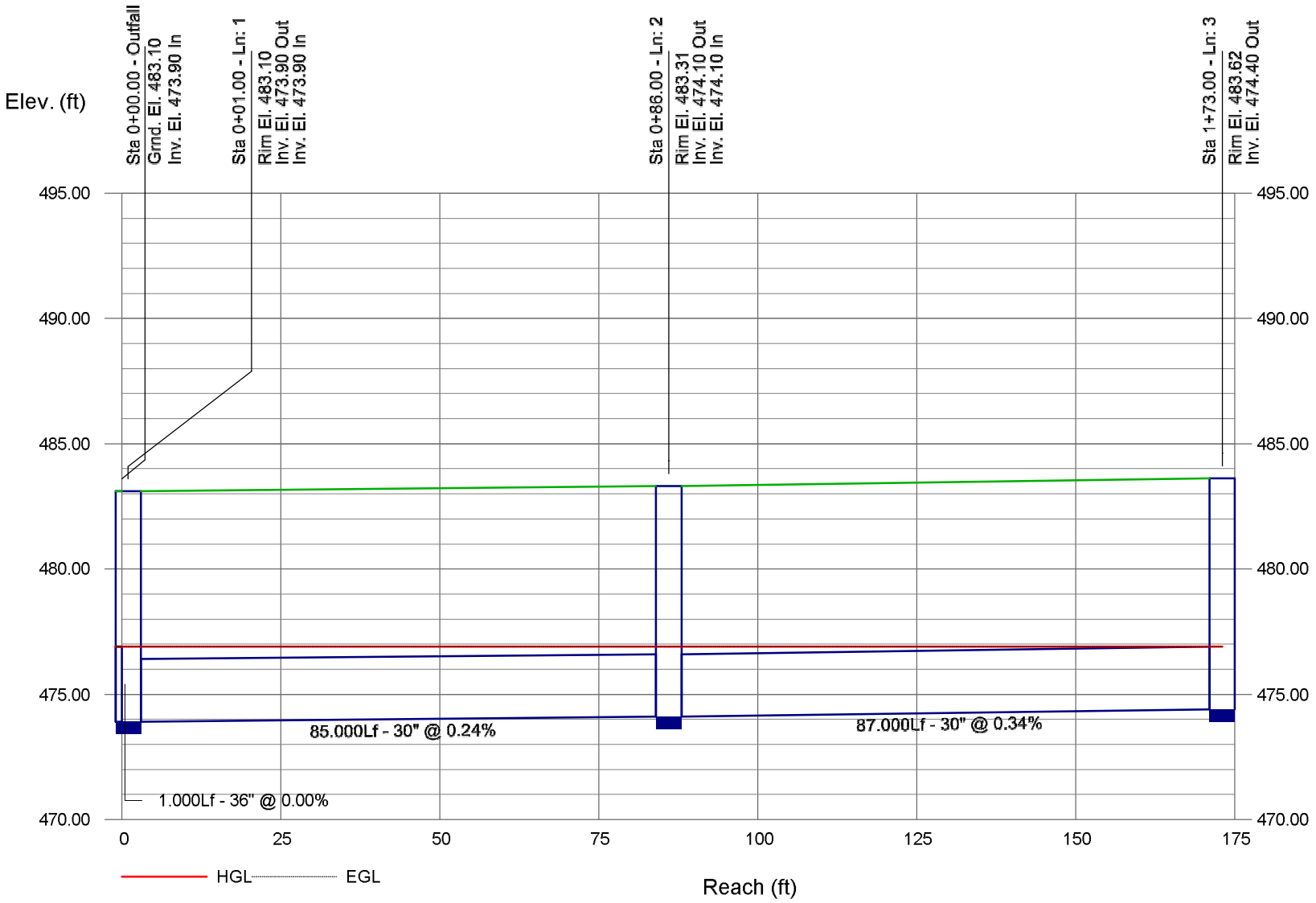
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	1407.0	0.0	0.02	0.00	0.00	36	0.00	473.90	473.90	476.90	476.90	483.10	483.10	Exist 36-in
2	1	85.000	0.00	0.00	0.00	0.00	0.00	0.0	711.7	0.0	0.01	10.35	0.00	30	0.24	473.90	474.10	476.90	476.90	483.10	483.31	d
3	2	87.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	12.52	0.00	30	0.34	474.10	474.40	476.90	476.90	483.31	483.62	b

BAIFA 680 DS-4 (crown) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 4.stm



BAIFA 680 DS-5 (crown)

Project File: Drainage System 5.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	471.30	0.00	471.30	42	Cir	0.013	0.50	481.43	Exist 42-in
2	1	93.000	3.000	MH	0.00	0.00	0.00	0.0	471.30	0.22	471.50	42	Cir	0.025	0.15	481.61	b
3	2	97.000	-6.000	Grate	0.01	0.00	0.00	0.0	471.50	0.10	471.60	42	Cir	0.025	1.00	481.90	d

BAIFA 680 DS-5 (crown) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

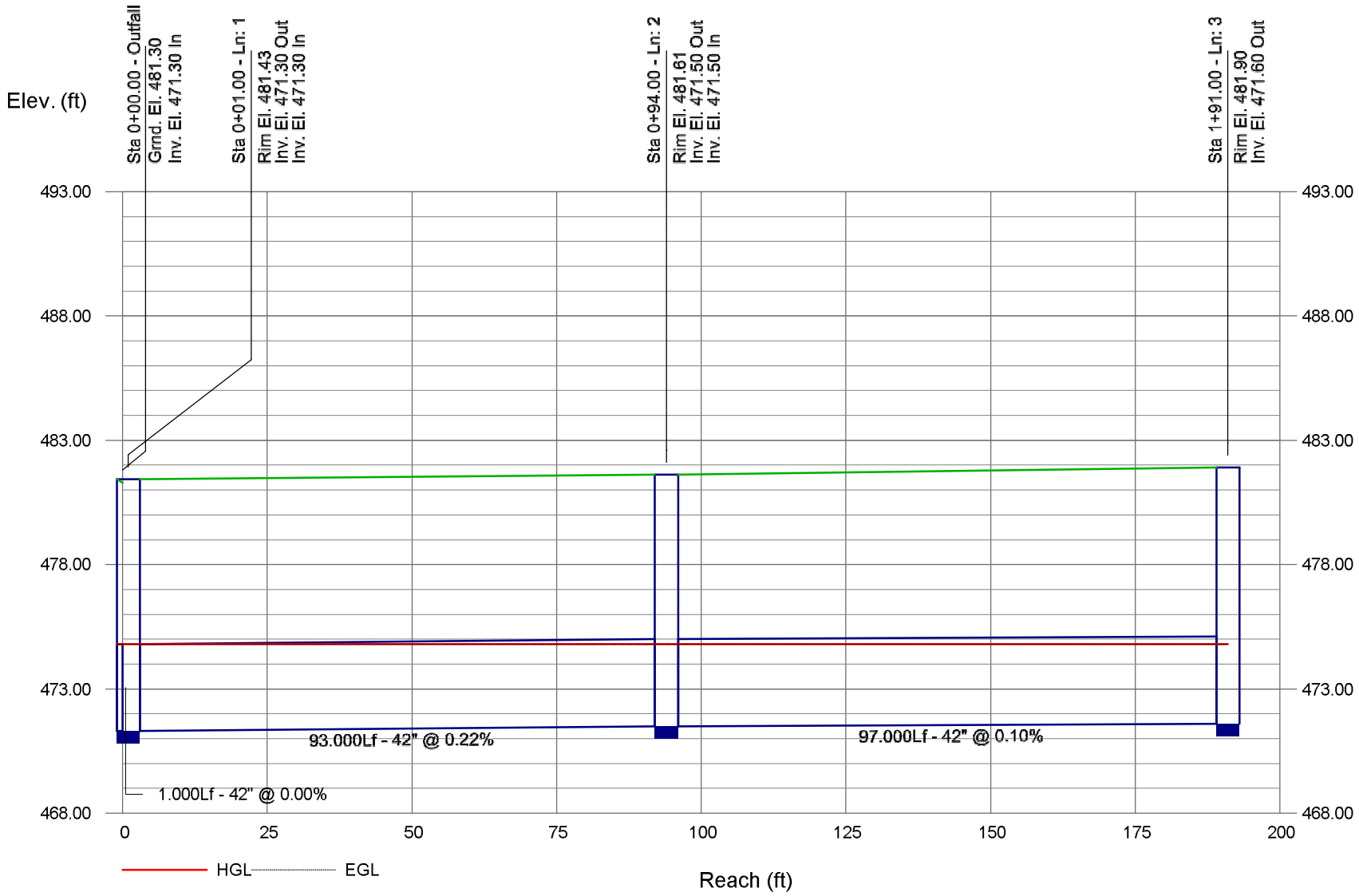
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	2978.9	0.0	0.02	0.00	0.00	42	0.00	471.30	471.30	474.80	474.80	481.30	481.43	Exist 42-in
2	1	93.000	0.00	0.00	0.00	0.00	0.00	0.0	1505.1	0.0	0.01	24.26	0.00	42	0.22	471.30	471.50	474.80	474.80	481.43	481.61	b
3	2	97.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	16.80	0.00	42	0.10	471.50	471.60	474.80	474.80	481.61	481.90	d

BAIFA 680 DS-5 (crown) | Number of lines: 3 | Run Date: 1/19/2015

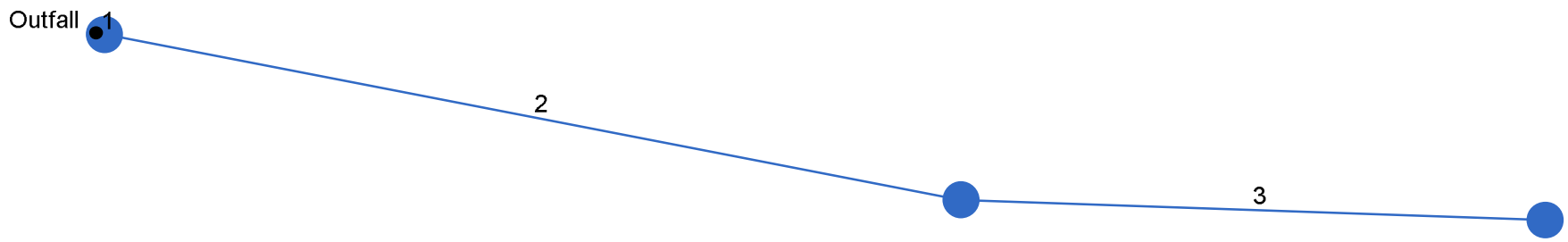
NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 5.stm



BAIFA 680 DS-6 (crown)



Project File: Drainage System 6.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	10.000	Grate	0.01	0.00	0.00	0.0	384.79	1.00	384.80	18	Cir	0.025	0.50	389.47	Exist 18-in
2	1	100.000	1.000	MH	0.00	0.00	0.00	0.0	384.80	1.10	385.90	18	Cir	0.025	0.19	389.94	b
3	2	67.000	-9.000	Grate	0.01	0.00	0.00	0.0	385.90	0.90	386.50	18	Cir	0.025	1.00	390.41	d

BAIFA 680 DS-6 (crown) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

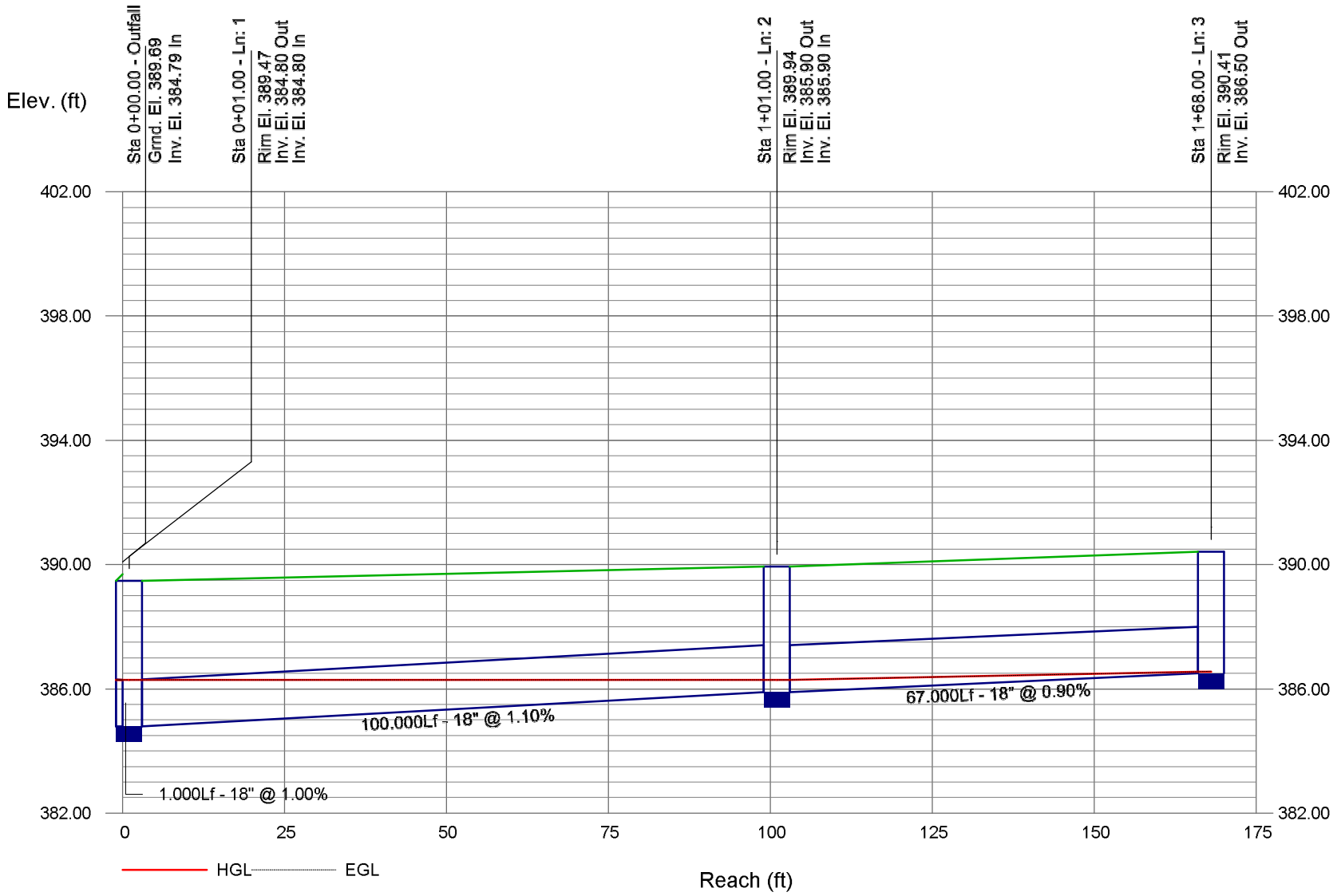
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	104.8	0.0	0.02	5.45	0.01	18	1.00	384.79	384.80	386.29	386.29	389.69	389.47	Exist 18-in
2	1	100.000	0.00	0.00	0.00	0.00	0.00	0.0	3.9	0.0	0.01	5.73	0.02	18	1.10	384.80	385.90	386.29	386.29	389.47	389.94	b
3	2	67.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	5.17	0.28	18	0.90	385.90	386.50	386.29	386.55	389.94	390.41	d

BAIFA 680 DS-6 (crown) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.15 / (Inlet time + 0.10) ^ 0.49 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 6.stm



BAIFA 680 DS-8 (crown)

Project File: Drainage System 8.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	-180.000	Grate	0.01	0.00	0.00	0.0	293.59	1.00	293.60	18	Cir	0.013	0.50	301.50	Exist 18-in
2	1	124.000	3.000	MH	0.00	0.00	0.00	0.0	293.60	1.05	294.90	18	Cir	0.025	0.15	302.04	e
3	2	62.000	-6.000	Grate	0.01	0.00	0.00	0.0	294.90	0.81	295.40	18	Cir	0.025	1.00	302.28	c

BAIFA 680 DS-8 (crown) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

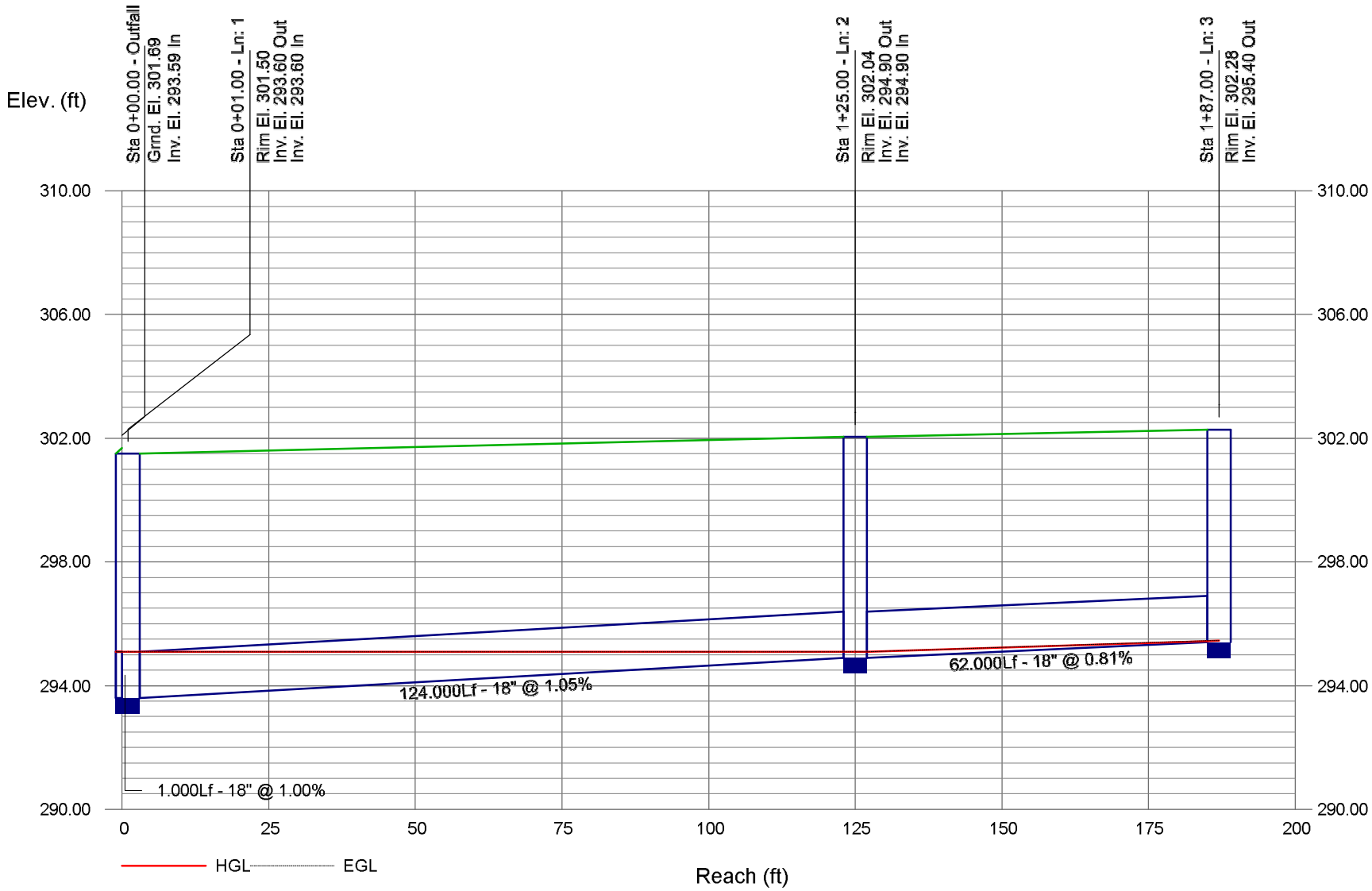
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	53.4	0.0	0.02	10.51	0.01	18	1.00	293.59	293.60	295.09	295.09	301.69	301.50	Exist 18-in
2	1	124.000	0.00	0.00	0.00	0.00	0.00	0.0	2.9	0.0	0.01	5.59	0.04	18	1.05	293.60	294.90	295.09	295.09	301.50	302.04	e
3	2	62.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	4.90	0.36	18	0.81	294.90	295.40	295.09	295.45	302.04	302.28	c

BAIFA 680 DS-8 (crown) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.92 / (Inlet time + 0.10) ^ 0.50 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 8.stm



BAIFA 680 DS-10 (crown)

Project File: Drainage System 10.stm	Number of lines: 3	Date: 1/19/2015

Storm Sewers v10.00

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	1.000	0.000	Grate	0.01	0.00	0.00	0.0	267.29	1.00	267.30	18	Cir	0.013	0.50	276.30	Exist 18-in
2	1	198.000	-3.000	MH	0.00	0.00	0.00	0.0	267.30	0.56	268.40	18	Cir	0.025	0.15	277.29	d
3	2	176.000	6.000	Grate	0.01	0.00	0.00	0.0	268.40	0.68	269.60	18	Cir	0.025	1.00	277.80	a

BAIFA 680 DS-10 (crown) | Number of lines: 3 | Date: 1/19/2015

Storm Sewer Tabulation

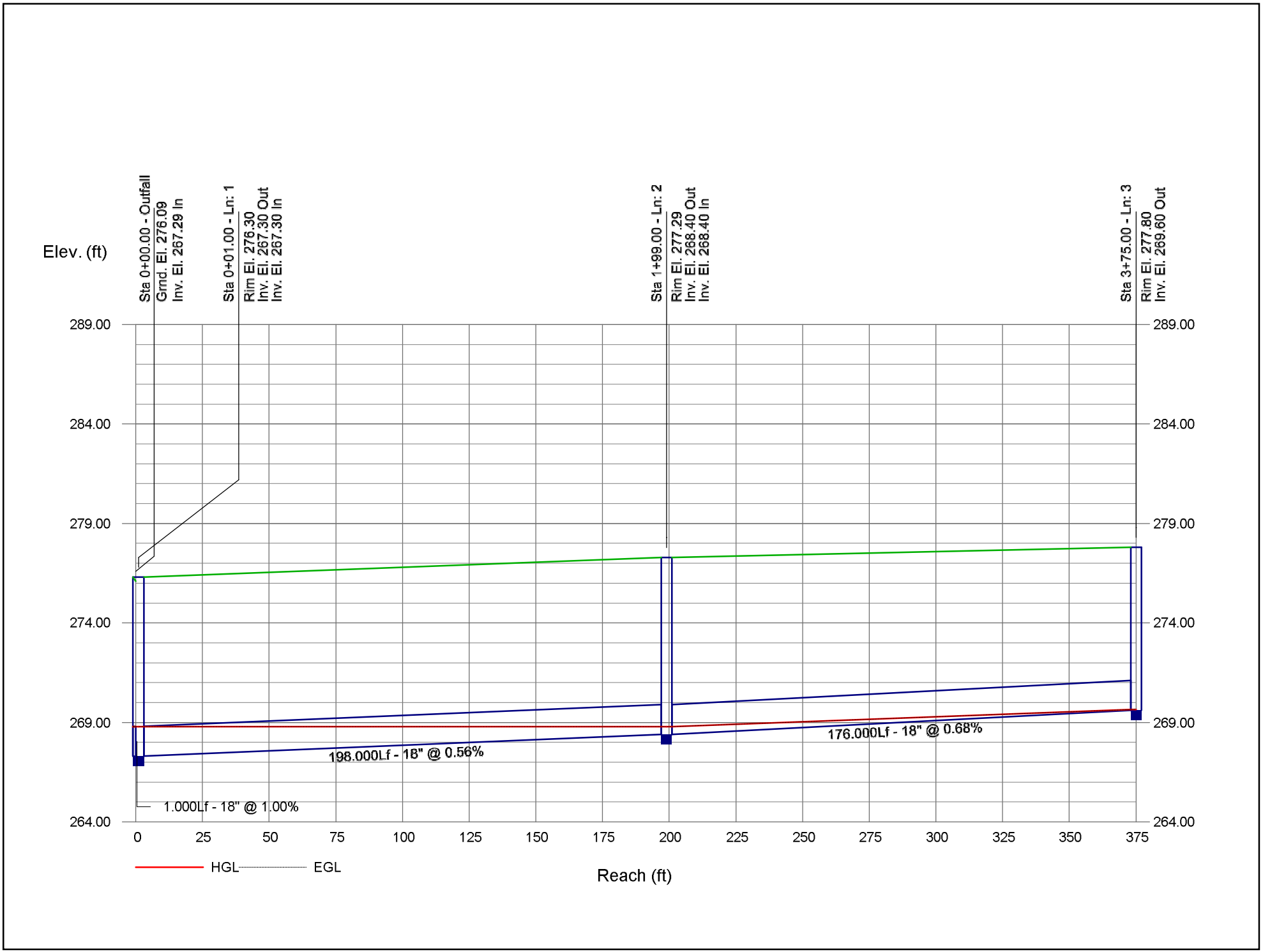
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	1.000	0.00	0.00	0.00	0.00	0.00	0.0	209.4	0.0	0.02	10.49	0.01	18	1.00	267.29	267.30	268.79	268.79	276.09	276.30	Exist 18-in
2	1	198.000	0.00	0.00	0.00	0.00	0.00	0.0	9.6	0.0	0.01	4.07	0.02	18	0.56	267.30	268.40	268.79	268.79	276.30	277.29	d
3	2	176.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	4.51	0.31	18	0.68	268.40	269.60	268.79	269.65	277.29	277.80	a

BAIFA 680 DS-10 (crown) | Number of lines: 3 | Run Date: 1/19/2015

NOTES:Intensity = 7.92 / (Inlet time + 0.10) ^ 0.50 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Drainage System 10.stm



Appendix E Inlet Capacity Calculations

BAIFA I-680 Express Lane

Caltrans Highway Drainage Inlet Calculations

Station: **"M" 480+00 to "M" 496+50 (Northbound 680)**

Designed by: HY ☑ **Date:** 1/19/2015
Checked by: JT ☑ **Date:** 1/19/2015

	Layout Line:		"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"
In#	**Inlet number:**		Exist	Exist	Exist	Exist	Exist	Exist	Exist	Exist	Exist
		(Input Data Required)									
	HYDROLOGY COMPUTATION:							Flip			
	Begin Station		480+00	484+50	487+00	489+30	489+60	490+10	492+50	494+00	494+50
	End Station		484+50	487+00	489+30	489+60	490+10	492+50	494+00	494+50	496+40
St	Structure location station:	>>	484+50	487+00	489+30	489+60	490+10	492+50	494+00	494+50	496+40
			Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt
N	Notes		->	->	->	->	->	->	->	->	->
	Off-site contributing watershed area (acres):	>>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	On-site contributing watershed area (acres):	>>	0.59	0.36	0.32	0.03	0.05	0.48	0.41	0.13	0.44
Ar	**Contributing watershed area (acres):**		**0.59**	**0.36**	**0.32**	**0.03**	**0.05**	**0.48**	**0.41**	**0.13**	**0.44**
C	Composite Runoff Coefficient "C":	>>	1	1	1	1	1	1	1	1	1
Ic	Precipitation intensity (in/hr):	>>	3.552	3.552	3.552	3.552	3.552	3.552	3.552	3.552	3.552
Qa	Subarea discharge Q (ft^3/s):		2.10	1.28	1.14	0.11	0.18	1.72	1.44	0.47	1.56
qq	Previous by-pass flow (ft^3/s):	>		0.31	0.05	0.01	0.00	0.00	0.08	0.06	0.00
Qadd	Discharge added by operator (ft^3/s):	>									
Qt	**Total discharge Q (ft^3/s):**		**2.10**	**1.59**	**1.19**	**0.12**	**0.18**	**1.72**	**1.53**	**0.53**	**1.57**
	SHOULDER AND GUTTER CONFIGURATION:										
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.006	0.010	0.012	0.005	0.019	0.002	0.002	0.002	0.002
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1	1	1	1	1	1	1
ID	Inlet description:	>	G2	G2	G2	G2	G2	G2	G2	G2	G2
	Grate Type:	>>	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2	2	2	2
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Gl	Grate length (in):	>	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
	3 or 4 sided weir?	>	3	3	3	3	3	3	3	3	3
Lco	Curb opening length provided (ft):	>									
Ls	Slotted drain length provided: (ft)	>									
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0122	0.0171	0.0097	0.0674	0.0093	0.0500	0.0500	0.0500	0.0500
W	Width of gutter from flowline (in):	>	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
a(t)	Gutter depression from horizontal (in):	>	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.054	0.059	0.051	0.109	0.051	0.092	0.092	0.092	0.092
	Available Flooded Width (ft)	>	15.00	12.60	11.50	11.35	11.42	10.00	10.00	10.00	10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**13.96**	**9.24**	**11.36**	**1.70**	**5.30**	**6.58**	**6.29**	**4.23**	**6.35**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**9.95**	**4.92**	**4.05**	**1.26**	**1.82**	**4.91**	**4.56**	**2.90**	**4.64**
Du/s	Depth at flowline before inlet (ft):		0.29	0.25	0.21	0.14	0.09	0.41	0.39	0.27	0.40
Au/s	Water cross-area before inlet (ft^2):		0.94	0.54	0.41	0.09	0.08	0.94	0.85	0.38	0.87
Vu/s	Velocity for total discharge before inlet (ft/s):		2.23	2.94	2.89	1.34	2.11	1.83	1.79	1.38	1.80
Eod	Ratio of gutter depression flow to total Q (Eod):		90%	100%	100%	100%	100%	99%	100%	100%	100%
Se	Equivalent cross-slope (ft/ft):		0.050	0.059	0.051	0.109	0.051	0.091	0.092	0.092	0.092
	GRATE INLETS ON-GRADE:										
Eog	Ratio of grate frontal flow to total flow:		78%	95%	99%	100%	100%	89%	91%	98%	90%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		1.63	1.52	1.18	0.12	0.18	1.52	1.39	0.52	1.42
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):		0.47	0.07	0.01	0.00	0.00	0.20	0.14	0.01	0.15
Gle	Effective grate length w/ 25% clogging (in):		27	27	27	27	27	27	27	27	27
Rs	Fraction of side flow interception (Rs):		33%	27%	25%	0%	0%	57%	58%	69%	58%
E	Grate Efficiency (E):		85%	97%	99%	100%	100%	95%	96%	100%	96%
Qi	**Total flow intercepted (ft^3/s):**		**1.78**	**1.54**	**1.18**	**0.12**	**0.18**	**1.63**	**1.47**	**0.53**	**1.50**
Qb	**Grate flow-by (ft^3/s):**		**0.31**	**0.05**	**0.01**	**0.00**	**0.00**	**0.08**	**0.06**	**0.00**	**0.06**
	SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)										
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----	-----	-----	-----
El	Efficiency for provided length L:		-----	-----	-----	-----	-----	-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**
	INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:										
	Grate Inlets										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
	Slotted drains										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
	Curb opening inlets										
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>									
g1	approach grade #1 (%):	>									
g2	approach grade #2 (%):	>									
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----

BAIFA I-680 Express Lane

Caltrans Highway Drainage Inlet Calculations

Station: **"M" 754+90 to "M" 762+00 (Southbound 680)**

Designed by: HY ☑ **Date:** 1/19/2015
Checked by: JT ☑ **Date:** 1/19/2015

	Layout Line:		"M"	"M"	"M"
In#	**Inlet number:**		Exist	Exist	Exist
		(Input Data Required)			
	HYDROLOGY COMPUTATION:				
	Begin Station		754+90	756+80	757+80
	End Station		756+80	757+80	762+00
St	Structure location station:	>>	754+90	756+80	757+80
			Lt	Lt	Lt
N	Notes		<-	<-	<-
	Off-site contributing watershed area (acres):	>>	0.00	0.00	0.00
	On-site contributing watershed area (acres):	>>	0.38	0.18	0.09
Ar	**Contributing watershed area (acres):**		**0.38**	**0.18**	**0.09**
C	Composite Runoff Coefficient "C":	>>	1	1	1
Ic	Precipitation intensity (in/hr):	>>	3.552	3.552	3.552
Qa	Subarea discharge Q (ft^3/s):		1.35	0.64	0.32
qq	Previous by-pass flow (ft^3/s):	>	0.01	0.00	
Qadd	Discharge added by operator (ft^3/s):	>			
Qt	**Total discharge Q (ft^3/s):**		**1.36**	**0.64**	**0.32**
	SHOULDER AND GUTTER CONFIGURATION:				
n	Manning's n:	>>	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.003	0.000	0.000
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1
ID	Inlet description:	>	G2	G2	G2
	Grate Type:	>>	24-12	24-12	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2
Gw	Grate width (in):	>	24.0	24.0	24.0
Gl	Grate length (in):	>	36.0	36.0	36.0
	3 or 4 sided weir?	>	3	3	3
Lco	Curb opening length provided (ft):	>			
Ls	Slotted drain length provided: (ft)	>			
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0477	0.0489	0.0196
W	Width of gutter from flowline (in):	>	48.0	48.0	48.0
a(t)	Gutter depression from horizontal (in):	>	2.00	2.00	2.00
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.089	0.091	0.061
	Available Flooded Width (ft)	>	11.00	11.00	11.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**5.74**	**9.22**	**10.24**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**3.88**	**7.97**	**6.99**
Du/s	Depth at flowline before inlet (ft):		0.35	0.56	0.30
Au/s	Water cross-area before inlet (ft^2):		0.67	1.89	0.81
Vu/s	Velocity for total discharge before inlet (ft/s):		2.02	0.34	0.39
Eod	Ratio of gutter depression flow to total Q (Eod):		100%	89%	96%
Se	Equivalent cross-slope (ft/ft):		0.089	0.086	0.060
	GRATE INLETS ON-GRADE:				
Eog	Ratio of grate frontal flow to total flow:		95%	68%	85%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		1.29	0.44	0.27
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		6.88	6.88	6.88
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):		0.07	0.20	0.05
Gle	Effective grate length w/ 25% clogging (in):		27	27	27
Rs	Fraction of side flow interception (Rs):		52%	96%	93%
E	Grate Efficiency (E):		98%	99%	99%
Qi	**Total flow intercepted (ft^3/s):**		**1.32**	**0.64**	**0.32**
Qb	**Grate flow-by (ft^3/s):**		**0.03**	**0.01**	**0.00**
	SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)				
Lt	Length required for total interception (ft):		-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----
El	Efficiency for providged length L:		-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**
	INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:				
	Grate Inlets				
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----
	Slotted drains				
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----
	Curb opening inlets				
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----
Lc	Length of the vertical curve (ft):	>			
g1	approach grade #1 (%):	>			
g2	approach grade #2 (%):	>			
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----
Df	Flanking inlets distance (ft):		-----	-----	-----

BAIFA I-680 Express Lane

Caltrans Highway Drainage Inlet Calculations

Station: **"M" 957+20 to "M" 977+70 (Northbound 680)**

Designed by: HY ☑ **Date:** 1/19/2015
Checked by: JT ☑ **Date:** 1/19/2015

	Layout Line:		"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"
In#	**Inlet number:**		Exist	Exist	Exist	Exist	6a	6f	Exist	Exist	Exist
	(Input Data Required)										
	HYDROLOGY COMPUTATION:										
	Begin Station		957+20	959+00	960+00	962+50	964+00	965+67	968+70	971+10	973+70
	End Station		959+00	960+00	962+50	964+00	965+67	968+70	971+10	973+70	977+70
St	Structure location station:	>>	957+20	959+00	960+00	962+50	964+00	965+67	968+70	971+10	973+70
			Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt
N	Notes		<-	<-	<-	<-	<-	<-	<-	<-	<-
	Off-site contributing watershed area (acres):	>>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	On-site contributing watershed area (acres):	>>	0.28	0.15	0.41	0.25	0.27	0.47	0.48	0.48	0.61
Ar	**Contributing watershed area (acres):**		**0.28**	**0.15**	**0.41**	**0.25**	**0.27**	**0.47**	**0.48**	**0.48**	**0.61**
C	Composite Runoff Coefficient "C":	>>	1	1	1	1	1	1	1	1	1
Ic	Precipitation intensity (in/hr):	>>	3.552	3.552	3.552	3.552	3.552	3.552	3.612	3.612	3.612
Qa	Subarea discharge Q (ft^3/s):		0.99	0.53	1.44	0.88	0.96	1.67	1.72	1.73	2.19
qq	Previous by-pass flow (ft^3/s):	>	0.00	0.03	0.02	0.10	0.24	0.03	0.14	0.29	
Qadd	Discharge added by operator (ft^3/s):	>									
Qt	**Total discharge Q (ft^3/s):**		**0.99**	**0.56**	**1.46**	**0.98**	**1.20**	**1.70**	**1.86**	**2.02**	**2.19**
	SHOULDER AND GUTTER CONFIGURATION:										
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.000	0.009	0.008	0.003	0.003	0.002	0.023	0.003	0.007
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	2	1	1	1	1	1	1	1	1
ID	Inlet description:	>	G2	G2	G2	G2	G2	G2	G2	G2	G2
	Grate Type:	>>	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2	2	2	2
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Gl	Grate length (in):	>	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
	3 or 4 sided weir?	>	3	3	3	3	3	3	3	3	3
Lco	Curb opening length provided (ft):	>									
Ls	Slotted drain length provided: (ft)	>									
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0070	0.0147	0.0302	0.0215	0.0119	0.0132	0.0340	0.0417	0.0141
W	Width of gutter from flowline (in):	>	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
a(t)	Gutter depression from horizontal (in):	>	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.049	0.056	0.072	0.063	0.054	0.055	0.076	0.083	0.056
	Available Flooded Width (ft)	>	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**-----**	**6.95**	**6.56**	**8.29**	**13.21**	**14.45**	**5.46**	**7.36**	**12.51**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**-----**	**3.00**	**3.81**	**4.66**	**8.76**	**10.99**	**3.31**	**5.52**	**8.67**
Du/s	Depth at flowline before inlet (ft):		-----	0.17	0.27	0.27	0.27	0.31	0.25	0.40	0.29
Au/s	Water cross-area before inlet (ft^2):		-----	0.25	0.52	0.57	0.79	1.13	0.41	0.97	0.86
Vu/s	Velocity for total discharge before inlet (ft/s):		-----	2.22	2.81	1.73	1.51	1.51	4.50	2.08	2.55
Eod	Ratio of gutter depression flow to total Q (Eod):		-----	100%	100%	100%	93%	86%	100%	99%	93%
Se	Equivalent cross-slope (ft/ft):		-----	0.056	0.072	0.063	0.051	0.049	0.076	0.083	0.053
	GRATE INLETS ON-GRADE:										
Eog	Ratio of grate frontal flow to total flow:		-----	99%	97%	95%	83%	72%	98%	86%	81%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		-----	0.56	1.42	0.93	1.00	1.22	1.82	1.74	1.78
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		-----	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88
Rf	Fraction of frontal flow intercepted (Rf):		-----	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):		-----	0.00	0.05	0.05	0.20	0.48	0.04	0.28	0.41
Gle	Effective grate length w/ 25% clogging (in):		-----	27	27	27	27	27	27	27	27
Rs	Fraction of side flow interception (Rs):		-----	37%	33%	50%	51%	50%	18%	49%	30%
E	Grate Efficiency (E):		-----	100%	98%	98%	92%	86%	98%	93%	87%
Qi	**Total flow intercepted (ft^3/s):**		**-----**	**0.56**	**1.43**	**0.96**	**1.10**	**1.46**	**1.83**	**1.87**	**1.90**
Qb	**Grate flow-by (ft^3/s):**		**-----**	**0.00**	**0.03**	**0.02**	**0.10**	**0.24**	**0.03**	**0.14**	**0.29**
	SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)										
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----	-----	-----	-----
El	Efficiency for provided length L:		-----	-----	-----	-----	-----	-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**
	INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:										
	Grate Inlets										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		0.17	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		0.21	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		4.55	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		9.80	-----	-----	-----	-----	-----	-----	-----	-----
	Slotted drains										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
	Curb opening inlets										
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>									
g1	approach grade #1 (%):	>									
g2	approach grade #2 (%):	>									
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----

BAIFA I-680 Express Lane

Caltrans Highway Drainage Inlet Calculations

Station: **"M" 1099+90 to "M" 1115+30 (Southbound 680)**

Designed by: HY ☑ **Date:** 1/19/2015
Checked by: JT ☑ **Date:** 1/19/2015

	Layout Line:		"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"
In#	**Inlet number:**		Exist	Exist	Exist	Exist	Exist	Exist	8a	8d	Exist
	(Input Data Required)										
	HYDROLOGY COMPUTATION:										
	Begin Station		1094+60	1100+10	1101+60	1103+50	1105+70	1108+70	1111+70	1113+58	1114+20
	End Station		1100+10	1101+60	1103+50	1105+70	1108+70	1111+70	1113+58	1114+20	1115+44
St	Structure location station:	>>	1100+10	1101+60	1103+50	1105+70	1108+70	1111+70	1113+58	1114+20	1115+44
			Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt	Lt
N	Notes		->	->	->	->	->	->	->	->	->
	Off-site contributing watershed area (acres):	>>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	On-site contributing watershed area (acres):	>>	0.79	0.29	0.38	0.52	0.57	0.49	0.33	0.10	0.13
Ar	**Contributing watershed area (acres):**		**0.79**	**0.29**	**0.38**	**0.52**	**0.57**	**0.49**	**0.33**	**0.10**	**0.13**
C	Composite Runoff Coefficient "C":	>>	1	1	1	1	1	1	1	1	1
Ic	Precipitation intensity (in/hr):	>>	3.612	3.612	3.612	3.612	3.612	3.612	3.612	3.612	3.612
Qa	Subarea discharge Q (ft^3/s):		2.84	1.06	1.39	1.88	2.05	1.78	1.20	0.35	0.45
qq	Previous by-pass flow (ft^3/s):	>		0.11	0.01	0.05	0.08	0.08	0.03	0.03	0.00
Qadd	Discharge added by operator (ft^3/s):	>									
Qt	**Total discharge Q (ft^3/s):**		**2.84**	**1.18**	**1.40**	**1.93**	**2.13**	**1.86**	**1.23**	**0.37**	**0.45**
	SHOULDER AND GUTTER CONFIGURATION:										
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.009	0.012	0.007	0.015	0.001	0.014	0.004	0.008	0.011
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1	1	1	1	1	1	1
ID	Inlet description:	>	G2	G2	G2	G2	G2	G2	G2	G2	G2
	Grate Type:	>>	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2	2	2	2
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Gl	Grate length (in):	>	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
	3 or 4 sided weir?	>	3	3	3	3	3	3	3	3	3
Lco	Curb opening length provided (ft):	>									
Ls	Slotted drain length provided: (ft)	>									
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0646	0.0377	0.0172	0.0151	0.0922	0.0589	0.0381	0.0082	0.0085
W	Width of gutter from flowline (in):	>	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
a(t)	Gutter depression from horizontal (in):	>	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.106	0.079	0.059	0.057	0.134	0.101	0.080	0.050	0.050
	Available Flooded Width (ft)	>	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**5.06**	**4.88**	**9.41**	**9.92**	**5.53**	**4.24**	**6.11**	**8.85**	**8.72**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**3.71**	**3.06**	**5.22**	**5.25**	**4.56**	**3.04**	**3.85**	**2.86**	**2.87**
Du/s	Depth at flowline before inlet (ft):		0.39	0.24	0.26	0.25	0.59	0.31	0.31	0.14	0.14
Au/s	Water cross-area before inlet (ft^2):		0.73	0.37	0.57	0.54	1.29	0.46	0.59	0.20	0.21
Vu/s	Velocity for total discharge before inlet (ft/s):		3.89	3.17	2.47	3.56	1.65	4.01	2.09	1.82	2.19
Eod	Ratio of gutter depression flow to total Q (Eod):		100%	100%	100%	100%	100%	100%	100%	100%	100%
Se	Equivalent cross-slope (ft/ft):		0.106	0.079	0.059	0.057	0.134	0.101	0.080	0.050	0.050
	GRATE INLETS ON-GRADE:										
Eog	Ratio of grate frontal flow to total flow:		94%	98%	94%	95%	87%	98%	96%	100%	100%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		2.69	1.16	1.32	1.83	1.86	1.82	1.18	0.37	0.45
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):		0.16	0.02	0.08	0.10	0.27	0.04	0.05	0.00	0.00
Gle	Effective grate length w/ 25% clogging (in):		27	27	27	27	27	27	27	27	27
Rs	Fraction of side flow interception (Rs):		28%	30%	33%	20%	70%	26%	48%	42%	34%
E	Grate Efficiency (E):		96%	99%	96%	96%	96%	98%	98%	100%	100%
Qi	**Total flow intercepted (ft^3/s):**		**2.73**	**1.16**	**1.35**	**1.85**	**2.05**	**1.83**	**1.21**	**0.37**	**0.45**
Qb	**Grate flow-by (ft^3/s):**		**0.11**	**0.01**	**0.05**	**0.08**	**0.08**	**0.03**	**0.03**	**0.00**	**0.00**
	SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)										
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----	-----	-----	-----
El	Efficiency for provided length L:		-----	-----	-----	-----	-----	-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**	**-----**
	INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:										
	Grate Inlets										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
	Slotted drains										
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
	Curb opening inlets										
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>									
g1	approach grade #1 (%):	>									
g2	approach grade #2 (%):	>									
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	-----	-----	-----
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----

BAIFA I-680 Express Lane

Caltrans Highway Drainage Inlet Calculations

Station: **"M" 1099+90 to "M" 1103+70 (Northbound 680)**

Designed by: HY ☑ **Date:** 1/19/2015
Checked by: JT ☑ **Date:** 1/19/2015

	Layout Line:		"M"
In#	**Inlet number:**		Exist
		(Input Data Required)	

HYDROLOGY COMPUTATION:

	Begin Station		1100+00
	End Station		1103+70
St	Structure location station:	>>	1103+70
			Rt
N	Notes		->
	Off-site contributing watershed area (acres):	>>	0.00
	On-site contributing watershed area (acres):	>>	0.60
Ar	**Contributing watershed area (acres):**		**0.60**
C	Composite Runoff Coefficient "C":	>>	1
Ic	Precipitation intensity (in/hr):	>>	3.612
Qa	Subarea discharge Q (ft^3/s):		2.16
qq	Previous by-pass flow (ft^3/s):	>	0.00
Qadd	Discharge added by operator (ft^3/s):	>	
Qt	**Total discharge Q (ft^3/s):**		**2.16**

SHOULDER AND GUTTER CONFIGURATION:

n	Manning's n:	>>	0.015
S	Longitudinal slope S (ft/ft):	>>	0.005
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1
ID	Inlet description:	>	G2
	Grate Type:	>>	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2
Gw	Grate width (in):	>	24.0
Gl	Grate length (in):	>	36.0
	3 or 4 sided weir?	>	3
Lco	Curb opening length provided (ft):	>	
Ls	Slotted drain length provided: (ft)	>	
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0330
W	Width of gutter from flowline (in):	>	48.0
a(t)	Gutter depression from horizontal (in):	>	2.00
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.075
	Available Flooded Width (ft)	>	10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**7.82**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**5.54**
Du/s	Depth at flowline before inlet (ft):		0.35
Au/s	Water cross-area before inlet (ft^2):		0.84
Vu/s	Velocity for total discharge before inlet (ft/s):		2.57
Eod	Ratio of gutter depression flow to total Q (Eod):		99%
Se	Equivalent cross-slope (ft/ft):		0.074

GRATE INLETS ON-GRADE:

Eog	Ratio of grate frontal flow to total flow:	88%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression	1.90
Vo	Vo for effective length (P-50, Chart 5) (ft/s):	6.88
Rf	Fraction of frontal flow intercepted (Rf):	1.00
Qs	Side flow in ft^3/s (Qs):	0.26
Gle	Effective grate length w/ 25% clogging (in):	27
Rs	Fraction of side flow interception (Rs):	37%
E	Grate Efficiency (E):	92%
Qi	**Total flow intercepted (ft^3/s):**	**1.99**
Qb	**Grate flow-by (ft^3/s):**	**0.16**

SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)

Lt	Length required for total interception (ft):	-----
Ci	Interception for provided length L (ft^3/s):	-----
El	Efficiency for providded length L:	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**	**-----**

INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:

	Grate Inlets		
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----
	Slotted drains		
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----
	Curb opening inlets		
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----
Lc	Length of the vertical curve (ft):	>	
g1	approach grade #1 (%):	>	
g2	approach grade #2 (%):	>	
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----
Df	Flanking inlets distance (ft):		-----

BAIFA I-680 Express Lane

Caltrans Highway Drainage Inlet Calculations

Station: **"M" 1152+70 to "M" 1167+90 (Northbound 680)**

Designed by: JT ☑ **Date:** 3/26/2015
Checked by: CS ☑ **Date:** 3/26/2015

	Layout Line:		"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"	"M"
In#	**Inlet number:**		Exist	Exist		PB Beg Barrier	Beg Ctr Bar	End Ctr Bar	End Barrier	Exist	Exist	Exist	Exist
		(Input Data Required)											
HYDROLOGY COMPUTATION:												Flip	
	Begin Station		1152+70	1155+90	1158+00	1160+00	1160+69	1161+42	1161+52	1162+16	1162+28	1162+80	1163+20
	End Station		1155+90	1158+00	1160+00	1160+69	1161+42	1161+52	1162+16	1162+28	1162+80	1163+20	1167+90
St	Structure location station:	>>	1155+90	1158+00	1160+00	1160+69	1161+42	1161+52	1162+16	1162+28	1162+80	1163+20	1167+90
			Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt
N	Notes		->	->	->	->	Slotted Drain->	Slotted Drain->	Slotted Drain->	->	->	->	->
	Off-site contributing watershed area (acres):	>>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	On-site contributing watershed area (acres):	>>	0.53	0.36	0.31	0.43	0.10	0.02	0.11	0.13	0.08	0.09	0.70
Ar	**Contributing watershed area (acres):**		**0.53**	**0.36**	**0.31**	**0.43**	**0.10**	**0.02**	**0.11**	**0.13**	**0.08**	**0.09**	**0.70**
C	Composite Runoff Coefficient "C":	>>	1	1	1	1	1	1	1	1	1	1	1
Ic	Precipitation intensity (in/hr):	>>	3.612	3.612	3.612	3.612	3.612	3.612	3.612	3.612	3.612	3.612	3.612
Qa	Subarea discharge Q (ft^3/s):		1.91	1.30	1.13	1.55	0.36	0.07	0.38	0.47	0.29	0.33	2.53
qq	Previous by-pass flow (ft^3/s):	>		0.03	0.05	0.05	0.11				0.00	0.00	0.00
Qadd	Discharge added by operator (ft^3/s):	>											
Qt	**Total discharge Q (ft^3/s):**		**1.91**	**1.33**	**1.18**	**1.60**	**0.47**	**0.07**	**0.38**	**0.47**	**0.29**	**0.33**	**2.53**
SHOULDER AND GUTTER CONFIGURATION:													
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.037	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.014
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	3	3	3	1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1	1	1	1	1	1	1	1	1
ID	Inlet description:	>	G2	G2	None	G2	None	None	None	G2	G2	G2	G2
	Grate Type:	>>	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2	2	2	2	2	2
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Gl	Grate length (in):	>	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
	3 or 4 sided weir?	>	3	3	3	3	3	3	3	3	3	3	3
Lco	Curb opening length provided (ft):	>											
Ls	Slotted drain length provided: (ft)	>					76.00	11.00	72.00				
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0195	0.0180	0.0200	0.0200	0.0158	0.0148	0.0084	0.0072	0.0020	0.0080	0.0233
W	Width of gutter from flowline (in):	>	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
a(t)	Gutter depression from horizontal (in):	>	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.061	0.060	0.062	0.062	0.057	0.056	0.050	0.049	0.044	0.050	0.065
	Available Flooded Width (ft)	>	11.00	11.00	11.00	9.60	6.16	6.15	9.53	11.00	11.00	10.00	10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**7.16**	**9.19**	**8.50**	**9.53**	**-----**	**-----**	**-----**	**11.39**	**21.19**	**9.30**	**8.52**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**3.50**	**5.11**	**4.63**	**6.12**	**-----**	**-----**	**-----**	**3.44**	**3.08**	**2.97**	**5.34**
Du/s	Depth at flowline before inlet (ft):		0.21	0.26	0.26	0.29	-----	-----	-----	0.17	0.13	0.15	0.29
Au/s	Water cross-area before inlet (ft^2):		0.37	0.57	0.55	0.71	-----	-----	-----	0.29	0.21	0.22	0.66
Vu/s	Velocity for total discharge before inlet (ft/s):		5.11	2.33	2.16	2.26	-----	-----	-----	1.62	1.40	1.49	3.80
Eod	Ratio of gutter depression flow to total Q (Eod):		100%	100%	100%	98%	-----	-----	-----	100%	100%	100%	99%
Se	Equivalent cross-slope (ft/ft):		0.061	0.059	0.062	0.061	0.016	0.015	0.008	0.049	0.044	0.050	0.065
GRATE INLETS ON-GRADE:													
Eog	Ratio of grate frontal flow to total flow:		98%	94%	96%	89%	-----	-----	-----	100%	100%	100%	92%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		1.88	1.25	1.13	1.43	-----	-----	-----	0.47	0.29	0.32	2.32
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		6.88	6.88	6.88	6.88	-----	-----	-----	6.88	6.88	6.88	6.88
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00	1.00	-----	-----	-----	1.00	1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):		0.03	0.07	0.05	0.17	-----	-----	-----	0.00	0.00	0.00	0.21
Gle	Effective grate length w/ 25% clogging (in):		27	27	27	27	-----	-----	-----	27	27	27	27
Rs	Fraction of side flow interception (Rs):		12%	36%	40%	38%	-----	-----	-----	47%	51%	51%	20%
E	Grate Efficiency (E):		99%	96%	97%	93%	-----	-----	-----	100%	100%	100%	93%
Qi	**Total flow intercepted (ft^3/s):**		**1.89**	**1.28**	**1.15**	**1.49**	**-----**	**-----**	**-----**	**0.47**	**0.29**	**0.32**	**2.36**
Qb	**Grate flow-by (ft^3/s):**		**0.03**	**0.05**	**0.03**	**0.11**	**-----**	**-----**	**-----**	**0.00**	**0.00**	**0.00**	**0.17**
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)													
Lt	Length required for total interception (ft):		-----	-----	-----	-----	13.40	6.36	17.99	-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	0.5	0.1	0.4	-----	-----	-----	-----
El	Efficiency for provided length L:		-----	-----	-----	-----	100%	100%	100%	-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**0.0**	**0.0**	**0.0**	**-----**	**-----**	**-----**	**-----**
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:													
	Grate Inlets												
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	Slotted drains												
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	Curb opening inlets												
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>											
g1	approach grade #1 (%):	>											
g2	approach grade #2 (%):	>											
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

BAIFA I-680 Express Lane

Caltrans Highway Drainage Inlet Calculations

Station: **"M" 1168+60 to "M" 1178+10 (Southbound 680)**

Designed by: JT ☑ **Date:** 3/26/2015
Checked by: CS ☑ **Date:** 3/26/2015

	Layout Line:		"M"		"M"	"M"	"M"	"M"	"M"
In#	**Inlet number:**		Exist	HP	10f	10g	Exist	Exist	Exist
	(Input Data Required)								
	HYDROLOGY COMPUTATION:								
	Begin Station		1168+60		1170+70	1171+80	1175+54	1177+00	1177+60
	End Station		1170+70		1171+80	1175+54	1177+00	1177+60	1178+12
St	Structure location station:	>>	1168+60		1171+80	1175+54	1177+00	1177+60	1178+12
			Lt		Lt	Lt	Lt	Lt	Lt
N	Notes		<-		->	->	->	->	->
	Off-site contributing watershed area (acres):	>>	0.00		0.00	0.00	0.00	0.00	0.00
	On-site contributing watershed area (acres):	>>	0.27		0.17	0.76	0.27	0.10	0.06
Ar	**Contributing watershed area (acres):**		**0.27**		**0.17**	**0.76**	**0.27**	**0.10**	**0.06**
C	Composite Runoff Coefficient "C":	>>	1		1	1	1	1	1
Ic	Precipitation intensity (in/hr):	>>	3.612		3.612	3.612	3.612	3.612	3.612
Qa	Subarea discharge Q (ft^3/s):		0.98		0.61	2.75	0.98	0.36	0.22
qq	Previous by-pass flow (ft^3/s):	>				0.00	0.48	0.06	0.00
Qadd	Discharge added by operator (ft^3/s):	>							
Qt	**Total discharge Q (ft^3/s):**		**0.98**		**0.61**	**2.75**	**1.46**	**0.42**	**0.22**
	SHOULDER AND GUTTER CONFIGURATION:								
n	Manning's n:	>>	0.015		0.015	0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.003		0.004	0.004	0.011	0.011	0.011
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1		1	1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1		1	1	1	1	1
ID	Inlet description:	>	G2		G2	G2	G2	G2	G2
	Grate Type:	>>	24-12		24-12	24-12	24-12	24-12	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2		2	2	2	2	2
Gw	Grate width (in):	>	24.0		24.0	24.0	24.0	24.0	24.0
Gl	Grate length (in):	>	36.0		36.0	36.0	36.0	36.0	36.0
	3 or 4 sided weir?	>	3		3	3	3	3	3
Lco	Curb opening length provided (ft):	>							
Ls	Slotted drain length provided: (ft)	>							
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0200		0.0200	0.0200	0.0100	0.0060	0.0012
W	Width of gutter from flowline (in):	>	48.0		48.0	48.0	48.0	48.0	48.0
a(t)	Gutter depression from horizontal (in):	>	2.00		2.00	2.00	2.00	2.00	2.00
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.062		0.062	0.062	0.052	0.048	0.043
	Available Flooded Width (ft)	>	11.00		11.00	11.00	11.00	11.00	11.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**8.74**		**6.84**	**11.99**	**12.33**	**10.62**	**22.74**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**4.98**		**3.38**	**9.39**	**6.08**	**2.91**	**2.43**
Du/s	Depth at flowline before inlet (ft):		0.27		0.21	0.35	0.23	0.14	0.10
Au/s	Water cross-area before inlet (ft^2):		0.58		0.35	1.22	0.52	0.20	0.13
Vu/s	Velocity for total discharge before inlet (ft/s):		1.68		1.74	2.26	2.82	2.08	1.72
Eod	Ratio of gutter depression flow to total Q (Eod):		100%		100%	88%	99%	100%	100%
Se	Equivalent cross-slope (ft/ft):		0.062		0.062	0.057	0.051	0.048	0.043
	GRATE INLETS ON-GRADE:								
Eog	Ratio of grate frontal flow to total flow:		94%		99%	72%	95%	100%	100%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		0.92		0.61	1.99	1.38	0.42	0.22
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		6.88		6.88	6.88	6.88	6.88	6.88
Rf	Fraction of frontal flow intercepted (Rf):		1.00		1.00	1.00	1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):		0.06		0.01	0.76	0.08	0.00	0.00
Gle	Effective grate length w/ 25% clogging (in):		27		27	27	27	27	27
Rs	Fraction of side flow interception (Rs):		51%		49%	36%	26%	35%	41%
E	Grate Efficiency (E):		97%		99%	82%	96%	100%	100%
Qi	**Total flow intercepted (ft^3/s):**		**0.95**		**0.61**	**2.26**	**1.40**	**0.42**	**0.22**
Qb	**Grate flow-by (ft^3/s):**		**0.03**		**0.00**	**0.48**	**0.06**	**0.00**	**0.00**
	SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)								
Lt	Length required for total interception (ft):		-----		-----	-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----		-----	-----	-----	-----	-----
El	Efficiency for providged length L:		-----		-----	-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**		**-----**	**-----**	**-----**	**-----**	**-----**
	INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:								
	Grate Inlets								
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----		-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----		-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----		-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----		-----	-----	-----	-----	-----
	Slotted drains								
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----		-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----		-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----		-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----		-----	-----	-----	-----	-----
	Curb opening inlets								
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----		-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----		-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----		-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----		-----	-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>							
g1	approach grade #1 (%):	>							
g2	approach grade #2 (%):	>							
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----		-----	-----	-----	-----	-----
Df	Flanking inlets distance (ft):		-----		-----	-----	-----	-----	-----

BAIFA 680 Express Lanes

Caltrans Highway Drainage Inlet Calculations

Job: **"M" 1205+29 to "M" 1216+80 (Northbound 680)**

Designed by: JT ☑ **Date:** 1/19/2015
Checked by: HY ☑ **Date:** 1/19/2015

	Layout Line:		"M"	"M"	"M"	"M"	"M"	"M"
In#	**Inlet number:**		Exist	Exist	Exist	Exist	Exist	Exist
		(Input Data Required)						
	HYDROLOGY COMPUTATION:			Flip				
	Begin Station		1205+29	1208+30	1209+71	1210+19	1213+84	1213+84
	End Station		1208+30	1209+71	1210+19	1213+84	1216+80	1216+80
St	Structure location station:	>>	1208+30	1209+71	1210+19	1213+84	1216+80	1216+80
			Rt	**Rt**	**Rt**	**Rt**	**Rt**	**Rt**
N	Notes		->	->	->	->	->	->
	Off-site contributing watershed area (acres):	>>						
	On-site contributing watershed area (acres):	>>	0.50	0.20	0.07	0.60	0.34	0.37
Ar	**Contributing watershed area (acres):**		**0.50**	**0.20**	**0.07**	**0.60**	**0.34**	**0.37**
C	Composite Runoff Coefficient "C":	>>	1	1	1	1	1	1
Ic	Precipitation intensity (in/hr):	>>	3.612	3.612	3.612	3.612	3.612	3.612
Qa	Subarea discharge Q (ft^3/s):		1.80	0.72	0.26	2.17	1.21	1.33
qq	Previous by-pass flow (ft^3/s):	>		0.28	0.02	0.00	0.31	0.02
Qadd	Discharge added by operator (ft^3/s):	>						
Qt	**Total discharge Q (ft^3/s):**		**1.80**	**1.00**	**0.28**	**2.17**	**1.52**	**1.35**
	SHOULDER AND GUTTER CONFIGURATION:							
n	Manning's n:	>>	0.015	0.015	0.015	0.015	0.015	0.015
S	Longitudinal slope S (ft/ft):	>>	0.002	0.021	0.012	0.006	0.016	0.026
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1	1	1	1	1	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1	1	1	1	1	1
ID	Inlet description:	>	G2	G2	G2	G2	G2	G2
	Grate Type:	>>	24-12	24-12	24-12	24-12	24-12	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2	2	2	2	2	2
Gw	Grate width (in):	>	24.0	24.0	24.0	24.0	24.0	24.0
Gl	Grate length (in):	>	36.0	36.0	36.0	36.0	36.0	36.0
	3 or 4 sided weir?	>	3	3	3	3	3	3
Lco	Curb opening length provided (ft):	>	10.00	10.00	10.00	10.00	10.00	10.00
Ls	Slotted drain length provided: (ft)	>						
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0500	0.0401	0.0066	0.0364	0.0149	0.0642
W	Width of gutter from flowline (in):	>	48.0	48.0	48.0	48.0	48.0	48.0
a(t)	Gutter depression from horizontal (in):	>	0.0	0.0	0.0	0.0	0.0	0.0
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.060	0.060	0.060	0.060	0.060	0.060
	Available Flooded Width (ft)	>	10.00	10.00	10.00	10.00	10.00	10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**6.69**	**3.97**	**8.50**	**7.15**	**9.03**	**3.18**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**6.34**	**3.08**	**2.14**	**5.99**	**3.78**	**3.32**
Du/s	Depth at flowline before inlet (ft):		0.36	0.18	0.13	0.31	0.23	0.20
Au/s	Water cross-area before inlet (ft^2):		1.08	0.28	0.14	0.84	0.43	0.33
Vu/s	Velocity for total discharge before inlet (ft/s):		1.66	3.52	2.04	2.58	3.56	4.07
Eod	Ratio of gutter depression flow to total Q (Eod):		94%	100%	100%	97%	100%	100%
Se	Equivalent cross-slope (ft/ft):		0.059	0.060	0.060	0.059	0.060	0.060
	GRATE INLETS ON-GRADE:							
Eog	Ratio of grate frontal flow to total flow:		69%	97%	100%	79%	99%	90%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		1.23	0.97	0.28	1.71	1.50	1.22
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		8.59	8.59	8.59	8.59	8.59	8.59
Rf	Fraction of frontal flow intercepted (Rf):		1.00	1.00	1.00	1.00	1.00	1.00
Qs	Side flow in ft^3/s (Qs):		0.57	0.03	0.00	0.46	0.02	0.13
Gle	Effective grate length w/ 25% clogging (in):		27	27	27	27	27	27
Rs	Fraction of side flow interception (Rs):		51%	21%	42%	32%	21%	17%
E	Grate Efficiency (E):		84%	98%	100%	86%	99%	92%
Qi	**Total flow intercepted (ft^3/s):**		**1.52**	**0.98**	**0.28**	**1.85**	**1.51**	**1.24**
Qb	**Grate flow-by (ft^3/s):**		**0.28**	**0.02**	**0.00**	**0.31**	**0.02**	**0.11**
	SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)							
Lt	Length required for total interception (ft):		-----	-----	-----	-----	-----	-----
Ci	Interception for provided length L (ft^3/s):		-----	-----	-----	-----	-----	-----
El	Efficiency for providged length L:		-----	-----	-----	-----	-----	-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**	**-----**	**-----**	**-----**	**-----**	**-----**
	INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:							
	Grate Inlets							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
	Slotted drains							
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
	Curb opening inlets							
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----	-----	-----	-----	-----	-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----	-----	-----	-----	-----	-----
Lc	Length of the vertical curve (ft):	>						
g1	approach grade #1 (%):	>						
g2	approach grade #2 (%):	>						
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----	-----	-----	-----	-----	-----
Df	Flanking inlets distance (ft):		-----	-----	-----	-----	-----	-----

BAIFA 680 Express Lanes

Caltrans Highway Drainage Inlet Calculations

Job: **"M" 1227+20 to "M" 1233+80 (Southbound 680)**

Designed by: JT ☑ **Date:** 1/19/2015
Checked by: HY ☑ **Date:** 1/19/2015

	Layout Line:		"M"
In#	**Inlet number:**		Exist
			(Input Data Required)
HYDROLOGY COMPUTATION:			
	Begin Station		1227+20
	End Station		1233+80
St	Structure location station:	>>	1233+80
			Lt
N	Notes		->
	Off-site contributing watershed area (acres):	>>	
	On-site contributing watershed area (acres):	>>	0.90
Ar	**Contributing watershed area (acres):**		**0.90**
C	Composite Runoff Coefficient "C":	>>	1
Ic	Precipitation intensity (in/hr):	>>	3.612
Qa	Subarea discharge Q (ft^3/s):		3.24
qq	Previous by-pass flow (ft^3/s):	>	
Qadd	Discharge added by operator (ft^3/s):	>	
Qt	**Total discharge Q (ft^3/s):**		**3.24**
SHOULDER AND GUTTER CONFIGURATION:			
n	Manning's n:	>>	0.015
S	Longitudinal slope S (ft/ft):	>>	0.023
IT	Inlet type (1=grate, 2=curb opening, 3=slotted):	>>	1
LP	Longitudinal profile (1=on-grade, 2=sag):	>>	1
ID	Inlet description:	>	G2
	Grate Type:	>>	24-12
	Standard Gutter Depression (1=SGD, 2=no SGD)	>	2
Gw	Grate width (in):	>	24.0
Gl	Grate length (in):	>	36.0
	3 or 4 sided weir?	>	3
Lco	Curb opening length provided (ft):	>	10.00
Ls	Slotted drain length provided: (ft)	>	
Sx	Shoulder cross-slope Sx (ft/ft):	>>	0.0080
W	Width of gutter from flowline (in):	>	48.0
a(t)	Gutter depression from horizontal (in):	>	0.0
Sw	Gutter cross-slope Sw (ft/ft): (S'w=Sw-Sx) (Sw=Sx if no gutter)		0.060
	Available Flooded Width (ft)	>	10.00
Tu/s	**Flooded Width from flowline (ft): at inlet w/o gutter depression**		**16.57**
Tu/s	**Flooded Width from flowline (ft): at inlet w/ gutter depression**		**8.83**
Du/s	Depth at flowline before inlet (ft):		0.28
Au/s	Water cross-area before inlet (ft^2):		0.73
Vu/s	Velocity for total discharge before inlet (ft/s):		4.45
Eod	Ratio of gutter depression flow to total Q (Eod):		96%
Se	Equivalent cross-slope (ft/ft):		0.058
GRATE INLETS ON-GRADE:			
Eog	Ratio of grate frontal flow to total flow:		91%
Qw	Inlet frontal flow in ft^3/s (Qw): at inlet w/ gutter depression		2.94
Vo	Vo for effective length (P-50, Chart 5) (ft/s):		8.59
Rf	Fraction of frontal flow intercepted (Rf):		1.00
Qs	Side flow in ft^3/s (Qs):		0.30
Gle	Effective grate length w/ 25% clogging (in):		27
Rs	Fraction of side flow interception (Rs):		15%
E	Grate Efficiency (E):		92%
Qi	**Total flow intercepted (ft^3/s):**		**2.98**
Qb	**Grate flow-by (ft^3/s):**		**0.26**
SLOTTED DRAINS AND CURB OPENING INLETS ON-GRADE: (No clogging factor)			
Lt	Length required for total interception (ft):		-----
Ci	Interception for provided length L (ft^3/s):		-----
El	Efficiency for providged length L:		-----
Qs	**Slotted drain or side opening flow-by (ft^3/s):**		**-----**
INTERCEPTION CAPACITY OF INLETS IN SAG LOCATION:			
	Grate Inlets		
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----
	Slotted drains		
d_{33}	Depth of ponding at inlet (33% Clogging - Freeway)(ft):		-----
d_{50}	Depth of ponding at inlet (50% Clogging City St)(ft):		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----
	Curb opening inlets		
d_{33}	Depth of ponding at inlet (Weir, 33% Clogging - Freeway)(ft):		-----
d_{50}	Depth of ponding at inlet (Weir, 50% Clogging City St)(ft):		-----
w_{33}	Ponded width at inlet (33% Clogging - Freeway)(ft):		-----
w_{50}	Ponded width at inlet (50% Clogging City St)(ft):		-----
Lc	Length of the vertical curve (ft):	>	
g1	approach grade #1 (%):	>	
g2	approach grade #2 (%):	>	
K	K = Min(Lc/(Diff(g1,g2),167) (Table 4-7, HEC-22):		-----
Df	Flanking inlets distance (ft):		-----