Appendix H: Hydrology and Water Quality

This Page Intentionally Left Blank

Water Quality Report
Dublin Boulevard-North Canyons Parkway Extension Project
Federal Project No. RTPL 5432(019)

Prepared for

City of Dublin, County of Alameda, and City of Livermore

Located in:

Dublin, Unincorporated Alameda County, and Livermore California

ENGINEERS / SURVEYORS / PLANNERS

BKF Engineers
4670 Willow Road, Suite 250
Pleasanton, CA 94588

July 16, 2018

Water Quality Report

Dublin Boulevard-North Canyons Parkway Extension Project

July 16, 2018

Prepared for

City of Dublin, County of Alameda, and City of Livermore

Located in:

Dublin, Unincorporated Alameda County, and Livermore California

This Water Quality report has been prepared by BKF Engineers under the supervision of the following Registered Engineer. To the best of my knowledge and belief, the information submitted is true, accurate and complete

Ramon Alvarez-Muro [signature] Date: 11/21/18

Ramon Alvarez-Muro, P.E.
Registered Civil Engineer

Table of Contents

List of Figures

List of Tables

List of Appendices

1. INTRODUCTION

1.1 Approach to Water Quality Report

The purpose of the Water Quality Report is to fulfill the requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), and to provide information for National Pollutant Discharge Elimination System (NPDES) permitting. The document includes a discussion of the proposed project, the general environmental setting of the project area, and the regulatory framework with respect to water quality; it also provides data on surface water within the project area and the water quality of these waters, describes water quality impairments and beneficial uses, and identifies potential water quality impacts/benefits associated with the proposed project, and recommends avoidance and/or minimization measures for potentially adverse impacts.

1.2 Project Description

The City of Dublin (Dublin), in cooperation with the City of Livermore (Livermore), Alameda County (County), Alameda County Transportation Commission (ACTC), and the California Department of Transportation (Caltrans) as assigned by the Federal Highway Administration (FHWA), proposes to extend Dublin Boulevard approximately 1.5 miles eastward through eastern Dublin and an unincorporated portion of the County, terminating at the boundary between the County and Livermore city limits (project). The work proposed will include the construction of a new 4-6 lane roadway, including bicycle and pedestrian facilities (i.e., sidewalks and bike lanes). Additionally, the project proposes to conduct intersection improvements at the Dublin Boulevard/Fallon Road and Doolan Road/North Canyon Parkway intersections; eliminate the frontage road connection/intersection and add a new intersection at Dublin Boulevard/Croak Road intersection; and construct a new bridge over Cottonwood Creek.

The maximum anticipated excavation depth will reach about 40 feet below current ground surface for the sewer line and the potential Disturbed Soil Area (DSA) is estimated to be about 84 acres. The project will construct about 19 acres of new impervious area all of which will require post-construction stormwater treatment.

The Project Location Map is shown on Figure 1, Project Vicinity Map on Figure 2 and Surface Waters within the project vicinity on Figure 3.

Figure 1. Project Location Map

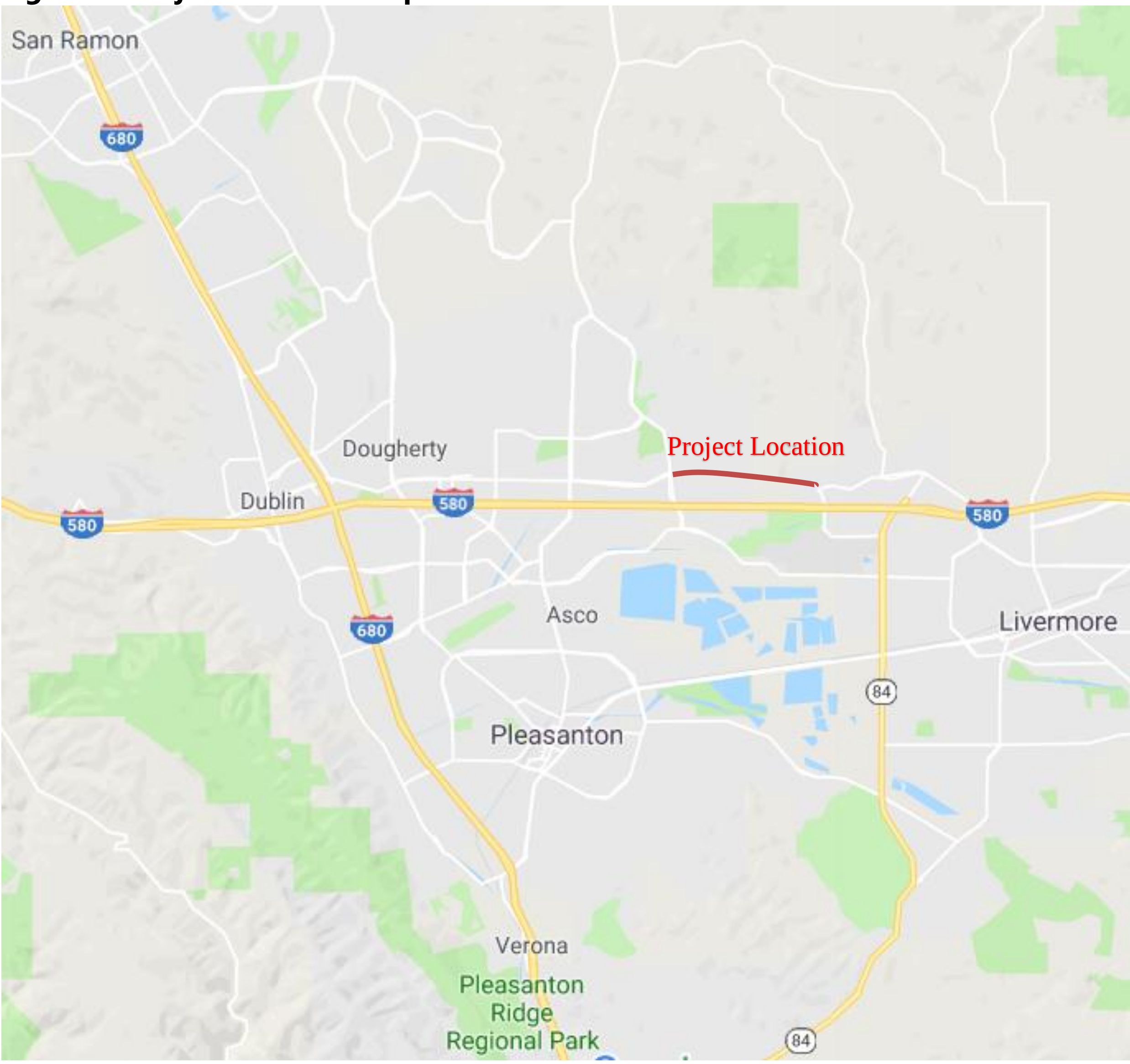
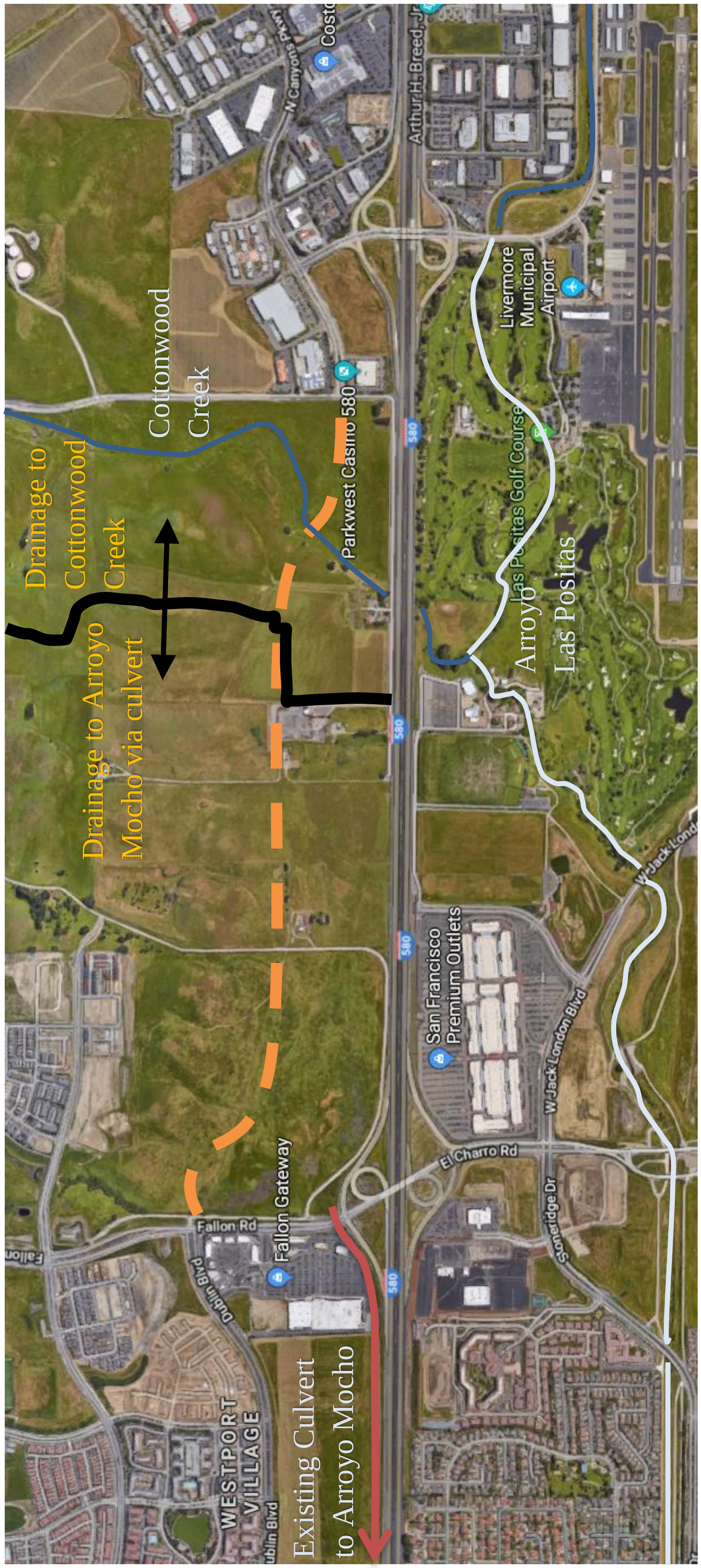


Figure 2. Project Vicinity Map

Figure 3. Surface Waters


Drainage to Cottonwood Creek
Drainage to Arroyo Mocho via culvert
Cottonwood Creek
Arroyo Las Positas
Existing Culvert to Arroyo Mocho
Livermore Municipal Airport
Las Positas Golf Course
San Francisco Premium Outlets
Parkwest Casino 580
Fallon Gateway
Fallon Rd
El Charro Rd
Dublin Blvd
W Jack London Blvd
Stoneridge Dr
N Canyons Pkwy
WESTPORT VILLAGE

2. Regulatory Setting

This section summarizes the water quality regulations mandated at the federal, state and local jurisdictional levels.

2.1 Federal Laws and Requirements

The primary regulation at the federal level for the quality of surface and ground water is the Clean Water Act (CWA). Details are summarized in the section below.

Clean Water Act

In 1972 Congress amended the Federal Water Pollution Control Act, making the addition of pollutants to the waters of the United States (U.S.) from any point source unlawful unless the discharge is in compliance with a NPDES permit. Known today as the Clean Water Act (CWA), Congress has amended it several times. In the 1987 amendments, Congress directed dischargers of stormwater from municipal and industrial/construction point sources to comply with the NPDES permit program. Important CWA sections are:

- Sections 303 and 304 require states to promulgate water quality standards, criteria, and guidelines.

- Section 401 requires an applicant for a federal license or permit to conduct any activity, which may result in a discharge to waters of the U.S., to obtain certification from the State that the discharge will comply with other provisions of the act. (Most frequently required in tandem with a Section 404 permit request. See below).

- Section 402 establishes the NPDES, a permitting system for the discharges (except for dredge or fill material) of any pollutant into waters of the U.S. The Federal Environmental Protection Agency delegated to the California State Water Resources Control Board (SWRCB) the implementation and administration of the NPDES program in California. The SWRCB established nine Regional Water Quality Control Boards (RWQCBs). The SWRCB enacts and enforces the Federal NPDES program and all water quality programs and regulations that cross Regional boundaries. The nine RWQCBs enact, administer and enforce all programs, including NPDES permitting, within their jurisdictional boundaries. Section 402(p) requires permits for discharges of stormwater from industrial, construction, and Municipal Separate Storm Sewer Systems (MS4s).

- Section 404 establishes a permit program for the discharge of dredge or fill material into waters of the U.S, including wetlands. This permit program is administered by the U.S. Army Corps of Engineers (USACE).

The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

The USACE issues two types of 404 permits: General and Individual. There are two types of General permits: Regional and Nationwide permits. Regional permits are issued for a general category of activities when they are similar in nature and cause minimal environmental effect. Nationwide permits are issued to authorize a variety of minor project activities with no more than minimal effects.

There are also two types of Individual permits: Standard Individual permit and Letter of Permission. Ordinarily, projects that do not meet the criteria for a Nationwide Permit may be permitted under one of USACE's Individual permits. For Standard Individual permit, the USACE decision to approve is based on compliance with U.S. Environmental Protection Agency's (EPA) Section 404 (b)(1) Guidelines (U.S. EPA CFR 40 Part 230), and whether permit approval is in the public interest. The 404(b)(1) Guidelines were developed by the U.S. EPA in conjunction with USACE, and allow the discharge of dredged or fill material into the aquatic system (waters of the U.S.) only if there is no practicable alternative which would have less adverse effects. The Guidelines state that USACE may not issue a permit if there is a least environmentally damaging practicable alternative (LEDPA), to the proposed discharge that would have less effects on waters of the U.S., and not have any other significant adverse environmental consequences. Per Guidelines, documentation is needed that a sequence of avoidance, minimization, and compensation measures have been followed, in that order. The Guidelines also restrict permitting activities that violate water quality or toxic effluent standards, jeopardize the continued existence of listed species, violate marine sanctuary protections, or cause "significant degradation" to waters of the U.S. In addition, every permit from the USACE, even if not subject to the 404(b)(1) Guidelines, must meet general requirements. See 33 CFR 320.4.

2.2 State Laws and Requirements

Porter-Cologne Water Quality Control Act

California's Porter-Cologne Act, enacted in 1969, provides the legal basis for water quality regulation within California. This Act requires a "Report of Waste Discharge" for any discharge of waste (liquid, solid, or gaseous) to land or surface waters that may impair beneficial uses for surface and/or groundwater of the State. It predates the

CWA and regulates discharges to waters of the State. Waters of the State include more than just waters of the U.S., like groundwater and surface waters not considered waters of the U.S. Additionally, it prohibits discharges of "waste" as defined and this definition is broader than the CWA definition of "pollutant". Discharges under the Porter-Cologne Act are permitted by Waste Discharge Requirements (WDRs) and may be required even when the discharge is already permitted or exempt under the CWA.

Water body segments that fail to meet standards for specific pollutants are included in a Statewide List in accordance with CWA Section 303(d). If a Regional Board determines that waters are impaired for one or more constituents and the standards cannot be met through point source or non-source point controls (NPDES permits or Waste Discharge Requirements), the CWA requires the establishment of Total Maximum Daily Loads (TMDLs). TMDLs specify allowable pollutant loads from all sources (point, non-point, and natural) for a given watershed.

State Water Resources Control Board and Regional Water Quality Control Boards
The SWRCB adjudicates water rights, sets water pollution control policy, and issues water board orders on matters of statewide application, and oversees water quality functions throughout the state by approving Basin Plans, TMDLs, and NPDES permits. RWCQBs are responsible for protecting beneficial uses of water resources within their regional jurisdiction using planning, permitting, and enforcement authorities to meet this responsibility.

The SWRCB and RWQCBs are responsible for establishing the water quality standards as required by the CWA, and regulating discharges to protect beneficial uses of water bodies. Details regarding water quality standards in a project area are contained in the applicable RWQCB Basin Plan. In California, Regional Boards designate beneficial uses for all water body segments in their jurisdictions, and then set standards necessary to protect these uses. Consequently, the water quality standards developed for particular water body segments are based on the designated use and vary depending on such use.

National Pollutant Discharge Elimination System (NPDES) Program

Municipal Separate Storm Sewer Systems (MS4)

Section 402(p) of the CWA requires the issuance of NPDES permits for five categories of stormwater dischargers, including MS4s. The U.S. EPA defines an MS4 as "any conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, human-made channels, and storm drains) owned or operated by a state, city, town, county, or other public body having jurisdiction over storm water, that are designed or used for collecting or conveying stormwater." The SWRCB or the RWQCB issues NPDES permits for five years, and permit requirements remain active until a new permit has been adopted. NPDES permits are required and issued for discharges from a MS4 serving a population of 100,000 or more for Phase I, and serving a population of 10,000 or more for Phase II. Alameda County is within a Phase I area.

Construction General Permit

Construction General Permit (NPDES No. CAS000002, SWRCB Order No. 2009-0009-DWQ) was amended by Order No. 2010-0014-DWQ and Order No. 2012-0006-DWQ. The permit regulates stormwater discharges from construction sites which result in a Disturbed Soil Area (DSA) of one acre or greater, and/or are smaller sites that are part of a larger common plan of development.

For all projects subject to the construction general permit (CGP), the applicant is required to utilize a Qualified Storm Water Pollution Prevention Plan (SWPPP) Developer (QSD) to develop and implement an effective SWPPP. All Project Registration Documents, including the SWPPP, are required to be uploaded into the SWRCB's on-line Stormwater Multiple Application and Report Tracking System (SMARTS), at least 30 days prior to construction.

Waivers from CGP coverage.

Projects that disturb over 1.0 acre but less than 5 acres of soil, may qualify for waiver of CGP coverage. This occurs whenever the R factor of the **Watershed Erosion Estimate (=RxKxLS) in tons/acre** is less than 5. Within this CGP formula, there is a factor related to when and where the construction will take place. This factor, the 'R' factor, may be low, medium or high. When the R factor is below the numeric value of 5, projects can be waived from coverage under the CGP, and are instead covered by the Caltrans Statewide MS4.

Construction activity that results in soil disturbances of less than one acre is subject to this CGP if there is potential for significant water quality impairment resulting from the activity as determined by the RWQCB. Operators of regulated construction sites are required to develop a SWPPP, to implement soil erosion and pollution prevention control measures, and to obtain coverage under the CGP.

The CGP contains a risk-based permitting approach by establishing three levels of risk possible for a construction site. Risk levels are determined during the planning, design, and construction phases, and are based on project risk of generating sediments and receiving water risk of becoming impaired. Requirements apply according to the Risk Level determined.

Section 401 Permitting

Under Section 401 of the CWA, any project requiring a federal license or permit that may result in a discharge to a water of the United States must obtain a 401 Certification, which certifies that the project will be in compliance with State water quality standards. The most common federal permit triggering 401 Certification is a CWA Section 404 permit, issued by USACE. The 401 permit certifications are obtained from the appropriate RWQCB, dependent on the project location, and are required before USACE issues a 404 permit.

In some cases the RWQCB may have specific concerns with discharges associated with a project. As a result, the RWQCB may prescribe a set of requirements known as Waste Discharge Requirements (WDRs) under the State Water Code (Porter-Cologne Act). WDRs may specify the inclusion of additional project features, effluent limitations, monitoring, and plan submittals that are to be implemented for protecting or benefiting water quality. WDRs can be issued to address both permanent and temporary discharges of a project.

2.3 Regional and Local Requirements

The Project is located in Alameda County (within the City of Dublin and Unincorporated Alameda County, abutting City of Livermore) which lies within the limits of the San Francisco Bay RWQCB and is under a Phase I MS4. The Project area is under regional/local requirements and subject to the following permit "California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit" (Order R2-2015-0049 NPDES Permit No. CAS612008). This permit is known as the MRP and presents the provisions for permanent post-construction stormwater requirements related to development, re-development and roadway projects outside of Caltrans Right-of-Way. The MRP in Alameda County is administered by the Alameda Countywide Clean Water Program (ACCWP). The ACCWP has developed a manual called "C.3 Stormwater Technical Guidance" to assist designers and reviewers in complying with post-construction stormwater treatment requirements as well as Hydromodification Management requirements. For new roadway projects the MRP requires post-construction stormwater treatment be provided for all new impervious areas.

3. AFFECTED ENVIRONMENT

3.1 General Environmental Setting

3.1.1 Topography

Perpendicular to the west-east path of the project, the existing grade generally falls north to south with many rolling hills. The elevation at the western boundary of Fallon Road is about 370 feet above sea level and meanders to match grade along the path reaching a maximum of elevation of about 420 feet at its highest point before connecting to Doolan Road at elevation 415 feet.

3.1.2 Soil and Geology

A Natural Resources Conservation Service (NRCS) Web Soil Survey was done to identify the underlying soils within the project limits. The predominant soil underlying the project are Diablo Clay and Linne Clay Loam with the soils under Cottonwood Creek as Clear Lake Clay. All three soils have a Hydraulic Soil Group (HSG) classification of C, which are soils having a slow infiltration rate (high runoff potential) when thoroughly wet. Wet Soil Survey can be found in Appendix A.

Erosion potential data was obtained via a NRCS Wed Soil Survey. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. The K factor for the soils in the Project area is primarily 0.24. These soils are considered to have low erosion potential.

3.1.3 Hydrology

3.1.3.1 Regional Hydrology

The Project is located within the South Bay Hydrologic unit, Alameda Creek hydrologic area and hydrologic sub-area 204.30

3.1.3.2 Local Hydrology

The Project is located within the Arroyo Mocho watershed and Lower Arroyo Mocho sub-watershed. Local drainage flows to Arroyo Mocho via one of two methods, in a storm drain culvert that is routed north of but next to Highway 580 westerly before crossing Highway 580 that then outfalls into Arroyo Mocho or into Cottonwood Creek which has a downstream confluence into Arroyo Las Positas south of 580 which in turn has a downstream confluence into Arroyo Mocho south of Highway 580 and west of Highway 580. Surface Waters are shown in Figure 3 on Page 4.

3.1.3.3 Precipitation and Climate

The climate in Alameda County is characterized by warm, dry summers and mild, wet winters. The City of Livermore, in the Livermore-Amador Valley, has an average annual temperature of 59 degrees Fahrenheit. The mean annual precipitation in the Dublin part of the Project area is 14.18 inches with precipitation occurring mostly in the months of October through April.

3.2 Surface Water Resources

3.2.1 Surface Waters

Within the Project area, stormwater runoff on the eastern side is discharged to Cottonwood Creek directly via storm drain line in Dublin Blvd or to Arroyo Mocho indirectly via an underground storm drain system.

3.2.2 Beneficial Uses of Receiving Water Bodies

Protection and enhancement of beneficial uses are the primary goals of water planning. The San Francisco Bay RWQCB Basin Plan identifies beneficial uses for water bodies within its jurisdiction. Table 1 below lists the identified beneficial uses for Cottonwood Creek and Arroyo Mocho, the two surface waterbodies the project area discharges to directly. Detailed descriptions of the individual beneficial uses are provided in the excerpts from Chapter 2 Beneficial Uses of the basin plan included in Appendix B of this report.

Table 1 Beneficial Uses

Water Body	Beneficial Uses								
	AGR	MUN	FRSH	GWR	IND	PROC	COMM	COLD	EST
Cottonwood Creek									
Arroyo Mocho				E				E	

Table 1 (Continued)

Water Body	Beneficial Uses (Continued)							
	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
Cottonwood Creek		E		E	E	E	E	
Arroyo Mocho	E		E	E	E	E	E	

Source: San Francisco Bay RWQCB Basin Plan (2017)

AGR	Agricultural Supply
MUN	Municipal And Domestic Supply
FRSH	Freshwater Replenishment
GWR	Groundwater Recharge
IND	Industrial Service Supply
PROC	Industrial Process Supply
COMM	Commercial And Sport Fishing
COLD	Cold Freshwater Habitat
EST	Estuarine Habitat
E	Existing Beneficial Use
MIGR	Fish Migration
RARE	Preservation Of Rare And Endangered Species
SPWN	And Fish Spawning
WARM	Warm Freshwater Habitat
WILD	Wildlife Habitat
REC1	Water Contact Recreation
REC2	Noncontact Water Recreation
NAV	Navigation

3.2.3 Water Quality Objectives

The San Francisco Bay RWQCB Basin Plan identifies two types of water quality objectives: narrative and numerical. Narrative objectives present general description of water quality that must be attained through pollutant control measures and watershed management. They also serve as the basis for the development of detailed numerical objectives. Numerical objectives typically describe pollutant concentrations, physical/chemical conditions of the water itself and the toxicity of the water to aquatic organisms.

The general water quality objectives established for surface waters within the San Francisco Bay region are set for bacteria, bioaccumulation, biostimulatory substances, color, dissolved oxygen, floating material, oil and grease, population and community ecology, pH, radioactivity, salinity, sediment, settleable material, suspended material, sulfide, taste and odors, temperature, toxicity, turbidity and un-ionized ammonia. Excerpts from Chapter 3 "Water Quality Objectives" of the Basin Plan is included in Appendix C of this report.

3.2.4 Possible Water Quality Pollutants

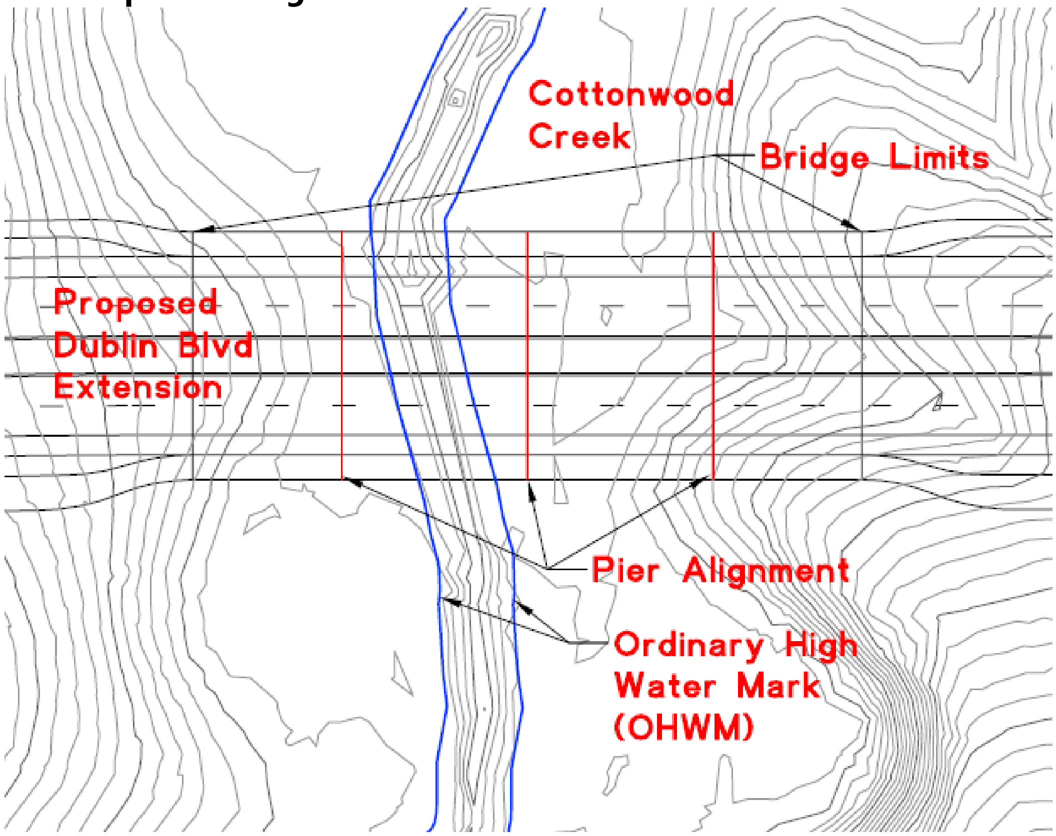
Arroyo Mocho appears on the California 2010 Integrated Report (Clean Water Act Section 303(d) list / 305 (b) Report). Listed pollutant are Diazinon and Temperature Water. Diazinon from urban storm runoff and Temperature from channelization, habitat modification and removal of Riparian Vegetation. It is listed as 303(d) Category 5 which means this is a water segment where standards are not met and a TMDL is required, but not yet completed, for at least one of the pollutants being listed for this segment. The project is not required to take any specific action to address these pollutants.

3.2.5 Floodplains

The FEMA Flood Insurance Rate Maps for the Project location identify Cottonwood Creek as a floodplain. Cottonwood Creek is identified as 0.2% Annual chance flood discharge contained in channel, which signifies the channel is sufficient to convey the 100-year and 500-year storm event.

The project will construct a new bridge across Cottonwood Creek as shown on Figure 4 below. At the proposed bridge crossing Cottonwood Creek is about 200-foot wide. Additionally there is a deep incision about the middle of the floodplain which contains the Ordinary High Water Mark (OHWM). Three lines of new piers will be built in the floodplain but clear of the OHWM. Hydraulic modeling contained in the Hydrology Report indicated the addition of piers in the floodplain will raise the water surface elevation by 0.18' locally. However, at 50-feet upstream of the bridge the proposed water surface elevation is equivalent to the pre-project condition.

Figure 4. Proposed Bridge Over Cottonwood Creek



3.2.6 Municipal Supply

No known municipal drinking water and water recharge facilities are known to be within the project area.

3.2.7 Biological Communities

3.2.7.1 Aquatic Habitat

The potential for aquatic habitat in the project vicinity is documented in the Biological Resources Technical Memorandum by H.T. Harvey & Associates dated May 12, 2017.

3.2.7.2 Special Status Species

Special Status Species in the project vicinity are documented in the Biological Resources Technical Memorandum by H.T. Harvey & Associates dated May 12, 2017.

3.2.7.3 Stream/Riparian Habitats

Perennial Stream and Mixed Riparian Woodlands occurring within the vicinity of the project site are documented in the Biological Resources Technical Memorandum by H.T. Harvey & Associates dated May 12, 2017.

3.2.7.4 Wetlands

Seasonal Wetlands occurring within the vicinity of the project site are documented in the Biological Resources Technical Memorandum by H.T. Harvey & Associates dated May 12, 2017.

3.3 Groundwater Resources

The Project is within the San Francisco Bay Hydrologic Region. The San Francisco Bay RWQCB Basin Plan identifies the Project as being within the Livermore Valley groundwater basin (Basin ID 2-10).

According to the draft Geotechnical Feasibility Summary information from the California Geological Survey (CGS) seismic hazard zone report for the project area indicates historic high groundwater levels are on the order of 20 to 25 feet below grade along the project alignment. The same CGS source indicates historic high groundwater levels closer to 10 feet below grade in the area northwest of the existing I-580 / Fallon Road interchange. An approximately 80-foot-deep boring performed by Caltrans in 1965 for the I-580 / Cottonwood Creek crossing encountered groundwater at a depth of approximately 32 feet. A deep soil boring performed in January 1997 at the I-580 / Airport Boulevard interchange encountered groundwater at a depth of approximately 39 feet. Shallower groundwater levels may be present throughout the proposed Project alignment, particularly at the Cottonwood Creek crossing.

3.3.1 Groundwater Objectives

The San Francisco Bay RWQCB Basin Plan identifies two types of ground water quality objectives: narrative and numerical. The objectives consist primarily of narrative objectives combined with a limited number of numeric objectives. The Basin Plan states, "at a minimum, groundwater shall not contain concentrations of bacteria, chemical constituents, radioactivity, or substances producing taste and odor in excess of the objectives description."

The Livermore Valley groundwater basin is identified as having the existing groundwater beneficial uses of municipal and domestic water supply, industrial process water supply, industrial service water supply, and agricultural water supply.

Groundwater basins with the beneficial use of municipal and domestic water supply, are subject to further narrative and numeric groundwater objectives for bacteria, organic and inorganic constituents, radioactivity, and taste and odor; these objectives are presented in Section 3.3 of the Basin Plan, which is included in Appendix C of this report.

4. STORMWATER TREATMENT

4.1 Introduction

The Project is required to implement stormwater treatment Best Management Practices (BMPs) because it surpasses the MRPs threshold of creating and/or replacing 10,000 sq-ft or more of impervious surface. As previously mentioned, the impervious area added by this project is about 827,640 sq-ft or 19 acres. Additionally if a project creates and/or replaces 1 acre or more it may be subject to Hydromodification Management (HM) requirements per the Phase I MRP which entail that peak runoff rates in the post-project condition match the pre-project condition for storm events between 10% of the 2-year storm up to the 10-year storm event. This ensures projects that drain to an erodible waterbody do not contribute to long term erosion and sedimentation of said waterbody. This Project is subject to HM requirements according to the Alameda County HMP susceptibility map shown in Appendix D.

4.2 Post Construction Treatment BMPs

The projects conceptual drainage systems will consist of superelevating or crowning Dublin Blvd pavement towards the median-island area separating eastbound and westbound traffic. The median-island will be used as a stormwater conveyance swale and also be the location for Low Impact Development (LID) stormwater treatment facilities. The exception to this strategy will be at street intersection locations with left turn pockets, where the median-island necks down to 4-feet. In those situations, the LID treatment area will be within the parkway strip areas which separate the roadway from the sidewalk and bike path/multi-use pathway (MUP areas. These other impervious areas (sidewalk and bike path/MUP) will be sloped towards the parkway strip and the LID treatment area.

The MRPs stormwater priorities are to provide LID based solutions. The goal of LID is to reduce runoff and mimic a site's predevelopment hydrology by minimizing disturbed areas and impervious cover and then infiltrating, storing, detaining, evapotranspiring, and/or biotreating stormwater runoff close to its source. Storing to later evaportranspirate/infiltrate is not a viable option for this project due to the limited areas available for storage of significant amounts of stormwater, particularly when considering the underlying soils are Hydraulic Soil Group C soils, having slow infiltration rates. Based on these conditions, the most feasible LID post-construction treatment BMPs for this Project are bioretention areas which will infiltrate stormwater runoff through an 18-inch minimum biotreatment soil media layer, then enter a perforated subsurface-drain before entering an MS4 drainage system. Typical street cross sections with treatment in the median and parkway strip are shown in Figure 4 and 5 below.

Figure 5. Typical Street Section with bioretention treatment in the median

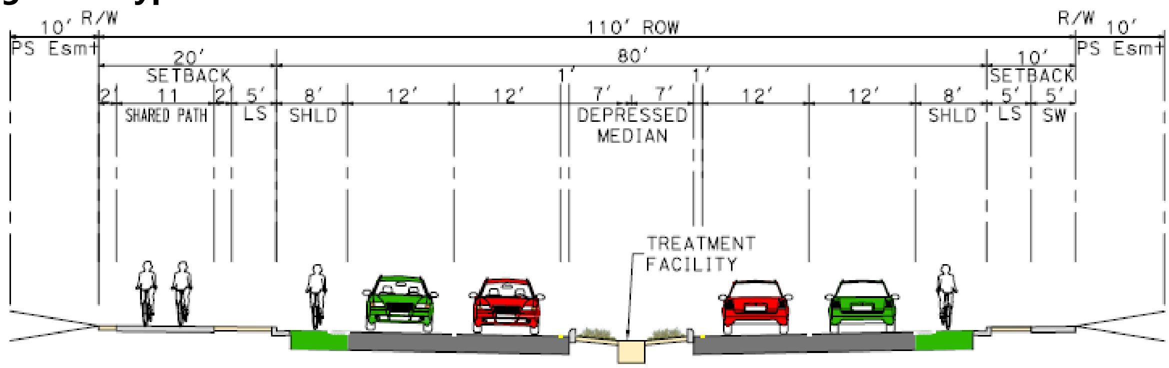
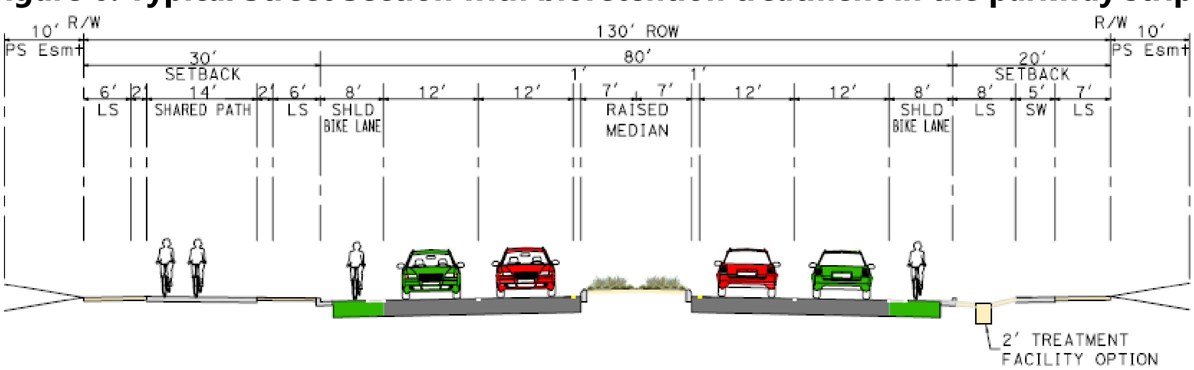


Figure 6. Typical Street Section with bioretention treatment in the parkway strip



The bioretention areas can be modified by adding orifices and deepening the ponding depth to function as a HM facility as well. Should the full HM requirement not be met by modifications to the bioretention areas along the median and shoulders, then supplemental storage can be explored on either side of the roadway, or through underground oversized storm drain lines or underground vaults; these options can be added to supplement bioretention areas as necessary until full HM compliance is achieved.

4.3 Potential Impacts to Water Quality

The Project would increase the total impervious surface area by about 19 acres and therefore, would increase the volume of stormwater runoff. As required by the Phase 1 MRP, this will be mitigated by implementing HM requirements as related to water quality measures of peak flow rates and velocities. The runoff from the Project would also increase the amount of pollutants typically related to roadway projects however, as required in the Phase I MRP, the implementation of post-construction treatment BMPs will mitigate against the increase.

The proposed treatment BMP bioretention area removes among other containments pesticides which include Diazinon. The proposed project BMPs would help minimize this containment from entering the 303d listed waterbodies.

5. AVOIDANCE AND MINIMIZATION MEASURES

5.1 Construction General Permit

The Project will disturb well over the 1 acre of soil threshold require to be subject to California's Construction General Permit (CGP) (NPDES No. CAS000002, SWRCB Order No. 2009-0009-DWQ, adopted on November 16, 2010). As part of the CGP requirements, a Stormwater Pollution Prevention Plan (SWPPP) will be developed prior to the commencement of construction. The SWPPP will be developed by the Contractor and uploaded to the Stormwater Multiple Application and Report Tracking System (SMARTS) before earth disturbing activities are to commence. The SWPPP will document temporary construction BMPs implementation strategies and inspection procedures to be used to comply with the CGP. The CGP also requires that annual reports be prepared to document any issues encountered throughout the year.

5.2 Potential Construction BMPs

In general, as the site DSA increases, the potential for temporary water quality impacts will also increase. Construction activities contributing to this will include but not limited to the removal of existing vegetation, excavation for the removal existing slopes, and grading activities in the placement of new slopes. These potential temporary stormwater impacts can be mitigated by implementing standard BMPs recommended for a particular construction activity. For example construction scheduling should take into consideration anticipated rain events before planning land disturbance earthwork activities. Suggested temporary construction site BMPs that should be considered for the Project are listed in Table 2. Construction BMPs fall into one of six categories, 1. Erosion Control 2. Sediment Control 3. Tracking Control 4.Wind Erosion Control 5. Non-Stormwater Management Control. 6. Waste Management and Material Pollution Control. Non-Stormwater Management Control and Waste Management and Material Pollution Control BMP are not listed in Table 2 below.

Table 2 Potential Temporary Construction BMPs

Erosion Control BMPs	
EC-1 Scheduling	EC-2 Preservation of Existing Vegetation
EC-3 Hydraulic Mulch	EC-4 Hydroseeding
EC-7 Geotextiles and Mats	EC-8 Wood Mulching
EC-9 Earth Dikes and Drainage Swales	
Sediment Control BMPs	
SE-1 Silt Fence	SE-4 Check Dams
SE-5 Fiber Rolls	SE-7 Street Sweeping and Vacuuming
SE-10 Storm Drain Inlet Protection	
Wind Erosion Control Type BMPs	
WE-1 Wind Erosion Control	
Tracking Control	
TC-1 Stabilized Construction Entrance/Exit	

Additional temporary construction BMPs that should be considered for the Project are presented in the California Stormwater Quality Association (CASQA) *Construction BMP Handbook* (2015). The SWPPP prepared by the Contractor before the commencement of construction will detail actual implementation of the construction BMPs to match changes in field conditions and construction phasing of the Project.

6. REFERENCES

California Regional Water Quality Control Board San Francisco Bay Region. (November 19, 2015). *California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit*. Order R2-2015-0049, NPDES Permit No. CAS612008.

California Regional Water Quality Control Board San Francisco Bay Region (May 4, 2017). *San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan)*.

Caltrans Water Quality Planning Tool: http://www.water-programs.com/wqpt.htm

U.S. Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Federal Emergency Management Agency. *Flood Insurance Rate Map-Alameda County, California and Incorporated Areas, Panel 329 of 725.* Map No. 06001C0329G.

Alameda County Clean Water Program (October 31, 2017). *C.3 Stormwater Technical Guidance-A handbook for developers, builders and project applicants, Version 6*.

H.T. Harvey (May 12, 2017). *Biological Resources Technical Memorandum*

State Water Resources Control Board, Division of Water Quality (July 17, 2012). *National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities.* Order No. 2009-0009-DWQ (As amended by 2010-0014-DWQ and 2012-0006-DWQ), NPDES No. CAS000002.

Appendix A

NCRS Web Soil Survey

- **Appendix A.1 Hydraulic Soil Group**
- **Appendix A.2 Soil Erodibility Factor (K)**

Hydrologic Soil Group—Alameda Area, California

Map Scale: 1:12,900 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Alameda Area, California
Survey Area Data: Version 11, Sep 13, 2017

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

Date(s) aerial images were photographed: Jun 11, 2015—Jun 17, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CdB	Clear Lake clay, drained, 3 to 7 percent slopes	C	2.7	4.5%
DvC	Diablo clay, very deep, 3 to 15 percent slopes	C	30.1	51.1%
LaC	Linne clay loam, 3 to 15 percent slopes	C	12.6	21.5%
LaD	Linne clay loam, 15 to 30 percent slopes, MLRA 15	D	6.5	11.0%
RdA	Rincon clay loam, 0 to 3 percent slopes	C	1.4	2.3%
RdB	Rincon clay loam, 3 to 7 percent slopes	C	5.7	9.7%
Totals for Area of Interest			**58.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

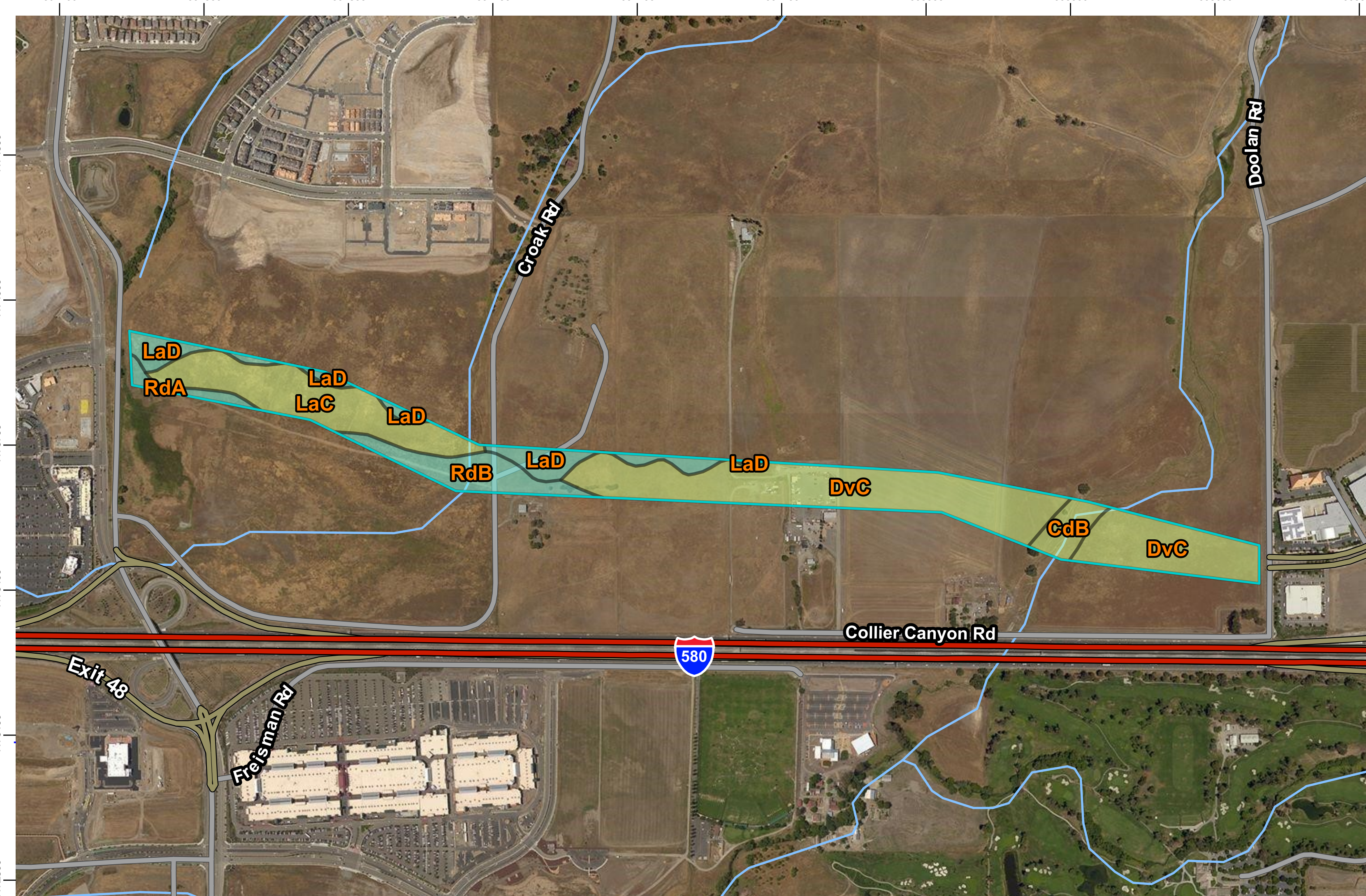
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

K Factor, Rock Free—Alameda Area, California



Map Scale: 1:12,900 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Soil Rating Lines

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Soil Rating Points

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Alameda Area, California
Survey Area Data: Version 11, Sep 13, 2017

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

Date(s) aerial images were photographed: Jun 11, 2015—Jun 17, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Rock Free

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CdB	Clear Lake clay, drained, 3 to 7 percent slopes	.24	2.7	4.5%
DvC	Diablo clay, very deep, 3 to 15 percent slopes	.24	30.1	51.1%
LaC	Linne clay loam, 3 to 15 percent slopes	.24	12.6	21.5%
LaD	Linne clay loam, 15 to 30 percent slopes, MLRA 15	.32	6.5	11.0%
RdA	Rincon clay loam, 0 to 3 percent slopes	.32	1.4	2.3%
RdB	Rincon clay loam, 3 to 7 percent slopes	.32	5.7	9.7%
Totals for Area of Interest			**58.9**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kf (rock free)" indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Appendix B

San Francisco Regional Water Board
Waterbodies Beneficial Uses Definition and Table

CHAPTER 2: BENEFICIAL USES

State policy for water quality control in California is directed toward achieving the highest water quality consistent with maximum benefit to the people of the state. Aquatic ecosystems and underground aquifers provide many different benefits to the people of the state. The beneficial uses described in detail in this chapter define the resources, services, and qualities of these aquatic systems that are the ultimate goals of protecting and achieving high water quality. The Water Board is charged with protecting all these uses from pollution and nuisance that may occur as a result of waste discharges in the region. Beneficial uses of waters of the State presented here serve as a basis for establishing water quality objectives and discharge prohibitions to attain these goals.

Beneficial use designations for any given water body do not rule out the possibility that other beneficial uses exist or have the potential to exist. Existing beneficial uses that have not been formally designated in this Basin Plan are protected whether or not they are identified. While the tables in this Chapter list a large, representative portion of the water bodies in our region, it is not practical to list each and every water body.

2.1 DEFINITIONS OF BENEFICIAL USES

The following definitions (in italic) for beneficial uses are applicable throughout the entire state. A brief description of the most important water quality requirements for each beneficial use follows each definition (in alphabetical order by abbreviation).

2.1.1 AGRICULTURAL SUPPLY (AGR)

Uses of water for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

The criteria discussed under municipal and domestic water supply (MUN) also effectively protect farmstead uses. To establish water quality criteria for livestock water supply, the Water Board must consider the relationship of water to the total diet, including water freely drunk, moisture content of feed, and interactions between irrigation water quality and feed quality. The University of California Cooperative Extension has developed threshold and limiting concentrations for livestock and irrigation water. Continued irrigation often leads to one or more of four types of hazards related to water quality and the nature of soils and crops. These hazards are (1) soluble salt accumulations, (2) chemical changes in the soil, (3) toxicity to crops, and (4) potential disease transmission to humans through reclaimed water use. Irrigation water classification systems, arable soil classification systems, and public health criteria related to reuse of wastewater have been developed with consideration given to these hazards.

2.1.2 AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE (ASBS)

Areas designated by the State Water Board.

These include marine life refuges, ecological reserves, and designated areas where the preservation and enhancement of natural resources requires special protection. In these areas, alteration of natural water quality is undesirable. The areas that have been designated as ASBS in this Region are Bird Rock, Point Reyes Headland Reserve and Extension, Double Point, Duxbury Reef Reserve and Extension, Farallon Islands, and James V. Fitzgerald Marine Reserve, depicted in Figure 2-1. The California Ocean Plan prohibits waste discharges into, and requires wastes to be discharged at a sufficient distance from, these areas to assure maintenance of natural water quality conditions. These areas have been designated as a subset of State Water Quality Protection Areas as per the Public Resources Code.

2.1.3 COLD FRESHWATER HABITAT (COLD)

Uses of water that support cold water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold freshwater habitats generally support trout and may support anadromous salmon and steelhead fisheries as well. Cold water habitats are commonly well-oxygenated. Life within these waters is relatively intolerant to environmental stresses. Often, soft waters feed cold water habitats. These waters render fish more susceptible to toxic metals, such as copper, because of their lower buffering capacity.

2.1.4 COMMERCIAL AND SPORT FISHING (COMM)

Uses of water for commercial or recreational collection of fish, shellfish, or other organisms, including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

To maintain fishing, the aquatic life habitats where fish reproduce and seek their food must be protected. Habitat protection is under descriptions of other beneficial uses.

2.1.5 ESTUARINE HABITAT (EST)

Uses of water that support estuarine ecosystems, including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds), and the propagation, sustenance, and migration of estuarine organisms.

Estuarine habitat provides an essential and unique habitat that serves to acclimate anadromous fishes (e.g., salmon, striped bass) migrating into fresh or marine water conditions. The protection of estuarine habitat is contingent upon (1) the maintenance of adequate Delta outflow to provide mixing and salinity control; and (2) provisions to protect wildlife habitat associated with marshlands and the Bay periphery (i.e., prevention of fill activities). Estuarine habitat is generally associated with moderate seasonal fluctuations in dissolved oxygen, pH, and temperature and with a wide range in turbidity.

2.1.6 FRESHWATER REPLENISHMENT (FRESH)

Uses of water for natural or artificial maintenance of surface water quantity or quality.

Fresh water inputs are important for maintaining salinity balance, flow, and/or water quantity for such surface water bodies as marshes, wetlands, and lakes.

2.1.7 GROUNDWATER RECHARGE (GWR)

Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting saltwater intrusion into freshwater aquifers.

The requirements for groundwater recharge operations generally reflect the future use to be made of the water stored underground. In some cases, recharge operations may be conducted to prevent seawater intrusion. In these cases, the quality of recharged waters may not directly affect quality at the wellfield being protected. Recharge operations are often limited by excessive suspended sediment or turbidity that can clog the surface of recharge pits, basins, or wells.

Under the state Antidegradation Policy, the quality of some of the waters of the state is higher than established by adopted policies. It is the intent of this policy to maintain that existing higher water quality to the maximum extent possible.

Requirements for groundwater recharge, therefore, shall impose the Best Available Technology (BAT) or Best Management Practices (BMPs) for control of the discharge as necessary to assure the highest quality consistent with maximum benefit to the people of the state. Additionally, it must be recognized that groundwater recharge occurs naturally in many areas from streams and reservoirs. This recharge may have little impact on the quality of groundwaters under normal circumstances, but it may act to transport pollutants from the recharging water body to the groundwater. Therefore, groundwater recharge must be considered when requirements are established.

2.1.8 INDUSTRIAL SERVICE SUPPLY (IND)

Uses of water for industrial activities that do not depend primarily on water quality, including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.

Most industrial service supplies have essentially no water quality limitations except for gross constraints, such as freedom from unusual debris.

2.1.9 MARINE HABITAT (MAR)

Uses of water that support marine ecosystems, including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

In many cases, the protection of marine habitat will be accomplished by measures that protect wildlife habitat generally, but more stringent criteria may be necessary for waterfowl marshes and other habitats, such as those for shellfish and marine fishes. Some marine habitats, such as important intertidal zones and kelp beds, may require special protection.

2.1.10 FISH MIGRATION (MIGR)

Uses of water that support habitats necessary for migration, acclimatization between fresh water and salt water, and protection of aquatic organisms that are temporary inhabitants of waters within the region.

The water quality provisions acceptable to cold water fish generally protect anadromous fish as well. However, particular attention must be paid to maintaining zones of passage. Any barrier to migration or free movement of migratory fish is harmful. Natural tidal movement in estuaries and unimpeded river flows are necessary to sustain migratory fish and their offspring. A water quality barrier, whether thermal, physical, or chemical, can destroy the integrity of the migration route and lead to the rapid decline of dependent fisheries.

Water quality may vary through a zone of passage as a result of natural or human- induced activities. Fresh water entering estuaries may float on the surface of the denser salt water or hug one shore as a result of density differences related to water temperature, salinity, or suspended matter.

2.1.11 MUNICIPAL AND DOMESTIC SUPPLY (MUN)

Uses of water for community, military, or individual water supply systems, including, but not limited to, drinking water supply.

The principal issues involving municipal water supply quality are (1) protection of public health; (2) aesthetic acceptability of the water; and (3) the economic impacts associated with treatment- or quality-related damages.

The health aspects broadly relate to: direct disease transmission, such as the possibility of contracting typhoid fever or cholera from contaminated water; toxic effects, such as links between nitrate and methemoglobinemia (blue babies); and increased susceptibility to disease, such as links between halogenated organic compounds and cancer.

Aesthetic acceptance varies widely depending on the nature of the supply source to which people have become accustomed. However, the parameters of general concern are excessive hardness, unpleasant odor or taste, turbidity, and color. In each case, treatment can improve acceptability although its cost may not be economically justified when alternative water supply sources of suitable quality are available.

Published water quality objectives give limits for known health-related constituents and most properties affecting public acceptance. These objectives for drinking water include the U.S. Environmental Protection Agency Drinking Water Standards and the California State Department of Health Services criteria.

2.1.12 NAVIGATION (NAV)

Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Navigation is a designated use where water is used for shipping, travel, or other transportation by private, military, or commercial vessels.

2.1.13 INDUSTRIAL PROCESS SUPPLY (PROC)

Uses of water for industrial activities that depend primarily on water quality.

Water quality requirements differ widely for the many industrial processes in use today. So many specific industrial processes exist with differing water quality requirements that no meaningful criteria can be established generally for quality of raw water supplies. Fortunately, this is not a serious shortcoming, since current water treatment technology can create desired product waters tailored for specific uses.

2.1.14 PRESERVATION OF RARE AND ENDANGERED SPECIES (RARE)

Uses of waters that support habitats necessary for the survival and successful maintenance of plant or animal species established under state and/or federal law as rare, threatened, or endangered.

The water quality criteria to be achieved that would encourage development and protection of rare and endangered species should be the same as those for protection of fish and wildlife habitats generally. However, where rare or endangered species exist, special control requirements may be necessary to assure attainment and maintenance of particular quality criteria, which may vary slightly with the environmental needs of each particular species. Criteria for species using areas of special biological significance should likewise be derived from the general criteria for the habitat types involved, with special management diligence given where required.

2.1.15 WATER CONTACT RECREATION (REC1)

Uses of water for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs.

Water contact implies a risk of waterborne disease transmission and involves human health; accordingly, criteria required to protect this use are more stringent than those for more casual water-oriented recreation.

Excessive algal growth has reduced the value of shoreline recreation areas in some cases, particularly for swimming. Where algal growths exist in nuisance proportions, particularly bluegreen algae, all recreational water uses, including fishing, tend to suffer.

One criterion to protect the aesthetic quality of waters used for recreation from excessive algal growth is based on chlorophyll a.

Public access to drinking water reservoirs is limited or prohibited by reservoir owner/operators for purposes of protecting drinking water quality and public health. In some cases, access to reservoir tributaries is also prohibited. For these water bodies, REC-1 is designated as E*, for the purpose of protecting water quality. No right to public access is intended by this designation.

2.1.16 NONCONTACT WATER RECREATION (REC2)

Uses of water for recreational activities involving proximity to water, but not normally involving contact with water where water ingestion is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Water quality considerations relevant to noncontact water recreation, such as hiking, camping, or boating, and those activities related to tide pool or other nature studies require protection of habitats and aesthetic features. In some cases, preservation of a natural wilderness condition is justified, particularly when nature study is a major dedicated use.

One criterion to protect the aesthetic quality of waters used for recreation from excessive algal growth is based on chlorophyll a.

2.1.17 SHELLFISH HARVESTING (SHELL)

Uses of water that support habitats suitable for the collection of crustaceans and filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes.

Shellfish harvesting areas require protection and management to preserve the resource and protect public health. The potential for disease transmission and direct poisoning of humans is of considerable concern in shellfish regulation. The bacteriological criteria for the open ocean, bays, and estuarine waters where shellfish cultivation and harvesting occur should conform with the standards described in the National Shellfish Sanitation Program, Manual of Operation.

Toxic metals can accumulate in shellfish. Mercury and cadmium are two metals known to have caused extremely disabling effects in humans who consumed shellfish that concentrated these elements from industrial waste discharges. Other elements, radioactive isotopes, and certain toxins produced by particular plankton species also concentrate in shellfish tissue. Documented cases of paralytic shellfish poisoning are not uncommon in California.

2.1.18 FISH SPAWNING (SPWN)

Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Dissolved oxygen levels in spawning areas should ideally approach saturation levels. Free movement of water is essential to maintain well-oxygenated conditions around eggs deposited in sediments. Water temperature, size distribution and organic content of sediments, water depth, and current velocity are also important determinants of spawning area adequacy.

2.1.19 WARM FRESHWATER HABITAT (WARM)

Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

The warm freshwater habitats supporting bass, bluegill, perch, and other fish are generally lakes and reservoirs, although some minor streams will serve this purpose where stream flow is sufficient to sustain the fishery. The habitat is also important to a variety of nonfish species, such as frogs, crayfish, and insects, which provide food for fish and small mammals. This habitat is less sensitive to environmental changes, but more diverse than the cold freshwater habitat, and natural fluctuations in temperature, dissolved oxygen, pH, and turbidity are usually greater.

2.1.20 WILDLIFE HABITAT (WILD)

Uses of waters that support wildlife habitats, including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.

The two most important types of wildlife habitat are riparian and wetland habitats. These habitats can be threatened by development, erosion, and sedimentation, as well as by poor water quality.

The water quality requirements of wildlife pertain to the water directly ingested, the aquatic habitat itself, and the effect of water quality on the production of food materials. Waterfowl habitat is particularly sensitive to changes in water quality. Dissolved oxygen, pH, alkalinity, salinity, turbidity, settleable matter, oil, toxicants, and specific disease organisms are water quality characteristics particularly important to waterfowl habitat. Dissolved oxygen is needed in waterfowl habitats to suppress development of botulism organisms; botulism has killed millions of waterfowl. It is particularly important to maintain adequate circulation and aerobic conditions in shallow fringe areas of ponds or reservoirs where botulism has caused problems.

2.2 EXISTING AND POTENTIAL BENEFICIAL USES

2.2.1 SURFACE WATERS

Surface waters in the Region consist of non-tidal wetlands, rivers, streams, and lakes (collectively described as inland surface waters), estuarine wetlands known as baylands, estuarine waters, and coastal waters. In this Region, estuarine waters consist of the Bay system including intertidal, tidal, and subtidal habitats from the Golden Gate to the Region's boundary near Pittsburg and the lower portions of streams that are affected by tidal hydrology, such as the Napa and Petaluma rivers in the north and Coyote and San Francisquito creeks in the south.

Inland surface waters support or could support most of the beneficial uses described above. The specific beneficial uses for inland streams include municipal and domestic supply (MUN), agricultural supply (AGR), commercial and sport fishing (COMM), freshwater replenishment (FRESH), industrial process supply (PRO), groundwater recharge (GWR), preservation of rare and endangered species (RARE), water contact recreation (REC1), noncontact water recreation (REC2), wildlife habitat (WILD), cold freshwater habitat (COLD), warm freshwater habitat (WARM), fish migration (MIGR), and fish spawning (SPWN).

The San Francisco Bay Estuary supports estuarine habitat (EST), industrial service supply (IND), and navigation (NAV) in addition to COMM, RARE, REC1, REC2, WILD, MIGR, and SPWN.

Coastal waters' beneficial uses include water contact recreation (REC1); noncontact water recreation (REC2); industrial service supply (IND); navigation (NAV); marine habitat (MAR); shellfish harvesting (SHELL); commercial and sport fishing (COMM); wildlife habitat (WILD), fish migration (MIGR), fish spawning (SPWN), and preservation of rare and endangered species (RARE). In addition, the California coastline within the Region is endowed with exceptional scenic beauty.

The beneficial uses of any specifically identified water body generally apply to all its tributaries. In some cases a beneficial use may not be applicable to the entire body of water, such as navigation in Richardson Bay or shellfish harvesting in the Pacific Ocean. In these cases, the Water Board's judgment regarding water quality control measures necessary to protect beneficial uses will be applied.

Beneficial uses of streams that have intermittent flows, as is typical of many streams in the region, must be protected throughout the year and are designated as "existing."

Beneficial uses of each significant water body have been identified and are organized according to the seven major Hydrologic Planning Areas within the Region (Figure 2-2). The maps locating each water body (Figures 2-3 through 2-9b) were produced using a geographical information system (GIS) at the Water Board. The maps use the hydrologic basin information compiled by the California Interagency Watershed map, with supplemental information from the Oakland Museum of California Creek and Watershed Map series, the Contra Costa County Watershed Atlas, and the San Francisco Estuary Institute EcoAtlas. More detailed representations of each location can be created using this GIS version.

Table 2-1 contains the beneficial uses for many surface water bodies in the Region, organized geographically by the Region's seven Hydrologic Planning Areas. Within each Hydrologic Planning Area, water bodies are listed geographically, with tributaries indented below their receiving water body. In cases where a water body shares the same name with another water body (e.g., Redwood Creek), the location of the water body (county and/or other identifier) is given in parentheses. An alternative name for a water body, where known, is also shown in parentheses. In Table 2-1, beneficial uses are indicated as follows:

E – indicates the beneficial use exists in the water body.

E* – indicates public access to the water body is limited or prohibited for purposes of protecting drinking water quality and public health. REC-1 is designated as E* for the purpose of protecting water quality. No right to public access is intended by this designation.

P – indicates the water body could potentially support the beneficial use.

2.2.2 GROUNDWATER

Groundwater is defined as subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated. Where groundwater occurs in a saturated geologic unit that contains sufficient permeable thickness to yield significant quantities of water to wells and springs, it can be defined as an aquifer. A groundwater basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers.

Water-bearing geologic units occur within groundwater basins in the Region that do not meet the definition of an aquifer. For instance, there are shallow, low permeability zones throughout the Region that have extremely low water yields. Groundwater may also occur outside of currently identified basins. Therefore, for basin planning purposes, the term "groundwater" includes all subsurface waters, whether or not these waters meet the classic definition of an aquifer or occur within identified groundwater basins.

The California Department of Water Resources (DWR) evaluated the characteristics of groundwater basins in the Region and throughout the state and summarized the results in California's Groundwater, Bulletin 118 (2003). Of special importance to the Region are the 28 groundwater basins and seven sub-basins classified by DWR that produce, or potentially could produce, significant amounts of groundwater (Figures 2-10 and 2-10A-D). The Water Board maintains a GIS for all water bodies in the Region and has the capacity to present information on each basin at a much higher level of resolution than is depicted in Figures 2-10A-D.

Existing and potential beneficial uses applicable to groundwater in the Region include municipal and domestic water supply (MUN), industrial water supply (IND), industrial process supply (PRO), agricultural water supply (AGR), groundwater recharge (GWR), and freshwater replenishment to surface waters (FRESH). Table 2-2 lists the 28 identified groundwater basins and seven sub-basins located in the Region and their existing and potential beneficial uses.

Unless otherwise designated by the Water Board, all groundwater is considered suitable, or potentially suitable, for municipal or domestic water supply (MUN). In making any exceptions, the Water Board will consider the criteria referenced in State Water Board Resolution No. 88-63 and Water Board Resolution No. 89-39, "Sources of Drinking Water," where:

- The total dissolved solids exceed 3,000 milligrams per liter (mg/L) (5,000 microSiemens per centimeter, µS/cm, electrical conductivity), and it is not reasonably expected by the Water Board that the groundwater could supply a public water system; or
- There is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot reasonably be treated for domestic use using either Best Management Practices (BMPs) or best economically achievable treatment practices; or
- The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day; or
- The aquifer is regulated as a geothermal energy-producing source or has been exempted administratively pursuant to 40 Code of Federal Regulations (CFR) Part 146.4 for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy, provided that these fluids do not constitute a hazardous waste under 40 CFR Part 261.3.

2.2.3 WETLANDS

Federal administrative law (e.g., 40 CFR Part 122.2, revised December 22, 1993) defines wetlands as waters of the United States. National waters include waters of the State of California, defined by the Porter-Cologne Act as "any water, surface or underground, including saline waters, within the boundaries of the State" (California Water Code §13050[e]). Wetland water quality control is therefore clearly within the jurisdiction of the State Water Board and Regional Water Boards.

Wetlands are further defined in 40 CFR 122.2 as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

The Water Board recognizes that wetlands frequently include areas commonly referred to as saltwater marshes, freshwater marshes, open or closed brackish water marshes, mudflats, sandflats, unvegetated seasonally ponded areas, vegetated shallows, sloughs, wet meadows, playa lakes, natural ponds, vernal pools, diked baylands, seasonal wetlands, floodplains, and riparian woodlands.

Mudflats make up one of the largest and most important habitat types in the Estuary. Snails, clams, worms, and other animals convert the rich organic matter in the mud bottom to food for fish, crabs, and birds.

Mudflats generally support a variety of edible shellfish, and many species of fish rely heavily on the mudflats during at least a part of their life cycle. Additionally, San Francisco Bay mudflats are one of the most important habitats on the coast of California for millions of migrating shorebirds.

Another important characteristic of the Estuary is the fresh, brackish, and salt water marshes around the Bay's margins. These highly complex communities are recognized as vital components of the Bay system's ecology. Most marshes around the Bay have been destroyed through filling and development. The protection, preservation, and restoration of the remaining marsh communities are essential for maintaining the ecological integrity of the Estuary.

Identifying wetlands may be complicated by such factors as the seasonality of rainfall in the Region. Therefore, in identifying wetlands considered waters of the United States, the Water Board will consider such indicators as hydrology, hydrophytic plants, and/or hydric soils for the purpose of mapping and inventorying wetlands. The Water Board will, in general, rely on the federal manual for wetland delineation in the Region when issuing Clean Water Act Section 401 water quality certifications (U.S. Army Corps of Engineers (Corps) Wetlands Delineation Manual, 1987). In the rare cases where the U.S. EPA and Corps guidelines disagree on the boundaries for federal jurisdictional wetlands, the Water Board will rely on the wetlands delineation made by the U.S. EPA or the California Department of Fish and Game (CDFG). For the purpose of mapping and inventorying wetlands, the Water Board will rely on the protocols and naming conventions of the National Wetlands Inventory (NWI) prepared by the U.S. Fish and Wildlife Service (USFWS).

Many individual wetlands provide multiple benefits depending on the wetland type and location. There are many potential beneficial uses of wetlands, including Wildlife Habitat (WILD); Preservation of Rare and Endangered Species (RARE); Shellfish Harvesting (SHELL); Water Contact Recreation (REC1); Noncontact Water Recreation (REC2); Commercial, and Sport Fishing (COMM); Marine Habitat (MAR); Fish Migration (MIGR); Fish Spawning (SPAWN); and Estuarine Habitat (EST). Some of these general beneficial uses can be further described in terms of their component wetland function. For example, many wetlands that provide groundwater recharge (GWR) also provide flood control, pollution control, erosion control, and stream baseflow.

Table 2-3 shows how beneficial uses are associated with different wetland types. Table 2-4 lists and specifies beneficial uses for 34 significant wetland areas within the Region; generalized locations of these wetlands are shown in Figure 2-11. It should be noted that most of the wetlands listed in Table 2-4 are saltwater marshes, and that the list is not comprehensive.

The Water Board has participated in completing the Baylands Ecosystem Habitat Goals Report (1999) and the Baylands Ecosystem Species and Community Profiles (2000), which were written by scientists and managers in the Region in order to recommend sound wetland restoration strategies. Other efforts around the Bay to locate wetland sites include San Francisco Estuary Institute's (SFEI) EcoAtlas Baylands Maps (Baylands Maps) and Bay Area Wetlands Project Tracker (Wetlands Tracker), and the Wetland Tracker managed by the San Francisco Bay Joint Venture. Because of the large number of small and non-contiguous wetlands, it is not practical to delineate and specify beneficial uses of every wetland area. Therefore, beneficial uses may be determined site specifically, as needed. Chapter 4 of this Plan contains additional information on the process used to determine beneficial uses for specific wetland sites.

FIGURES

TABLES

COUNTY Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
ALAMEDA COUNTY, continued																			
Upper San Leandro Reservoir		E							E					E	E	E	E*	P	
Kaiser Creek			E						E					E	E	E	E	E	
Buckhorn Creek			E						E					E	E	E	E	E	
Redwood Creek (Alameda)			E						E					E	E	E	E	E	
Moraga Creek (in Contra Costa Co.)			E						E					E	E	E	E	E	
Estudillo Canal															E	E	E	E	
San Lorenzo Creek		E	E	E					E			E		E	E	E	E	E	
Don Castro Reservoir							E		E					E	E	E	E	E	
Castro Valley Creek									E				E		E	E	E	E	
Crow Creek									E			E	E	E	E	E	E	E	
Cull Creek									E				E	E	E	E	E	E	
Cull Canyon Reservoir							E		E					E	E	E	E	E	
Bolinas Creek									E						E	E	E	E	
Norris Creek									E						E	E	E	E	
Palomares Creek									E			E		E	E	E	E	E	
Eden Canyon Creek									E						E	E	E	E	
Hollis Creek									E				E		E	E	E	E	
Sulphur Creek (west Alameda)															E	E	E	E	
Mount Eden Creek										E						E	E	E	
Old Alameda Creek										E						E	E	E	
Ward Creek															E	E	E	E	
Zeile Creek															E	E	E	E	
Alameda Creek Quarry Ponds				E			E		E						E	E	E	E	
Coyote Hills Slough										E		E	E	E		E	E	E	
Alameda Creek	E			E			E		E			E	E	E	E	E	E	E	
Crandall Creek															E	E	E	E	
Dry Creek (Alameda, low in watershed)													E		E	E	E	E	
Stonybrook Creek									E			E	E	E	E	E	E	E	
Sinbad Creek									E			E	E	E	E	E	E	E	
San Antonio Creek (Alameda)			E						E				E	E	E	E	E*	E	
San Antonio Reservoir		E							E				E	E	E	E	E*	E	

E: Existing beneficial use   E*: Water quality objectives apply; water contact recreation is prohibited or limited to protect public health   P: Potential beneficial use

SOUTH BAY BASIN

COUNTY Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
ALAMEDA COUNTY, continued																			
Indian Creek (central Alameda)			E						E				E	E	E	E	E*	E	
La Costa Creek			E						E				E	E	E	E	E	E	
Arroyo de la Laguna				E					E			E		E	E	E	E	E	
Vallecitos Creek															E	E	E	E	
Happy Valley Creek															E	E	E	E	
Sycamore Creek															E	E	E	E	
Arroyo del Valle		E		E					E			P	E	E	E	E	E	E	
Shadow Cliffs Reservoir				E			E		E					E	E	E	E	E	
Del Valle Reservoir		E					E		E					E	E	E	E	E	
Arroyo Mocho				E					E			E		E	E	E	E	E	
Tassajara Creek				E					P			E	E	E	E	E	E	E	
Arroyo las Positas				E					E			E	E	E	E	E	E	E	
Cottonwood Creek													E		E	E	E	E	
Collier Canyon Creek													E		E	E	E	E	
Cayetano Creek													E		E	E	E	E	
Arroyo Seco (Alameda)				E					E			E	E	E	E	E	E	E	
Altamont Creek				E					E				E		E	E	E	E	
Alamo Canal				E					P			E		E	E	E	E	E	
Alamo Creek				E					P			E	E	E	E	E	E	E	
Dublin Creek															E	E	E	E	
Martin Canyon Creek															E	E	E	E	
South San Ramon Creek															E	E	E	E	
SANTA CLARA COUNTY																			
Tributary to Alameda Creek:																			
Calaveras Creek			E						E				E	E	E	E	E	E	
Calaveras Reservoir		E							E				E	E	E	E	E*	E	
Arroyo Hondo		E	E						E				E	E	E	E	E	E	
Isabel Creek		E	E						E					E	E	E	E	E	
Smith Creek		E	E						E					E	E	E	E	E	
Sulphur Creek (Santa Clara)		E	E						E					E	E	E	E	E	
Colorado Creek *Trib. to Arroyo del Val*			E						E						E	E	E	E	

E: Existing beneficial use   E*: Water quality objectives apply; water contact recreation is prohibited or limited to protect public health   P: Potential beneficial use

Appendix C

San Francisco Regional Water Board
Water Quality Objectives
Surface Waters & Groundwater

CHAPTER 3: WATER QUALITY OBJECTIVES

The overall goals of water quality regulation are to protect and maintain thriving aquatic ecosystems and the resources those systems provide to society and to accomplish these in an economically and socially sound manner. California's regulatory framework uses water quality objectives both to define appropriate levels of environmental quality and to control activities that can adversely affect aquatic systems.

3.1 WATER QUALITY OBJECTIVES

There are two types of objectives: narrative and numerical. Narrative objectives present general descriptions of water quality that must be attained through pollutant control measures and watershed management. They also serve as the basis for the development of detailed numerical objectives.

Historically, numerical objectives were developed primarily to limit the adverse effect of pollutants in the water column. Two decades of regulatory experience and extensive research in environmental science have demonstrated that beneficial uses are not fully protected unless pollutant levels in all parts of the aquatic system are also monitored and controlled. The Regional Board is actively working towards an integrated set of objectives, including numerical sediment objectives, that will ensure the protection of all current and potential beneficial uses.

Numerical objectives typically describe pollutant concentrations, physical/chemical conditions of the water itself, and the toxicity of the water to aquatic organisms. These objectives are designed to represent the maximum amount of pollutants that can remain in the water column without causing any adverse effect on organisms using the aquatic system as habitat, on people consuming those organisms or water, and on other current or potential beneficial uses (as described in Chapter 2).

The technical bases of the region's water quality objectives include extensive biological, chemical, and physical partitioning information reported in the scientific literature, national water quality criteria, studies conducted by other agencies, and information gained from local environmental and discharge monitoring (as described in Chapter 6). The Regional Board recognizes that limited information exists in some cases, making it difficult to establish definitive numerical objectives, but the Regional Board believes its conservative approach to setting objectives has been proper. In addition to the technical review, the overall feasibility of reaching objectives in terms of technological, institutional, economic, and administrative factors is considered at many different stages of objective derivation and implementation of the water quality control plan.

Together, the narrative and numerical objectives define the level of water quality that shall be maintained within the region. In instances where water quality is better than that prescribed by the objectives, the state Antidegradation Policy applies (State Board Resolution 68-16: Statement of Policy With Respect to Maintaining High Quality of Waters in California). This policy is aimed at protecting relatively uncontaminated aquatic systems where they exist and preventing further degradation. The state's Antidegradation Policy is consistent with the federal Antidegradation Policy, as interpreted by the State Water Resources Control Board in State Board Order No. 86-17.

When uncontrollable water quality factors result in the degradation of water quality beyond the levels or limits established herein as water quality objectives, the Regional Board will conduct a case-by-case analysis of the benefits and costs of preventing further degradation. In cases where this analysis indicates that beneficial uses will be adversely impacted by allowing further degradation, then the Regional Board will not allow controllable water quality factors to cause any further degradation of water quality. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the state and that may be reasonably controlled.

The Regional Board establishes and enforces waste discharge requirements for point and nonpoint source of pollutants at levels necessary to meet numerical and narrative water quality objectives. In setting waste discharge requirements, the Regional Board will consider, among other things, the potential impact on beneficial uses within the area of influence of the discharge, the existing quality of receiving waters, and the appropriate water quality objectives.

In general, the objectives are intended to govern the concentration of pollutant constituents in the main water mass. The same objectives cannot be applied at or immediately adjacent to submerged effluent discharge structures. Zones of initial dilution within which higher concentrations can be tolerated will be allowed for such discharges.

For a submerged buoyant discharge, characteristic of most municipal and industrial wastes that are released from submerged outfalls, the momentum of the discharge and its initial buoyancy act together to produce turbulent mixing. Initial dilution in this case is completed when the diluting wastewater ceases to rise in the water column and first begins to spread horizontally.

For shallow water submerged discharges, surface discharges, and nonbuoyant discharges, characteristic of cooling water wastes and some individual discharges, turbulent mixing results primarily from the momentum of discharge. Initial dilution, in these cases, is considered to be completed when the momentum-induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution.

Compliance with water quality objectives may be prohibitively expensive or technically impossible in some cases. The Regional Board will consider modification of specific water quality objectives as long as the discharger can demonstrate that the alternate objective will protect existing beneficial uses, is scientifically defensible, and is consistent with the state Antidegradation Policy. This exception clause properly indicates that the Regional Board will conservatively compare benefits and costs in these cases because of the difficulty in quantifying beneficial uses.

These water quality objectives are considered necessary to protect the present and potential beneficial uses described in Chapter 2 of this Plan and to protect existing high quality waters of the state. These objectives will be achieved primarily through establishing and enforcing waste discharge requirements and by implementing this water quality control plan.

3.2 OBJECTIVES FOR OCEAN WATERS

The provisions of the State Board's "Water Quality Control Plan for Ocean Waters of California" (Ocean Plan) and "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" (Thermal Plan) and any revision to them will apply to ocean waters. These plans describe objectives and effluent limitations for ocean waters.

3.3 OBJECTIVES FOR SURFACE WATERS

The following objectives apply to all surface waters within the region, except the Pacific Ocean.

3.3.1 BACTERIA

Table 3-1 provides a summary of the bacterial water quality objectives and identifies the sources of those objectives. Table 3-2 summarizes U.S. EPA's water quality criteria for water contact recreation based on the frequency of use a particular area receives. These criteria will be used to differentiate between pollution sources or to supplement objectives for water contact recreation.

3.3.3.1 Implementation Provisions for Water Contact Recreation Bacteria Objectives

Water quality objectives for bacteria in Table 3-1 shall be strictly applied except when otherwise provided for in a TMDL. In the context of a TMDL, the Water Board may implement the objectives in fresh and marine waters by using a “reference system and antidegradation approach” as discussed below. Implementation of water quality objectives for bacteria using a “reference system and antidegradation approach” requires control of bacteria from all anthropogenic sources so that bacteriological water quality is consistent with that of a reference system. A reference system is defined as an area (e.g., a subwatershed or catchment) and associated monitoring point(s) that is minimally impacted by human activities that potentially affect bacteria densities in the reference receiving water body.

This approach recognizes that there are natural sources of bacteria (defined as non-anthropogenic sources) that may cause or contribute to exceedances of the objectives for indicator bacteria. It also avoids requiring treatment or diversion of water bodies or treatment of natural sources of bacteria from undeveloped areas. Such requirements, if imposed by the Water Board, could have the potential to adversely affect valuable aquatic life and wildlife beneficial uses supported by water bodies in the region.

Under the reference system approach, a certain frequency of exceedance of the single-sample objectives shall be permitted. The permitted number of exceedances shall be based on the observed exceedance frequency in a selected reference system(s) or the targeted water body, whichever is less. The “reference system and antidegradation approach” ensures that bacteriological water quality is at least as good as that of a reference system and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of the selected reference system(s).

The appropriateness of this approach, the specific exceedance frequencies to be permitted under it, and the permittees to whom it would apply will be evaluated within the context of TMDL development for a specific water body, and decided by the Water Board when considering adoption of a TMDL. These implementation provisions may only be used within the context of a TMDL addressing municipal stormwater (including discharges regulated under statewide municipal NPDES waste discharge requirements), discharges from confined animal facilities, and discharges from nonpoint sources.

3.3.2 BIOACCUMULATION

Many pollutants can accumulate on particles, in sediment, or bioaccumulate in fish and other aquatic organisms. Controllable water quality factors shall not cause a detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life. Effects on aquatic organisms, wildlife, and human health will be considered.

3.3.3 BIOSTIMULATORY SUBSTANCES

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses. Changes in chlorophyll a and associated phytoplankton communities follow complex dynamics that are sometimes associated with a discharge of biostimulatory substances. Irregular and extreme levels of chlorophyll a or phytoplankton blooms may indicate exceedance of this objective and require investigation.

3.3.4 COLOR

Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.

3.3.5 DISSOLVED OXYGEN

For all tidal waters, the following objectives shall apply:

In the Bay:

Downstream of Carquinez Bridge	5.0 mg/l minimum
Upstream of Carquinez Bridge	7.0 mg/l minimum

For nontidal waters, the following objectives shall apply:

Waters designated as:

Cold water habitat	7.0 mg/l minimum
Warm water habitat	5.0 mg/l minimum

The median dissolved oxygen concentration for any three consecutive months shall not be less than 80 percent of the dissolved oxygen content at saturation.

Dissolved oxygen is a general index of the state of the health of receiving waters. Although minimum concentrations of 5 mg/l and 7 mg/l are frequently used as objectives to protect fish life, higher concentrations are generally desirable to protect sensitive aquatic forms. In areas unaffected by waste discharges, a level of about 85 percent of oxygen saturation exists. A three-month median objective of 80 percent of oxygen saturation allows for some degradation from this level, but still requires a consistently high oxygen content in the receiving water.

3.3.6 FLOATING MATERIAL

Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.

3.3.7 OIL AND GREASE

Waters shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.

3.3.8 POPULATION AND COMMUNITY ECOLOGY

All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce significant alterations in population or community ecology or receiving water biota. In addition, the health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those for the same waters in areas unaffected by controllable water quality factors.

3.3.9 pH

The pH shall not be depressed below 6.5 nor raised above 8.5. This encompasses the pH range usually found in waters within the basin. Controllable water quality factors shall not cause changes greater than 0.5 units in normal ambient pH levels.

3.3.10 RADIOACTIVITY

Radionuclides shall not be present in concentrations that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life. Waters designated for use as domestic or municipal supply shall not contain concentrations of radionuclides in excess of the limits specified in Table 4 of Section 64443 (Radioactivity) of Title 22 of the California Code of Regulations (CCR), which is incorporated by reference into this Plan. This incorporation is prospective, including future changes to the incorporated provisions as the changes take effect (see Table 3-5).

3.3.11 SALINITY

Controllable water quality factors shall not increase the total dissolved solids or salinity of waters of the state so as to adversely affect beneficial uses, particularly fish migration and estuarine habitat.

3.3.12 SEDIMENT

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

Controllable water quality factors shall not cause a detrimental increase in the concentrations of toxic pollutants in sediments or aquatic life.

3.3.13 SETTLEABLE MATERIAL

Waters shall not contain substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses.

3.3.14 SUSPENDED MATERIAL

Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

3.3.15 SULFIDE

All water shall be free from dissolved sulfide concentrations above natural background levels. Sulfide occurs in Bay muds as a result of bacterial action on organic matter in an anaerobic environment.

Concentrations of only a few hundredths of a milligram per liter can cause a noticeable odor or be toxic to aquatic life. Violation of the sulfide objective will reflect violation of dissolved oxygen objectives as sulfides cannot exist to a significant degree in an oxygenated environment.

3.3.16 TASTES AND ODORS

Waters shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, that cause nuisance, or that adversely affect beneficial uses.

3.3.17 TEMPERATURE

Temperature objectives for enclosed bays and estuaries are as specified in the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California," including any revisions to the plan.

In addition, the following temperature objectives apply to surface waters:

- The natural receiving water temperature of inland surface waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.
- The temperature of any cold or warm freshwater habitat shall not be increased by more than 5°F (2.8°C) above natural receiving water temperature

3.3.18 TOXICITY

All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms. Detrimental responses include, but are not limited to, decreased growth rate and decreased reproductive success of resident or indicator species. There shall be no acute toxicity in ambient waters. Acute toxicity is defined as a median of less than 90 percent survival, or less than 70 percent survival, 10 percent of the time, of test organisms in a 96-hour static or continuous flow test.

There shall be no chronic toxicity in ambient waters. Chronic toxicity is a detrimental biological effect on growth rate, reproduction, fertilization success, larval development, population abundance, community composition, or any other relevant measure of the health of an organism, population, or community.

Attainment of this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, or toxicity tests (including those described in Chapter 4), or other methods selected by the Water Board. The Water Board will also consider other relevant information and numeric criteria and guidelines for toxic substances developed by other agencies as appropriate.

The health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those for the same waters in areas unaffected by controllable water quality factors.

3.3.19 TURBIDITY

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases from normal background light penetration or turbidity relatable to waste discharge shall not be greater than 10 percent in areas where natural turbidity is greater than 50 NTU.

3.3.20 UN-IONIZED AMMONIA

The discharge of wastes shall not cause receiving waters to contain concentrations of un-ionized ammonia in excess of the following limits (in mg/l as N):

Annual Median	0.025
Maximum, Central Bay (as depicted in Figure 2-5) and upstream	0.16
Maximum, Lower Bay (as depicted in Figures 2-6 and 2-7):	0.4

The intent of this objective is to protect against the chronic toxic effects of ammonia in the receiving waters. An ammonia objective is needed for the following reasons:

- Ammonia (specifically un-ionized ammonia) is a demonstrated toxicant. Ammonia is generally accepted as one of the principle toxicants in municipal waste discharges. Some industries also discharge significant quantities of ammonia.

- Exceptions to the effluent toxicity limitations in Chapter 4 of the Plan allow for the discharge of ammonia in toxic amounts. In most instances, ammonia will be diluted or degraded to a nontoxic state fairly rapidly. However, this does not occur in all cases, the South Bay being a notable example. The ammonia limit is recommended in order to preclude any build up of ammonia in the receiving water.
- A more stringent maximum objective is desirable for the northern reach of the Bay for the protection of the migratory corridor running through Central Bay, San Pablo Bay, and upstream reaches.

3.3.21 OBJECTIVES FOR SPECIFIC CHEMICAL CONSTITUENTS

Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use. Water quality objectives for selected toxic pollutants for surface waters are given in Tables 3-3, 3-3A, 3-3B, 3-3C, 3-4 and 3-4A.

The Water Board intends to work towards the derivation of site-specific objectives for the Bay-Delta estuarine system. Site-specific objectives to be considered by the Water Board shall be developed in accordance with the provisions of the federal Clean Water Act, the State Water Code, State Board water quality control plans, and this Plan. These site-specific objectives will take into consideration factors such as all available scientific information and monitoring data and the latest U.S. EPA guidance, and local environmental conditions and impacts caused by bioaccumulation. The objectives in Tables 3-3 and 3-4 apply throughout the region except as otherwise indicated in the tables or when site-specific objectives for the pollutant parameter have been adopted. Site-specific objectives have been adopted for copper in segments of San Francisco Bay (see Figure 7.2-1-01), for nickel in South San Francisco Bay (Table 3-3A), and for cyanide in all San Francisco Bay segments (Table 3-3C). Objectives for mercury that apply to San Francisco Bay are listed in Table 3-3B. Objectives for mercury that apply to Walker Creek, Soulajule Reservoir, and their tributaries, and to waters of the Guadalupe River watershed are listed in Table 3-4A.

South San Francisco Bay south of the Dumbarton Bridge is a unique, water-quality-limited, hydrodynamic and biological environment that merits continued special attention by the Water Board. Controlling urban and upland runoff sources is critical to the success of maintaining water quality in this portion of the Bay. Site-specific water quality objectives have been adopted for dissolved copper and nickel in this Bay segment. Site-specific objectives may be appropriate for other pollutants of concern, but this determination will be made on a case-by-case basis, and after it has been demonstrated that all other reasonable treatment, source control and pollution prevention measures have been exhausted. The Water Board will determine whether revised water quality objectives and/or effluent limitations are appropriate based on sound technical information and scientific studies, stakeholder input, and the need for flexibility to address priority problems in the watershed.

3.3.22 CONSTITUENTS OF CONCERN FOR MUNICIPAL AND AGRICULTURAL WATER SUPPLIES

At a minimum, surface waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of constituents in excess of the maximum (MCLs) or secondary maximum contaminant levels (SMCLs) specified in the following provisions of Title 22, which are incorporated by reference into this plan: Table 64431-A (Inorganic Chemicals) of Section 64431, and Table 64433.2-A (Fluoride) of Section 64433.2, Table 64444-A (Organic Chemicals) of Section 64444, and Table 64449-A (SMCLs-Consumer Acceptance Limits) and 64449-B (SMCLs-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. Table 3-5 contains water quality objectives for municipal supply, including the MCLs contained in various sections of Title 22 as of the adoption of this plan.

At a minimum, surface waters designated for use as agricultural supply (AGR) shall not contain concentrations of constituents in excess of the levels specified in Table 3-6.

3.4 OBJECTIVES FOR GROUNDWATER

Groundwater objectives consist primarily of narrative objectives combined with a limited number of numerical objectives. Additionally, the Water Board will establish basin- and/or site-specific numerical groundwater objectives as necessary. For example, the Water Board has groundwater basin-specific objectives for the Alameda Creek watershed above Niles to include the Livermore-Amador Valley as shown in Table 3-7.

The maintenance of existing high quality of groundwater (i.e., "background") is the primary groundwater objective.

In addition, at a minimum, groundwater shall not contain concentrations of bacteria, chemical constituents, radioactivity, or substances producing taste and odor in excess of the objectives described below unless naturally occurring background concentrations are greater. Under existing law, the Water Board regulates waste discharges to land that could affect water quality, including both groundwater and surface water quality. Waste discharges that reach groundwater are regulated to protect both groundwater and any surface water in continuity with groundwater. Waste discharges that affect groundwater that is in continuity with surface water cannot cause violations of any applicable surface water standards.

3.4.1 BACTERIA

In groundwater with a beneficial use of municipal and domestic supply, the median of the most probable number of coliform organisms over any seven-day period shall be less than 1.1 most probable number per 100 milliliters (MPN/100 mL) (based on multiple tube fermentation technique; equivalent test results based on other analytical techniques as specified in the National Primary Drinking Water Regulation, 40 CFR, Part 141.21 (f), revised June 10, 1992, are acceptable).

3.4.2 ORGANIC AND INORGANIC CHEMICAL CONSTITUENTS

All groundwater shall be maintained free of organic and inorganic chemical constituents in concentrations that adversely affect beneficial uses. To evaluate compliance with water quality objectives, the Water Board will consider all relevant and scientifically valid evidence, including relevant and scientifically valid numerical criteria and guidelines developed and/or published by other agencies and organizations (e.g., U.S. Environmental Protection Agency (U.S. EPA), the State Water Board, California Department of Health Services (DHS), U.S. Food and Drug

Administration, National Academy of Sciences, California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA), U.S. Agency for Toxic Substances and Disease Registry, Cal/EPA Department of Toxic Substances Control (DTSC), and other appropriate organizations.)

At a minimum, groundwater designated for use as domestic or municipal supply (MUN) shall not contain concentrations of constituents in excess of the maximum (MCLs) or secondary maximum contaminant levels (SMCLs) specified in the following provisions of Title 22, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) of Section 64431, Table 64433.2-A (Fluoride) of Section 64433.2, and Table 64444-A (Organic Chemicals) of Section 64444. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

Groundwater with a beneficial use of agricultural supply shall not contain concentrations of chemical constituents in amounts that adversely affect such beneficial use. In determining compliance with this objective, the Water Board will consider as evidence relevant and scientifically valid water quality goals from sources such as the Food and Agricultural Organizations of the United Nations; University of California Cooperative Extension, Committee of Experts; and McKee and Wolf's "Water Quality Criteria," as well as other relevant and scientifically valid evidence. At a minimum, groundwater designated for use as agricultural supply (AGR) shall not contain concentrations of constituents in excess of the levels specified in Table 3-6.

Groundwater with a beneficial use of freshwater replenishment shall not contain concentrations of chemicals in amounts that will adversely affect the beneficial use of the receiving surface water.

Groundwater with a beneficial use of industrial service supply or industrial process supply shall not contain pollutant levels that impair current or potential industrial uses.

3.4.3 RADIOACTIVITY

At a minimum, groundwater designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the MCLs specified in Table 4 (Radioactivity) of Section 64443 of Title 22, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

3.4.4 TASTE AND ODOR

Groundwater designated for use as domestic or municipal supply (MUN) shall not contain taste- or odor-producing substances in concentrations that cause a nuisance or adversely affect beneficial uses. At a minimum, groundwater designated for use as domestic or municipal supply shall not contain concentrations in excess of the SMCLs specified in Tables 64449-A (Secondary MCLs-Consumer Acceptance Limits) and 64449-B (Secondary MCLs-Ranges) of Section 64449 of Title 22, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

3.5 OBJECTIVES FOR THE DELTA

The objectives contained in the State Water Board's 1995 "Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary" and any revisions thereto shall apply to the waters of the Sacramento-San Joaquin Delta and adjacent waters as specified in that plan.

3.6 OBJECTIVES FOR ALAMEDA CREEK WATERSHED

The water quality objectives contained in Table 3-7 apply to the surface and groundwaters of the Alameda Creek watershed above Niles.

Wastewater discharges that cause the surface water limits in Table 3-7 to be exceeded may be allowed if they are part of an overall wastewater resource operational program developed by those agencies affected and approved by the Water Board.

TABLES

Table 3-1: Water Quality Objectives for Bacteria[a]

Beneficial Use	Fecal Coliform (MPN/100ml)	Total Coliform (MPN/100ml)	Enterococcus (MPN/100ml)[g]
Water Contact Recreation	geometric mean < 200 90th percentile < 400	median < 240 no sample > 10,000	geometric mean < 35 no sample > 104
Shellfish Harvesting[b]	median < 14 90th percentile < 43	median < 70 90th percentile < 230[c]	
Non-contact Water Recreation[d]	mean < 2000 90th percentile < 4000		
Municipal Supply: - Surface Water[e] - Groundwater	 geometric mean < 20	 geometric mean < 100 < 1.1[f]	

Notes:

a. Based on a minimum of five consecutive samples equally spaced over a 30-day period.

b. Source: National Shellfish Sanitation Program.

c. Based on a five-tube decimal dilution test or 300 MPN/100 ml when a three-tube decimal dilution test is used.

d. Source: Report of the Committee on Water Quality Criteria, National Technical Advisory Committee, 1968.

e. Source: California Department of Public Health recommendation.

f. Based on multiple tube fermentation technique; equivalent test results based on other analytical techniques, as specified in the National Primary Drinking Water Regulation, 40 CFR, Part 141.21(f), revised June 10, 1992, are acceptable.

g. Applicable to marine and estuarine waters only. Numeric values are based on Section 7958 of Title 17 of the California Code of Regulations, 69FR 67217 et seq., and 40 CFR Part 131.41 (effective date December 16, 2004).

Table 3-2: U.S. EPA Bacteriological Criteria for Water Contact Recreation[1,2] (in colonies per 100 ML)

	Fresh Water		Salt Water
	Enterococci	**E. Coli**	**Enterococci**
Steady State (all areas)	33	126	35
Maximum at:			
- designated beach	61	235	104
- moderately used area	89	298	124
- lightly used area	108	406	276
- infrequently used area	151	576	500

NOTES:

1. The criteria were published in the Federal Register, Vol. 51, No. 45 / Friday, March 7, 1986 / 8012-8016. The Criteria are based on:
   (a) Cabelli, V.J. 1983. Health Effects Criteria for Marine Recreational Waters. U.S. EPA, EPA 600/1-80-031, Cincinnati, Ohio, and
   (b) Dufour, A.P. 1984. Health Effects Criteria for Fresh Recreational Waters. U.S. EPA, EPA 600/1-84-004, Cincinnati Ohio.

2. The U.S. EPA criteria apply to water contact recreation only. The criteria provide for a level of production based on the frequency of usage of a given water contact recreation area. The criteria may be employed in special studies within this region to differentiate between pollution sources or to supplement the current coliform objectives for water contact recreation.

Table 3-3: Marine[a] Water Quality Objectives for Toxic Pollutants for Surface Waters (all values in ug/l)

Compound	4-day Average	1-hr Average	24-hr Average
Arsenic[b, c, d]	36	69	
Cadmium[b, c, d]	9.3	42	
Chromium VI[b, c, d, e]	50	1100	
Copper[c, d, f]			
Cyanide[g]			
Lead[b, c, d]	8.1	210	
Mercury[h]	0.025	2.1	
Nickel[b, c, d]	8.2	74	
Selenium[i]			
Silver[b, c, d]		1.9	
Tributyltin[j]			
Zinc[b, c, d]	81	90	
PAHs[k]			15

NOTES:

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. Unless a site-specific objective has been adopted, these objectives shall apply to all marine waters except for the South Bay south of Dumbarton Bridge (where the California Toxics Rule (CTR) applies) or as specified in note h (below). For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater (Table 3-4) or marine objectives.

b. Source: 40 CFR Part 131.38 (California Toxics Rule or CTR), May 18, 2000.

c. These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.

d. According to the CTR, these objectives are expressed as a function of the water-effect ratio (WER), which is a measure of the toxicity of a pollutant in site water divided by the same measure of the toxicity of the same pollutant in laboratory dilution water. The 1-hr. and 4-day objectives = table value X WER. The table values assume a WER equal to one.

e. This objective may be met as total chromium.

f. Water quality objectives for copper were promulgated by the CTR and may be updated by U.S. EPA without amending the Basin Plan. Note: at the time of writing, the values are 3.1 ug/l (4-day average) and 4.8 ug/l (1-hr. average). The most recent version of the CTR should be consulted before applying these values.

g. Cyanide criteria were promulgated in the National Toxics Rule (NTR) (Note: at the time of writing, the values are 1.0 µg/l (4-day average) and 1.0 µg/l (1-hr. average)) and apply, except that site-specific marine water quality objectives for cyanide have been adopted for San Francisco Bay as set forth in Table 3-3C.

h. Source: U.S. EPA Ambient Water Quality Criteria for Mercury (1984). The 4-day average value for mercury does not apply to San Francisco Bay; instead, the water quality objectives specified in Table 3-3B apply. The 1-hour average value continues to apply to San Francisco Bay.

i. Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 ug/l (4-day average) and 20 ug/l (1-hr. average).

j. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations. U.S. EPA has published draft criteria for protection of aquatic life (Federal Register: December 27, 2002, Vol. 67, No. 249, Page 79090-79091). These criteria are cited for advisory purposes. The draft criteria may be revised.

k. The 24-hour average aquatic life protection objective for total PAHs is retained from the 1995 Basin Plan. Source: U.S. EPA 1980.

Table 3-3A: Water Quality Objectives for Copper and Nickel in San Francisco Bay Segments (ug/L)

Compound	4-day Average (CCC)[1]	1-hr Average (CMC)[2]	Extent of Applicability
Copper	6.9	10.8	The portion of Lower San Francisco Bay south of the line representing the Hayward Shoals shown on Figure 7.1. and South San Francisco Bay
Copper	6.0	9.4	The portion of the delta located in the San Francisco Bay Region, Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, and the portion of Lower San Francisco Bay north of the line representing the Hayward Shoals on Figure 7.1.
Nickel	11.9	62.4*	South San Francisco Bay

[1]Criteria Continuous Concentration

[2]Criteria Maximum Concentration

*Handbook of Water Quality Standards, 2nd ed. 1994 in Section 3.7.6 states that the CMC = Final AcuteValue/2; 62.4 is the Final Acute Value (resident species database)/2; so the site-specific CMC is lower than the California Toxics Rule value because we are using the resident species database instead of the National Species Database.

Table 3-3B: Marine[a] Water Quality Objectives for Mercury in San Francisco Bay[b]		
Protection of Human Health	0.2 mg mercury per kg fish tissue	Average wet weight concentration measured in the edible portion of trophic level 3 and trophic level 4 fish[c]
Protection of Aquatic Organisms and Wildlife	0.03 mg mercury per kg fish	Average wet weight concentration measured in whole fish 3–5 cm in length

Notes:

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater or marine objectives.

b. Objectives apply to all segments of San Francisco Bay, including Sacramento/San Joaquin River Delta (within San Francisco Bay region), Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, Central San Francisco Bay, Lower San Francisco Bay, and South San Francisco Bay (including the Lower South Bay).

c. Compliance shall be determined by analysis of fish tissue as described in Chapter 6, Surveillance and Monitoring.

Table 3-3C: Marine [a] Water Quality Objectives for Cyanide in San Francisco Bay [b] (values in ug/l)		
Cyanide	Chronic Objective (4-day Average)	2.9
Cyanide	Acute Objective (1-hour Average)	9.4

Notes:

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater or marine objectives.

b. Objectives apply to all segments of San Francisco Bay, including Sacramento/San Joaquin River Delta (within San Francisco Bay region), Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, Lower San Francisco Bay, and South San Francisco Bay.

Table 3–4: Freshwater[a] Water Quality Objectives for Toxic Pollutants for Surface Waters (all values in ug/l)

Compound	4-day Average	1-hr Average
Arsenic[b, c, d]	150	340
Cadmium[b, d]	e	e
Chromium III[f]		
Chromium VI[b, c, d, g]	11	16
Copper[b, c, d]	9.0[h]	13[h]
Cyanide[i]		
Lead[b, c, d]	2.5[j]	65[j]
Mercury[k]	0.025	2.4
Nickel[b, c, d]	52[l]	470[l]
Selenium[m]		
Silver[b, c, d]		3.4[n]
Tributyltin[o]		
Zinc[b, c, d]	120[p]	120[p]

Notes:

a. Freshwaters are those in which the salinity is equal to or less than 1 part per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. Unless a site-specific objective has been adopted, these objectives shall apply to all freshwaters except for the South Bay south of Dumbarton Bridge, where the California Toxics Rule (CTR) applies. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the marine (Table 3-3) and freshwater objectives.

b. Source: 40 CFR Part 131.38 (California Toxics Rule or CTR), May 18, 2000.

c. These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.

d. These objectives are expressed as a function of the water-effect ratio (WER), which is a measure of the toxicity of a pollutant in site water divided by the same measure of the toxicity of the same pollutant in laboratory dilution water. The 1-hr. and 4-day objectives = table value X WER. The table values assume a WER equal to one.

e. The objectives for cadmium and other noted metals are expressed by formulas where H = ln (hardness) as $CaCO_3$ in mg/l: The four-day average objective for cadmium is $e^{(0.7852 H - 3.490)}$. This is 1.1 µg/l at a hardness of 100 mg/l as $CaCO_3$. The one-hour average objective for cadmium is $e^{(1.128 H - 3.828)}$. This is 3.9 µg/l at a hardness of 100 mg/l as $CaCO_3$.

f. Chromium III criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 180 ug/l (4-day average) and 550 ug/l (1-hr. average). The objectives for chromium III are based on hardness. The values in this footnote assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for chromium III is $e^{(0.8190H+1.561)}$. The 1-hour average for chromium III is $e^{(0.8190 H+3.688)}$.

g. This objective may be met as total chromium.

h. The objectives for copper are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for copper is $e^{(0.8545H-1.702)}$. The 1-hour average for copper is $e^{(0.9422H-1.700)}$.

i. Cyanide criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.2 ug/l (4-day average) and 22 ug/l (1-hr. average).

j. The objectives for lead are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is $e^{(1.273H - 4.705)}$. The 1-hour average for lead is $e^{(1.273H - 1.460)}$.

k. Source: U.S. EPA Quality Criteria for Water 1986 (EPA 440/5-86-001), which established a mercury criterion of 0.012 ug/l. The Basin Plan set the objective at 0.025 based on considerations of the level of detection attainable at that time. The 4-day average value for mercury does not apply to Walker Creek and Soulajule Reservoir and their tributaries nor to waters of the Guadalupe River watershed; instead, the water quality objectives specified in Table 3-4A apply. The 1-hour average value continues to apply to waters specified in Table 3-4A.

l. The objectives for nickel are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is $e^{(0.8460H + 0.0584)}$. The 1-hour average objective is $e^{(0.8460H + 2.255)}$.

m. Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 ug/l (4-day average) and 20 ug/l (1-hr. average).

n. The objective for silver is based on hardness. The table value assumes a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objective must be calculated using the following formula where H = ln (hardness): The 1-hour average objective for silver is $e^{(1.72H - 6.52)}$. U.S. EPA has not developed a 4-day criterion.

o. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations. U.S. EPA has published draft criteria for protection of aquatic life (Federal Register: December 27, 2002, Vol. 67, No. 249, Page 79090-79091). These criteria are cited for advisory purposes. The draft criteria may be revised.

p. The objectives for zinc are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for zinc is $e^{(0.8473 H + 0.884)}$. The 1-hour average for zinc is $e^{(0.8473 H + 0.884)}$.

Table 3-4A: Freshwater Water Quality Objectives for Mercury in Walker Creek, Soulajule Reservoir, and Their Tributaries; and in Waters of the Guadalupe River Watershed, Except Los Gatos Creek and its Tributaries Upstream of Vasona Dam, Lake Elsman, Lexington Reservoir, and Vasona Lake

Protection of Aquatic Organisms and Wildlife[a]	0.05 mg methylmercury per kg fish	Average wet weight concentration measured in whole trophic level 3 fish 5–15 cm in length
	0.1 mg methylmercury per kg fish	Average wet weight concentration measured in whole trophic level 3 fish 15 – 35 cm in length

a. The freshwater water quality objectives for the protection of aquatic organisms and wildlife also protect humans who consume fish from the Walker Creek and Guadalupe River watersheds.

Table 3-5: Water Quality Objectives for Municipal Supply

Parameter	Objective (in MG/L)
Physical:	
Color (units)[a]	15.0
Odor (number)[a]	3.0
Turbidity (NTU)[a]	5.0
pH[b]	6.0 - 8.5
TDS[c]	500.0
EC (mmhos/cm)[c]	900
Corrosivity	non-corrosive
Inorganic Parameters:	
Aluminum[d]	1.0[d] / 0.2[a]
Antimony[d]	0.006
Arsenic[d]	0.05
Asbestos[d]	7 MFL[e]
Barium[d]	1.0
Beryllium[d]	0.004
Chloride[c]	250.0
Cadmium[d]	0.005
Chromium[d]	0.05
Copper[a]	1.0
Cyanide[d]	0.15
Fluoride[f]	0.6 - 1.7[g]
Iron[a]	0.3
Lead[b]	0.05
Manganese[a]	0.05
Mercury[d]	0.002
Nickel[d]	0.1
Nitrate (as NO_3)[d]	45.0
Nitrate + Nitrite (as N)[d]	10.0
Nitrite (as N)[d]	1.0
Selenium[d]	0.05
Silver[b]	0.1
Sulfate[c]	250.0
Thallium[d]	0.002
Zinc[a]	5.0
Organic Parameters:	
MBAS (Foaming agents)[a]	0.5
Oil and grease[b]	none
Phenols[b]	0.001
Trihalomethanes[b]	0.1
Chlorinated Hydrocarbons:	
Endrin[h]	0.002
Lindane[h]	0.0002
Methoxychlor[h]	0.03
Toxaphene[h]	0.003
2,3,7,8-TCDD (Dioxin)[h]	3×10^{-8}
2,4-D[h]	0.07
2,4,4-TP Silvex[h]	0.05

Parameter	Objective (in MG/L)
Synthetic Organic Chemicals:	
Alachor[h]	0.002
Atrazine[h]	0.001
Bentazon[h]	0.018
Benzo(a)pyrene[h]	0.0002
Dalapon[h]	0.2
Dinoseb[h]	0.007
Diquat[h]	0.02
Endothall[h]	0.1
Ethylene dibromide[h]	0.00005
Glyphosate[h]	0.7
Heptachlor[h]	0.00001
Heptachlor epoxide[h]	0.00001
Hexachlorecyclopentadiene[h]	0.001
Molinate[h]	0.02
Oxarnyl[h]	0.05
Pentachlorophenol[h]	0.001
Picloram[h]	0.5
Polychlorinated Biphenyls[h]	0.0005
Simazine[h]	0.004
Thiobencarb[h]	0.07 / 0.001
Volatile Organic Chemicals:	
Benzene[h]	0.001
Carbon Tetrachloride[h]	0.005
1,2-Dibromo-3-chloropropane[h]	0.0002
1,2-Dichlorobenzene[h]	0.6
1,4-Dichlorobenzene[h]	0.005
1,1-Dichloroethane[h]	0.005
1,2-Dichloroethane[h]	0.0005
cis-1,2-Dichloroethlyene[h]	0.006
trans-1,2-Dichloroethylene[h]	0.01
1,1-Dichloroethylene[h]	0.006
Dichloromethane[h]	0.005
1,2-Dichloropropane[h]	0.005
1,3-Dichloropropene[h]	0.0005
Ethylbenzene[h]	0.7
Methyl-tert-butyl ether[h]	0.013 / 0.005
Monochlorobenzene[h]	0.07
Styrene[h]	0.1
1,1,2,2-Tetrachloroethane[h]	0.001
Tetrachloroethylene[h]	0.005
1,2,4-Trichlorobenzene[h]	0.005
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane[h]	0.005
Trichloroethylene[h]	0.005
Trichlorofluoromethane	0.15

Parameter	Objective (in MG/L)
Volatile Organic Chemicals (cont'd):	
1,1,2-Trichloro-1,2,2 trifluoromethane[h]	1.2
Toluene[h]	0.15
Vinyl Chloride[h]	0.0005
Xylenes (single or sum of isomers)[h]	1.750
Radioactivity:	
Combined Radium-226 and Radium-228[i]	5
Gross Alpha Particle Activity[i]	15
Tritium[i]	20,000
Strontium-90[i]	8
Gross Beta Particle Activity[i]	50
Uranium[i]	20

NOTES:

a. Secondary Maximum Contaminant Levels as specified in Table 64449- A of Section 64449, Title 22 of the California Code of Regulations, as June 3, 2005.

b. Table III-2, 1986 Basin Plan

c. Secondary Maximum Contaminant Levels as specified in Table 64449-B of Section 64449, Title 22 of the California Code of Regulations, as of June 3, 2005. (Levels indicated are "recommended" levels. Table 64449-B contains a complete list of upper and short-term ranges.)

d. Maximum Contaminant Levels as specified in Table 64431-A (Inorganic Chemicals) of Section 64431, Title 22 of the California Code of Regulations, as of June 3, 2005.

e. MFL = million fibers per liter; MCL for fibers exceeding 10 um in length.

f. Flouride objectives depend on temperature.

g. A complete list of optimum and limiting concentrations is specified in Table 64433.2-A of Section 64433.2, Title 22 of the California Code of Regulations, as of June 3, 2005.

h. Maximum Contaminant Levels as specified in Table 64444-A (Organic Chemicals) of Section 64444, Title 22 of the California Code of Regulations, as of June 3, 2005.

i. Maximum Contaminant Levels as specified in Table 4 (Radioactivity) of Section 64443, Title 22 of the California Code of Regulations, as of June 3, 2005.

j. Included Radium-226 but excludes Radon and Uranium.

MG/L Milligrams per liter
pCi/L pico Curries per liter

Table 3-6: Water Quality Objectives for Agricultural Supply[a] (in mg/l)

Parameter	Threshold	Limit	Limit for Livestock Watering
Physical:			
pH	5.5-8.3	4.5-9.0	
TDS			10,000.0
EC (mmhos / cm)		0.2-3.0	
Inorganic Parameters:			
Aluminum	5.0	20.0	5.0
Arsenic	0.1	2.0	0.2
Beryllium	0.1	0.5	
Boron	0.5	2.0	5.0
Chloride	142.0	355.0	
Cadmium	0.01	0.5	0.05
Chromium	0.1	1.0	1.0
Cobalt	0.05	5.0	1.0
Copper	0.2	5.0	0.5
Flouride	1.0	15.0	2.0
Iron	5.0	20.0	
Lead	5.0	10.0	0.1
Lithium		2.5[b]	
Manganese	0.2	10.0	
Molybdenum	0.01	0.05	0.5
Nickel	0.2	2.0	
$NO_3 + NO_2$ (as N)	5.0	30[c]	100.0
Selenium		0.02	0.05
Sodium adsorption ratio (adjusted)[d]	3.0	9.0	
Vanadium	0.1	1.0	0.1
Zinc	2.0	10.0	25

NOTES:

a. For an extensive discussion of water quality for agricultural purposes, see "A Compilation of Water Quality Goals," Central Valley Regional Water Quality Control Board, May 1993.

b. For citrus irrigation, maximum 0.075 mg/l.

c. For sensitive crops. Values are actually for NO_3-N + NH_4-N.

d. Adjusted SAR = { Na /[(Ca + Mg)+2]$^{0.5}$ }{1 + [8.4 – pHc]}, where pHc is a calculated value based on total cations, Ca + Mg, and CO_3 + HCO_3, in me/l. Exact calculations of pHc can be found in “Guidelines for Interpretation of Water Quality for Agriculture” prepared by the Univ. of California Cooperative Extension.

Table 3-7: Water Quality Objectives for the Alameda Creek Watershed Above Niles

SURFACE WATER QUALITY OBJECTIVES (ALAMEDA CREEK AND TRIBUTARIES)

TDS:	250 mg/l (90 day-arithmetic mean)
	360 mg/l (90 day-90th percentile)
	500 mg/l (daily maximum)
Chlorides:	60 mg/l (90 day-arithmetic mean)
	100 mg/l (90 day-90th percentile)
	250 mg/l (daily maximum)

GROUNDWATER QUALITY OBJECTIVES

(Concentration not to be exceeded more than 10 percent of the time during one year.)

Central Basin

TDS:	Ambient or 500 mg/l, whichever is lower
Nitrate (NO_3):	45 mg/l

Fringe Subbasins

TDS:	Ambient or 1000 mg/l, whichever is lower
Nitrate (NO_3):	45 mg/l

Upland and Highland Areas

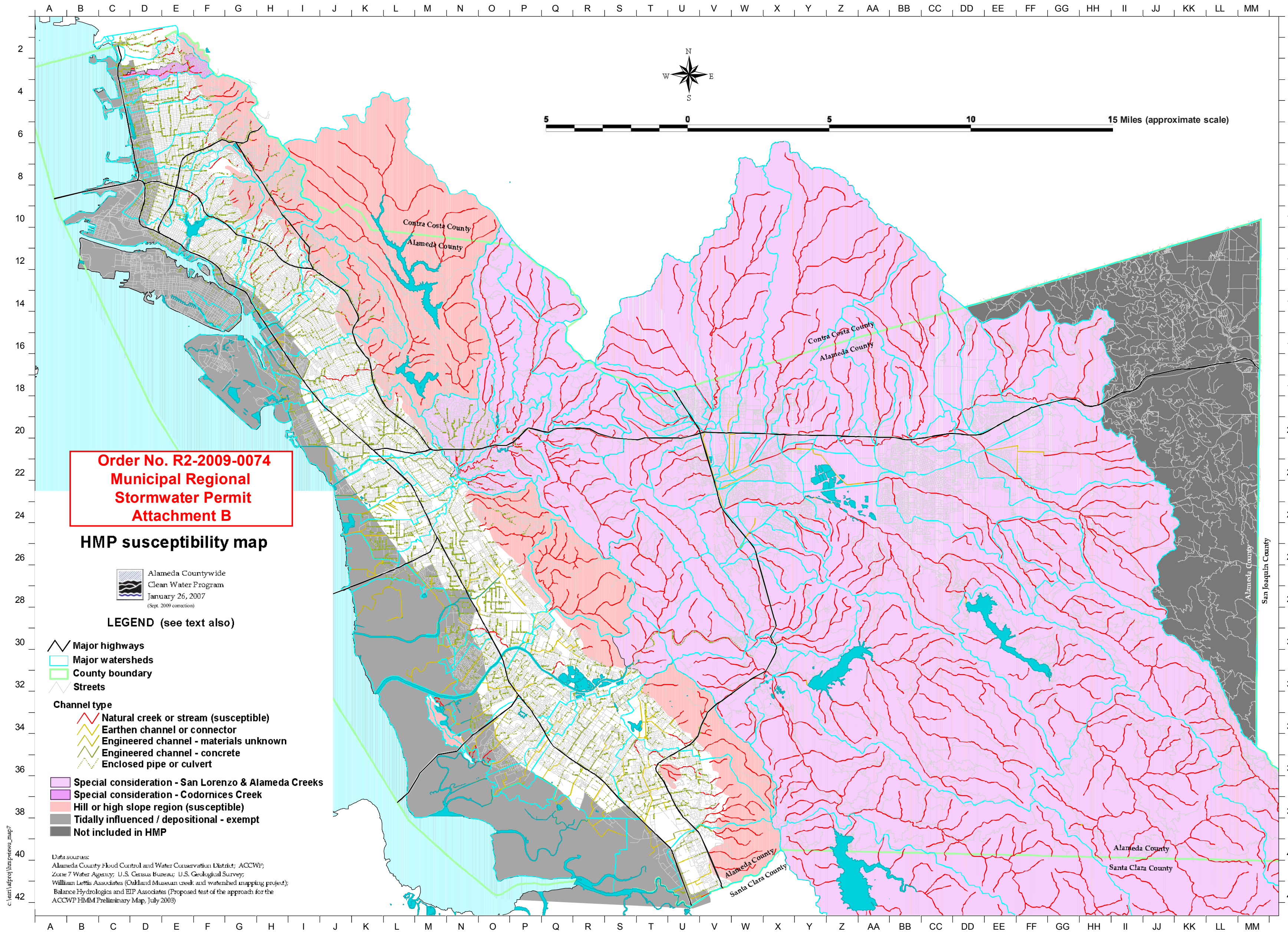
California domestic water quality standards set forth in California Code of Regulations, Title 22 and current county standards.

Ambient water quality conditions at a proposed project area will be determined by Zone 7 of the Alameda County Flood Control and Water Conservation District at the time the project is proposed, with the cost borne by the project proponents. Ambient conditions apply to the water-bearing zone with the highest quality water.

Waters designated for use as domestic or municipal water supply shall not contain concentrations of chemicals in excess of natural concentrations or the limits specified in California Code of Regulations, Title 22, Chapter 15, particularly Tables 64431-A and 64431-B of Section 64431, Table 64444-A of Section 64444, and Table 4 of Section 64443.

Appendix D

Alameda Countywide Clean Water Program
HMP Susceptibility Map


Order No. R2-2009-0074
Municipal Regional
Stormwater Permit
Attachment B
HMP susceptibility map
Alameda Countywide
Clean Water Program
January 26, 2007
(Sept. 2009 correction)
LEGEND (see text also)
Major highways
Major watersheds
County boundary
Streets
Channel type
Natural creek or stream (susceptible)
Earthen channel or connector
Engineered channel - materials unknown
Engineered channel - concrete
Enclosed pipe or culvert
Special consideration - San Lorenzo & Alameda Creeks
Special consideration - Codornices Creek
Hill or high slope region (susceptible)
Tidally influenced / depositional - exempt
Not included in HMP
Data sources:
Alameda County Flood Control and Water Conservation District; ACCWP;
Zone 7 Water Agency; U.S. Census Bureau; U.S. Geological Survey;
William Lettis Associates (Oakland Museum creek and watershed mapping project);
Balance Hydrologics and EIP Associates (Proposed test of the approach for the
ACCWP HMM Preliminary Map, July 2003)
c:\esri\afproj\hmpviews_map7
N
W
E
S
5
0
5
10
15 Miles (approximate scale)
Contra Costa County
Alameda County
Contra Costa County
Alameda County
Alameda County
San Joaquin County
Alameda County
Santa Clara County
Alameda County
Santa Clara County

Hydrology Report

Dublin Boulevard-North Canyons Parkway Extension Project
Federal Project No. RTPL 5432(019)

Prepared for

City of Dublin, County of Alameda, and City of Livermore

Located in:

Dublin, Unincorporated Alameda County, and Livermore California

BKF Engineers
4670 Willow Road, Suite 250
Pleasanton, CA 94588
July 16, 2018

Hydrology Report

Dublin Boulevard-North Canyons Parkway Extension Project

July 16, 2018

Prepared for

City of Dublin, County of Alameda, and City of Livermore

Located in:

Dublin, Unincorporated Alameda County, and Livermore California

This Hydrology report has been prepared by BKF Engineers under the supervision of the following Registered Engineer. To the best of my knowledge and belief, the information submitted is true, accurate and complete

_______________________ Date: 11/21/18

Ramon Alvarez-Muro, P.E.
Registered Civil Engineer

Table of Contents

List of Figures

List of Tables

List of Appendices

1. Introduction

1.1 Approach to Hydrology Report

The purpose of the Hydrology Report is to document storm flows and any drainage improvement necessary to address the drainage needs of the Dublin Boulevard-North Canyons Parkway Extension known from hereon as the "Project". This hydrology report is built upon previous efforts by MacKay and Somps in the "Dublin Ranch Master Drainage Study" and by Engeo in the "Jordan Ranch Stormwater and Hydromodification Management Plan". These documents, along with other works, create a backdrop upon which this Hydrology Report is built upon.

1.2 Project Description

The City of Dublin (City), in coordination with the City of Livermore, Alameda County, and the California Department of Transportation (Caltrans), District 4, propose to improve east-west local roadway connectivity by extending Dublin Boulevard from Fallon Road to Doolan Road/North Canyon Parkway in the Cities of Dublin and Livermore in Alameda County. The work proposed will include the construction of a new 4-6 lane roadway, sidewalk, path, and bicycle facilities. Additionally, the City proposes to conduct intersection improvements at the Dublin Boulevard/Fallon Road and Doolan Road/North Canyon Parkway intersections. A new intersection is proposed at Dublin Boulevard/Croak Road, eliminating the frontage road connection of Croak Road/Fallon Road. A new bridge is proposed over Cottonwood Creek.

Drainage improvements will include storm drainage inlets and manholes, storm drain laterals, a longitudinal storm drain main located under Dublin Boulevard, post construction stormwater treatment and hydromodification facilities, and cross culverts beneath the Dublin Boulevard extension.

The Project Location Map is shown on Figure 1 and Project Vicinity Map on Figure 2.

Figure 1. Project Location Map

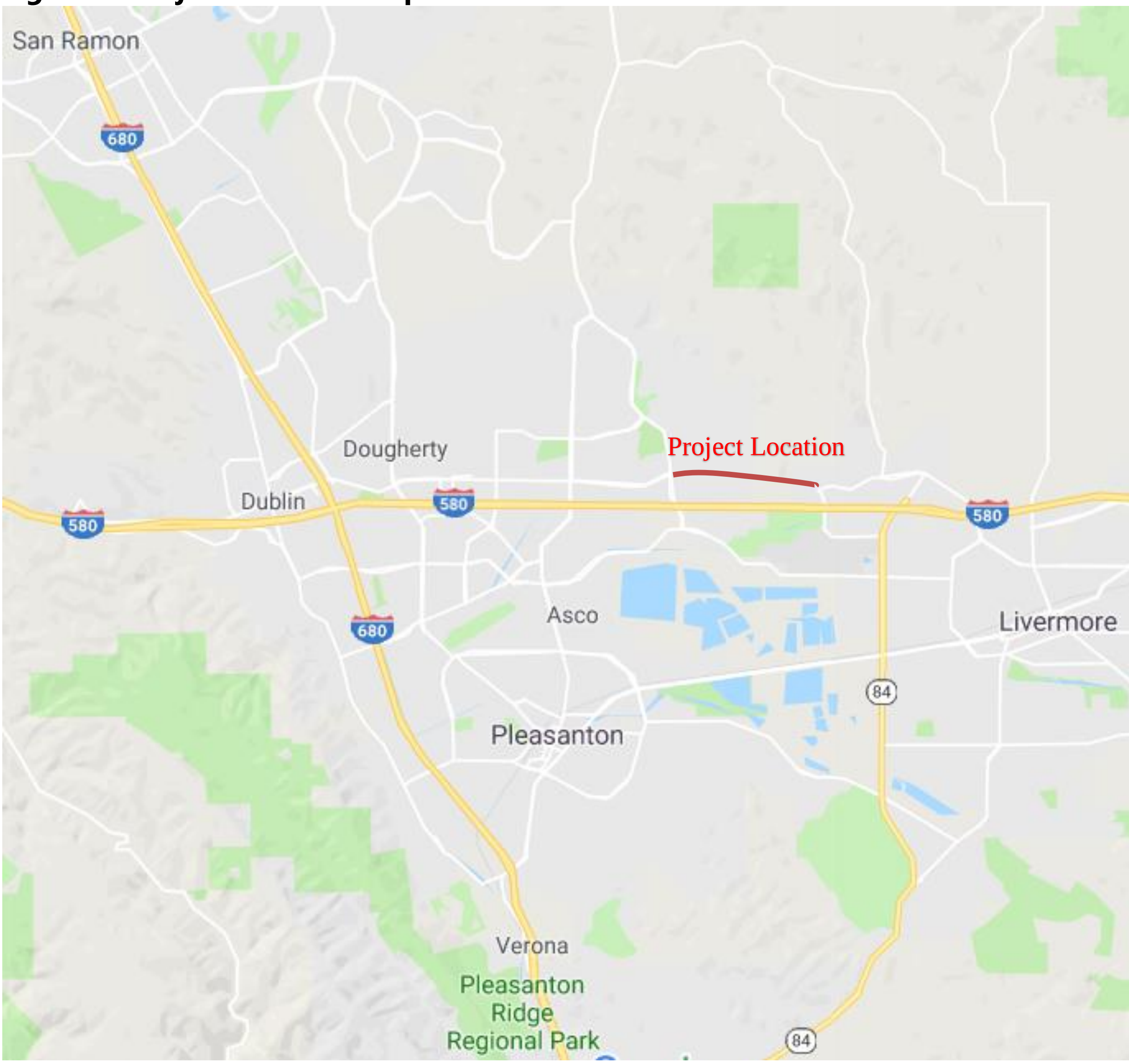


Figure 2. Project Vicinity Map

2. Drainage Background

2.1 Previous Study

In 2004, with subsequent updates in 2006, MacKay and Somps prepared the "Dublin Ranch Drainage Master Plan". This document establishes the watershed limits in the Alameda County and City of Livermore portions of the project. In 2011, Engeo Inc. prepared a "Stormwater and Hydromodification Management Plan" for Jordan Ranch. This document establishes watershed limits in the City of Dublin portion of the project.

2.2 Criteria and Methodology

Alameda County Flood Control and Water Conservation District's (District) Hydrology and Hydraulics criteria form the basis of this hydrology report's calculations. Other criteria include matching the design storm capacities of other storm drain lines built in Fallon Road. The proposed longitudinal storm drain main built along the Dublin Boulevard extension flowing west toward Fallon Road and south down Fallon Road will be capable of conveying a 100-year peak storm event. It should be noted that the proposed system along Fallon Road has been previously environmentally cleared by others, but is assumed to be constructed separately (future existing) for connection, or as part of the Dublin Blvd Extension project improvements to convey storm drainage.

The District's Rational Formula was used to determine peak runoff rates. All factors in the rational formula such as runoff coefficient, time of concentration, and rainfall intensity come from the District's Hydrology and Hydraulics manual. Watershed delineation was primarily based on the Project's aerial planimetric (contour) topographic base mapping provided by the City, but subsequently checked against other drainage studies and their mapping. This crosscheck was required for the planned northern watershed limits, which may or may not have been developed/constructed to date, but alter the undeveloped historical watershed limits derived from the aerial topography.

The Project's drainage facilities west of the crest curve located at approximately Station 157+00 (herein referred to as the "high point") will be designed as a Primary Facility, as defined by the District's Hydrology and Hydraulics manual. Primary Facilities have watershed areas between 50 acres and 25 square miles, and are designed to a higher design storm event than secondary facilities. The rest of the drainage facilities are fed by minor watersheds, less than 50 acres and will be designated as a Secondary Facility.

2.3 Regional and Local Requirements

The Project is located in Alameda County which resides within the limits of the San Francisco Bay Regional Water Quality Control Board (RWQCB). As a result, the Project is subject to the "California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit" (Order R2-2015-0049 NPDES Permit No. CAS612008). This permit is informally known as the "MRP," and presents the provisions for permanent post-construction stormwater treatment requirements related to development, re-development and roadway projects outside of Caltrans Right-of-Way. The MRP in Alameda County is administered by the Alameda Countywide Clean Water Program (ACCWP). The ACCWP has developed a manual called "C.3 Stormwater Technical Guidance" to assist designers and reviewers in complying with post-construction stormwater treatment requirements, as well as Hydromodification Management (HM) requirements. This project is required to meet post-construction stormwater treatment and HM. HM will require post-construction peak flow rates to match pre-construction flow rate for the flow ranges of 10% of a 2-year storm, up to the 10-year storm event.

3. EXISTING HYDROLOGY

3.1 Existing Topography and Soils

Grades across the Project generally fall north to south, with the area north of the project defined by rolling hills on gentle 10-20% slopes, while the area south consists of flat grasslands with slopes generally less than 5%. The elevation at Fallon Road is about 370 feet, meandering easterly to match grade along the existing contours reaching a maximum elevation of about 420 feet at the high point, and descends to a sag (low point) at Cotton Wood Creek near elevation 390 feet, and ascends to connect to Doolan Road/North Canyon Boulevard, at approximately elevation 415 feet. Soils in the area have a Hydraulic Soil Group classification of C, which mean the native material has a slow infiltration rate and high runoff potential.

3.2 Existing Hydrology

Regionally, all stormwater within the project watershed enters Alameda Creek downstream of the Project. The Project area itself drains either to an existing drainage system that crosses Fallon Road to the west, Cottonwood Creek to the south, a Caltrans drainage system under I-580 to the south, or a City of Livermore existing drainage system to the east; ultimately – drainages cross I-580 and enteri Arroyo Mocho on the way to Alameda Creek. The mean annual precipitation for the area is 16 inches. No man-made drainage improvements exist within the project area, though the following systems exist (or are planned) on either end of the Project, located at the intersection termini:

- 48" CMP Bypass/Outfall – NE corner of Fallon Road, Dublin Boulevard, and Croak Road
- 84" RCP – Fallon Road
- 96" RCP – Fallon Road (Future)
- 30" RCP – Doolan Road

Within the project area, runoff is routed north to south as sheet flow and concentrated shallow flow run along tributary areas, following the natural topography before entering one of the three drainage systems that cross I-580:

- 8'x9' RCB in CT R/W running east-west converging with 84" RCP to feed the "G3" system west of Fallon Road before running south under I-580.
- 30" Cross Culvert CMP – Collier Canyon Road running south under I-580
- Double 8'x10' RCBs - Cottonwood Creek running south under I-580

The aforementioned (existing) 48" CMP bypass/outfall conveys existing creek corridor drainage from upstream areas, and feeds a perennial marsh and seasonal wetland area that runs along the easterly edge of Croak Road, ultimately crossing via a culvert and RCB beneath Croak Road, feeding the large 8'x9' RCB in Caltrans R/W under Fallon Road; the existing 84" RCP located between Fallon and Croak Road crosses Fallon Road and converges with the 8'x9' RCB, creating the easterly G3 system heading westerly before crossing I-580 towards Arroyo Mocho.

Based on as-builts for the construction of the 84" RCP main along Fallon, a 59-foot (48" diameter) storm drain connection was proposed (and constructed) between the existing SDMH (for the existing creek corridor drainage) and the 84" SD main at SDMH #5; note in the as-built indicate that the 59-foot bypass/connection should remain plugged at the existing SDMH until which time the existing bypass to the perennial marsh and seasonal wetland areas are no longer needed (future-by others). Therefore, the 48" CMP bypass/outfall to the open drainage/culvert is an existing hydrology component.

3.3 Existing Floodplains

The FEMA Flood Insurance Rate Maps for the Project location identify Cottonwood Creek as a floodplain. Cottonwood Creek is identified as 0.2% Annual chance flood discharge, but this discharge is contained in the channel. This means the channel is large enough to contain the 100-year event; the creek contains a 500-year storm event as well. The project will include a new bridge spanning Cottonwood Creek. No other floodplain is identified within the project limits.

4. Proposed Hydrology

4.1 Potential Interim Hydrology and Storm Drainage Improvements

As part of the proposed improvements along Dublin Boulevard and prior to the completion of development surrounding the Project, the hydrology patterns will preserve the existing overland drainage pattern from north to south. As the constructed Dublin Boulevard will cut off these existing drainage patterns, the project proposes storm drain cross-culverts to preserve and convey the drainage under Dublin Boulevard when possible and feasible. As an option, the City could opt to connect the upstream cross culverts with the proposed longitudinal drainage system located the new roadway discussed in Section 4.2, however, the ability to maintain and convey overland drainage from north to south in the interim conditions (prior to development) will be preserved to minimize biological and permitting impacts and mitigation.

Watershed areas for these cross-culverts are shown in Figure 3 and in Table 1. Swales will be built along the north side of the Project to convey and direct runoff to one of five proposed cross-culvert systems or Cottonwood Creek. The aforementioned existing 48" CMP bypass/outfall will be extended under the Dublin Boulevard/Fallon Road intersection as part of a "sixth" proposed cross culvert system; this system conveys drainage from 237 acres upland, mostly undeveloped and is summarized in Figure 3 and Table 1.

These culverts are sized for existing conditions where no development upstream of the Project has yet occurred. The culverts can be discharged in one of two ways:

1. Discharge at grade on the south side of the project and continue its existing routing downstream towards I-580.
2. Connect into the newly constructed longitudinal drainage system (main) proposed within Dublin Boulevard.

These culverts can be abandoned in place or removed in the build-out conditions should future development deem them unnecessary, however, those property owners will be responsible for their direct and downstream environmental/biological impacts, which feed the downstream jurisdictional waters and wetlands.

The new drainage system running along Dublin Boulevard will be sized for a 100-year flow of the ultimate build-out condition, based on zoning and development in the City's General Plan and East Dublin Specific Plan, and has adequate capacity to handle the undeveloped watershed peak flows should the cross-culverts be rerouted to the storm drain main. Hydrology calculations for each of the cross culverts can be found in Table 1 below.

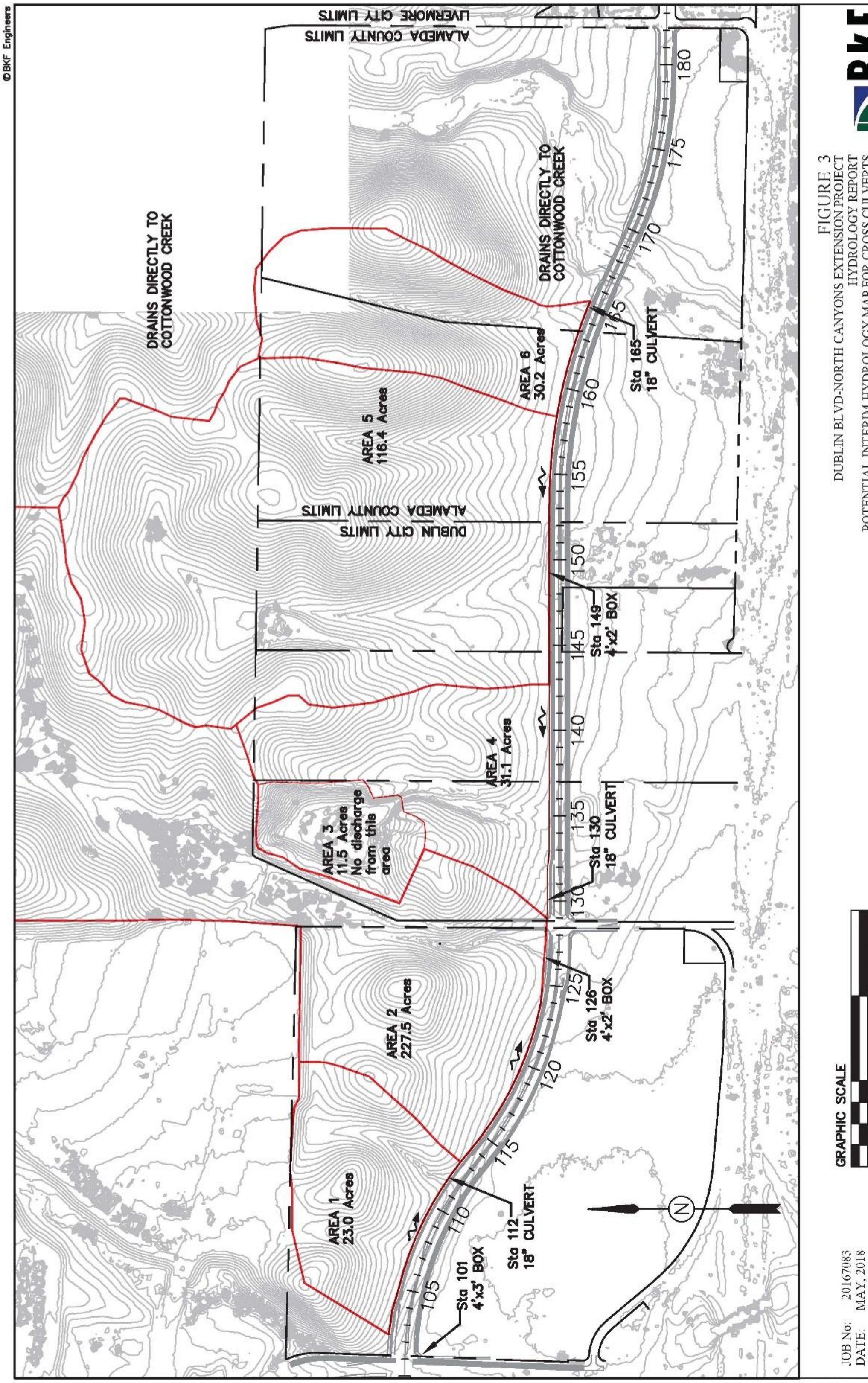

©BKF Engineers
LIVERMORE CITY LIMITS
ALAMEDA COUNTY LIMITS
DRAINS DIRECTLY TO COTTONWOOD CREEK
DRAINS DIRECTLY TO COTTONWOOD CREEK
AREA 1
23.0 Acres
AREA 2
227.5 Acres
AREA 3
11.5 Acres
No discharge from this area
AREA 4
31.1 Acres
AREA 5
116.4 Acres
AREA 6
30.2 Acres
ALAMEDA COUNTY LIMITS
DUBLIN CITY LIMITS
Sta 101
4'x3' BOX
Sta 112
18" CULVERT
Sta 126
4'x2' BOX
Sta 130
18" CULVERT
Sta 149
4'x2' BOX
Sta 165
18" CULVERT
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
GRAPHIC SCALE
500
0
500
1,000
N
JOB No: 20167083
DATE: MAY, 2018
BY: R.A.M
REV:
FIGURE 3
DUBLIN BLVD-NORTH CANYONS EXTENSION PROJECT
HYDROLOGY REPORT
POTENTIAL INTERIM HYDROLOGY MAP FOR CROSS CULVERTS
BKF

Table 1: Hydrology for 15-Year Peak Flow for Cross Culverts

Watershed Area No.	Runoff Coefficient	Overland Flow Length	Time of Concentration	Intensity	Area	15-Year Peak Flow	Station	Cross Culvert Size/Type
		(ft)	(minutes)	(in/hr)	(acres)	(cfs)		
N/A							101	4'x3' Box Culvert (existing 48")
1	0.25	1,320	11	1.98	23.0	11.4	112	18" Culvert
2	0.25	7,070	59	0.77	227.5	43.8	126	4'x2' Box Culvert
3	-	-	-	-	11.5	-		N/A
4	0.25	1,950	16	1.60	31.1	12.4	130	18" Culvert
5	0.25	3,430	29	1.14	116.4	33.2	149	4'x2' Box Culvert
6	0.25	2,225	19	1.46	30.2	11.0	165	18" Culvert

The existing 48" culvert located at Station 101 could be extended with a 48" (round) culvert under Dublin Boulevard, essentially preserving the bypass to the wetlands indefinitely or until it is no longer needed, however, due to the existing invert and limited cover at the intersection, has been shown as a 4'x2' box structure instead.

The watersheds No. 2 and 5 are larger and will require a 4' wide by 2' high box culvert, while the other smaller watersheds No. 1, 4 and 6 require an 18" culvert.

Watershed No. 3 is in a bowl configuration and does not produce runoff down to the Project area.

It should be noted that preserving native beds intact on cross culverts is desirable from a resource (permitting) agency standpoint, specifically for the cross-culverts located at Station 101, Station 165, and Cottonwood Creek due to connectivity to the downstream resources. Provided hydraulic demand for the 100-year flow event is met, native bed culvert alternatives (to those types/sizes shown in Table 1) will be pursued when possible and feasible during the design phase of the project.

4.2 Final Build-Out Hydrology and Storm Drainage Improvements

Project drainage improvements will consist of:

- drainage inlets as needed to meet City and County gutter spread requirements,
- storm drain laterals connecting the inlets to a storm drain main,
- storm drain manholes spaced as needed for maintenance, and
- the possibility of laterals or secondary mains for future connections stubbed-out to the Right-of-Way in pre-determined locations.

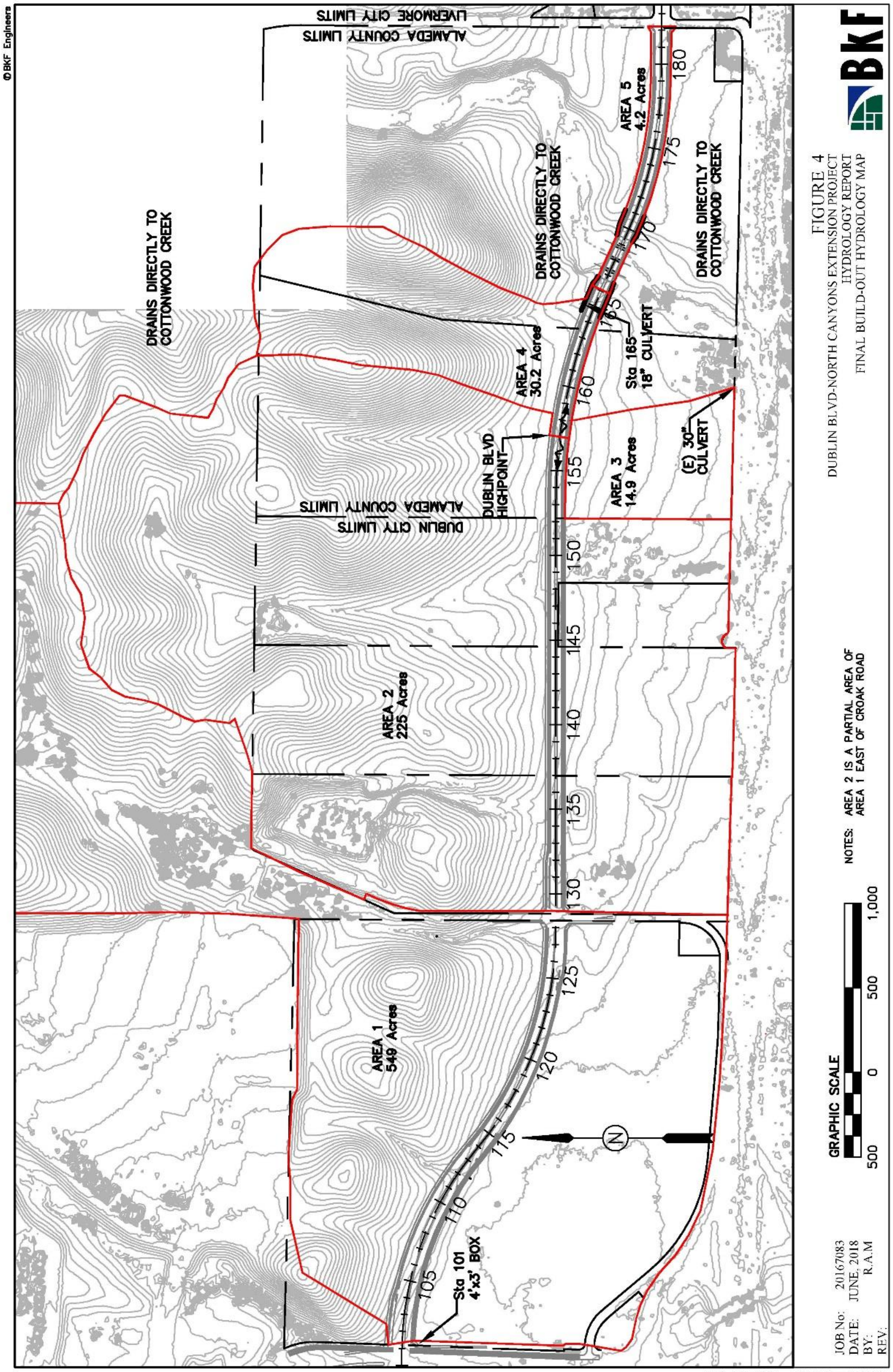
The purpose of integrating laterals or secondary mains is to limit, if not eliminate future connections and disturbing the newly built roadway.

A Final Build-Out Hydrology map is shown in Figure 4, and assumes future development in Dublin City limits located on either side of Dublin Boulevard, flowing towards the new roadway; it is assumed planned development will meet ACCWP post-construction stormwater treatment and HM requirements on site, before releasing/connecting to the new drainage main along Dublin Boulevard. An overview of the 5 watersheds from east to west:

- Watershed 5 is located at the easterly limits of the project area in unincorporated Alameda County, and includes the western limits of the Cottonwood Creek Bridge and the new street terminus at Doolan Road to the east. Drainage will be conveyed along the north side of the Project to direct runoff towards Cottonwood Creek. To the south – existing topography and overland drainage will continue to drain southerly towards Cottonwood Creek and Collier Canyon Road (which outfalls to Cottonwood Creek under I-580). Drainage within the roadway will be conveyed along Dublin Boulevard via an 18″ longitudinal storm drain line, which will discharge to Cottonwood Creek.
- Watershed No 4 is essentially the same watershed as Area 6 from Section 4.1 (Figure 3), but includes roadway drainage, and will continue to be conveyed from north to south via the 18″ cross-culvert (shown in Table 1) outfalling to Cottonwood Creek. The roadway will be drained via an 18″ longitudinal drainage system built along Dublin Boulevard, collecting roadway drainage between the high point to the west and the Cottonwood Creek to the east. It is proposed to tie the roadway culvert directly to the 18″ cross-culvert, outfalling to Cottonwood Creek.
- Watershed No 3 is a small undeveloped area south of the Project (east of Dublin City Limits) that will continue to drain southerly to an existing 30″ cross-culvert underneath Collier Canyon Road and I-580.

- Watershed No 2 is a partial watershed beginning at the high point in the east, spanning to Croak Road in the west. This roadway area will drain to a 60" longitudinal storm drainage system running along Dublin Boulevard that ultimately makes its way to Fallon Road.
- Watershed No 1 is the final watershed on the west side of the project, located from Croak Road in the east to Fallon Road on the west. This watershed will encompass all the areas of Watershed No 1 and Watershed No 2 (conveyed in a 60" stormdrain line) into a 72" longitudinal storm drainage system running along Dublin Boulevard connecting at Fallon Road.
- Under the build-out conditions, the 4'x3' box culvert extension of the 48" CMP located at Station 101 conveying the existing (upstream) creek corridor/watershed along Fallon Road discussed in the previous section of the report would be addressed as part of any future development proposed on the property located at the corner of Fallon Road and the Dublin Boulevard Extension. Options could include leaving the 4'x3' box culvert system in place indefinitely or unplugging the bypass upstream which would redirect the creek corridor to the 84" RCP running along Fallon Road (as designed).

It is assumed that the 72" culvert supporting the extension of Dublin Boulevard will tie directly into a 96" RCP studied and sized in the Dublin Ranch Drainage Master Plan (MacKay & Somps, 2006). Based on this report and related information available, the culvert will be constructed along the east side of Dublin (just east of the existing 84" RCP) within City R/W identified in the ultimate build-out conditions of the Fallon Plan Line. The 96" RCP is proposed to originate at the new intersection of Dublin Boulevard/Fallon Road (supporting the drainage of the Dublin Blvd Extension) and tie directly to the existing 8'x9' RCB in Caltrans R/W. The 96" RCP (via the 8'x9' RCB) converges with the aforementioned 84" RCP, before heading easterly towards the G3 System.


©BKF Engineers
LIVERMORE CITY LIMITS
ALAMEDA COUNTY LIMITS
DRAINS DIRECTLY TO COTTONWOOD CREEK
DRAINS DIRECTLY TO COTTONWOOD CREEK
DRAINS DIRECTLY TO COTTONWOOD CREEK
AREA 5 4.2 Acres
AREA 4 30.2 Acres
Sta 165 18" CULVERT
AREA 3 14.9 Acres
(E) 30" CULVERT
DUBLIN BLVD HIGHPOINT
ALAMEDA COUNTY LIMITS
DUBLIN CITY LIMITS
AREA 2 225 Acres
AREA 1 549 Acres
Sta 101 4'x3' BOX
NOTES: AREA 2 IS A PARTIAL AREA OF AREA 1 EAST OF CROAK ROAD
GRAPHIC SCALE
500 0 500 1,000
JOB No: 20167083
DATE: JUNE, 2018
BY: R.A.M
REV:
FIGURE 4
DUBLIN BLVD-NORTH CANYONS EXTENSION PROJECT
HYDROLOGY REPORT
FINAL BUILD-OUT HYDROLOGY MAP
BKF

15-Year storm hydrology calculations for each watershed and sub-watershed requiring storm drainage facilities can be found in Table 2 below.

Table 2: Final Build-Out Hydrology 15-Year Peak Flow

Watershed Area No.	Runoff Coefficient	Overland Flow Length	Time of Concentration	Intensity	Area	15-Year Peak Flow
		(ft)	(minutes)	(in/hr)	(acres)	(cfs)
Full Watershed 1	0.25	7,070	59	0.77	549	105.7
Sub Watershed 2	0.25	3,430	29	1.14	225	64.1
4	0.25	2,225	19	2.38	14.9	8.9
5	0.25	-	5	3.10	4.2	3.3

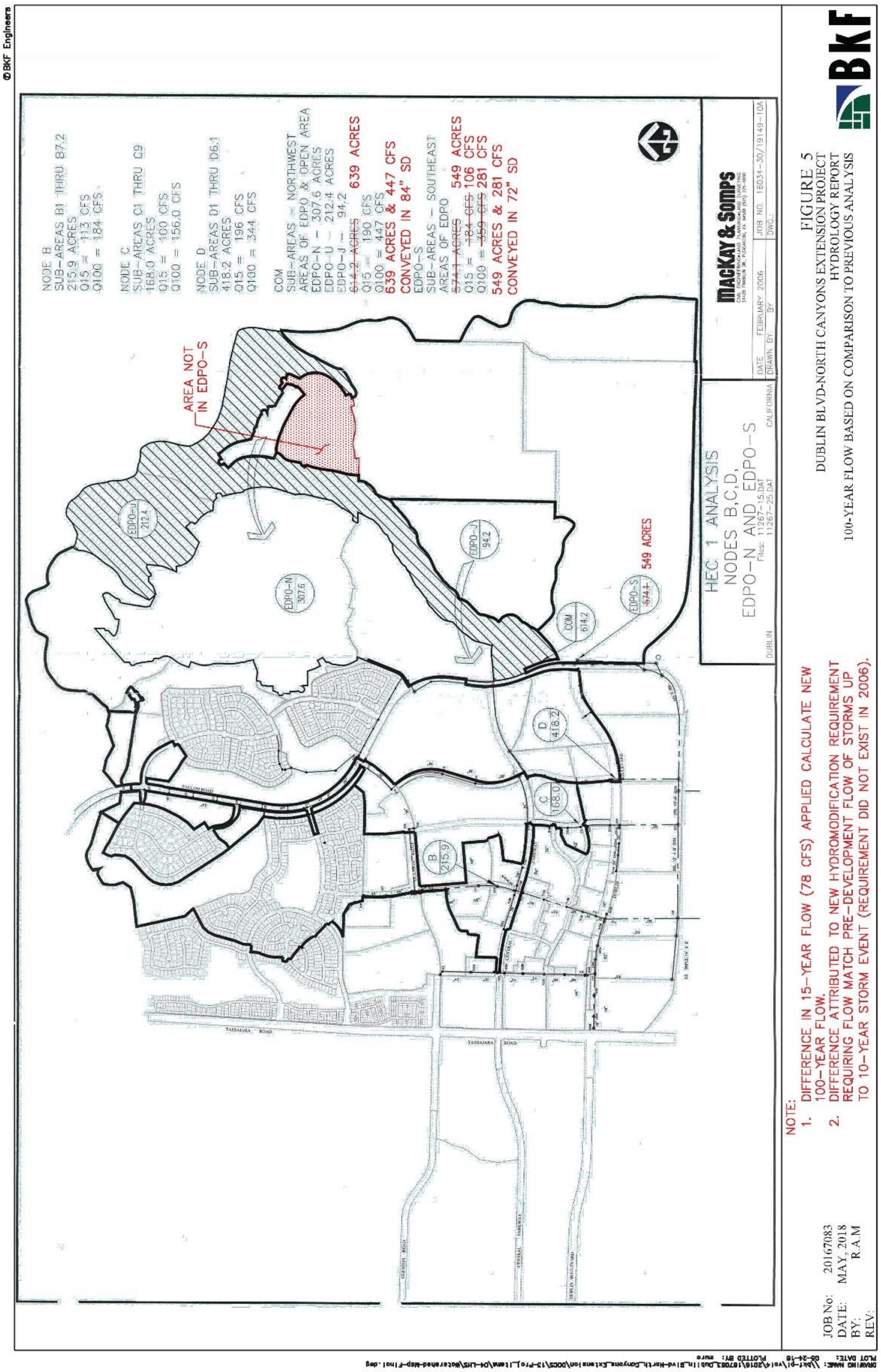
The calculations above use the same runoff coefficient associated with undeveloped land for the future development because future developments will also be subject to HM. Post-development peak flow rates will be required to match pre-development peak flow rates for storm events up to a 10-year event. For the watersheds No 4 an 18" storm drain is still sufficient as a cross culverts. Watersheds No 4 and 5 longitudinal storm drain mains will also be 18" which, coincidently 18" is the District minimum pipe sized allowed.

The storm drain main in Dublin Boulevard from the high point and continuing to the west connecting at Fallon Road will be sized to convey the 100-year storm event. A rational method calculation, like the one above for the 15-year storm will not work for the 100-year storm event because it will either be conservative if parcel post development runoff coefficients are used and the mitigation HM provides on peak flows is ignored, or be unconservative if the undeveloped land runoff coefficients are used to compute the 100-year event peak flow.

For these reasons, an approach of using previously published values (while updating, per new current watersheds and detention requirement) was used. Figure 5 contains the 100-year flows estimated for the Project area in the 2006 Dublin Ranch Drainage Master Plan. The project area labeled Watershed 1 on Figure 4 is comparable to "EDPO-S" in Figure 5.
The first adjustment removes a 25-acre area at the northern most limit of Watershed 1/EDPO-S, which has been developed and is routed westerly to the aforementioned

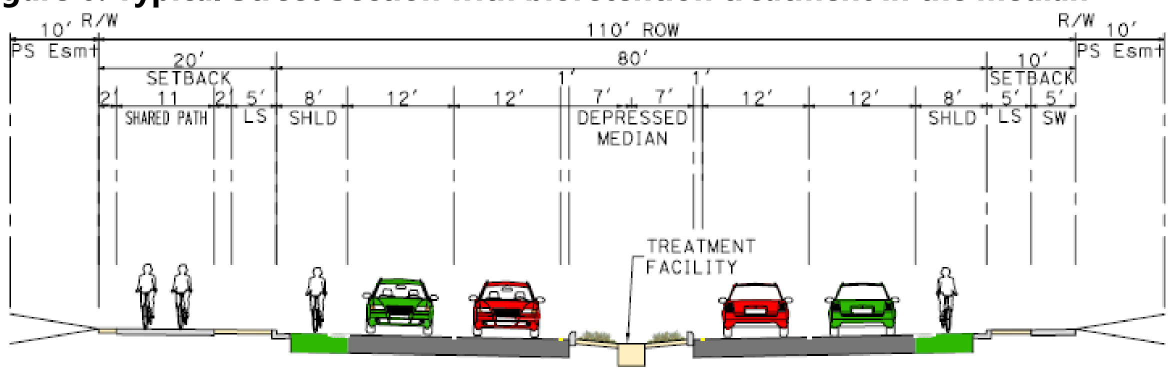
48" culvert crossing Dublin Boulevard at Station 101, and therefore is no longer a tributary to Watershed 1/EDPO-S. With the mitigation required per HM, the calculated 15-Year peak flow for Watershed 1/EDPO-S will be 106 cfs and not 184 cfs previously calculated in the 2006 Dublin Ranch Drainage Master Plan. Applying this HM mitigation and reduction of 78 cfs to the previously calculated 100-year peak flow will drop the peak flow from 359 cfs to 281 cfs. The existing (as-built) 84-inch storm drain main in Fallon Road collects 639 acres that produce a 447 cfs flow rate. Watershed 1/EDPO-S is recalculated to 549 acres, and would therefore produce a 281 cfs flow rate, that can be conveyed by a 72-inch culvert along Dublin Boulevard, and connecting to Fallon Road.

Adjustments and final culvert sizing will be addressed during the design phase of the Project, and will involve incremental sizing upstream (resulting in a slight reduction in required culvert size) of the drainage systems along Dublin Boulevard and Fallon Road.


©BKF Engineers
NODE B
SUB-AREAS B1 THRU B7.2
215.9 ACRES
Q15 = 113 CFS
Q100 = 184 CFS
NODE C
SUB-AREAS C1 THRU C9
168.0 ACRES
Q15 = 100 CFS
Q100 = 156.0 CFS
NODE D
SUB-AREAS D1 THRU D6.1
418.2 ACRES
Q15 = 196 CFS
Q100 = 344 CFS
COM
SUB-AREAS - NORTHWEST
AREAS OF EDPO & OPEN AREA
EDPO-N - 307.6 ACRES
EDPO-U - 212.4 ACRES
EDPO-J - 94.2
614.2 ACRES
639 ACRES
Q15 = 190 CFS
Q100 = 447 CFS
639 ACRES & 447 CFS
CONVEYED IN 84" SD
EDPO-S
SUB-AREAS - SOUTHEAST
AREAS OF EDPO
574.1 ACRES
549 ACRES
Q15 = 184 CFS 106 CFS
Q100 = 309 CFS 281 CFS
549 ACRES & 281 CFS
CONVEYED IN 72" SD
AREA NOT
IN EDPO-S
549 ACRES
HEC 1 ANALYSIS
NODES B,C,D,
EDPO-N AND EDPO-S
MacKAY & SOMPS
FIGURE 5
DUBLIN BLVD-NORTH CANYONS EXTENSION PROJECT
HYDROLOGY REPORT
100-YEAR FLOW BASED ON COMPARISON TO PREVIOUS ANALYSIS
NOTE:
1. DIFFERENCE IN 15-YEAR FLOW (78 CFS) APPLIED CALCULATE NEW 100-YEAR FLOW.
2. DIFFERENCE ATTRIBUTED TO NEW HYDROMODIFICATION REQUIREMENT REQUIRING FLOW MATCH PRE-DEVELOPMENT FLOW OF STORMS UP TO 10-YEAR STORM EVENT (REQUIREMENT DID NOT EXIST IN 2006).
JOB No: 20167083
DATE: MAY, 2018
BY: R.A.M
REV:

Although the main will be sized to convey the 100-year storm event, adjacent local developments on either side of Dublin Boulevard will be required to size their systems for the 10-year storm event if the development is less than 50 acres. During larger storm events, this will lead to substantial surface runoff conveyed to the 60″/72″ longitudinal storm drain main running along Dublin Boulevard. Based on the typical cross section proposed, which will utilize the depressed median and parkway strips for C.3 treatment and HM, additional inlets located at sag locations of the roadway profile will be necessary (and included in this project) to provide additional capacity to collect the 10-year/100-year into the underground storm drain system. The need for additional capacity will be evaluated at a later date during the detailed design phase of the project.

Figure 6. Typical Street Section with bioretention treatment in the median



4.3 Location Hydraulics Study

As part of the Project improvements, a new bridge measuring approximately 270′ in length and 168′ in width will be built over Cottonwood Creek. This bridge will have four spans (two abutments and three bents/piers) spaced 60 and 75-feet on center in the floodplain, but will stay outside the Ordinary High Water Mark (OHWM). A location hydraulic study with HEC-RAS modeling of the Cottonwood Creek pre and post-construction conditions is included in Appendix B.

The lowest bridge profile grade is approximately 402.70′ with the bottom of the bridge elevation of about 399.70′. Hydraulic modeling results show the 100-Year water surface elevation (WSE) of 393.86′ post-bridge. This represents a freeboard of approximately 5.8 feet between the 100-Year WSE and the bottom of bridge elevation. Per the Districts requirements, 1-foot of freeboard is required between these two elevations. The same station 2+62 in HEC-RAS has a pre-bridge (WSE) of

393.68 which indicates a local rise in WSE of 0.18′. However, this elevation jump does not track farther upstream as stations 10′, 50′ and 100′ north of the bridge have the same WSE pre and post-bridge. At the perpendicular bridge/creek crossing, the top width is 168-feet. The three sets of piers remove approximately 6 feet of flow area which is equivalent to about 3.5% of the flow area.

5. References

California Regional Water Quality Control Board San Francisco Bay Region. (November 19, 2015). *California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit*. Order R2-2015-0049, NPDES Permit No. CAS612008.

Federal Emergency Management Agency. *Flood Insurance Rate Map-Alameda County, California and Incorporated Areas, Panel 329 of 725.* Map No. 06001C0329G.

Alameda County Clean Water Program (October 31, 2017). *C.3 Stormwater Technical Guidance-A handbook for developers, builders and project applicants, Version 6*.

State Water Resources Control Board, Division of Water Quality (July 17, 2012). *National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities.* Order No. 2009-0009-DWQ (As amended by 2010-0014-DWQ and 2012-0006-DWQ), NPDES No. CAS000002.

Alameda County Flood Control & Water Conservation District (2018) *Alameda County Hydrology & Hydraulics Manual*

MacKay & Somps (April 2004, March 2006) *Dublin Ranch Drainage Master Plan*

Engeo (March 23, 2011) *Stormwater and Hydromodification Management Plan for Jordan Ranch, Dublin, California*

Appendix A

FEMA FIRMettes

FEMA FIS - Cottonwood Creek Flood Profile

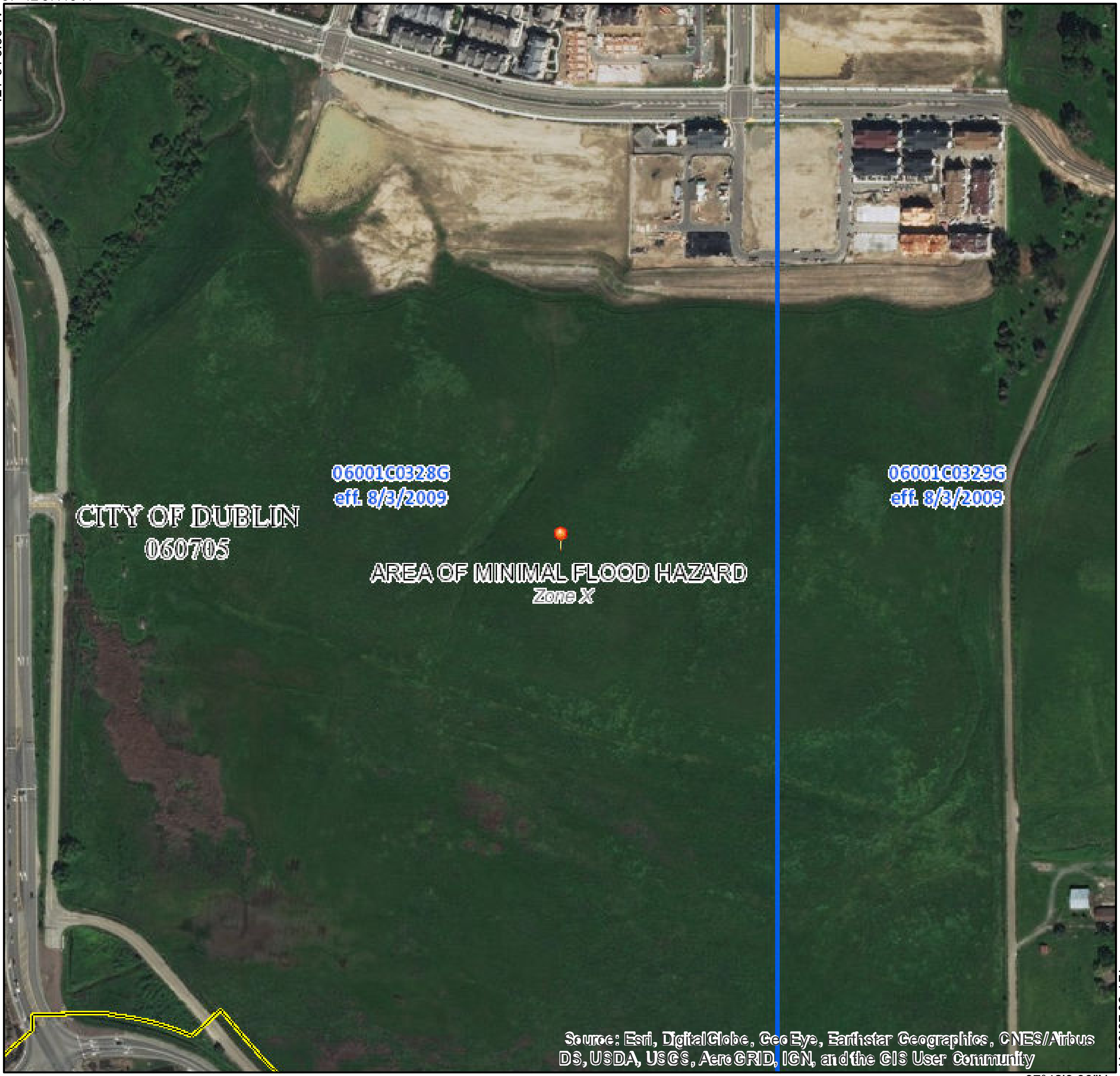
This Page Intentionally Left Blank

National Flood Hazard Layer FIRMette

FEMA

37°42'37.43"N

121°51'3.55"W



121°50'26.09"W

37°42'8.96"N

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

1:6,000

Legend

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

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

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

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

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

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

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

N

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/19/2018 at 2:12:14 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

National Flood Hazard Layer FIRMette

FEMA

37°42'23.70"N

121°50'42.77"W

121°50'5.32"W

37°41'55.23"N

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

1:6,000

Legend

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

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

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

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

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

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

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

N

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/19/2018 at 2:11:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

National Flood Hazard Layer FIRMette

FEMA

37°42'20.84"N

121°50'0.79"W

121°49'23.33"W

37°41'52.37"N

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

1:6,000

Legend

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

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

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

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

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

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

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

N

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/19/2018 at 2:10:25 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0329G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 329 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ALAMEDA COUNTY	060001	0329	G
DUBLIN, CITY OF	060705	0329	G
LIVERMORE, CITY OF	060008	0329	G

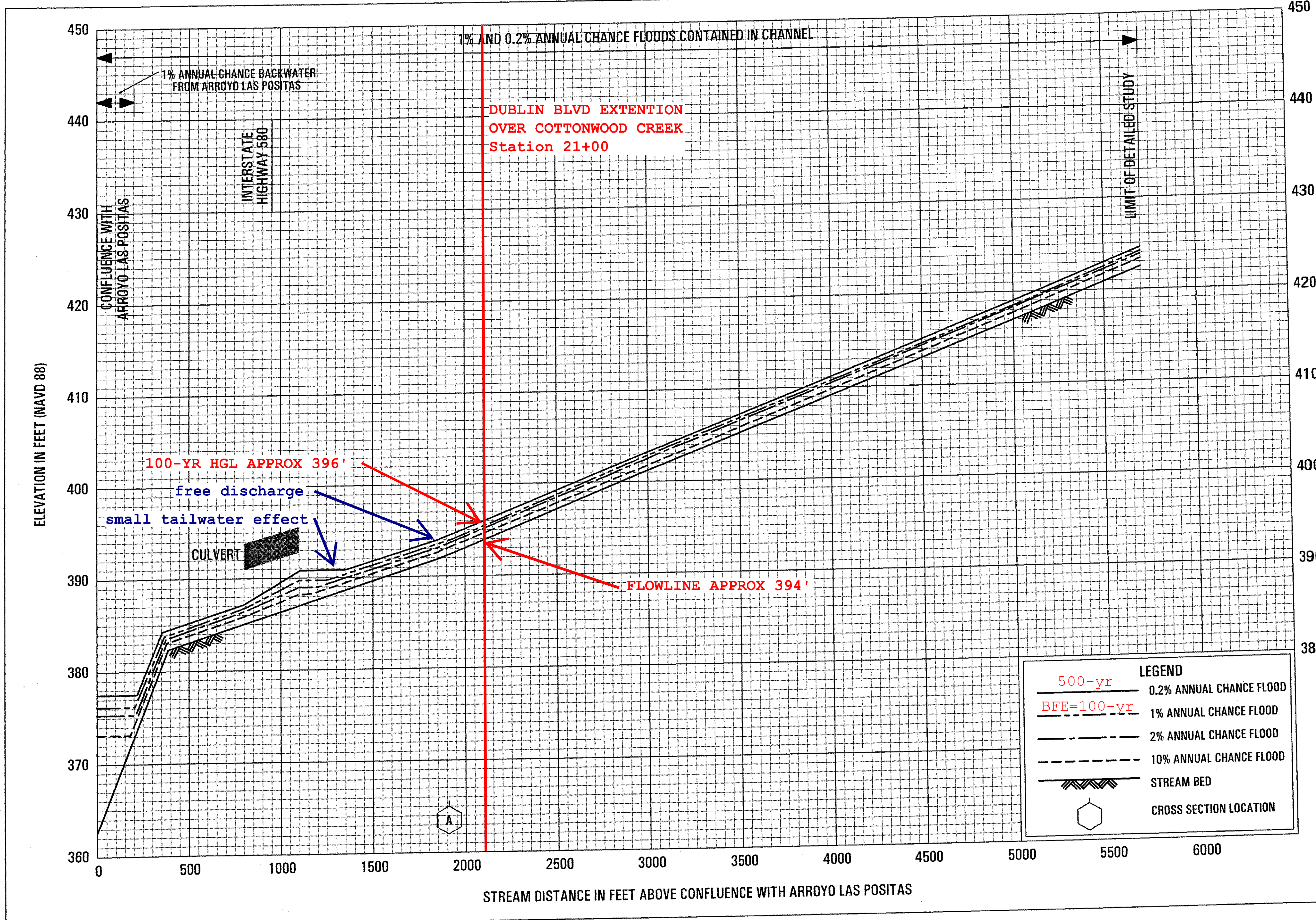
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

U.S. DEPARTMENT OF HOMELAND SECURITY

MAP NUMBER
06001C0329G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency



FLOOD PROFILES

COTTONWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ALAMEDA COUNTY, CA
AND INCORPORATED AREAS

79P

Appendix B

Location Hydraulic Study
For Proposed Bridge over Cottonwood Creek

LOCATION HYDRAULIC STUDY FORM

Dist. _______Co.___Alameda_____Rte.___Dublin Avenue______P.M.__________
EA ______________ Bridge No.__________
Floodplain Description:

There is one existing floodplain within the Dublin Avenue Extension Project, Cottonwood Creek. Cottonwood Creek sufficient capacity to contain the 0.2% Annual Chance Flood Discharge (500-Year storm event) within the channel.

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts)

As part of the Dublin Avenue Extension project a new bridge is proposed over Cottonwood Creek. The bridge crosses Cottonwood Creek near perpendicular to the flowline. At this crossing the Top Width during the Base Flood is about 167-feet. Three rows of 2-foot diameter piers will be installed in the floodway 75-feet apart on center to support the bridge. The Piers will be outside of the Ordinary High Water Mark and will remove 6-feet of flow area from the 167-foot wide floodway.

2. ADT: Current_____________ Projected___________

3. Hydraulic Data: Base Flood Q_{100}=____940___CFS
WSE_{100}= ______394-feet, NAVD_____
The flood of record, if greater than Q_{100}:
Q=____-______CFS WSE= _______-______
Overtopping flood Q= _______-______CFS WSE= _______-______
Are NFIP maps and studies available? YES___X______ NO__________

4. Is the Project location alternative within a regulatory floodway?
YES__________ NO___X______

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.

Potential Q_{100} backwater damages:

A. Residences? NO___X______YES__________
B. Other Buildings? NO___X______YES__________

C. Crops? NO___X_____YES__________

D. Natural and beneficial floodplain values?

NO___X_____YES__________

6. Type of Traffic:

A. Emergency supply or evacuation route? NO__________YES__________

B. Emergency vehicle access? NO__________YES__________

C. Practicable detour available? NO__________YES__________

D. School bus or mail route? NO__________YES _________

7. Estimated duration of traffic interruption for 100-year event hours:_______0______

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A. Roadway $______0______

B Property $______0______

Total $______0______

9. Assessment of Level of Risk Low___X______

Moderate____

High_________

For High Risk projects, during design phase, additional Design Study Risk Analysis May be necessary to determine design alternative.

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible?

Floodplain development? NO___X_____YES__________

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

SUMMARY FLOODPLAIN ENCROACHMENT REPORT

Dist. _________Co. ___Alameda_____ Rte.__Dublin Avenue___ P.M. ____________
Project No.: _______________________ Bridge No. ____________________
Limits:

Project limits are from the existing terminus of Dublin Avenue at Fallon Road to the west and the intersection of North Canyons Parkway and Doolan Road to the east. Along the way a 270' long proposed bridge will cross over Cottonwood Creek.

Floodplain Description:

There is one existing floodplain within the Dublin Avenue Extension Project, Cottonwood Creek. Cottonwood Creek sufficient capacity to contain the 0.2% Annual Chance Flood Discharge (500-Year storm event) within the channel.

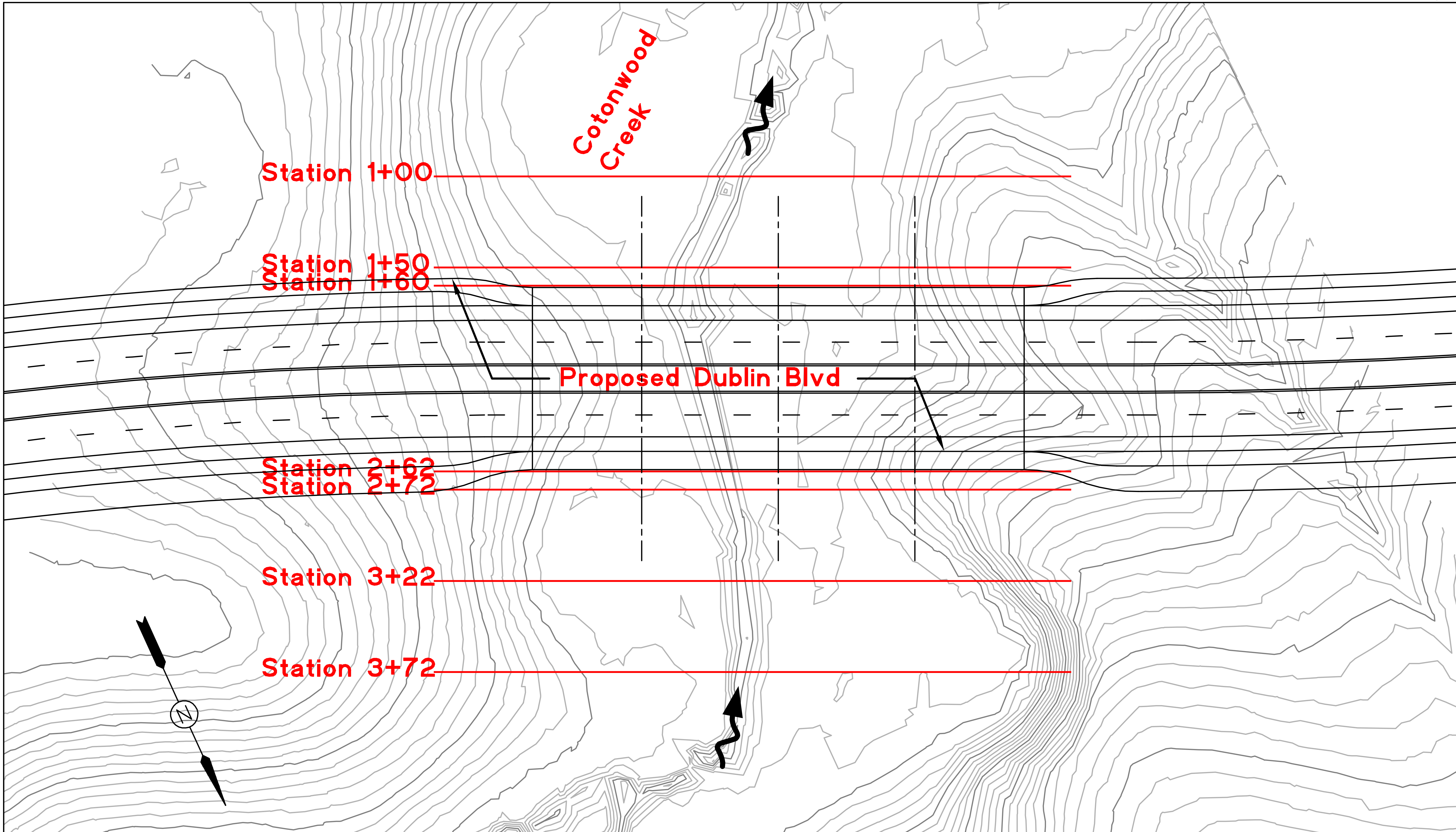
		No	Yes
1.	Is the proposed action a longitudinal encroachment of the base floodplain?	X	___
2.	Are the risks associated with the implementation of the proposed action significant?	X	___
3.	Will the proposed action support probable incompatible floodplain development?	X	___
4.	Are there any significant impacts on natural and beneficial floodplain values?	X	___
5.	Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values? If yes, explain.	X	___
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105(q).	X	___
7.	Are Location Hydraulic Studies that document the above answers on file? If not explain.	___	X

Table 1
Hydraulic Condition Pre and Post-Project Cottonwood Creek (100-Year Storm)

River River Station	100-Year Flow (cfs)	Minimum Channel Elev (ft)	Water Surface Elevation (ft)	Flow Depth (ft)	Crit W.S. (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Velocity Channel (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Channel
Existing Cottonwood Creek											
372	940	390	394.74	4.74		395.06	0.0048	5.86	291.0	223.4	0.55
322	940	390	394.53	4.53		394.8	0.0048	5.64	305.1	230.0	0.54
272	940	390	393.85	3.85	393.85	394.43	0.0101	7.84	207.0	164.7	0.78
262	940	390	393.68	3.68	393.68	394.26	0.0110	7.87	202.2	154.3	0.81
160	940	389	392.71	3.71		393.15	0.0080	6.82	229.4	167.9	0.69
150	940	389	392.81	3.81	392.22	393.03	0.0042	5.07	298.8	179.4	0.51
100	940	389	392.22	3.22	392.22	392.68	0.0112	7.27	227.7	210.0	0.8
Proposed Condition - Bridge over Cottonwood Creek											
372	940	390	394.74	4.74		395.06	0.0049	5.86	290.7	223.3	0.55
322	940	390	394.53	4.53		394.8	0.0049	5.65	304.6	229.9	0.54
272	940	390	393.85	3.85	393.85	394.43	0.0101	7.84	207.0	164.7	0.78
262	940	390	393.86	3.86	393.68	394.29	0.0077	6.88	231.4	159.9	0.68
210	Bridge										
160	940	389	392.71	3.71		393.15	0.0080	6.82	229.4	167.9	0.69
150	940	389	392.81	3.81	392.22	393.03	0.0042	5.07	298.8	179.4	0.51
100	940	389	392.22	3.22	392.22	392.68	0.0112	7.27	227.7	210.0	0.8

Notes:

1. Downstream boundary condition set to critial depth
2. 100-Year flow Q=940 from Hydrologic Procedures and Design Discharges, Schaaf & Wheeler date Dec 3, 1997



JOB No: 20167083
DATE: APRIL, 2018
BY: R.A.M
REV:

GRAPHIC SCALE

50 0 50 100

FIGURE 1
DUBLIN BLVD-NORTH CANYONS EXTENSION PROJECT
LOCATION HYDRAULIC STUDY
COTTONWOOD CREEK HEC-RAS STATIONS

BKF

DRAWING NAME: \\bkf-pl\vol4\2016\167083_Dublin_Blvd-North_Canyons_Extension\DOCS\13-Proj_Items\04-LHS\HEC_RAS_Model\Exhibit.dwg
PLOT DATE: 04-24-18 PLOTTED BY: muro

Appendix C

Zone 7 Design Discharges

By Schaaf & Wheeler

HYDROLOGIC PROCEDURES

AND

DESIGN DISCHARGES

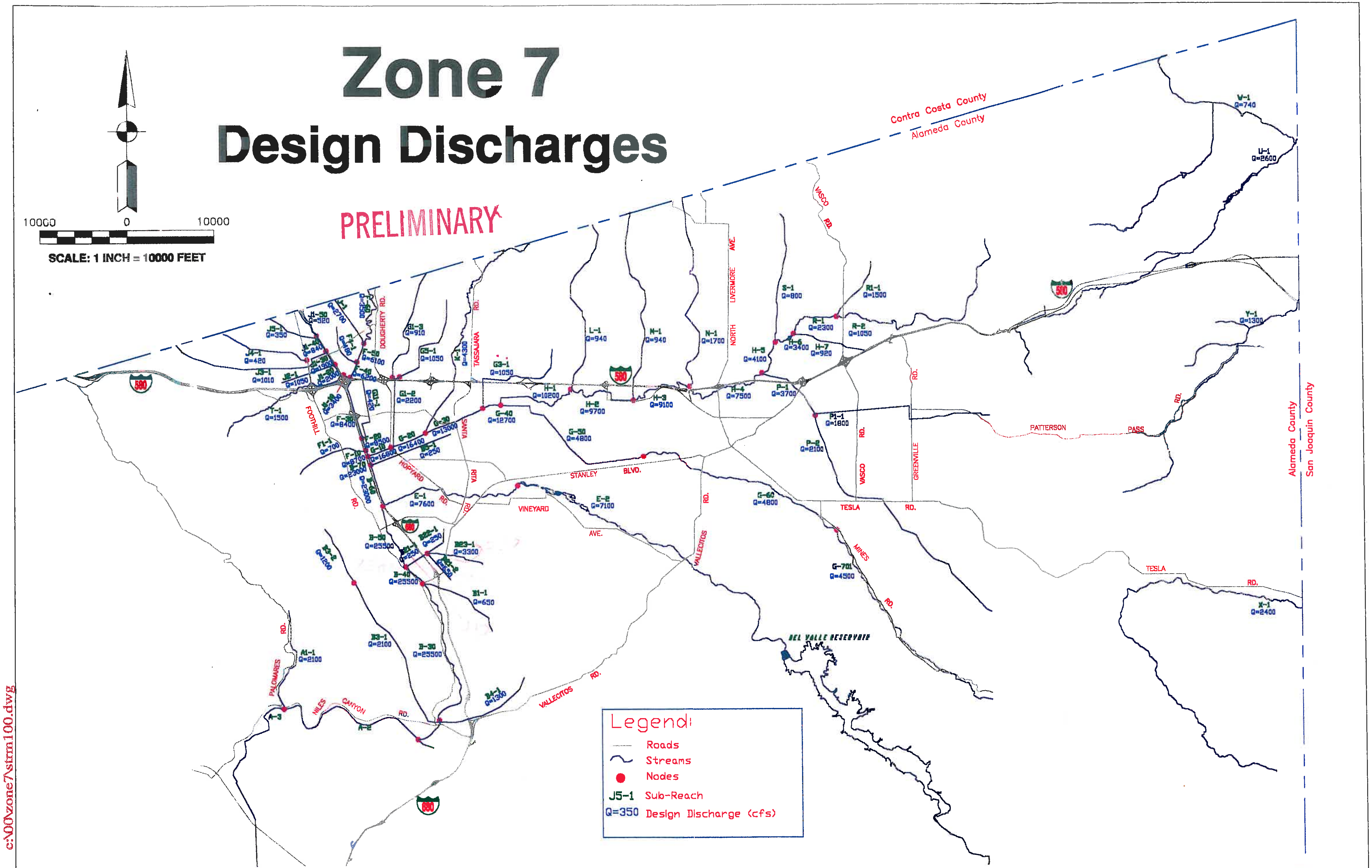
DRAFT

Prepared for:

Zone 7, Alameda County Flood Control
and
Water Conservation District

December 3, 1997

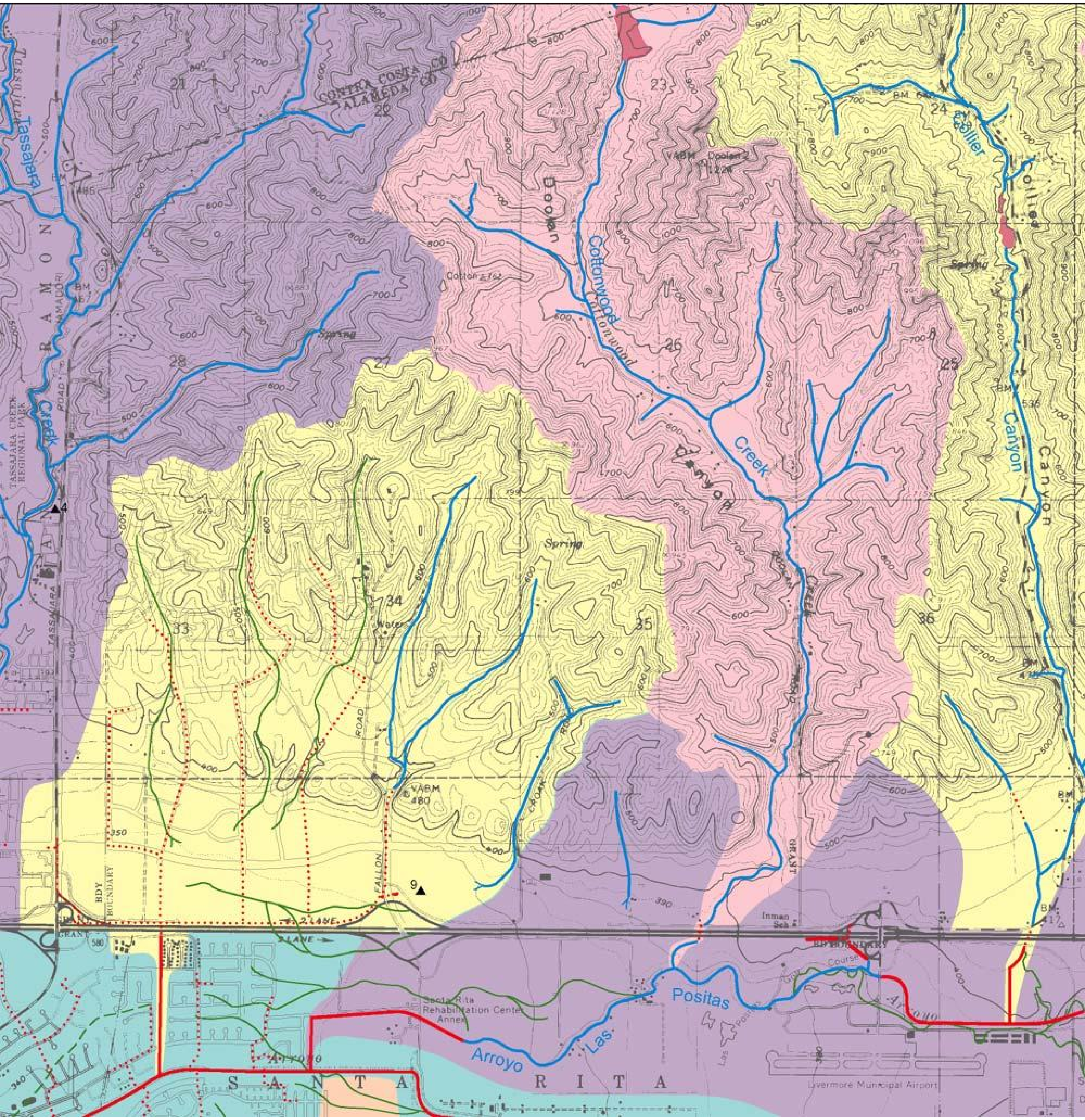
Schaaf & Wheeler, Consulting Civil Engineers
100 N. Winchester Blvd., Suite 200
Santa Clara, CA 95050
408-246-4848
FAX:408-246-5624



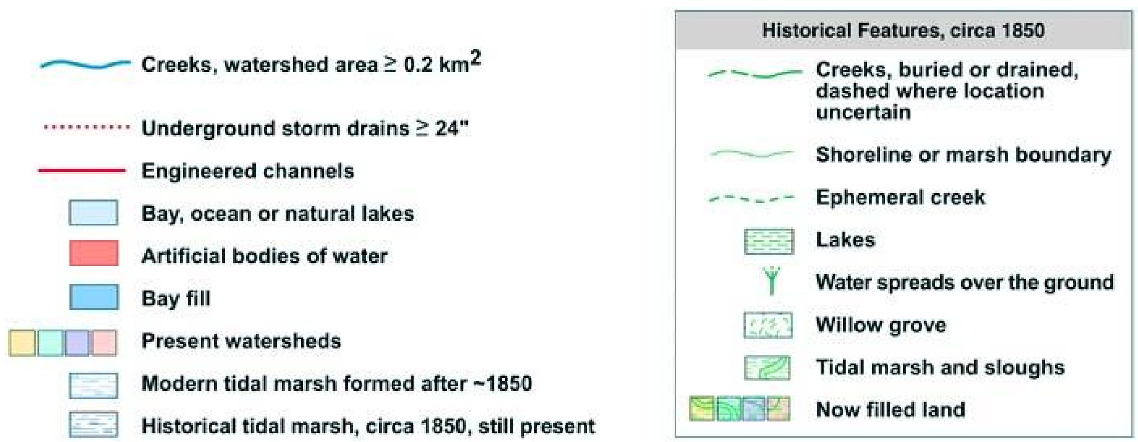
c:\00\zone7\strm100.dwg

Appendix D

Historic Watershed Map



CONTRA COSTA CO
ALAMEDA CO
Tassajara Creek
Doolan Canyon
Cottonwood Creek
Collier Canyon
Spring
Cotton
TASSAJARA CREEK REGIONAL PARK
TASSAJARA ROAD
FALLON ROAD
CROAK ROAD
GRANT
Inman Sch
Santa Rita Rehabilitation Center Annex
Arroyo Las Positas
SANTA RITA
Livermore Municipal Airport
VABM 480
Water


Creeks, watershed area ≥ 0.2 km2
Underground storm drains ≥ 24"
Engineered channels
Bay, ocean or natural lakes
Artificial bodies of water
Bay fill
Present watersheds
Modern tidal marsh formed after ~1850
Historical tidal marsh, circa 1850, still present
Historical Features, circa 1850
Creeks, buried or drained, dashed where location uncertain
Shoreline or marsh boundary
Ephemeral creek
Lakes
Water spreads over the ground
Willow grove
Tidal marsh and sloughs
Now filled land