Appendix 5.6

Water Quality Report

engineers | scientists | innovators

Entrada South and Valencia Commerce Center

Supplemental Water Quality Analysis

Prepared for

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Modified Project Number: CWR0782

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ACRONYMS AND ABBREVIATIONS

AFY	Acre feet per year
ASCE	American Society of Civil Engineers
BAT	Best Available Technology
BCT	Best Conventional Technology
BMP	Best Management Practice
CDFW	California Department of Fish and Wildlife
CASQA	California Stormwater Quality Association
CECs	Chemicals of Emerging Concern
CEQA	California Environmental Quality Act
CFS	Cubic Feet Per Second
Corps	U.S. Army Corps of Engineers
CTR	California Toxics Rule
CWA	Clean Water Act
DDT	Dichlorodiphenyltrichloroethane
DLWC	Department of Land and Water Conservation
DPH	Department of Public Health
DPW	Department of Public Works
EIA	Effective Impervious Area
EIR	Environmental Impact Report
EMC	Event Mean Concentration
Ep	Erosion Potential
HOA	Homeowners Association
LACDPW	Los Angeles County Department of Public Works
LARWQCB	Los Angeles Regional Water Control Board
LACSD	Los Angeles County Sanitation Districts
LID	Low Impact Development
MBAS	Methylene Blue Activated Substances
MCL	Maximum Contaminant Level
MGD	Million Gallons Per Day
MPN	Most Probable Number

MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRSP	Newhall Ranch Specific Plan
NTU	Nephelometric Turbidity Unit
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PFAAs	Perfluoroalkyl Acids
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
RMDP	Resource Management and Development Plan
RO	Reverse Osmosis
RWQCB	Regional Water Quality Control Board
SGMA	Sustainable Groundwater Management Act
SRWS	Self-Regenerating Water Softeners
SCR	Santa Clara River
SCP	Spineflower Conservation Plan
SCVSD	Santa Clarita Valley Sanitation District
SRPA	Sub-Regional Planning Area
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
SWQDv	Stormwater Quality Design Volume
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
USCR	Upper Santa Clara River
USEPA	U.S. Environmental Protection Agency

USGS	United States Geological Survey
VCC	Valencia Commerce Center
VTPM	Vesting Tentative Parcel Map
WDR	Waste Discharge Requirements
WRP	Water Reclamation Plant

1. INTRODUCTION

The California Department of Fish and Wildlife (CDFW) prepared and took final action on an Environmental Impact Report and Additional Environmental Assessment in 2017 (herein referred to as the "State Certified EIR;" SCH No. 200001125) for the Newhall Ranch Resource Management and Development Plan (RMDP) and Spineflower Conservation Plan (SCP) (herein referred to as the "2017 Approved Project") (CDFW, 2017).[1] The State Certified EIR addressed the impacts associated with the resource management and development facilitated by the RMDP/SCP, which included development within the Newhall Ranch Specific Plan (NRSP), Entrada South, and Valencia Commerce Center (VCC) planning areas. The "2017 Approved Project" refers to the resource management activities and development facilitated by the RMDP/SCP as approved by CDFW in 2017 for the Entrada and VCC Planning Areas.

Because development in the Entrada South and VCC planning areas was previously analyzed in the State Certified EIR, this report assesses potential impacts to surface water quality, groundwater quality, and hydromodification due to the proposed changes in the land use plan for the Modified Entrada South and VCC Project (herein referred to as the "Modified Project"), as compared to the impacts associated with the 2017 Approved Project. More specifically, the purpose of this report is to analyze whether the Modified Project gives rise to any new significant impacts or results in a substantial increase in the severity of previously identified impacts on water quality.

[1] The State Certified EIR was originally certified by CDFW in December 2010, which was comprised of a Draft EIR circulated for public review in August 2009, the Final EIR in June 2010, an "Addendum/Additional Information" published in November 2010, and all supporting technical appendices and reports. In response to litigation challenging the 2010 certification, CDFW published a Draft Additional Environmental Analysis (AEA) and supporting technical materials in November 2016, responded to public comments, and, on June 14, 2017, certified the 2017 AEA, in combination with the 2010 Final EIR, in compliance with CEQA. Accordingly, citations to the State Certified EIR refer to the entirety of the record considered and certified by CDFW.

2. ENVIRONMENTAL SETTING

As described herein, the environmental setting of the Modified Project has not changed substantially since the State Certified EIR was prepared and certified.

2.1 Physical Setting

2.1.1 Modified Project Location

Entrada South is located in the Santa Clarita Valley west of Interstate 5 (I-5) and The Old Road, south of the Six Flags Magic Mountain Theme Park, and northerly of the existing community of Westridge, separated from the Westridge site by a utility easement of approximately 300 feet in width. Entrada South is located easterly of the boundary of the Newhall Ranch Specific Plan area, immediately adjacent to the Mission Village project (Vesting Tentative Tract Map No. 61105) (Figure 2-1).

Vesting Tentative Parcel Map (VTPM) 18108 proposes the final major phase of development within the VCC planning area. The Modified Project's proposed development is located on approximately 330 acres within unincorporated Los Angeles County in the Santa Clarita Valley. More specifically, the VCC development area is located within the partially developed VCC business and industrial park development area, just north of State Route 126 (SR-126) and just west of the I-5 freeway (Figure 2-1).

Two existing water reclamation plants (WRPs) discharge treated wastewater into reaches of the Santa Clara River lying upstream from the Modified Project (Figure 2-1). The Saugus WRP is located four miles upstream from the Modified Project, across Bouquet Canyon Road at Soledad Canyon Road, and the Valencia WRP is located just north of Magic Mountain Parkway at The Old Road. The Newhall Ranch WRP, proposed in conjunction with the Newhall Ranch Specific Plan, will be located approximately 6.7 river miles downstream of the Modified Project site and will also discharge treated wastewater into the Santa Clara River.

2.1.2 Existing Site Characteristics

2.1.2.1 Entrada South

The southern portion of the Entrada site is dominated by several north/south trending ridges (CDFW, 2017). A narrow panhandle (roughly 100 meters wide) extends along the western portion of the site (east of Airport Mesa) to an agricultural field adjacent to the Santa Clara River. The northeastern portion of the site contains a large agricultural field with fragments of remnant oak woodlands, California sagebrush scrub and California buckwheat scrub. Site elevations range from approximately 1,000 feet above mean sea level (AMSL) along the Santa Clara River to approximately 1,550 feet AMSL on the ridges in the southwestern portion of the site.

Slope gradients range from moderate to very steep in the hillside areas, to very gentle within the ephemeral drainages and associated mesas (CDFW, 2017). Distinctive geographic features include the north/south trending ridges on the southern portion of the site, and a wash that drains north through the site to a concrete-lined drainage channel that passes through the Six Flags Magic Mountain Theme Park.

Native and naturalized habitats within the Entrada site are representative of those found in the region and provide examples of those plant communities found in the Santa Susana Mountains and the Santa Clara River ecosystems (CDFW, 2017). California sagebrush scrub, undifferentiated chaparral, big sagebrush scrub, and California annual grasslands are the major upland plant communities on the site. Ephemeral and intermittent drainages on site provide habitat for alluvial scrubs. While upland habitats dominate the landscape within the site, immediately adjacent to the site are areas that support a variety of riparian plant communities. These include southern cottonwood-willow riparian forest, southern willow scrub, mulefat scrub, arrow weed scrub, and coastal and valley freshwater marsh and seeps.

Portions of the Entrada site have been historically leased for cattle grazing and agricultural operations. Grazing activities have affected much of the natural habitat on-site. Scrub habitats have been displaced by California annual grasslands, apparently as a result of grazing. Southern California Edison and Southern California Gas Company have transmission lines within easements along the southern portion of the Entrada site, all of which are actively maintained. The Six Flags Magic Mountain Theme Park is to the north of the Entrada site, and an existing residential development is located to the south.

The adjacent Mission Village project has constructed an extension of Magic Mountain Parkway southwest from its previous terminus near The Old Road for a distance of approximately 5,000 feet through the Entrada South project to the Mission Village project site.

2.1.2.2 Valencia Commerce Center

The VCC site is dominated by north/south trending ridges that lie north of Castaic Creek, near the confluence with Hasley Canyon (CDFW, 2017). Site elevations range from just under 1,000 feet AMSL in the Castaic Creek bottom to just over 1,500 feet AMSL at the top of the western ridge. The ridges are generally rounded at the top with slopes ranging from steep to gentle. Aside from the ridges, the two major wash areas on the VCC planning area, Castaic Creek and Hasley Canyon, contain flood control protection benches and braided channels with associated riparian/wash scrub habitats.

Native and naturalized habitats within the VCC planning area include representative examples of those plant communities found in the Santa Susana, Topatopa, and Liebre mountains and the Santa Clara River and Castaic Creek ecosystems (CDFW, 2017). Upland habitats dominate the landscape within the study area (e.g., California sagebrush scrub, California annual grasslands); however, Castaic Creek and Hasley Canyon support a variety of riparian plant communities (e.g., herbaceous wetland, southern cottonwood-willow riparian forest, and mulefat scrub). No observations were made of any coastal and valley freshwater marsh or seep areas in the study area (CDFW, 2017).

Historically, the applicant has leased portions of the VCC area for sand and gravel production, cattle grazing, and agricultural operations; only agricultural operations are currently ongoing. All of these activities have affected much of the natural habitat on-site (i.e., scrub habitats have been displaced by California annual grasslands). Southern California Edison and Southern California

Gas Company also have distribution lines and access roads within on-site easements. There is existing commercial/industrial development located adjacent to the VCC planning area, as the planning area is a portion of the larger, mostly developed VCC commercial/industrial complex.

2.1.3 Climate

The Modified Project site has a Mediterranean climate with cool, wet winters and hot, dry summers.

The average annual rainfall for the Modified Project area is approximately 18.3 inches, based upon hourly precipitation data from a 40-year period of record (water years (WY) 1969-2008)[2] recorded at the National Climatic Data Center (NCDC) Newhall rain gauge[3] (Station #046162, see Figure 2-1). Additional records for water years (WY) 2009, 2010, 2011, and 2012 are available; however, all of the data from WY 2011 and 2012 are flagged as missing or deleted, and data from WY 2010 has approximately 4.5 months of missing or deleted data, most of which are during the wet season (June through December). Water year 2009 is a more complete record with 8.5 percent flagged data; however, adding this one year of data into the 40-year record would yield similar results. An additional check of data through 2023, including 12 nearby rain gauges, concluded that there are no high-quality data available at or in the vicinity of the Newhall rain gauge for years after 2008.

As throughout Southern California, rainfall in the Modified Project area alternates between wet and dry periods, a variation that is central to understanding the geomorphic history of the Modified Project area. Wet cycles may persist for several years, sometimes for periods of six or eight years, during which rainfall, although variable, may average about 140 to 150 percent of the long-term average.

A detailed rainfall analysis of the Newhall rain gauge period of record (1969 - 2008) was conducted for three data groups: dry water years (less than the 25^{th} percentile average annual rainfall depth), normal water years (between the 25^{th} and 75^{th} percentile average annual rainfall depth), and wet water years (greater than the 75^{th} percentile average annual rainfall depth). The 25^{th} and 75^{th} percentile rainfall depths were determined to be 10.3 inches and 22.2 inches, respectively. The rainfall data were analyzed using the United States Environmental Protection Agency's (USEPA's) Storm Water Management Model (SWMM) 5 for the Newhall gauge. The statistics function in SWMM subdivides the rainfall record into discrete events separated by an inter-event dry period, which in this case, was set to a minimum of six hours. The discrete events were aggregated by water year and ranked by average annual rainfall depth to determine whether a particular year was representative of dry, normal, or wet conditions. Average annual rainfall depths for the dry, normal, wet, and total (all WYs) data sets are provided in Table 2-1 below. Additional summary statistics are provided in Table 2-2 below.

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[2] The term "water year" is defined as the 12-month period from October 1 of any given year through September 30 of the following year. The water year is designated by the calendar year in which it ends. Thus, the water year ending September 30, 1999 is called the "1999" water year.

[3] Periods of missing data within the Newhall rain gauge record were estimated using a correlation with the San Fernando rain gauge (NCDC Station #047762). See Appendix D for a detailed analysis.

The rainfall distribution per month for each water year classification indicates that rainfall occurs primarily from December through March for each of the water year designations. In dry years, approximately 67 percent of rainfall occurs in this period, in normal years approximately 75 percent of rainfall occurs in this period, and in wet years approximately 88 percent falls in this period. When all water years are considered, approximately 80 percent of rainfall occurs between December and March. Table 2-3 presents the average monthly precipitation totals and percentage of annual rainfall that occurs per month for each of the water year classifications.

Table 2-1: Precipitation Analysis Results for Dry, Normal, Wet, and Total Water Years

Designation	Water Years	Average Annual Rainfall Depth (inches)
Dry	1972, 1976, 1981, 1984, 1987, 1990, 1994,1999, 2002, 2004, 2007	7.8
Normal	1970, 1971, 1973, 1974, 1975, 1977, 1982, 1985, 1986, 1988, 1989, 1991, 1996, 1997, 2000, 2001, 2003, 2006, 2008	16.4
Wet	1969, 1978, 1979, 1980, 1983, 1992, 1993, 1995, 1998, 2005	33.5
Total	All	18.3

Table 2-2: Precipitation Summary for the Modified Project Area

Storms	Newhall Rain Gauge Patched Record[1]	
All Water Years	Average annual rainfall (in):	18.3
	Total number of storms:	1,011
	Average number of storms per year:	25.3
	Average storm depth (in):	0.7
	Average storm duration (hrs):	7.1
Dry Water Years	Average annual rainfall (in):	7.8
	Total number of storms:	213
	Average number of storms per year:	19.4
	Average storm depth (in):	0.4
	Average storm duration (hrs):	4.3
Normal Water Years	Average annual rainfall (in):	16.4
	Total number of storms:	446
	Average number of storms per year:	23.5
	Average storm depth (in):	0.7
	Average storm duration (hrs):	7.5
Wet Water Years	Average annual rainfall (in):	33.5
	Total number of storms:	352
	Average number of storms per year:	35.2

Storms	Newhall Rain Gauge Patched Record[1]	
	Average storm depth (in):	1.0
	Average storm duration (hrs):	8.3

[1] Newhall Gauge (Station #046162) for Water Year 1969 – 2008, augmented record includes adjusted data from San Fernando gauge to fill gaps in Newhall gauge record.

Table 2-3: Monthly Precipitation for Dry, Normal, Wet, and Total Water Years

Month	Total Rainfall Depth (Dry WYs) (in)	Total Rainfall Depth (Normal WYs) (in)	Total Rainfall Depth (Wet WYs) (in)	Total Rainfall Depth (All WYs) (in)	% of Annual Rainfall (Dry WYs)	% of Annual Rainfall (Normal WYs)	% of Annual Rainfall (Wet WYs)	% of Annual Rainfall (All WYs)
October	4.2	16.5	9.6	30.3	5	5	3	4
November	10.9	33.5	11.7	56.1	13	11	3	8
December	20.0	44.9	37.6	102.6	23	14	12	14
January	13.8	65.8	107.5	187.1	16	21	32	26
February	16.6	77.0	102.6	196.3	19	25	31	27
March	8.0	46.8	43.8	98.5	9	15	13	13
April	6.2	15.6	10.2	32.0	7	5	3	4
May	1.3	6.3	5.6	13.1	2	2	2	2
June	0.8	-	0.8	1.6	1	0	0	0
July	-	0.2	0.7	0.9	0	0	0	0
August	0.1	2.7	1.4	4.2	0	1	0	1
September	3.9	3.2	3.9	11.0	5	1	1	1
Overall	85.8	312.4	335.3	733.5	100	100	100	100

WY – Water Year

This period of record has been used in this Supplemental Water Quality Analysis to represent the distribution of rainfall expected for the Modified Project because long-term trends in annual precipitation cannot be anticipated. Analysis of historical precipitation records throughout California shows large year-to-year variability in the amount of annual precipitation with periods of consecutive dry or wet years and no apparent trend over the past century (CalEPA, 2013).

Global climate change is expected to cause a future warming trend in the Santa Clarita region even under moderate emissions scenarios. While there is no clear trend in annual precipitation, climate projections show continued year-to-year variability in precipitation through 2100 with a shift toward larger year-to-year fluctuations (Pierce et al., 2018). The stormwater management facilities analyzed in this Supplemental Water Quality Analysis are designed to collect smaller, more frequent rain events and to bypass the biggest rainstorms, thus, this analysis would not be affected by potential future increases in extreme rainfall events.

2.2 Proposed Modified Project

Since the publication of the State Certified EIR, the Applicant has refined the Modified Project's design in an effort to reduce environmental impacts to the on-site drainage courses.

2.2.1 Entrada South Proposed Land Uses

The Modified Project increases environmental protections for wetlands and related biological resources within the Entrada South Planning Area. The Modified Project enhances and restores the majority of a drainage channel referred to as Unnamed Canyon 2. With the proposed design refinements, the majority of Unnamed Canyon 2—from the storm drain outlet at the southern Entrada boundary to Magic Mountain Parkway—would be enhanced and restored as a natural, open, vegetated drainage channel with grade control structures that would retain the look and feel of a natural canyon, thus reducing permanent impacts to biological resources and jurisdictional waters and providing additional open space within the developed portions of the Modified Project site. This environmentally beneficial modification would result in increased open space, restored drainage areas, and habitat for species as compared to that evaluated in the State Certified EIR.

The State Certified EIR for the 2017 Approved Project evaluated the environmental impacts of 1,725 dwelling units, 450,000 square feet of non-residential development, a public facilities area for a neighborhood park and a potential school site, private recreational amenities, a Spineflower preserve, and trails and infrastructure within the Entrada South Planning Area. The Modified Project includes 1,574 dwelling units, 730,000 square feet of non-residential development, a public park and potential school site, a Spineflower preserve, and trails and infrastructure within the Entrada South Planning Area. As such, this analysis considers the environmental implications of reducing the number of residences by 151 units and increasing the amount of non-residential development by 280,000 square feet. These minor refinements do not substantially change the scope of the Entrada South land use plan when comparing the Modified Project to the 2017 Approved Project.

Table 2-4 below lists the modeled land use areas for the Entrada South portion of the Modified Project from the Vesting Tentative Tract Map (Hunsaker, 2023a); the modeled land uses are shown in Figure 2-2. As described in Section 5 below, the control measures incorporated into the Modified Project to address water quality and hydrologic impacts include low impact development (LID) treatment control best management practices (BMPs) that reflect the current National Pollutant Discharge Elimination System (NPDES) stormwater permit requirements. The analysis in the State Certified EIR for the 2017 Approved Project analyzed non-LID BMPs consistent with the 2001 NPDES permit requirements. Thus, the modeling conducted for this Supplemental Water Quality Analysis analyzes the entire Modified Project area to assess the incremental changes of the Modified Project on stormwater runoff quality as a result of the application of new Project-specific LID BMPs.

Table 2-4: Modeled Land Use Areas within the Entrada South Modified Project Area

Land Use	Modified Project Area (Gross Acres)
Open Space	130.4
Multi-Family Residential	153.3
Commercial	49.1
Road	10.0
Public Facilities (Water Quality)	2.2
Park	5.4
Recreation	20.0
Total	370.4

Source: Hunsaker, 2023a.

2.2.2 Valencia Commerce Center Proposed Land Uses

In 1990, an EIR for VCC was approved by the County of Los Angeles. The project approved by the County in 1990 included approximately 12.6 million square feet of non-residential development (industrial, general commercial, and office uses). The State Certified EIR analyzed the environmental implications of 3.4 million square feet of industrial/commercial space on approximately 164 acres, approximately 144 acres of open space, and about 13.7 acres of public facilities. No changes to the proposed 3.4 million square feet of non-residential (industrial/commercial) space within the VCC Planning Area are proposed as part of the Modified Project. The proposed minor changes and refinements under the Modified Project, as compared to the 2017 Approved Project analyzed in the State Certified EIR, include a reduction in permanent impacts to jurisdictional streams and certain vegetation communities, including significant avoidance of permanent impacts in Hasley Creek (although such areas may be temporarily impacted during construction, as analyzed in the State Certified EIR, but would be restored and revegetated after construction based on the Modified Project design). This environmentally beneficial modification would result in increased open space, restored drainage areas, and habitat for species.

The VCC portion of the Modified Project consists of approximately 3.4 million square feet of remaining, unbuilt industrial and business park uses within the County-approved development area. The proposed non-residential development would be integrated into the existing VCC development pattern, and complement existing, approved and proposed development in its vicinity. The proposed development would also be supported by a network of on-site roads and parking, and requisite wet and dry utilities.

Table 2-5 below lists the modeled land uses for the VCC portion of the Modified Project from the Vesting Tentative Parcel Map (Hunsaker, 2023b). The proposed VCC land uses are shown on Figure 2-3. As described above for Entrada South, the modeling conducted for this Supplemental Water Quality Analysis analyzes the entire Modified Project area to assess the incremental changes of the Modified Project on stormwater runoff quality as a result of the application of new BMPs consistent with the current NPDES stormwater permit requirements.

Table 2-5: Modeled Land Use Areas within the VCC Modified Project Area

Land Use	Modified Project Area (Gross Acres)
Open Space	187.2
Commercial	120.0
Open Space - Access Road	9.3
Road	12.3
Total	328.8

Source: Hunsaker, 2023b.

2.2.3 Drainage and Flood Control, and Water Quality Improvements

The Modified Project includes drainage, flood control, and water quality improvements such as storm drains, debris basins, water quality facilities, and outlet structures in compliance with Los Angeles County drainage requirements and the Regional Phase I Municipal Separate Storm Sewer System (MS4) Permit requirements.

Control measures incorporated into the Modified Project to address water quality and hydrologic impacts include site design, source control, LID treatment control, and hydromodification control BMPs, which are described in Section 5.2.4 of this report. Additional drainage-related improvements that would be implemented as part of the Modified Project include the conveyance of runoff through underground pipes and installation of energy dissipaters. Please refer to Section 5.5, Hydrology and Water Quality – Hydrology, of the Modified Project's Supplemental EIR for a detailed discussion of the proposed drainage improvements to be undertaken in connection with development of the proposed Modified Project.

2.2.3.1 Entrada South

Existing conditions within Unnamed Canyon 2 include a deep channel incision as a result of stormwater runoff from development in the off-site, upstream Westridge and Stevenson Ranch communities, which were built before hydromodification control was required. In order to stabilize and restore the drainage course, a geomorphic channel design is proposed (see Appendix A for further detail). The channel reach will remain as natural open space, with some minor grading to stabilize the stream banks and channel bed. The proposed design for the drainage corridor will incorporate a series of grade control structures used to maintain a stable bed slope of 0.5 percent, which will reduce flow velocities within the channel and reduce the potential for erosion of the channel bed. Additionally, bank stabilization measures will also be provided along the channel banks to prevent the potential for lateral erosion of the channel.

2.2.3.2 Valencia Commerce Center

Under the 2017 Approved Project, approximately 8,500 feet of soil cement bank protection would be installed on the east and west sides of Castaic Creek. The soil cement bank protection on the east bank would extend downstream from the I-5 bridge to the existing rip rap bank protection and extend downstream from the existing rip rap to the Commerce Center Drive bridge. The soil cement bank protection on the west bank would extend downstream from the existing concrete slope lining to the confluence with Hasley Creek where it will turn upstream along the east bank of Hasley Creek (PACE, 2022). Under the Modified Project, the length of the soil cement bank protection would be the same as in the Approved Project, with the same upstream and downstream limits; however, the planned bank protection alignments on the east and west side of Castaic Creek would be pulled back from the creek bed. The revised alignments in the Modified Project conditions would reduce permanent impacts to waters of the U.S. in Castaic Creek.

Under the 2017 Approved Project, the planned Hasley Creek channel is relatively straight and aligned approximately downslope, resulting in a steep channel profile that requires the numerous grade control structures to maintain a stable channel (PACE, 2022). The 2017 Approved Project channel profile design would require substantial grading and infill over the existing streambed and surrounding overbank areas. The design would consist of approximately 6,500 feet of engineered soft bottom channel with soil cement bank protection on the east and west embankments, and eleven grade control structures, spaced out over the project reach. The soil cement bank protection on the east side of Hasley Creek would extend from the existing channel bank improvements downstream and merge with the soil cement bank protection on the west side of Castaic Creek, forming a continuous embankment protection. The soil cement bank protection on the west side of Hasley Creek would extend from the existing channel bank improvements downstream to the Commerce Center Drive bridge.

Under the Modified Project, the existing natural channel bed of Hasley Creek would be preserved by maintaining the existing sinuous creek alignment. The soil cement bank protection would have the same upstream and downstream extents as in the Approved Project, but the alignments would be revised to follow the existing stream corridor so that the existing natural channel bed area and lengthwise elevation profile would be maintained, thus preserving large amounts of existing jurisdictional area within Hasley Creek (PACE, 2022).

2.2.4 Water Supply Source and Quality

The Modified Project's water supply would be provided by the Santa Clarita Valley Water Agency (SCV Water), which consists of three divisions: Newhall Water Division (NWD), Santa Clarita Water Division (SCWD), and Valencia Water Division (VWD)[4]. SCV Water's water supply comes from four main sources - imported water from the State Water Project (SWP), groundwater, recycled water, and water banking (storage) (SCV Water, 2022). The SWP consists of facilities operated by the California Department of Water Resources to transmit water to SWP

[4] SCV Water is a full-service regional water agency formed in January 2018 pursuant to the Santa Clarita Valley Water Agency Act of 2017 (SB 634) through the merger of three water agencies in the Santa Clarita Valley. The merger included the Castaic Lake Water Agency (CLWA), the Newhall County Water District, the Santa Clarita Water Division of CLWA, and the Valencia Water Company. CLWA was a wholesale water agency that acquired, treated, and delivered State Water Project water supply throughout the Santa Clarita Valley. The NCWD, SCWD, and VWC were three of the four retail water purveyors in the Valley (Los Angeles County Waterworks District #36 was the fourth, but it was not merged into SCV Water and remains an independent retail purveyor within SCV Water's service area). Pre-2018 water management documents, like the 2015 Urban Water Management Plan (Kennedy/Jenks Consultants and Luhdorff & Scalmanini Consulting Engineers, 2017), refer to CLWA as the local wholesaler of imported SWP water and to NCWD, SCWD and VWC as the local retail purveyors.

contractors for agricultural or urban supply uses. The SWP supplies about 63 percent (42,683 acre-feet) of SCV Water's needs. On average, more than a third (25,600 acre-feet) of SCV Water's supply comes from the Alluvial Aquifer and the Saugus Formation groundwater sources. Approximately one percent (480 acre-feet) of the water supply currently comes from recycled water. SCV Water also stores 114,000 acre-feet of water in Kern County for use in a drought or emergency.

Existing water quality conditions for urban water uses in the SCV Water service area are documented in the 2022 Consumer Confidence Report (SCV Water, 2022). An annual Consumer Confidence Report is provided prior to July 1st to all Santa Clarita Valley residents who receive water in the SCV Water service area. There is detailed information in that report about the results of quality testing of the groundwater and treated SWP water supplied to the residents of the Santa Clarita Valley (SCV Water, 2022).

2.2.4.1 Perchlorate and PFAS

The 2020 Santa Clarita Valley Urban Water Management Plan (Kennedy/Jenks Consultants, 2021) discusses water quality constituents, both naturally occurring and man-made, in source waters. The Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan (GSI Water Solutions et al., 2022) also provides an overview of groundwater quality. The following sections summarize this information for perchlorate and per- and polyfluoroalkyl substances (PFAS), constituents of concern in groundwater.

Perchlorate, a chemical used in making rocket and ammunition propellants, has been a groundwater quality constituent of concern in the Santa Clarita Valley since 1997. The maximum contaminant level (MCL) of six micrograms per liter (µg/L) was adopted by the California Department of Public Health (DPH) in 2007. Nine wells within the Santa Clarita Valley Water service area have been impacted by perchlorate, including seven Saugus wells and two Alluvial wells (Kennedy/Jenks Consultants, 2021). All have been either: (a) abandoned; (b) abandoned and replaced; (c) returned to service with the addition of treatment facilities that allow the wells to be used for municipal water supply as part of the overall water supply systems permitted by the Division of Drinking Water; or (d) receive regular Division of Drinking Water monitoring as concentrations are below the detection limit for reporting (Kennedy/Jenks Consultants, 2021). SCV Water's long term efforts in response to the perchlorate impacts to groundwater have focused on stopping the migration of the contaminant plume and restoring lost well capacity through pump and treat methods and replacement wells (Kennedy/Jenks Consultants, 2021).

PFAS refers to a group of per- and polyfluoroalkyl substances formerly extensively used in firefighting foams, non-stick coatings, cookware, carpets, and furniture. These substances tend to accumulate in groundwater and long-term exposure could potentially affect the immune system, thyroid, liver, and can cause cancer (GSI Water Solutions et al., 2022). Under response levels established by the State Water Resources Control Board – Division of Drinking Water in February 2020, 17 of the 42 active agency wells were removed from service, accounting for approximately 45 percent of the Agency's groundwater supply. SCV Water has since completed three PFAS treatment facilities and is planning one additional treatment facility (SCV Water, 2023). Further information on PFAS is provided in Section 7.2.9.1.

2.2.4.2 *Recycled Water*

Currently, recycled water in the Modified Project Site vicinity is available from the Valencia WRP located within the SCV Water service area along The Old Road east of the Modified Project Site. The Modified Project proposes to use recycled water for landscape irrigation purposes by obtaining recycled water from the Valencia WRP. This report addresses the potential impacts of recycled water use for irrigation on groundwater quality.

2.2.5 Wastewater Treatment

The Modified Project's wastewater needs would be served by the Santa Clarita Valley Sanitation District (SCVSD), which is part of the County Sanitation Districts of Los Angeles County (LACSD). The Modified Project will discharge wastewater to the Valencia WRP. The SCVSD provides wastewater management services for approximately 250,000 residents in the City of Santa Clarita and adjacent unincorporated areas (LACSD, 2017). The SCVSD collects wastewater from households and businesses within its service area and treats the wastewater at its Saugus WRP and Valencia WRP. These two WRPs have a combined treatment capacity of 28.1 million gallons per day (mgd) and currently treat approximately 20 mgd. The treated water is of high quality and suitable for a wide range of recycled water uses, such as irrigation of street medians, golf courses, parks, and schools. Some treated wastewater is reused, and the remainder is discharged to the Santa Clara River. The Valencia WRP is discharging wastewater to the Santa Clara River pursuant to Order No. R4-2022-0174 (NPDES Permit No. CA0054216).

2.3 Surface Receiving Water Bodies and Beneficial Uses

2.3.1 Santa Clara River

The Modified Project Site comprises 699.2 acres within the 1,634 square-mile Santa Clara River Watershed.

2.3.1.1 *Watershed Description*

The Santa Clara River watershed drains an area of 1,634 square miles in the Transverse mountain range of Southern California (Upper Santa Clara River Watershed Management Group, 2016). The Upper Santa Clara River (USCR) watershed, which comprises approximately 410 square miles, is that portion of the watershed within Los Angeles County (Upper Santa Clara River Watershed Management Group, 2016). Elevations within the watershed range from sea level at the river mouth to 8,900 feet at the summit of Mount Pinos in the northwest corner of the watershed. The river is fed by numerous named stream tributaries as it flows westward from the Acton Basin, through a confined canyon (Soledad Canyon), through the Santa Clarita Valley, and finally through the Santa Clara River Valley in Ventura County, which eventually opens out across the Oxnard Plain before flowing into the Pacific Ocean near the City of Ventura, approximately 40 miles downstream of the Modified Project Site.

The Santa Clara River is perennial from the existing Valencia WRP, downstream to approximately 3.5 miles downstream of the Los Angeles County/Ventura County line near Rancho Camulos (CDFW, 2017). Flows in the Santa Clara River also can be affected by groundwater dewatering operations or by diversions for agriculture or groundwater recharge. Throughout the Santa Clara River channel, complex surface water/groundwater interactions lead to areas of alternating gaining and losing river segments. In particular, downstream of the Los Angeles County/Ventura County line, the Santa Clara River flows through the Piru groundwater basin where surface flows in the river are lost to groundwater. This ephemeral reach of the river is referred to as the “Dry Gap” (see Figure 2-4). Perennial flow generally returns downstream of the confluence with Hopper Canyon Creek and continues past Piru, Sespe, and Santa Paula Creeks, and into the Oxnard Plain (LARWQCB, 2006).

Artificial stream flow in the USCR (i.e., that portion of the River within Los Angeles County) is derived from discharges of treated effluent from the Saugus and Valencia WRPs and runoff from agricultural fields and existing urban areas (LARWQCB, 2006). The Saugus WRP, located near Bouquet Canyon Road bridge, creates surface flows in the Santa Clara River from its outfall to near the I-5 bridge. The Valencia WRP outfall is located immediately downstream of the I-5 bridge and creates surface flows extending to the Dry Gap.

Other wastewater treatment facilities in Ventura County that discharge to the Lower Santa Clara River (i.e., that portion of the river within Ventura County) or to groundwater near the river, include (LARWQCB, 2006):

- The Piru Wastewater Treatment Plant, which serves the community of Piru. It discharges secondary-treated effluent to two percolation ponds located about 500 feet from the Santa Clara River (Reach 4).
- The Fillmore Wastewater Treatment Plant, which discharges secondary-treated wastewater to percolation/evaporation ponds and/or to a subsurface percolation field or to Santa Clara River Reach 3 if the groundwater table is high. The surface water discharge accounts for approximately 30 percent of the total effluent discharged annually.
- The Santa Paula Wastewater Reclamation Facility, which discharges secondary-treated wastewater to the Peck Road storm drain, which flows into a natural, unlined channel and thence to Santa Clara River Reach 3.
- The Saticoy Sanitary District Treatment Facility, which discharges treated municipal wastewater to evaporation/percolation ponds located on the north bank of Santa Clara River Reach 2.
- The Ventura Water Reclamation Facility, which discharges tertiary-treated wastewater from domestic, commercial, and industrial sources into the Santa Clara River Estuary.

The existing Santa Clara River floodplain generally consists of a natural alluvial river system with a sand-bedded, braided channel and broad floodplain terraces (Stillwater Sciences, 2011a). Bed material in the Santa Clara River is mostly composed of non-cohesive sands and gravels. Bank erosion is due to flow impinging upon the banks. This kind of system is characterized by high sediment loads, high bank erodibility, and intense and intermittent runoff conditions. Combined with the relatively flat gradient of the River through the Modified Project Site area (average slopes range from five to 0.5 percent), it has a high potential to aggrade (deposit sediment) at low velocities (CDFW, 2017).

The following description of the Santa Clara River is summarized primarily from Assessment of Potential Impacts Resulting from Cumulative Hydromodification Effects, Selected Reaches of the Santa Clara River, Los Angeles County, California (Balance Hydrologics, 2005 (provided in Appendix B)).

Physiography

The Santa Clara River flows through a complex, tectonically active trough. Some of the world's most rapid rates of geologically current uplift are reported from the Ventura anticline and San Gabriel Mountains, just to the northwest and southeast, respectively, of the river. Slopes are very steep, with local relief of 3,000 to 4,000 feet being common. Geologic faults in the area have brought harder, more resistant sedimentary rocks over softer and younger sedimentary formations, but all formations are fundamentally soft and erodible. On either side of the faults, sandstone and mudstone formations are dominant. The northeastern and southeastern corners of the watershed are underlain by deeply weathered granitic and schistose rocks, which produce sands that are coarser than those of other rock units when they weather and erode. The San Gabriel fault crosses the valley, bringing slightly more resistant rock to the surface and creating a local base level reflected as a slight rise or 'bump' on the river's longitudinal profile.

Most geologic materials in the watershed decompose mainly to silts and clays and sand, with some coarser materials. Most sediment moved by the Santa Clara River and its main tributaries is fine, with less than five percent bedload-sized material (greater than 0.25 millimeters or about 0.01 inches in diameter). Some gravels and cobbles occur within the stream's beds and in the alluvium. Nonetheless, both the bed and the sediment transported by the river tend to be finer than in most Southern California watersheds.

Alluvial Groundwater Basins

As illustrated in Figure 2-4, the Santa Clara River is underlain by several distinct alluvial groundwater basins—the Piru, Fillmore, and Santa Paula Basins in Ventura County and the Santa Clara River Valley East Basin in Los Angeles County (Modified Project Site location). These basins are divided longitudinally by sills or ridges of bedrock that support areas of locally high (shallow) groundwater, including the area upstream from the County line (above the Piru Basin) and upstream from the mouth of Sespe Creek (the transition between the Piru and Fillmore Basins). This locally high groundwater helps to sustain summer baseflow and riparian vegetation within the Santa Clara River corridor even through relatively dry climatic cycles.

Flows

Like most southern California streams, flows in the Santa Clara River are highly episodic. For the gauged period between 1953 and 1996, annual flow at the Los Angeles/Ventura County line gauge ranged between 253,000 acre-feet (1969) and 561 acre-feet (1961). Annual peak flows at the County line between 1953 and 1996 ranged from 68,800 cfs (1969) to 109 cfs (1960). Of note is that the second highest annual peak, 32,000 cfs in 1966, was less than half of the highest peak (68,800 in 1969). These large episodic events significantly impact the geomorphic characteristics of the Santa Clara River mainstem.

After studying the response of the river to several different anthropogenic and natural disturbances, Balance Hydrologics (2005) concluded that the Santa Clara River, as with many streams in semi-arid southern California, is highly episodic. Concepts of "normal" or "average" sediment-supply and flow conditions have limited value in this "flashy" environment, where episodic storm and wildfire events have enormous influence on sediment and storm flow conditions. In these streams, a large portion of the sediment movement events can occur in a matter of hours or days. Other perturbations which can potentially affect channel geometry appear to have transitory or minor manifestations. For example, the effects on the Santa Clara River channel width of 1980s levee construction were barely discernible by the first few years of the 21st century, probably mostly due to morphologic compensation associated with the storm events in the mid- to late-1990s. As a result, channel morphology, stability, and character of the Santa Clara River are almost entirely determined by the "reset" events that occur within the watershed.

Stillwater (2011b) also describes sediment delivery from hillslopes and tributaries to the mainstem river as being dominated by extreme events associated with large, infrequent storms. The episodic and extreme nature of discharge in the watershed results in the majority of sediment transport occurring in very short periods of time. For example, annual sediment discharge over the past several decades at the County line, Sespe Creek, and Montalvo stream gauges (i.e., representing the upper Santa Clara River, Sespe Creek, and lower Santa Clara River watersheds) is estimated to have varied by a factor of more than 50,000. The three water years that contain the highest annual maximum instantaneous discharge at the Montalvo gauge account for nearly half of the total sediment yield out of the Santa Clara River. In contrast, most years have an annual total sediment yield of less than ten percent of the average annual total sediment yield. Unlike humid-region rivers, moderate discharges of intermediate recurrence thus do not carry the majority of the sediment load—the "dominant discharge" for the Santa Clara River is the largest discharge on record.

Vegetation and Habitat Types

Much of the watershed upstream of the Modified Project Site area receives rainfall averaging about 18 to 25 inches per year (Balance Hydrologics, 2005). As throughout Southern California, rainfall in the Santa Clara River watershed alternates between wet and dry periods, a variation that is central to understanding the geomorphic history of the watershed. Wet cycles tend to persist for several years, sometimes for periods of six or eight years, during which rainfall, although variable, may average about 140 to 150 percent of the long-term average. For the woody riparian vegetation along the banks and on islands in the braided channels, the wet cycles are crucial periods for establishment and growth. During dry cycles, the roots of the riparian vegetation must grow downward to the water table or perched zones, and where it cannot do so, vegetation dies back.

The diversity of habitat conditions in the Santa Clara River at any one time supports various aquatic invertebrates, aquatic plants, and fishes (CDFW, 2017). The density, biomass, and location of vegetation in relation to the channel bottom are directly dependent upon the frequency of disturbance by flood flows. Successional mulefat scrub occupies the active channel and is disturbed annually by flows. Channel-bottom habitat also includes all aquatic features, such as pools and flowing water, as well as most of the emergent wetlands in the Santa Clara

River corridor because of the presence of water. In contrast, mature riparian forests are located above the active Santa Clara River channel and are only flooded during infrequent storm events, which allow large trees to become established between events.

High flows erode stands of vegetation, and newly vegetated areas are created where vegetation becomes established by seeds or buried stems (CDFW, 2017). New sandbars are often formed during high flows, and old ones are destroyed. High flows can also change the alignment of the low-flow channel as well as the number and location of aquatic habitats of the Santa Clara River. In high-flow years, wetland vegetation along the margins of the low-flow channel and pools may increase. In high-flow years, this vegetation is removed, but likely re-establishes during the spring and summer by natural colonization processes.

The aquatic habitats of the Santa Clara River are in a dynamic state of creation, development, disturbance, and destruction (CDFW, 2017). The amount of vegetation within the Santa Clara River Corridor appears to have increased since the 1960s, likely due to the increased summer return flows from agricultural water and to year-round augmentation of base flows due to treated effluent discharge to the Santa Clara River from the Valencia and Saugus WRPs. However, this vegetation does not seem to provide enough erosion resistance to maintain a “stable” channel capable of withstanding regular "resets," which occur at intervals averaging about a decade, or much less than the expected lifetime of the riparian woodlands which do get established.

Dry Gap

The Dry Gap is underlain by the Piru Groundwater Basin, which begins about 0.7 stream miles below the Blue Cut gauging station at a point where the alluvium is thin and underlain by non-water bearing rocks (McEachron, 2005). The western boundary of the Piru Groundwater Basin is in the vicinity of the Fillmore Fish Hatchery, just east of the City of Fillmore at a reach of rising water. Under most flow conditions, all of the stream flow of the Santa Clara River from above the confluence with Piru Creek infiltrates into the Piru Groundwater Basin so that there is no continuity of surface flow. Continuous surface flow between Blue Cut and Piru Creek often exists following large winter storms, during large releases from Castaic Lake, and in the winter and early spring of exceptionally wet years. The United Water Conservation District (UWCD) has estimated, using flow data collected over the past 50 years, that the Santa Clara River has continuous flows from the Los Angeles County Line to the Pacific Ocean only 21.9 days year (six percent of the year), with the vast majority falling in wet years (McEachron, 2008).

Conservation releases from Lake Piru, which is located within the Piru Groundwater Basin, also contribute to the connectivity of the Santa Clara River below the confluence with Piru Creek. UWCD releases water from the Santa Felicia Dam (SFD) at scheduled intervals in order to replenish downstream aquifers in the Santa Clara River and Oxnard Plain (McEachron, 2005). The SFD is located at the southernmost end of Lake Piru. These conservation releases normally start in September and last for between three to eight weeks depending on the water supply and release rate. In the one to three weeks following the initiation of a release, a low-flow channel is gradually created in Santa Clara River Reach 4 below Piru Creek which allows some surface waters to continue downstream in the normally dry reach. The incised channel created by the conservation releases typically remains in the reach and maintains the high efficiency of surface flows until storm flows from upstream watersheds fill in the channel and restore the flat, wide, braided morphology to the floodplain.

Flows that breach the dry gap appear to be attributed to a number of factors:

1. Lower than normal percolation rates in the Piru Groundwater Basin. UWCD developed the Santa Clara River Surface Water Groundwater percolation model to estimate the surface flows in the ungagged reaches of the Santa Clara River downstream of Los Angeles County (McEachron, 2005). The model estimates that under antecedent dry conditions, the Piru Basin can percolate at a rate of 300 cubic feet per second (cfs) (observed during conservation releases). With wetter conditions, the average percolation rate is closer to 150 cfs. A decrease in percolation rate was simulated in the model when flows over 60 cfs were sustained for more than six days. The magnitude of the decrease in percolation rate is a function of the water year classification (greater decrease during wet years) and the duration of the sustained flows.
2. Wetter than normal water years. A study by Harrison (2006) estimates that a minimum flow of 800 cfs is required to provide a depth of 0.6 feet continually across 10 feet of channel, from the Santa Clara River estuary to Santa Paula Creek; a flow of 500 cfs is needed to provide the same depth and width of flow from Santa Paula to Sespe Creek; and 700 cfs would be needed between Sespe Creek and Piru Creek. Based on hydraulic modeling, a discharge between 1,800 to 2,000 cfs would be required to maintain a higher critical depth of one foot in the river below Piru Creek. A simple regression model indicated that achievement of the minimum depth in the river was found to be highly correlated with the total annual runoff (Harrison et al., 2006).
3. Larger storms. Large storms have been shown to breach the Dry Gap; however, these flows are often not sustained because of the high percolation rates in the Piru Groundwater Basin (McEachron, 2005). Two storms in water year 2001 (5.6- and 6.7-inches total rainfall) breached the Dry Gap and high flows were observed during and immediately following the events, but quickly decreased within one to two days afterward.
4. Conservation releases from Lake Piru/SFD. Conservation releases are intended to recharge groundwater, and their magnitude and frequency are dependent on supply and demand in the groundwater basin. As described above, the flows released from Lake Piru/SFD create an incised channel in the Santa Clara River and recharge groundwater, which creates a greater potential for surface flows to pass through Santa Clara River Reach 4 continuously.

Based on the information available, single large precipitation events alone may not be indicative of when the Dry Gap is breached. Other factors, such as antecedent moisture conditions and timing and magnitude of conservation releases, influence when storm flows may continually flow through the Dry Gap.

Estuary

The Santa Clara River Estuary is located at the interface between the Santa Clara River and the Pacific Ocean. The Santa Clara River Estuary is composed of a river channel that empties into a main lagoon impounded by a seasonally closed-mouth berm (Stillwater, 2011c). The mouth of the Santa Clara River Estuary is typically open to the ocean during the winter and spring due to high flows following storms (LARWQCB, 2006). Lack of rainfall, lower river flows, and smaller surf result in the mouth closing during the summer and early fall. The main lagoon contains a network of channels and bars that are formed and reworked during storm events and subsequent tidal exchange while the mouth remains open (Stillwater, 2011c). A large amount of sediment passes through the Santa Clara River Estuary and is discharged to the nearshore ocean, with coarser sediment contributing to the building of both offshore and nearshore deltas, which in turn supply sediment for subsequent mouth berm building and downcoast beach replenishment.

Analysis conducted by Stillwater (2011c) of current and historical data shows that the relative rate of flows into and out of the Santa Clara River Estuary varies inter-annually as well as over longer timescales, due to both natural and anthropogenic influences. In general, the Santa Clara River flow is the dominant inflow to the Santa Clara River Estuary from the fall through the spring, causing a relatively high mouth breaching and subsequent open-mouth frequency from November through June (i.e., the mouth is open greater than 50 percent of the time on average). During the summer months, the Ventura Water Reclamation Facility (VWRF) effluent discharge is the dominant inflow to the Santa Clara River Estuary and the mouth breaching frequency is relatively low during most years (i.e., the mouth is closed greater than 50 percent of the time on average). When the mouth remains closed for long periods during dry conditions, the VWRF effluent discharge fills the Santa Clara River Estuary to quasi-equilibrium “full” elevation that can be maintained for extended periods. The Santa Clara River Estuary water balance developed for the Stillwater study period (October 2009 and September 2010) showed that approximately 80 percent of the total Santa Clara River Estuary inflow and outflow volume occurred during and in the days following storm events. The water balance also showed that approximately 90 percent of the flow into the Santa Clara River Estuary during closed-mouth periods from March through September 2010 came from the VWRF (effluent and pond percolation), indicating the relatively large role the VWRF plays in maintaining Santa Clara River Estuary volume during the spring and summer months.

2.3.2 Castaic Creek and Hasley Creek

The VCC Planning Area will drain to Castaic Creek and Hasley Creek.

2.3.2.1 Castaic Creek

Castaic Creek is located within the boundaries of the VCC Planning Area. The 8.7 square mile (5,555.3 acre) Castaic Creek watershed is a tributary located north of the Santa Clara River. The total length of the mainstem channel is approximately 36,819 feet, with an average overall slope of 3.7 percent. The maximum elevation difference from the headwaters to the mouth of the creek at the Santa Clara River is 1,378 feet. Generally, the soils in the watershed are characterized as Saugus loam and are predominately classified as being in hydrologic soil group "B" (lower runoff potential). The associated vegetative cover within the watershed varies, but primarily consists of California coastal sage scrub.

2.3.2.2 Hasley Creek

Hasley Creek is located within the boundaries of the VCC planning area. The 89.7 square mile (57,416 acre) Hasley Creek watershed is a tributary located north of the Santa Clara River. The total length of the mainstem channel is approximately 112,708 feet with an average overall slope of 2.2 percent. The maximum elevation difference from the headwaters to the mouth of the creek at the Santa Clara River is 2,430 feet. Generally, the soils in the watershed are characterized as Stonyford-Millsholm Family soils and are predominately classified as being in hydrologic soil group "D" (high runoff potential). The associated vegetative cover within the watershed varies, but primarily consists of Chamise chaparral.

2.3.3 Beneficial Uses

The Water Quality Control Plan for the Los Angeles Region (Basin Plan) (LARWQCB, 1994, as amended) lists beneficial uses of major water bodies within this region (Table 2-6). Santa Clara River Reach 5 and Castaic Creek are listed and have specific beneficial uses assigned to them. Halsey Creek is not listed in the Basin Plan. As identified in Table 2-6, the existing and potential beneficial uses of Santa Clara River Reach 5 and Castaic Creek from Santa Clara River Reach 5 to Castaic Lake include the following:

- MUN: Community, military, or individual water supply systems including, but not limited to, drinking water supply (a potential beneficial use)
- IND: Industrial activities that do not depend primarily on water quality
- PROC: Industrial activities that depend primarily on water quality
- AGR: Agricultural supply waters used for farming, horticulture, or ranching
- GWR: Groundwater recharge for natural or artificial recharge of groundwater
- FRSH: Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity)
- REC1: Water contact recreation involving body contact with water and ingestion is reasonably possible
- REC2: Non-contact water recreation for activities in proximity to water, but not involving body contact
- WARM: Warm freshwater habitat to support warm water ecosystems
- WILD: Wildlife habitat waters that support wildlife habitats
- RARE: Waters that support rare, threatened, or endangered species and associated habitats
- WET: Wetland ecosystems

Table 2-6: Beneficial Uses of Surface Receiving Water

Water Body	Beneficial Uses											
	MUN	IND	PROC	AGR	GWR	FRSH	REC1	REC2	WARM	WILD	RARE	WET [1]
Santa Clara River (Hydrologic Unit 403.51)	P*	E	E	E	E	E	E	E	E	E	E	E
Castaic Creek (Santa Clara River Reach 5 to Castaic Lake)	I	I	I	I	I	I	I	E	I	E	E	

1 Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory action would require a detailed analysis of the area.

E – Existing beneficial use; P – Potential beneficial use; I – Intermittent beneficial use; *Asterixed MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemptions at a later date.

Source: Water Quality Control Plan for the Los Angeles Region (Basin Plan) (LARWQCB, 1994, as amended)

2.3.4 Existing Surface Water Quality

Existing surface water quality was described in the State Certified EIR. Due to the highly variable nature of wet weather surface water quality in the Santa Clara River at the Modified Project Site location (i.e., Santa Clara River Reach 5), it is not appropriate to summarize water quality data for a single timeframe in order to establish baseline water quality conditions. As discussed above, flows in the Santa Clara River are highly episodic in nature and this characteristic can affect surface water quality considerably. The data summarized below, however, are recent and provide an accurate and reasonable characterization of existing water quality conditions currently present in the Modified Project Site area. These data are consistent with the summary of wet weather and dry weather water quality contained in the State Certified EIR.

The existing wet and dry weather surface water quality in the Modified Project Site area were characterized from recent available water quality monitoring data obtained from the following sources (see Figure 2-1 for monitoring locations):

1. Los Angeles County Mass Emission Station Monitoring. The Los Angeles County Department of Public Works (LACDPW) conducts in-stream monitoring at a mass emission station (S29) located at the upper end of Santa Clara River Reach 5 (at The Old Road bridge crossing), upstream of the Modified Project Site location. Monitoring data collected in both dry and wet weather are summarized from January 2017 through June 2019.[5]

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[5] See: https://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/monitoring_data.html. LACDPW monitoring data at S29 are available through June 2019.

2. Newhall RMDP WDR Monitoring. Newhall Land has conducted in-stream monitoring in accordance with the Clean Water Act Section 401 Water Quality Certification and Waste Discharge Requirements (WDR) for the Newhall Ranch Resource Management and Development Plan (Order No. R4-2012-0139) at five locations within Santa Clara River Reach 5 in the vicinity of the Modified Project Site. SCR-US is located immediately upstream, SCR-PR1, SCR-PR2, and SCR-PR3 are adjacent, and SCR-DS is downstream of the Modified Project site. Wet and dry weather data are summarized from November 2017 through March 2023.

2.3.4.1 Wet Weather Water Quality Monitoring

Average wet weather concentrations recently observed in Santa Clara River Reach 5 are provided in Table 2-7 and Table 2-8. The monitoring data for each station are provided in Appendix C.

Table 2-7: Wet Weather Water Quality Data for General and Conventional Parameters, Nutrients, Pesticides, and Indicator Bacteria in Santa Clara River Reach 5

Constituent	Santa Clara Reach 5 Summary Statistics[1]				
	Maximum	Minimum[2]	Average[3]	No. of Samples	No. of Non-Detects
General and Conventional Parameters					
Total Suspended Solids (mg/L)	11,000	<5	705	152	1
Hardness[4] (mg/L as CaCO3)	232	91.2	148	6	0
Dissolved Oxygen (mg/L)	27.2	5.0	12.1	151	0
Chloride (mg/L)	26.5	9.3	17.0	6	0
pH (standard units)	8.3	5.8	7.6	151	0
Nutrients					
Ammonia-N (mg/L)	0.4	<0.12	0.21	6	1
Nitrate-N (mg/L)	1.8	0.42	0.88	6	0
Nitrite-N (mg/L)	0.12	0.014	0.064	6	0
Indicator Bacteria					
E. Coli (MPN/100 mL)	20,000	49	5,590	12	0

Notes:

1 Summary statistics for Santa Clara River Reach 5 wet weather include the LACDPW Santa Clara River Mass Emission Station S29 (January 2017 – June 2019) and Newhall RMDP monitoring stations (November 2017 – March 2023).

2 Minimum value reported within Santa Clara Reach 5. The minimum value for a constituent at a site is listed as "< Minimum MDL" when at least one of the samples was non-detect.

3 Average value reported within Santa Clara Reach 5. The average value for a constituent at a site are listed as "< Maximum MDL" when all the samples were non-detects. Average values are otherwise calculated as the average of detected values.

4 Historical wet weather samples collected in the Santa Clara River Reach 5 since 2002 (49 samples) indicated an average observed hardness of 264 mg/L. This is the acute criterion for hardness in calculated CTR acute criteria (Table 2-8).

Mg/L – milligrams per liter, µg/L – micrograms per liter, MPN/100 ml – most probable number per 100 milliliter

Table 2-8: Wet Weather Water Quality Data for Metals in Santa Clara River Reach 5

Constituent	Santa Clara Reach 5 Summary Statistics[1]					CTR Acute Criteria[4]
	Maximum	Minimum[2]	Average[3]	No. of Samples	No. of Non-Detects	
Dissolved Copper (µg/L)	5	<0.2	2.9	6	1	34
Total Copper (µg/L)	198	39.5	92.3	6	0	35
Dissolved Zinc (µg/L)	5.5	<1	3.1	6	1	270
Total Zinc (µg/L)	870	86.4	323	6	0	270
Dissolved Iron (µg/L)	176	<100	96	6	1	NA
Total Iron (µg/L)	72,000	41,000	61,900	6	0	NA
Dissolved Mercury (µg/L)	0.005	0.002	0.003	7	0	1.4
Total Mercury (µg/L)	0.28	0.04	0.12	7	0	NA
Dissolved Selenium (µg/L)	0.81	<0.4	0.42	6	2	NA
Total Selenium (µg/L)	2.6	<0.5	1.15	6	1	20

Notes:

1 Summary statistics for Santa Clara River Reach 5 wet weather include the LACDPW Santa Clara River Mass Emission Station S29 (January 2017 – June 2019) and Newhall RMDP monitoring stations (November 2017 – March 2023).

2 Minimum value reported within Santa Clara Reach 5. The minimum value for a constituent at a site is listed as "< Minimum MDL" when at least one of the samples was non-detect.

3 Average value reported within Santa Clara Reach 5. The average value for a constituent at a site are listed as "< Maximum MDL" when all the samples were non-detects. Average values are otherwise calculated as the average of detected values.

4 Acute criteria for hardness = 264 mg/L, based on the historic average observed value in Santa Clara River Reach 5 during wet weather. Not applicable (NA) – there are no CTR criteria for dissolved iron, total iron, total mercury, dissolved selenium. The criterion for dissolved mercury is a National Recommended Water Quality Criteria.

µg/L – micrograms per liter

Selected General Constituents

The selected general constituents examined were total suspended solids (TSS), hardness, dissolved oxygen, chloride, and pH. TSS measures the particulate matter suspended in water. Although total dissolved solids (TDS) concentrations are not available with the recent monitoring data, hardness and chloride data are available and represent primary components related to TDS measurements. Overall TDS measures the dissolved cations and anions in water, primarily inorganic salts (calcium, magnesium, potassium, sodium, chlorides, and sulfates). TDS is an impairing pollutant in Reach 3 of the Santa Clara River as listed in the State's Section 303(d) list of impaired water bodies (see Section 3.1.2). High TDS levels can impair agricultural, municipal supply, and groundwater recharge beneficial uses. Dissolved oxygen is a measure of oxygen dissolved in water. pH is a measure of the hydrogen ion activity of water.

Hardness is a measure of the polyvalent cations, primarily calcium and magnesium. It is expressed as an equivalent concentration of calcium carbonate ($CaCO_3$). Hardness measurements are important because the toxicity of metals (and the associated water quality objectives) is an inverse function of the hardness. Chloride comprises a large proportion of the TDS and is responsible for impairments in its own right. High levels of chloride in Santa Clara River Reaches 3, 5, and 6 are causing impairment of listed beneficial uses for agricultural irrigation. Irrigation of salt-sensitive crops, such as avocados and strawberries, with water containing elevated levels of chloride can result in reduced crop yields. A chloride total maximum daily load (TMDL) was approved for these reaches in 2005.

TSS. It is generally expected that TSS concentrations in alluvial streams can be greatly elevated during storm runoff because of the combination of high sediment supply and a high capacity for in-stream transport and erosion. TSS concentrations measured in the Modified Project Site area are sometimes very high, with a recent maximum of 11,000 mg/L, likely due to the highly erodible, easily transportable, sandy alluvial soils and sediments (Table 2-7). These results show the capacity of high flows in the Santa Clara River to transport sediment, and additionally support the conclusion that large rainfall events result in a “reset” of the main channel. As concluded by Balance Hydrologics (2005), concepts of “normal” or “average” sediment-supply and flow conditions have limited value in this “flashy” environment, where episodic storm and wildfire events have enormous influence on sediment and storm flow conditions. In the Santa Clara River, a large portion of sediment movement events can occur in a matter of hours or days.

The water quality objective for TSS in the Basin Plan is a narrative standard, which states, “[w]ater shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.”

Hardness. Hardness is a measure of the multivalent cations in water, principally calcium, magnesium, strontium, iron, and manganese (Sawyer et al., 1994). These cations are capable of reacting with soap to form precipitates and with certain anions to form scale. The hardness in water is mainly derived from contact with soil and rock formations and affects the California Toxic Rule (CTR) values for certain metals. Waters with a hardness concentration from 121 mg/L to 180 mg/L as $CaCO_3$ are considered hard; waters with a hardness concentration above 180 mg/L as $CaCO_3$ are considered very hard (USGS, 2015). In Santa Clara River Reach 5, the recently observed average hardness is 148 mg/L as $CaCO_3$ (Table 2-7), thus is considered hard. This is most likely due to the influence of tributary inflows of high hardness waters (such as Potrero Canyon and San Martinez Grande), groundwater inputs, and agricultural return flows that enter the Santa Clara River.

Dissolved Oxygen. Dissolved oxygen is sensitive to temperature, with lower dissolved oxygen concentrations typically observed at higher temperatures. The average dissolved oxygen concentration recently observed in Santa Clara River Reach 5 was 12.1 mg/L and the minimum was 5.0 mg/L. The Basin Plan objective for dissolved oxygen requires that the average annual dissolved oxygen concentration of all waters be greater than 7 mg/L, and no single measurement be less than 5.0 mg/L, except when natural conditions cause lesser concentrations. The dissolved oxygen content of surface waters designated as WARM, such as Santa Clara River Reach 5, shall not be depressed below 5 mg/L as a result of waste discharges.

Chloride. Overall, the average chloride concentrations during stormwater monitoring in Santa Clara River Reach 5 were widely variable and ranged between 9.3 mg/L and 26.5 mg/L, with an average in recent years’ data of 17.0 mg/L. The Basin Plan objective for chloride is 100 mg/L.

pH. The hydrogen ion activity of water (pH) is measured on a logarithmic scale, ranging from 0 to 14. While the pH of "pure" water at 25 °C is 7.0, the pH of natural waters is usually slightly basic due to the solubility of carbon dioxide from the atmosphere. The average pH recently observed in Santa Clara River Reach 5 was 7.6 and pH ranged from 5.8 to 8.3. The Basin Plan for pH states that the pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges and that ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge.

Nutrients

The major nutrients of concern (nitrogen and phosphorus compounds) are described below. Table 2-7 summarizes recent monitoring data available for these compounds.

Phosphorus. Phosphorus can be measured as total phosphorus (TP) or as dissolved phosphorus. Dissolved phosphorus is the more bioavailable form of phosphorus compared to TP, which is often made up of a high proportion of particulate phosphorus (i.e., associated with sediment).

Phosphorus data were not available in the recent water quality data for Santa Clara River Reach 5. Historic wet weather monitoring data in Santa Clara River Reach 5 show a range of TP levels from 0.4 mg/L to 28 mg/L, with an average of 3.1 mg/L. Samples taken during larger storm events show elevated results due the higher concentration of TSS measured during the same storm events, because TP is predominately found in the particulate-phase in stormwater runoff.

The Basin Plan water quality objective for phosphorus is a narrative standard, which states, "[w]aters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses."

Nitrogen. Nitrogen is measured variously as nitrate, nitrite, ammonia (NH3), ammonia nitrogen (as N), and total Kjeldahl nitrogen (TKN). TKN is the measure of ammonia plus organic forms of nitrogen. Nitrate, nitrite, and ammonia are the more bioavailable forms of nitrogen, and of these, nitrate (or nitrate + nitrite) has a higher concentration in natural waters and is more important than ammonia as a nutrient.

Most of the monitoring data from Santa Clara River Reach 5 summarized in Table 2-7 demonstrated relatively low nitrate concentrations (recently averaging 0.88 mg/L). The Basin Plan nitrate + nitrite-N water quality objective for Santa Clara River Reach 5 is 5 mg/L.

The recent average ammonia nitrogen concentrations in Santa Clara River Reach 5 were low (0.21 mg/L). The ammonia water quality objectives in the Santa Clara River Nitrogen Compounds TMDL range from 3.4 mg/L to 5.5 mg/L (one-hour average) and 1.2 mg/L to 2.0 mg/L (30-day average).

As with TP, organic forms of nitrogen in stormwater runoff are often bound to particulates, which is supported by high levels of TSS correlating to higher observed levels of TKN and TP. The Basin Plan does not contain a water quality objective for TKN, but does include a narrative standard which states, "Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses."

Selected Pesticides
Pesticides are known to be toxic; the organophosphorus pesticides chlorpyrifos and diazinon are especially toxic to a number of aquatic organisms and, in the past, have been frequently detected downstream from urban and agricultural land uses. Recent data for the pesticides chlorpyrifos and diazinon were not available in the Santa Clara River Reach 5. In historical data collected since 2002, chlorpyrifos was not detected in any of 70 samples collected at Santa Clara River Reach 5 stations. Diazinon was detected in about 14 percent of the Santa Clara River Reach 5 samples (10 of 73), with an average concentration of 0.026 μg/L, using one-half the detection limit for non-detected samples. The average diazinon criterion derived by the CDFW is 0.08 μg/L (SWRQCB, 2020). There is no CTR criterion for diazinon.

Fecal Indicator Bacteria
Pathogens such as viruses, bacteria, and protozoa that cause illness in humans are difficult to measure. Fecal indicator bacteria (FIB) such as Enterococci and E. coli are commonly measured instead, and their presence indicates the potential for fecal contamination and the possible presence of associated pathogenic organisms. However, it does not indicate the origin of the contamination, which could be attributed to numerous natural and anthropogenic sources. Table 2-7 summarizes recent E. coli data for Santa Clara River Reach 5. The average is presented as a geometric mean.

Recent concentrations E. coli in wet weather flows at Santa Clara River Reach 5 were highly variable and sometimes very high. They ranged from 49 to 20,000 MPN/100 mL, with a geometric mean of 5,590 MPN/100 mL. In waters designated for water contact recreation (REC-1), the Basin Plan objective for FIB states that E. coli shall not exceed a geometric mean of 126/100 mL, nor a single sample limit of 235/100 mL. Santa Clara River Reach 5 is listed as impaired for bacteria indicators and a TMDL has been adopted into the Basin Plan (see Section 3.1.2).

Metals
Table 2-8 summarizes recent data for the metals copper, zinc, iron, mercury, and selenium in Santa Clara River Reach 5.

Metals can be measured in water samples as total metals or dissolved metals. Total metals analyses for water samples include the metals content both dissolved in the water and present in the suspended particles in the water. Typically, a dissolved metals analysis of a water sample is performed by removing the particulates with a filter, then analyzing the filtered water for dissolved metals. The most common filters used for this purpose have a 0.45 μm pore size. Dissolved metals are comprised of the 'free' ionic form plus complexed species (USEPA, 2007b).

Copper and zinc can be toxic at high concentrations. The bioavailability of these metals is an important factor in evaluating the potential for toxicity. Specifically, correlations have been found between toxicity and 'free' or weakly-complexed metal species; strongly complexed metals and metals that are absorbed into suspended particles have been found to be less toxic (USEPA, 2007b). These metals occur naturally in soils and sediments and can be present in urban runoff. Iron, mercury, and selenium are indicative of overall water quality and may also be toxic at high concentrations.

The recently observed average concentration of total copper exceeded the CTR criteria calculated with the historical average observed hardness in Santa Clara River Reach 5. It is likely that elevated levels of total metals in Santa Clara River Reach 5 are a function of the high observed levels of sediment in the river, as total metals are associated with particulate matter. Santa Clara River Reach 5 is listed as impaired for iron.

2.3.4.2 Dry Weather Water Quality Monitoring

As described above, the Santa Clara River is perennial at the Modified Project Site location. Dry season base flows may include contributions from natural groundwater flows; however, discharges from the upstream Saugus and Valencia WRPs contribute the majority of base flow.

Table 2-9 and Table 2-10 report summary statistics for recent dry weather monitoring of selected constituents in Santa Clara River Reach 5. The monitoring data for each station are provided in Appendix C.

Table 2-9: Dry Weather Water Quality Data for General and Conventional Parameters, Nutrients, Pesticides, and Indicator Bacteria in Santa Clara River Reach 5

Constituent	Santa Clara Reach 5 Summary Statistics[1]				
	Maximum	Minimum[2]	Average[3]	No. of Samples	No. of Non-Detects
General and Conventional Parameters					
Total Suspended Solids (mg/L)	981	<5	31.6	1,118	536
Hardness[4] (mg/L as CaCO3)	512	135	405	7	0
Dissolved Oxygen (mg/L)	43	4.6	10.6	1,120	0
Chloride (mg/L)	96	10	63	7	0
pH	8.6	5.8	7.7	1,119	0
Nutrients					
Ammonia-N (mg/L)	0.23	<0.1	0.13	7	5
Nitrate-N (mg/L)	1.6	0.45	1.1	7	0
Nitrite-N (mg/L)	0.3	<0.1	0.12	7	4
Indicator Bacteria					
E. coli (MPN/100 mL)	3,400	2	364	39	0

Notes:
1. Summary statistics for Santa Clara River Reach 5 wet weather include the LACDPW Santa Clara River Mass Emission Station S29 (January 2017 – June 2019) and Newhall RMDP monitoring stations (November 2017 – March 2023).
2. Minimum value reported within Santa Clara Reach 5. The minimum value for a constituent at a site is listed as "< Minimum MDL" when at least one of the samples was non-detect.
3. Average value reported within Santa Clara Reach 5. The average value for a constituent at a site are listed as "< Maximum MDL" when all the samples were non-detects. Average values are otherwise calculated as the average of detected values.
4. Historical dry weather samples collected in the Santa Clara River Reach 5 since 2002 (119 samples) indicated an average observed hardness of 423 mg/L. This is the acute criterion for hardness in calculated CTR acute criteria (Table 2-10).

Mg/L – milligrams per liter, µg/L – micrograms per liter, MPN/100 ml – most probable number per 100 milliliters

Table 2-10: Dry Weather Water Quality Data for Metals in Santa Clara River Reach 5

Constituent	Santa Clara Reach 5 Summary Statistics[1]					CTR Chronic Criteria
	Maximum	Minimum[2]	Average[3]	No. of Samples	No. of Non-Detects	
Dissolved Copper (µg/L)	3	0.94	1.9	7	0	31
Total Copper (µg/L)	120	1.2	26.2	7	0	32
Dissolved Zinc (µg/L)	3.8	1.5	2.8	7	0	400
Total Zinc (µg/L)	330	2.1	74.2	7	0	410
Dissolved Iron (µg/L)	77	<20	30.2	7	0	NA
Total Iron (µg/L)	110,000	100	21,400	7	1	1,000
Dissolved Mercury (µg/L)	0.006	0.0007	0.002	6	0	0.77
Total Mercury (µg/L)	0.043	0.0009	0.01	6	0	NA
Dissolved Selenium (µg/L)	9.7	<0.4	3.4	7	2	NA
Total Selenium (µg/L)	9.9	<0.5	3.5	7	1	5.0

Notes:

1 Summary statistics for Santa Clara River Reach 5 wet weather include the LACDPW Santa Clara River Mass Emission Station S29 (January 2017 – June 2019) and Newhall RMDP monitoring stations (November 2017 – March 2023).

2 Minimum value reported within Santa Clara Reach 5. The minimum value for a constituent at a site is listed as "< Minimum MDL" when at least one of the samples was non-detect.

3 Average value reported within Santa Clara Reach 5. The average value for a constituent at a site are listed as "< Maximum MDL" when all the samples were non-detects. Average values are otherwise calculated as the average of detected values.

4 Chronic criteria for hardness = 423 mg/L, based on the historic average observed value in Santa Clara River Reach 5 during dry weather. Not applicable (NA) – there are no CTR criteria for dissolved iron or dissolved selenium. The criteria for total iron and dissolved mercury are National Recommended Water Quality Criteria.

µg/L – micrograms per liter

General Constituents

TSS. Average TSS concentrations observed in recent dry weather flows are much lower than those observed in wet weather flows, as is generally expected since TSS concentrations in alluvial streams can be greatly elevated during storm runoff because of the combination of high sediment supply and a high capacity for in-stream transport and erosion. Dry weather flows are typically low in sediment because the flows are relatively low and coarse suspended sediment tends to settle out or is filtered out by vegetation. As a consequence, pollutants that tend to be associated with suspended solids (e.g., TP and some metals) are typically found in very low concentrations in dry weather flows.

Hardness and Chloride. The average hardness concentration (405 mg/L as $CaCO_3$) was very hard, although the average chloride concentration (63 mg/L) is below the Basin Plan objective for Santa Clara River Reach 5 (100 mg/L). TDS components hardness and chloride are generally higher in dry weather flows than those observed in wet weather flows, reflecting the influence of WRP discharges and groundwater inflows in dry weather.

Dissolved Oxygen and pH. The average dissolved oxygen concentration observed in dry weather flows (10.6 mg/L) is less than the average for wet weather flows (12.1 mg/L). Both are greater than the Basin Plan minimum objective for dissolved oxygen.

The average observed pH in dry weather flows (7.7) was slightly greater than the average pH in wet weather flows (7.6). Both are within the acceptable range for pH established by the Basin Plan.

Nutrients

Nitrogen. The average ammonia nitrogen concentration in dry weather flows (0.13 mg/L) was well below the ammonia water quality objectives in the Santa Clara River Nitrogen Compounds TMDL (from 1.2 mg/L to 2.0 mg/L (30-day average)), and less than the average ammonia concentration in wet weather flows in Santa Clara River Reach 5 (0.21 mg/L). The average nitrate-N concentration in dry weather flows (1.1 mg/L) was greater than the average observed nitrate-N in wet weather (0.88 mg/L), but both are well below the Basin Plan standard of 5 mg/L (for nitrate-N plus nitrite-N). While still relatively low, average nitrite-N concentrations in dry weather flows were double those in wet weather (0.12 mg/L and 0.06 mg/L, respectively).

Fecal Indicator Bacteria

The concentrations of indicator bacteria indicated highly variable but generally elevated concentrations in Santa Clara River Reach 5. The observed mean concentration of E. coli in dry weather flows (364/100 mL) was greater than the geometric mean Basin Plan objective (126/100 mL), and the single sample objective was exceeded (235/100 mL).

Metals

Average concentrations of heavy metals in dry weather flows were generally low and, for the most part, below the CTR chronic criteria. The dry weather average total iron recently observed in Santa Clara River Reach 5 exceeded the National Recommended Water Quality Criteria. Total metal concentrations, a measure of the dissolved metals and metals associated with particulates, are generally controlled by TSS concentrations (a measure of particulates), which is reflected in the difference between concentrations observed in wet and dry weather flows. Metals concentrations are typically greater in wet weather flows due to stormwater wash off of sediment and associated pollutants from the watershed.

2.4 Groundwater

2.4.1 Groundwater Beneficial Uses

The Modified Project Site is within the Basin Plan's Castaic Valley and Saugus Aquifer sub-basins of the Santa Clarita Valley Groundwater Basin, East Subbasin. This sub-basin has been designated as a high-priority groundwater basin under the California Sustainable Groundwater Management Act (SGMA). Beneficial uses for groundwaters for this subbasin are shown in Table 2-11.

Table 2-11: Beneficial Uses of Groundwaters

Groundwater Basin	MUN
DWR 4.07 – Eastern Santa Clara Sub-basin: Castaic Valley and Saugus Aquifer	E

E – Existing Beneficial Use
MUN: Community, military, or individual water supply systems including, but not limited to, drinking water supply
Source: Water Quality Control Plan for the Los Angeles Region (Basin Plan) (LARWQCB, 1994 as amended)

2.4.2 Alluvial Aquifer

The Modified Project Site lies at the western end of the upper Santa Clara River hydrologic area, as defined by the California Department of Water Resources (DWR). The sole source of local groundwater for urban water supply in the Santa Clarita Valley is the groundwater basin identified in the DWR Bulletin 118, 2003 Update as the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin) (Basin No. 4-4.07) (Kennedy/Jenks Consultants and Luhdorff & Scalmanini Consulting Engineers, 2017). The Basin is comprised of two aquifer systems, the Alluvial aquifer and the Saugus Formation (Figure 2-4). The Alluvial aquifer generally underlies the Santa Clara River and its several tributaries, to maximum depths of about 200 feet, and the Saugus Formation underlies practically the entire USCR area, to depths of at least 2,000 feet. The Alluvial aquifer and the Saugus Formation are underlain by bedrock units consisting of the Pico Formation in the Modified Project Site area and other geologic units in the eastern and northern portions of the Santa Clarita Valley. These deep bedrock units yield little water and are not considered viable for groundwater development.

The alluvial sediments lie within the portion of the Valley occupied by the Santa Clara River and also are present inside canyons that contain tributaries to the River. The Alluvial aquifer consists of extensively interlayered and interfingered mixtures of gravel and sand, with variable amounts of cobbles and boulders and minor amounts of silt and clay. Due to the unconsolidated to poorly consolidated condition of the Alluvial aquifer and its lack of cementation, the Alluvial aquifer has relatively high permeability and porosity. The groundwater flow direction in the alluvial aquifer follows the topography of the Valley and its tributaries. Groundwater recharge occurs in the eastern, northern, and southern portions of the Valley, along with natural groundwater discharge mechanisms, such as discharge to the Santa Clara River, subsurface outflow beneath the River, and evapotranspiration by deep-rooted vegetation. There is no groundwater recharge at the west end of the valley; only natural mechanisms for groundwater discharge occur.

The Saugus Formation is present beneath the Modified Project Site and most of the Santa Clarita Valley area east of the Modified Project Site. The upper subunits of the Saugus Formation consist of terrestrial sediments deposited in stream channels, floodplains, and alluvial fans by ancestral drainage systems. The upper subunits are a source of groundwater supply in the Santa Clarita Valley because of their productive nature and their good water quality. Deeper subunits of the Saugus Formation were deposited in a marine environment and are subsequently not used for water supplies because of their brackish water quality and fine-grained, low-permeability nature.

Faulting and folding of the Saugus Formation and the underlying bedrock units have created a bowl-shaped structure beneath the Santa Clarita Valley. The Saugus Formation and underlying bedrock generally dip downwards from the periphery of the Valley towards the deepest portion of the "bowl" beneath the central portion of the Valley. The thickness of the Saugus Formation also is controlled by the San Gabriel fault, which is present in the eastern and northern portions of the Valley. Because of its structure and connection with the overlying alluvial aquifer, groundwater flow in the Saugus Formation is generally towards the center of the bowl and the western portion of the Santa Clara Valley. Like the alluvial aquifer, the Saugus Formation is recharged in the eastern and other peripheral portions of the Santa Clarita Valley. Groundwater discharge from the Saugus Formation occurs at the west end of the Valley in the form of groundwater discharge into the overlying alluvial aquifer, which in turn discharges to the Santa Clara River in the western end of the Valley.

2.4.3 Existing Groundwater Quality

2.4.3.1 Alluvial Aquifer

Groundwater quality is a key factor in assessing the Alluvial aquifer as a municipal and agricultural water supply (Luhdorff & Scalmanini Consulting Engineers, 2019). Groundwater quality details and long-term conditions, examined by integrating individual records from several wells completed in the same aquifer materials and in close proximity to each other, are discussed in the 2021 Santa Clarita Valley Water Report (SCV Water, 2023), and in SCV Water's 2020 Urban Water Management Plan (Kennedy/Jenks, 2021). Historical groundwater quality data summarized in the 2021 Santa Clarita Valley Water Report show that historical total dissolved solids (TDS) concentrations, which is a measure of the amount of dissolved minerals and salts in water, generally respond to wet periods by exhibiting a downward trend, followed by an increasing trend during dry periods. Groundwater quality has generally inversely varied with precipitation and streamflow. The fluctuations occur during dry and wet periods when low streamflow and recharge during dry periods result in increased mineral concentrations. High streamflow and recharge during wet periods result in decreased mineral concentrations. Testing by SCV Water demonstrates that groundwater meets acceptable drinking water standards. However, there are historical instances of minor variances in TDS above the recommended secondary MCL. (SCV Water, 2023).

Table 2-12 summarizes average metals, general chemistry, nutrient, and perchlorate data for two alluvial aquifer wells located near the Modified Project Site location (see Figure 2-1). The NRSP Conditions of Approval monitoring wells (NRSP-GW01 and NRSP-GW02R) are located upgradient and downgradient of the NRSP boundary. NSRP-GW01 was monitored from November 2013 through September 2022 and NSRP-GW02R was monitored from May 2015 through September 2022.

Several parameters have been detected above the Basin Plan Objective or MCL, including perchlorate in the NRSP Conditions of Approval monitoring wells.

Table 2-12: Alluvial Aquifer Groundwater Monitoring Data Summary Statistics

Parameter	Units	Basin Plan Objective / MCL	Maximum	Minimum	Average[1]	No. of Samples	No. of Detects
Aluminum	mg/l	1.0	**34**	<0.005	**1.8**	24	20
Arsenic	µg/l	10	**23**	0.42	2.0	33	33
Barium	µg/l	1,000	270	12	41	33	33
Cadmium	µg/l	5.0	0.90	<0.1	0.16	33	17
Chromium	µg/l	50	**75**	0.14	5.4	33	32
Copper	µg/l	1,300	72	<0.5	7.7	33	30
Iron	µg/l	300	**85,000**	<20	**5,503**	33	30
Nickel	µg/l	100	76	1	9.5	33	33
Selenium	µg/l	50	**140**	1	39	33	33
Silver	µg/l	100	<0.4	<0.2	<0.3	33	0
Zinc	µg/l	5,000	200	<5	22	33	21
Boron	µg/l	1,000	**7,800**	490	**2,833**	33	33
Chloride	mg/l	150	**1,000**	72	**284**	33	33
Cyanide, total	µg/l	150	100	<5	5.5	33	1
Fluoride	mg/l	2.0	**3.2**	0.33	1.0	33	33
Perchlorate	µg/l	6.0	**18**	<2	**7.9**	33	4
Nitrate as N	mg/l	10	**260**	3	**30**	33	33
Nitrite as N	mg/l	1.0	0.14	<0.1	0.22	33	2
Nitrate + Nitrite as N	mg/l	10	**120**	3	**27**	33	33
Specific Conductance	µS/cm	--	16,000	1,200	6,468	12	12
Sulfate	mg/l	350	**10,000**	200	**2,371**	33	33
TDS	mg/l	1,000	**9,895**	768	**3,774**	21	21
Turbidity	NTU	1.0	**8.4**	0	**1.1**	12	12

Notes:

[1] For parameters with only non-detect (ND) results, the average shown is the average of the detection limits. For parameters with ND and detected results, the average was calculated using one-half the detection limit for the ND results.

Bold = Value exceeds Basin Plan objective or MCL

-- = No applicable Basin Plan objective or MCL

2.4.3.2 Saugus Formation

Based on available data over the last 50 years, groundwater quality in the Saugus Formation has not historically exhibited the recharge-related fluctuations seen in the Alluvium (SCV Water, 2023). Groundwater quality in the Saugus Formation has exhibited stable to slightly increasing trends in TDS concentrations over the 50-year period. Recent TDS concentrations in the Saugus Formation remain within the range of historic concentrations and below the Secondary MCL upper level (SCV Water, 2023).

3. REGULATORY SETTING

3.1 Federal Regulations

3.1.1 Clean Water Act

In 1972, the Federal Water Pollution Control Act [later referred to as the Clean Water Act (CWA)] was amended to require NPDES permits for the discharge of pollutants to waters of the U.S. from any point source. In 1987, the CWA was amended to require the USEPA to establish regulations for permitting municipal and industrial stormwater discharges under the NPDES permit program. The USEPA published final regulations regarding stormwater discharges on November 16, 1990. The regulations require that municipal separate storm sewer system discharges to surface waters be regulated by an NPDES permit.

In addition, the CWA requires the States to adopt water quality standards for receiving water bodies and to have those standards approved by the USEPA. Water quality standards consist of designated beneficial uses for a particular receiving water body (e.g., wildlife habitat, agricultural supply, fishing etc.), along with water quality criteria necessary to support those uses. Water quality criteria are prescribed concentrations or levels of constituents – such as lead, suspended sediment, and fecal coliform bacteria – or narrative statements representing the quality of water that supports a particular use. Because California did not establish a complete list of acceptable water quality criteria, the USEPA established, in the CTR, numeric water quality criteria for certain toxic constituents in receiving waters with human health or aquatic life designated uses (40 CFR 131.38).

3.1.2 CWA Section 303(d) – TMDLs

When designated beneficial uses of a particular receiving water body are being compromised by water quality, Section 303(d) of the CWA requires identifying and listing that water body as "impaired." Once a water body has been deemed impaired, a TMDL must be developed for the impairing pollutant(s). A TMDL is an estimate of the total load of pollutants from point, non-point, and natural sources that a water body may receive without exceeding applicable water quality standards (with a "factor of safety" included). Once established, the TMDL allocates the loads among current and future pollutant sources to the water body. Water quality impairments at the Modified Project Site location and downstream of the Modified Project Site location were considered when selecting the pollutants of concern for the water quality impact analysis in this Supplemental Water Quality Analysis.

The Modified Project would discharge runoff to Santa Clara River Reach 5. Table 3-1, 2020-2022 CWA Section 303(d) Listings for the Santa Clara River Mainstem, lists the current water quality impairments for the Santa Clara River, including reaches upstream of the Modified Project Site location (although impairments upstream of the Modified Project Site would not affect the Modified Project), as reported in the 2020-2022 CWA Section 303(d) List of Water Quality Limited Segments, which USEPA approved in May 2022.

Upstream of the Modified Project location, the Santa Clara River is listed for chloride (Reach 6), chlorpyrifos (Reach 6), coliform bacteria (Reach 7), temperature (Reach 6), and toxicity (Reach 6). Reach 5 of the Santa Clara River (the Modified Project location) is listed for chloride, indicator bacteria, iron, and trash. Santa Clara Reach 4a, approximately six miles downstream of the Modified Project location, is listed for trash. Santa Clara River Reach 3, approximately 25 miles downstream of the Modified Project location and below the Dry Gap in Reach 4, is listed for chloride, total dissolved solids (TDS), toxicity, selenium, indicator bacteria, and trash. Santa Clara River Reach 1, approximately 30 miles downstream of the Modified Project location, is listed for toxicity, dissolved oxygen, and trash. The Santa Clara River estuary, located approximately 40 miles downstream of the Modified Project location, is listed for indicator bacteria, chlorinated legacy pesticides (ChemA), Toxaphene, toxicity, and ammonia.

The Los Angeles Regional Water Quality Control Board (LARWQCB) has adopted nitrogen compounds (nitrate plus nitrite-nitrogen and ammonia), chloride, and indicator bacteria TMDLs in the Basin Plan. The wasteload allocations for municipal stormwater discharges into Reach 5 of the Santa Clara River are summarized in Table 3-2, TMDL Wasteload Allocations for MS4 and Stormwater Sources to Santa Clara River Reach 5. Pollutant reductions are regulated through effluent limits prescribed in Publicly Owned Treatment Works (POTW) and minor point source NPDES Permits, BMPs required in NPDES Regional MS4 Permits, and State Water Resources Control Board (SWRCB) Management Measures for non-point source discharges.

The trash impairments are being addressed by implementation actions required under the Amendment to the Water Quality Control Plan for Ocean Waters of California to Control Trash and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Water Resources Control Board Resolution 2015-0019). These actions are implemented through the Regional MS4 Permit (summarized below).

Table 3-1: 2020/2022 CWA Section 303(d) Listings for the Santa Clara River Mainstem

River Reach	Geographic Description and Distance from Modified Project	Pollutants	TMDL Completion	Potential Sources
7	Bouquet Canyon Rd to above Lang Gaging Station (5 miles upstream)	Coliform Bacteria	TMDL Adopted 2012	Source Unknown
6	West Pier Hwy 99 to Bouquet Canyon Road (Directly upstream of Modified Project site)	Chloride Chlorpyrifos Toxicity Temperature	TMDL Adopted 2005 Requires TMDL/2029 Requires TMDL/2029 Requires TMDL/2027	Nonpoint and Point Sources Source Unknown Source Unknown Source Unknown
5	Blue Cut Gaging Station to West Pier Highway 99 (Modified Project location)	Chloride Indicator Bacteria Iron Trash	TMDL Adopted 2005 TMDL Adopted 2012 Requires TMDL/2029 Addressed by Other Action	Nonpoint and Point Sources Source Unknown Source Unknown Source Unknown
4a	"A" Street, Fillmore to Piru Creek (6 miles)	Trash	Addressed by Other Action	Source Unknown
3	Freeman diversion dam to "A" Street, Fillmore (25 miles)	Chloride Total Dissolved Solids Toxicity Selenium Indicator Bacteria Trash	TMDL Adopted 2002 Requires TMDL/2015 Requires TMDL/2021 Requires TMDL/2027 TMDL Adopted 2012 Addressed by Other Action	Nonpoint and Point Sources Source Unknown Source Unknown Source Unknown Source Unknown Source Unknown
1	Estuary to Highway 101 Bridge (30 miles)	Toxicity Dissolved Oxygen pH Trash	Requires TMDL/2019 Requires TMDL/2027 Requires TMDL/2027 Addressed by Other Action	Source Unknown Source Unknown Source Unknown Source Unknown
--	Estuary (40 miles)	Indicator Bacteria ChemA Toxaphene Toxicity Ammonia	TMDL Adopted 2012 TMDL Adopted 2011 TMDL Adopted 2011 Requires TMDL/2019 Requires TMDL/2027	Source Unknown Source Unknown Source Unknown Source Unknown Source Unknown

Table 3-2: TMDL Wasteload Allocations for MS4 and Stormwater Sources to Santa Clara River Reach 5

<table>
<tr><th>Impairing Pollutant</th><th>Numeric Water Quality Objective</th><th>Wasteload Allocation</th></tr>
<tr><td>Chloride</td><td>100 mg/L.</td><td>Wasteload allocations have been adopted for the Saugus Water Reclamation Plant (WRP) and the Valencia WRP. Other NPDES discharges contribute a minor chloride load. The wasteload allocation for these point sources is 100 mg/L.
The source analysis indicates that non-point sources are not a major source of chloride. The load allocations for non-point sources is 100 mg/L.</td></tr>
<tr><td>Indicator Bacteria (Resolution R10-006)</td><td>Numeric Targets:
<table>
<tr><th>Constituent</th><th>SCR Reach 5 Requirement</th></tr>
<tr><td>E. Coli (Single Sample)</td><td>235/100 mL</td></tr>
<tr><td>E. Coli (Geometric Mean)</td><td>126/100 mL</td></tr>
</table></td><td>Wasteload allocations are given in terms of allowable exceedance days. The numeric targets may not be exceeded more than the number of allowable exceedance days allotted in the tables below.
Interim Allowable Exceedance Days
(Dry Weather and Wet Weather deadline March 21, 2016):
<table>
<tr><th rowspan="2">Time Period</th><th colspan="3">Annual Allowable Exceedance Days of the Single Sample Objective (days)</th></tr>
<tr><th>Daily Sampling</th><th>Weekly Sampling</th><th>3 Wet and 2 Dry Weather Events</th></tr>
<tr><td>Dry Weather</td><td>17</td><td>3</td><td>1</td></tr>
<tr><td>Wet Weather</td><td>61</td><td>9</td><td>1</td></tr>
</table>
Final Allowable Exceedance Days
(Dry Weather deadline March 21, 2023; Wet Weather deadline March 21, 2029):
<table>
<tr><th rowspan="2">Time Period</th><th colspan="2">Annual Allowable Exceedance Days of the Single Sample Objective (days)</th></tr>
<tr><th>Daily Sampling</th><th>Weekly Sampling</th></tr>
<tr><td>Dry Weather</td><td>5</td><td>1</td></tr>
<tr><td>Wet Weather</td><td>16</td><td>3</td></tr>
</table></td></tr>
</table>

[1] The numeric targets are 10 percent smaller to incorporate a margin of safety.

3.1.3 California Toxics Rule

The CTR is a federal regulation issued by the USEPA providing water quality criteria for potentially toxic constituents in receiving waters with human health or aquatic life designated uses in the State of California (USEPA, 2000). The USEPA adopted the CTR in 2000 to create legally applicable water quality criteria for priority toxic pollutants for inland surface waters, enclosed bays, and estuaries to protect human health and the environment for all purposes and programs under the CWA. The CTR aquatic life criteria were derived using a CWA Section 304(a) method that produces an estimate of the highest concentration of a substance in water which does not present a significant risk to the aquatic organisms in the water and their uses (USEPA, 2000). The CTR water quality criteria provide a reasonable and adequate amount of protection with only a small possibility of substantial overprotection or under-protection. In this document, the CTR criteria are used as one type of benchmark to evaluate the potential impacts of the Modified Project on water quality of the receiving waters. The CTR's numerical aquatic life criteria are expressed as short-term (acute) and long-term (chronic) averages, rather than one number, in order that the criterion more accurately reflect toxicological and practical realities (USEPA, 2000). Due to the intermittent nature of stormwater runoff (especially in Southern California), the acute criteria are considered to be more applicable to stormwater conditions than chronic criteria and therefore are used in assessing Modified Project impacts. For example, the average storm duration for all storms in the 40-year Newhall rain gauge record is 7.1 hours. Acute criteria represent the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (one hour) without deleterious effects; chronic criteria equal the highest concentration to which aquatic life can be exposed for an extended period of time (four days) without deleterious effects.

CTR criteria are applicable to the receiving water body; therefore, the metals criteria, which are expressed as a function of receiving water hardness, must be calculated based upon the probable hardness values of the Modified Project's receiving waters for evaluation of acute (and chronic) toxicity criteria. At higher hardness values for the receiving water, copper, lead, and zinc are more likely to be complexed (bound) with other chemical constituents in the water column. This in turn reduces the bioavailability and resulting potential toxicity of these metals. The average wet weather hardness value of 264 mg/L as CaCO3 in Santa Clara River Reach 5 (see Section 2.3.3 above) was used to approximate CTR criteria for metals.

3.1.4 Federal Antidegradation

The Federal Antidegradation Policy (40 CFR §131.12) requires states to develop statewide antidegradation policies and identify methods for implementing them. Pursuant to the Code of Federal Regulations, state antidegradation policies and implementation methods shall, at a minimum, protect and maintain: (1) existing in-stream water uses; (2) existing water quality where the quality of the waters exceeds levels necessary to support existing beneficial uses, unless the State finds that allowing lower water quality is necessary to accommodate economic and social development in the area; and (3) water quality in waters considered an outstanding national resource. State-permitting actions must be consistent with the federal Antidegradation Policy.

3.1.5 Discharge of Fill or Dredge Materials

Hydrologic conditions of concern addressed in this report include in-stream changes in sediment transport, erosion, sedimentation, and ultimately channel stability. There is a nexus between these concerns and the stream, habitat, and species protection programs administered by the Corps, CDFW, and the USFWS.

Section 404 of the CWA is a program that regulates the discharge of dredged and fill material into waters of the U.S., including wetlands. Activities in waters of the U.S. that are regulated under this program include fills for development (including physical alterations to drainages to accommodate storm drainage, stabilization, and flood control improvements), water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. The USEPA and the Corps have issued Section 404(b)(1) Guidelines (40 CFR § 230) that regulate dredge and fill activities, including water quality aspects of such activities. Subpart C, located at Sections 230.20 through 230.25 of the Section 404(b)(1) Guidelines, contains water quality regulations applicable to dredge and fill activities. Among other topics, these guidelines address discharges which alter substrate elevation or contours, suspended particulates, water clarity, nutrients, and chemical content, current patterns and water circulation, water fluctuations (including those that alter erosion or sediment rates), and salinity gradients.

Section 401 of the CWA requires that any person applying for a federal permit or license which may result in a discharge of pollutants into waters of the U.S. must obtain a state water quality certification that the activity complies with all applicable water quality standards, limitations, and restrictions. Subject to certain limitations, no license or permit may be issued by a federal agency until the Section 401 certification has been granted. Further, no license or permit may be issued if certification has been denied. CWA Section 404 permits and authorizations are subject to Section 401 certification by the Regional Water Quality Control Boards (RWQCBs).

This report does not analyze the habitat and wildlife impacts associated with physical alterations to waters of the U.S. proposed in conjunction with the Modified Project, such as dredge, fill, or bed, bank or channel improvements or stabilization measures affecting waters of the U.S. The impacts associated with these physical alterations are analyzed in detail in SEIR Section 5.2. As discussed in Section 4.4.2 below, this report does analyze the adverse impacts to natural drainage systems that may be caused by the Modified Project's alteration of hydrologic conditions.

3.2 State Regulations

3.2.1 California Porter-Cologne Act

The federal CWA places the primary responsibility for the control of surface water pollution and for planning the development and use of water resources with the states, although it does establish certain guidelines for the states to follow in developing their programs and allows USEPA to withdraw control from states with inadequate implementation mechanisms.

California's primary statute governing water quality and water pollution issues with respect to both surface waters and groundwater is the Porter-Cologne Water Quality Control Act of 1970

(Porter-Cologne Act). The Porter-Cologne Act grants the SWRCB and the RWQCBs power to protect water quality and it is the primary vehicle for implementation of California's responsibilities under the federal CWA. The Porter-Cologne Act grants the SWRCB and the RWQCBs authority and responsibility to adopt plans and policies, to regulate discharges of waste to surface and groundwater, to regulate waste disposal sites, and to require cleanup of discharges of hazardous materials and other pollutants. The Porter-Cologne Act also establishes reporting requirements for unintended discharges of any hazardous substance, sewage, oil, or petroleum product.

Each RWQCB must formulate and adopt a Basin Plan for its region. The Basin Plan must conform to the policies set forth in the Porter-Cologne Act and established by the SWRCB in its state water policy. To implement state and federal law, the Basin Plan establishes beneficial uses for surface water and groundwater in the region and sets forth narrative and numeric water quality standards to protect those beneficial uses. The Porter-Cologne Act also provides that a RWQCB may include water discharge prohibitions applicable to particular conditions, areas, or types of waste within its regional plan.

3.2.2 California Antidegradation

The California Antidegradation Policy, otherwise known as the Statement of Policy with Respect to Maintaining High Quality Water in California, was adopted by the SWRCB (State Board Resolution No. 68-16) in 1968. Unlike the Federal Antidegradation Policy, the California Anti-Degradation Policy applies to all waters of the State, not just surface waters. Under the policy, whenever the existing quality of a water body is better than the quality established in individual Basin Plans, such high quality must be maintained, and discharges to that water body must not unreasonably affect any present or anticipated beneficial use of the water resource.

3.2.3 Basin Plan

The applicable Basin Plan (LARWQCB, 1994, as amended) provides numeric and narrative criteria for a range of water quality constituents applicable to certain receiving water bodies and groundwater basins within the Los Angeles region. Specific criteria are provided for the larger, designated water bodies within the region, as well as general criteria or guidelines for ocean waters, bays and estuaries, inland surface waters, and ground waters. Those waters not specifically listed (generally smaller tributaries) are assumed to have the same beneficial uses as the streams, lakes, or reservoirs to which they are tributary. In general, the narrative criteria require that degradation of water quality not occur due to increases in pollutant loads that will adversely impact the designated beneficial uses of a water body. For example, the Los Angeles Basin Plan requires that "[i]nland surface waters shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors." Water quality criteria apply within receiving waters as opposed to applying directly to runoff; therefore, water quality criteria from the Basin Plan are utilized as benchmarks as one method to evaluate the potential ecological impacts of Modified Project runoff on the receiving waters of the proposed project. Table 2-6 above lists the beneficial uses of applicable surface receiving waters.

The Basin Plan also contains water quality criteria for groundwater basins. For example, the Basin Plan requires that "[g]round waters shall not contain taste or odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses". Table 2-10 above lists the beneficial uses of the applicable groundwater basin.

3.2.3.1 Trash Amendments

On April 7, 2015, the SWRCB adopted statewide requirements, referred to as the Trash Amendments, for the implementation of trash controls in priority land uses.[6] The Trash Amendments do the following: (1) establish a narrative water quality objective for trash, (2) provide corresponding applicability, (3) establish a prohibition on the discharge of trash, (4) provide implementation requirements for permitted storm water and other discharges, (5) set a time schedule for compliance, and (6) provide a framework for monitoring and reporting requirements (SWRCB, 2015).

Two compliance tracks are offered, and each municipality may select either compliance track at its discretion. Track 1 requires municipalities to install and maintain full trash capture systems[7] in storm drains that receive runoff from priority land uses (which include commercial development). Track 2 requires the municipality to implement a plan with a combination of full capture systems, multi-benefit projects, institutional controls, and/or other treatment controls to achieve full capture system equivalency. Any new development within the MS4 permittee's jurisdiction must be built to immediately comply with the compliance track selected by the municipality.

The Regional MS4 Permit, and the California National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (CA CGP) contain trash control implementation requirements to implement the Trash Amendments. The General Permit for Stormwater Discharges Associated with Industrial Activities will also contain the prohibition of trash in stormwater and non-stormwater discharges when that permit is reissued.

3.2.4 Permits and Policies

3.2.4.1 Construction General Permit

Pursuant to CWA Section 402(p) requiring regulations for permitting certain stormwater discharges, the SWRCB issued a statewide general permit for stormwater discharges from construction sites. The latest CA CGP (Order No. 2022-0057-DWQ) was adopted by the

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[6] On April 7, 2015, the SWRCB adopted (1) an Amendment to the Water Quality Control Plan for the Ocean Waters of California (Ocean Plan) to Control Trash and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California (ISEBE Plan), collectively referred to as the "Trash Amendments", and (2) approval of the Final Staff Report, including the Substitute Environmental Documentation. Priority land uses include commercial areas.

[7] Full capture systems for storm drains are defined in the Trash Amendments as treatment controls (either a single device or a series of devices) that traps all particles that are five mm or greater and has a design treatment capacity that is either: a) of not less than the peak flow rate, Q, resulting from a one-year, one-hour, storm in the sub-drainage area, or b) appropriately sized to and designed to carry at least the same flows as the corresponding storm drain.

SWRCB on September 8, 2022 and became effective on September 1, 2023, replacing the prior CA CGP.

In California, coverage under the CA CGP is triggered for construction projects that include construction or land disturbance activities that results in a disturbance of one or more acres including, but not limited to, clearing, grading, excavation, stockpiling, and demolition activities that expose or disturb soil. This includes smaller areas less than one acre that is part of a larger common plan of development or sales that totals one or more acres of land disturbance.

Projects are required to submit a Notice of Intent (NOI) to the SWRCB under the CA CGP. The NOI is submitted via an online system called the Stormwater Multiple Applications and Report Tracking System (SMARTS) and certified by the Legally Responsible Person (LRP), as defined in the CA CGP. As part of obtaining coverage, a discharger must submit an application fee; complete a construction site risk assessment to determine a project's Risk Level; prepare a Stormwater Pollution Prevention Plan (SWPPP), including site maps, a Construction Site Monitoring Program, and sediment basin design calculations, if applicable. For projects located outside of a Phase I or Phase II Municipal Separate Storm Sewer System (MS4) permit area, complete a post-construction water balance calculation for hydromodification controls.

Once CA CGP coverage is obtained, the SWPPP must be implemented throughout the duration of the project until a Notice of Termination (NOT) is submitted. The SWPPP has three major objectives: (1) to help identify the sources of sediment and other pollutants that affect the quality of stormwater discharges, (2) to describe and ensure the implementation of site-specific Best Management Practices (BMPs) to reduce or eliminate sediment and other pollutants in stormwater and non-stormwater discharges, and (3) to convey a plan to restore erosion protection and site hydrology post-construction. The SWPPP also outlines the monitoring and sampling program required for the construction site to verify compliance with discharge Numeric Action Levels (NALs) and Numeric Effluent Limitations (NELs) set by the CA CGP based on the project Risk Level, receiving water body Total Maximum Daily Loads (TMDLs), and/or use of an Active Treatment System (ATS).

3.2.4.2 Regional MS4 Permit

In 2021, the LARWQCB (LARWQCB, 2021) issued a revised NPDES Permit and Waste Discharge Requirement (WDR) (Order No. R4-2021-0105; NPDES Permit No. CAS004001) under the CWA and the Porter-Cologne Act for discharges of urban runoff in public storm drains in Los Angeles County and Ventura County. The Permittees are the Los Angeles County Flood Control District, County of Los Angeles, 85 incorporated cities within the coastal watersheds of Los Angeles County, Ventura County Watershed Protection District, the County of Ventura, and ten incorporated cities within Ventura County. Order No, R4-2021-015 supersedes the previous Orders for the City of Long Beach, 86 Permittees in the coastal watersheds of Los Angeles County, and 12 Permittees in Ventura County to cover 99 Permittees within the coastal watersheds of the Los Angeles Region with one region-wide Phase I Regional MS4 Permit (Regional MS4 Permit). This permit regulates stormwater discharges from MS4s in the Modified Project Site area.

Watershed Management Program

The Regional MS4 Permit details specific minimum control measure requirements. The Permittees may implement the specific requirements in the Regional MS4 Permit or may implement customized requirements as set forth in an approved Watershed Management Program in lieu of the specific requirements. Preparation of a Watershed Management Program is voluntary and is intended to allow the Permittees to address the highest watershed priorities, including complying with the receiving water limitations and TMDL provisions in the permit, by customizing the specific control measures contained in the permit.

The USCR Watershed Group, which is comprised of the County of Los Angeles, the Los Angeles County Flood Control District, and the City of Santa Clarita, prepared an EWMP for the USCR watershed. An EWMP is a Watershed Management Program that comprehensively evaluates opportunities, within the participating Permittees' collective jurisdictional area in the watershed, for collaboration among the Permittees and other partners on multi-benefit regional projects.

These projects, wherever feasible, should retain stormwater runoff from the 85th percentile, 24-hour storm event and all non-stormwater runoff for the drainage areas tributary to the projects, while also achieving other benefits such as flood control and water supply. In drainage areas within the EWMP area where retention of the 85th percentile, 24-hour storm event is not feasible, the EWMP included a Reasonable Assurance Analysis to demonstrate that applicable water quality-based effluent limitations and receiving water limitations will be achieved through the implementation of other watershed control measures.

The LARWQCB approved the USCR EWMP on April 7, 2016. The implementation of the approved EWMP went into effect immediately. The USCR Watershed Group submitted a revised draft Watershed Management Plan (WMP) to the LARWQCB dated June 2021. The revised draft WMP was conditionally approved by the LARWQCB in April 2023 (LARWQCB, 2023).

Planning and Land Development Program Requirements

The Regional MS4 Permit details specific requirements for new development and significant redevelopment projects, including selection, sizing, and design criteria for low impact development (LID), treatment control, and hydromodification control BMPs. These requirements are as follows:

- Projects shall control runoff from impervious surfaces through infiltration, bioretention, and/or rainfall harvest and use.
- Except where technically infeasible, projects shall retain the Stormwater Quality Design Volume (SWQDv) on-site. The SWQDv is defined as the runoff from the 0.75-inch, 24-hour rain event or the 85th percentile, 24-hour rain event, as determined from the Los Angeles County 85th percentile precipitation isohyetal map, whichever is greater. The SWQDv for the Modified Project is 1.1 inches.
- Where it is technically infeasible to retain 100 percent of the SWQDv onsite, the project must biofilter 1.5 times the portion of the SWQDv that is not reliably retained on-site. Alternatively, the project may retain the portion of the SWQDv that is not

reliably retained onsite at an off-site location and provide on-site treatment of the project's stormwater runoff.

- Bioretention[8] and biofiltration[9] systems meet design specifications consistent with those provided in the Los Angeles County LID Manual, Ventura County Technical Guidance Manual for Storm Water Quality Control Measures (July 2002 and its revisions), or equivalent LID Manual.
- Projects that discharge to a receiving water body that is impaired for nitrogen compounds must design and maintain biofiltration systems to achieve enhanced nitrogen removal capability.
- When evaluating the potential for on-site retention, each project must consider the maximum potential for evapotranspiration from green roofs and rainfall harvest and use.
- Technical infeasibility may result from conditions including:
  - An in-situ saturated soil infiltration rate less than 0.3 inches per hour (and it is not technically feasible to amend the in-situ soils to attain an infiltration rate necessary to achieve reliable performance of infiltration or bioretention BMPs in retaining the SWQDv on-site).
  - Depth to seasonal high groundwater is within five to ten feet of the surface.
  - Locations within 100 feet of a groundwater well used for drinking water.
  - Brownfield development sites where infiltration poses a risk of causing pollutant mobilization.
  - Other locations at or near properties that are contaminated or store hazardous substances underground, where pollutant mobilization is a documented concern.
  - Locations with potential geotechnical hazards.
  - Smart growth, infill, or redevelopment locations where the project's density and/or nature would create significant difficulty for compliance with the on-site volume retention requirement.
- If a project is complying with the requirements for new development and significant redevelopment projects via retention at an off-site location, then on-site treatment BMPs must be designed and implemented to meet specific benchmark effluent limitations contained in the Regional MS4 Permit and to ensure that the treated discharge does not cause or contribute to an exceedance of water quality standards at the downstream MS4 outfall. These treatment BMPs may include sand filters or other

[8] As defined in the Regional MS4 Permit, a bioretention BMP may not include an underdrain. When a bioretention BMP is designed or constructed with an underdrain, it is regulated by the Regional MS4 Permit as biofiltration.

[9] Biofiltration is defined in the Regional MS4 Permit to include only systems designed to facilitate incidental infiltration or achieve the equivalent pollutant reduction as biofiltration BMPs with an underdrain (subject to Executive Officer approval). Biofiltration BMPs include bioretention systems with an underdrain and bioswales.

proprietary BMPs that are certified for “Basic Treatment” under the Washington State Department of Ecology’s TAPE Program; or an appropriate future BMP certification developed by the State of California.

- The sizing of a flow-through treatment BMP must be based on a rainfall intensity of 0.2 inches per hour or the one-year, one-hour rainfall intensity as determined from the most recent Los Angeles County isohyetal map, whichever is greater.
- Projects that discharge to natural drainage systems must implement hydrologic control measures (i.e., hydromodification controls) to prevent accelerated downstream erosion and to protect stream habitat. Hydromodification control in natural drainage systems must be achieved by maintaining the Erosion Potential (Ep) in the natural drainage system at a value of 1, unless an alternative value can be shown to protect the natural drainage system from erosion, incision, and sedimentation and to prevent damage to stream habitat.
- Hydromodification control may include one or a combination of on-site, regional or sub-regional hydromodification control BMPs, LID BMPs, or stream and riparian buffer restoration measures. Any in-stream restoration measure cannot adversely affect the beneficial uses of the natural drainage system.
- Natural drainage systems that are subject to the hydromodification control requirements in the Regional MS4 Permit include all drainages that have not been improved (e.g., channelized or armored with concrete, shotcrete, or riprap) and drainage systems that are tributary to a natural drainage system, except as specifically exempted in the Regional MS4 Permit. Exemptions include:
  - Projects that are replacement, maintenance or repair of a Permittee’s existing flood control facility, storm drain, or transportation network.
  - Redevelopment projects in the urban core that do not increase the effective impervious area or decrease the infiltration capacity of pervious areas compared to the pre-project condition.
  - Projects that have any increased discharge directly or via a storm drain to a sump, lake, or area under tidal influence into a waterway with a 100-year peak flow (Q100) of 25,000 cfs or more, or other receiving water that is not susceptible to hydromodification impacts. Note, this is the Modified Project condition (see discussion in Section 7.7.1).
  - Projects that discharge directly or via a storm drain into concrete or otherwise engineered (not natural) channels (e.g., channelized or armored with rip rap, shotcrete, etc.), which, in turn, discharge into receiving water that is not susceptible to hydromodification impacts.
  - LID BMPs implemented on single-family homes are sufficient to comply with Hydromodification criteria.

- Projects disturbing 50 acres or more within natural drainage systems are presumed to meet the hydromodification control Modified Project Performance Criteria based on demonstration of one of the following conditions:
  - The site infiltrates on-site at least the runoff from a 2-year, 24-hour storm event, or
  - The runoff flow rate, volume, velocity, and duration for the post-development condition does not exceed the pre-development condition for the 2-year, 24-hour rainfall events. These conditions must be substantiated by hydrologic modeling acceptable to the LARWQCB Executive Officer, or
  - The Erosion Potential (Ep) in the receiving water channel will approximate one, as determined by a Hydromodification Analysis Study and the equation presented in the Regional MS4 Permit.

The preliminary selection and sizing of facilities to meet the Regional MS4 Permit's Project Performance Criteria are set forth in this document and the Entrada South and Valencia Commerce Center Hydrology and Drainage Concept Reports (Hunsaker, 2023c,d). Facility sizing will be finalized by the Project engineer with the final hydrology study prior to the issuance of a grading permit.

3.2.4.3 Newhall Ranch Resource Management and Development Plan and Spineflower Conservation Plan Water Quality Certification

The LARWQCB adopted a CWA Section 401 Water Quality Certification and WDR (Order No. R4-2012-0139) for the Newhall Ranch Resource Management and Development Plan (RMDP) and Spineflower Conservation Plan on September 14, 2012 (LARWQCB, 2012b).

3.2.4.4 General Waste Discharge Requirements for Dischargers of Groundwater from Construction and Project Dewatering

The LARWQCB reissued a General NPDES Permit and General WDR for Discharges of Groundwater from Construction and Project Dewatering to Surface Waters in Coastal Watersheds of Los Angeles and Ventura County (Order No. R4-2018-0125, NPDES No. CAG994004), which supersedes the former dewatering permit (Order No. R4 2013-0095). This permit governs construction-related dewatering discharges within the project development areas (the "General Dewatering Permit.") The General Dewatering Permit addresses discharges from temporary dewatering operations associated with construction and permanent dewatering operations associated with development. The discharge requirements include provisions mandating notification, sampling and analysis, and reporting of dewatering and testing-related discharges. The General Dewatering Permit authorizes such construction-related activities so long as all conditions of the permit are fulfilled. Compliance with the requirements of the General Dewatering Permit is used as one method to evaluate Modified Project construction-related impacts on surface water quality.

3.2.4.5 Lake or Streambed Alteration Agreement (LSAA)

The CDFW is responsible for conserving, protecting, and managing California's fish, wildlife, and native plant resources. To meet this responsibility, the law requires the proponent of a project that may impact a river, stream, or lake to notify the CDFW before beginning the project.

Section 1602 of the Fish and Game Code[10] requires any person who proposes a project that will substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake or use materials from a streambed to notify the CDFW before beginning the project. Similarly, under section 1602 of the Fish and Game Code, before any State or local governmental agency or public utility begins a construction project that will: (1) divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake; (2) use materials from a streambed; or (3) result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake, it must first notify the CDFW of the proposed project. If the CDFW determines that the project may adversely affect existing fish and wildlife resources, a Lake or Streambed Alteration Agreement is required.

As discussed above, this report does not analyze the habitat and wildlife impacts associated with physical alterations to waters of the U.S. proposed in conjunction with the Modified Project, such as dredge, fill, or bed, bank or channel improvements or stabilization measures affecting waters of the U.S. The impacts associated with these physical alterations are analyzed in SEIR Section 5.2 (Biological Resources) and Section 5.5 (Hydrology and Water Quality – Hydrology). As discussed in Section 4.4.2 below, this report does analyze the potential impacts to natural drainage systems that may be caused by the project's alteration of hydrologic conditions.

3.2.4.6 Recycled Water Policy

The State Water Board recognizes the importance of recycled water as a critical water supply for California and is implementing the Recycled Water Policy adopted in 2009, streamlining permitting for recycled water projects and identifying and funding the highest priority research needs to ensure the state's recycled water goals are achieved. The State Water Board adopted an amendment to the Recycled Water Policy in 2018 (effective on April 8, 2019), which includes numeric goals for the use of recycled water, two narrative goals to encourage recycled water use in areas with overdrafted groundwater and coastal areas, and annual reporting requirements statewide for the volume of recycled water produced and used as well as the volume of wastewater treated and discharged.

The Recycled Water Policy provides direction to the RWQCBs regarding appropriate criteria in issuing permits for recycled water projects intended to streamline permitting of the vast majority of recycled water projects; while reserving sufficient authority and flexibility to address site-specific conditions. The Policy also addresses the benefits of recycled water and encourages other public agencies to use this presumption in evaluating the impacts of recycled water projects on the environment as required by the California Environmental Quality Act (CEQA). The

[10] While the name of the Department has changed to the California Department of Fish and Wildlife (CDFW), the regulations are still referred to as the Fish and Game Code.

Policy addresses a mandate for use of recycled water and indicates the SWRCB will exercise their authority to the fullest extent possible to encourage the use of recycled water, consistent with state and federal water quality laws and indicates that the water industry and environmental community have agreed jointly to advocate for one billion dollars in state and federal funds to fund projects needed to meet the goals and mandates established in this Policy.

The Policy indicates that some groundwater basins contain salts and nutrients that exceed or threaten to exceed water quality objectives established in Basin Plans and states that it is the intent of the Policy that all salts and nutrients be managed on a basin-wide or watershed-wide basis through development of regional or sub-regional management plans. The Policy describes the components of these salt and nutrient management plans.

Finally, the Policy addresses the control of incidental runoff from landscape irrigation projects, recycled water groundwater recharge projects, antidegradation, control of emerging constituents and chemicals of emerging concern and incentives for use of recycled water.

In accordance with the provisions of the Recycled Water Policy, a Constituents of Emerging Concern[11] (CEC)[12] Advisory Panel was established to address questions about regulating CECs with respect to the use of recycled water. The Panel's primary charge was to provide guidance for developing monitoring programs that assess potential CEC threats from various water recycling practices, including groundwater recharge/reuse and urban landscape irrigation. On June 25, 2010, the CEC Advisory Panel provided recommendations to the SWRCB and California DPH in their Final Report "*Monitoring Strategies for Chemicals of Emerging Concern in Recycled Water – Recommendations of a Scientific Advisory Panel*" (SCCWRP, 2012a). The SWRCB used those recommendations to amend the Recycled Water Policy (SWRCB Resolution No. 2013-003).

The 2013 and 2018 amendments provide direction to the RWQCBs on monitoring requirements for CECs in recycled water. The monitoring requirements pertain to the production and use of recycled water for groundwater recharge reuse by surface and subsurface application methods,[13] and for landscape irrigation. The amendment identifies three classes of constituents to monitor:

- Health-based CECs - CECs of toxicological relevance to human health

[11] For the Recycled Water Policy, CECs are defined to be chemicals in personal care products, pharmaceuticals including antibiotics, antimicrobials; industrial, agricultural, and household chemicals; hormones; food additives; transformation products, inorganic constituents; and nanomaterials.

[12] "Constituents of Emerging Concern" (CECs) are also known as "emerging contaminants".

[13] Use of recycled water for groundwater recharge reuse has the same meaning as indirect potable reuse for groundwater recharge as defined in Water Code section 13561(c), where it is defined as the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system. Groundwater recharge by surface application is the controlled application of water to a spreading area for infiltration resulting in the recharge of a groundwater basin. Subsurface application is the controlled application of water to a groundwater basin or aquifer by a means other than surface application, such as direct injection through a well.

- Performance Indicator CECs – an individual CEC used for evaluating removal through treatment processes of a family of CECs with similar physicochemical or biodegradable characteristics.
- Surrogates – a measurable physical or chemical property, such as chlorine residual or electrical conductivity, which provides a direct correlation with the concentration of an indicator compound. Surrogates are used to monitor the efficiency of CEC treatment.

The specific CECs and surrogates listed in the policy amendment are subject to change on a case-by-case basis and shall be appropriate for the treatment process or processes. Monitoring is not required for recycled water used for landscape irrigation due to the low risk for ingestion of the water.

3.2.4.7 Municipal Recycled Water Landscape Irrigation Use Permit

The General WDR for Landscape Irrigation Uses of Municipal Recycled Water (Water Quality Order No. 2009-0006-DWQ) (Landscape Irrigation General Permit) regulates landscape irrigation with recycled water. Specified uses of recycled water considered to be "landscape irrigation" include any of the following: (i) parks, greenbelts, and playgrounds; (ii) school yards; (iii) athletic fields; (iv) golf courses; (v) cemeteries; (vi) residential landscaping and common areas (not including individually owned residential areas); (vii) commercial landscaping, except eating areas; (viii) industrial landscaping, except eating areas; and (ix) freeway, highway, and street landscaping. Producers or distributors of recycled water must submit a Notice of Intent for coverage under the Landscape Irrigation General Permit. This permit is not required for individual recycled water users and does not cover use of harvested stormwater for irrigation.

Producer and Distributor Responsibilities
Producers must produce disinfected tertiary recycled water as defined by California Code of Regulations (CCR) Title 22, sections 60301.230 and 60301.320, which address disinfection requirements and "filtered wastewater" requirements, respectively. Producers are responsible for ensuring that recycled water meets the quality standards for disinfected tertiary recycled water as described in Title 22 and any associated waste discharge requirement order for the WRP. Distributors are responsible for drafting and submitting an Operations and Maintenance (O&M) Plan to the SWRCB. The plan contents are contained in the permit and include operation and maintenance/management of transport facilities and associated infrastructure necessary to convey and distribute recycled water from the point of production to the point of use. Additionally, distributors must designate a Recycled Water Use Supervisor for each use area. The permit also addresses BMPs, including general operations and maintenance, which producers and distributors must apply to manage recycled water and prevent water quality impacts.

Usage
The permit establishes terms and conditions of discharge to ensure that the discharge does not unreasonably affect beneficial uses of groundwater and surface water. This includes minimum setback distances, signage, application control, and use restrictions, along with other preventative measures, such as backflow prevention and cross-contamination programs.

3.2.4.8 California Green Building Standards Code (CALGreen Code)

In January 2013, the State of California enacted the third revision of the California Green Building Standards Code (CALGreen Code) as Part 11 of the California Building Standards Code (Title 24). CALGreen measures are designed to improve public health, safety, and general welfare by utilizing design and construction methods that reduce the negative environmental impact of development and encourage sustainable construction practices.

CALGreen provides mandatory direction to developers of all new construction and renovations of residential and non-residential structures with regard to all aspects of design and construction, including but not limited to site drainage design, stormwater management, and water use efficiency. Required measures are accompanied by a set of voluntary standards that are designed to encourage developers and cities to aim for a higher standard of development.

Under CALGreen, all residential and non-residential sites are required to be planned and developed to keep surface water from entering buildings and to incorporate efficient outdoor water use measures. Construction plans are required to show appropriate grading and surface water management methods such as swales, water collection and disposal systems, French drains, water retention gardens, and other water measures which keep surface water away from buildings and aid in groundwater recharge. Plans should also include outdoor water use plans that utilize weather or soil moisture-controlled irrigation systems. In addition to the above-mentioned requirements, non-residential structures are also required to develop an irrigation water budget for landscapes greater than 2,500 square feet that conforms to the local water efficient landscape ordinance or to the California Department of Water Resources Model Water Efficient Landscape Ordinance where no local ordinance is applicable.

3.3 Local Regulations

3.3.1 Los Angeles County LID Ordinance and Manual

Chapter 12.84 of the Los Angeles County Municipal Code[14] requires the use of LID BMPs in development projects. This chapter applies to all development within the unincorporated area of the County after January 1, 2009, except for those developments that filed a complete discretionary or non-discretionary permit application with the Los Angeles County Department of Regional Planning, Public Works, or any County-controlled design control board, prior to January 1, 2009.

Chapter 12.84 requires that applicable development projects:

- Mimic undeveloped stormwater runoff rates and volumes in any storm event up to and including the “Capital Flood” event, as defined by LACDPW;
- Prevent pollutants of concern from leaving the development site in stormwater as the result of storms, up to and including a Water Quality Design Storm Event; and

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[14] Chapter 12.84 was amended in September 2013 to conform to the requirements of the revised Los Angeles County Regional MS4 Permit (Order No. R4-2012-0175).

- Minimize hydromodification impacts to natural drainage systems.

To meet these standards, applicable development projects shall comply with the following:

1. The project shall retain one hundred percent of the Stormwater Quality Design Volume (SWQDv) on-site, through infiltration, evapotranspiration, rainfall harvest and use, or a combination thereof, unless the Director of Public Works determines that it would be technically infeasible to do so;
2. If the Director determines that it would be technically infeasible to retain one hundred percent of the SWQDv on-site, the project shall comply with one of the following alternative compliance measures:
   a. The project shall provide for on-site biofiltration of one and one-half (1.5) times the portion of the SWQDv that is not retained on-site;
   b. The project shall include infiltration or bioretention BMPs to intercept the portion of the SWQDv that is not retained on-site at an off-site location, as approved by the Director of Public Works. The project shall also provide for treatment of the portion of the SWQDv discharged from the project site, as approved by the Director of Public Works;
   c. The project shall provide for the replenishment of groundwater supplies that have a designated beneficial use in the Basin Plan;
      i. Groundwater replenishment projects shall include infiltration or bioretention BMPs to intercept the portion of the SWQDv that is not retained on-site at an off-site location, as approved by the Director of Public Works;
      ii. Groundwater replenishment projects shall also provide for treatment of the portion of the SWQDv discharged from the project site, as approved by the Director of Public Works;
   d. The project shall include infiltration, bioretention, or rainfall harvest and use BMPs to retrofit an existing development with similar land uses as the project to intercept the portion of the SWQDv that is not retained on-site; or
   e. The County, independently or in conjunction with one or more cities, may apply to the LARWQCB for approval of a regional or sub-regional stormwater mitigation program to substitute in part or wholly for the provisions of this chapter for the area covered by the regional or sub-regional stormwater mitigation program. If the LARWQCB approves the program, provisions of the program shall apply in lieu of any conflicting provisions of this chapter.

In addition, development projects that consist of five or more residential units, or nonresidential development projects, shall comply with the following:

- The excess volume (ΔV, defined as the post-developed runoff volume minus the pre-developed runoff volume for the 85th percentile storm event) from each lot upon

> which such development is occurring shall be infiltrated at the lot level, or in the alternative, the excess volume from the entire development site, including streets and public right-of-way, shall be infiltrated in sub-regional facilities. The tributary area of a sub-regional facility shall be limited to five acres but may be exceeded with approval of the Director of Public Works. When the Director of Public Works determines that infiltration of all excess volume is not technically feasible, on-site storage, reuse, or other water conservation uses of the excess volume is required and shall be implemented as authorized by the Director of Public Works and the runoff from the SWQDv must be treated to the satisfaction of the Director of Public Works before discharge.

LACDPW prepared the 2014 LID Standards Manual (LACDPW, 2014b) to comply with the revised Los Angeles County Regional MS4 Permit (Order No. R4-2012-0175).[15] The LID Standards Manual outlines stormwater runoff quantity and quality control development principles, technologies, and design standards for achieving the LID Standards of Chapter 12.84. The LID Standards Manual requires that Designated Projects[16] prioritize the selection of BMPs to retain 100 percent of the SWQDv on-site through infiltration, evapotranspiration, stormwater runoff harvest and use, or a combination thereof, unless it is demonstrated that it is technically infeasible to do so. The Manual states that BMPs should be implemented in the following order of preference:

- Infiltration and/or bioretention.
- Stormwater runoff harvest and use.

Designated Projects that are unable to fully retain the SWQDv on-site through retention-based stormwater quality control measures must implement alternative compliance measures (e.g., on-site biofiltration, off-site groundwater replenishment, off-site infiltration and/or bioretention, and off-site retrofit). Prior to off-site mitigation, the portion of the SWQDv that cannot be reliably retained on-site must be treated to meet effluent quality standards.

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[15] The LID Standards Manual is an update to and compilation of the following documents: 1) Development Planning for Storm Water Management: A Manual for the Standard Urban Storm Water Mitigation Plan (SUSMP Manual, September 2002); 2) Technical Manual for Stormwater Best Management Practices in the County of Los Angeles (2004 Design Manual, February 2004); 3) Stormwater Best Management Practice Design and Maintenance Manual (2010) Design Manual, August 2010); and 4) Low Impact Development Standards Manual (2009 LID Manual, January 2009). Additionally, the LID Standards Manual supersedes the water quality portions of the following ordinances and policies: 1) Water Quality section of the Los Angeles County Hydrology Manual; 2) Interim Drainage Policy for Quartz Hill; 3) Acton Interim Drainage Policy and Guidelines; 4) Antelope Valley Interim Drainage Policy; 5) Financing the Cost to Maintain Standard Urban Stormwater Mitigation Plan Devices/Systems; 6) Permanent Standard Urban Storm Mitigation Plan Devices for No Fee Miscellaneous Transfer Drains, Small Drainage Systems, and Storm Drain Connection Permits; 7) Interim Peak Flow Runoff Criteria for New Development; 8) Policy for New Percolation Basin Testing, Design, and Maintenance; and 8) Clarification on the Policy for Financing the Cost to Maintain Standard Urban Stormwater Mitigation Plan (SUSMP) Devices/Systems Constructed by New Development or Other Agencies.

[16] Designated Projects are identified as meeting one or more criteria listed in the LID Standards Manual. The Entrada South and VCC projects are Designated Projects.

The LID Standards Manual outlines site conditions where infiltration may be technically infeasible:

- Locations where the corrected in-situ infiltration rate is less than 0.3 inches per hour, as determined according to the most recent Geotechnical and Materials Engineering Division Policy GS 200.1, and it is not technically feasible to amend the in-situ soils to attain an infiltration rate necessary to achieve reliable performance of retention-based stormwater quality control measures for the SWQDv on-site.
- Locations where seasonal high groundwater is within 10 feet of the surface.
- Within 100 feet of a groundwater well used for drinking water.
- Brownfield development sites or other locations where pollutant mobilization is a documented concern.
- Locations with potential geotechnical hazards.
- Smart growth and infill or redevelopment locations where the density and/or nature of the project would create significant difficulty for compliance with the on-site retention requirement.
- Locations where infiltration may cause adverse impacts to biological resources.
- Locations where infiltration may cause health and safety concerns.

The LID Standards Manual also outlines site conditions where stormwater runoff harvest and use may be technically infeasible:

- Projects that would not provide sufficient irrigation or (where permitted) domestic grey water demand for use of stored stormwater runoff due to limited landscaping or extensive use of low water use plant palettes in landscaped areas.
- Projects that are required to use recycled water for landscape irrigation.
- Projects in which the harvest and use of stormwater runoff would conflict with local, state, or federal ordinances or building codes.
- Locations where storage facilities may cause potential geotechnical hazards as outlined in the geotechnical report.
- Locations where storage facilities may cause health and safety concerns.

Chapter 12.84 and the LID Standards Manual also contain requirements for hydromodification control. Chapter 12.84 provides for the following exemptions from hydromodification control requirements:

- Projects that replace, maintain, or repair existing, publicly maintained flood control facilities, storm drains, or transportation networks;

- Redevelopment projects in an urbanized area that do not increase the effective impervious area or decrease the infiltration capacity of pervious areas compared to pre-project conditions;
- Projects that have any increased discharge directly or via a storm drain to a sump, lake, area under tidal influence, waterway that has an estimate 100-year peak flow of 25,000 cubic feet per second (cfs) or more, or other receiving water that is not susceptible to hydromodification impacts;
- Projects that discharge directly or through a storm drain into concrete or other engineered channels (e.g., channelized or armored with riprap, shotcrete, etc.), which in turn discharge into a sump area under tidal influence, or other receiving water that is not susceptible to hydromodification impacts;
- Non-designated projects that disturb less than one acre or create less than 10,000 square feet of new impervious area; and
- Single family homes that incorporate LID BMPs in accordance with the LID Standards Manual.

Chapter 12.84 requires projects to fully mitigate off-site drainage impacts caused by hydromodification and changes in water quality, flow velocity, flow volume, and depth/width of flow, as determined by the Director of Public Works, in accordance with the requirements and provisions specified in the LID Standards Manual. If the Director of Public Works determines that it is infeasible for a project to comply with this standard, then the project must obtain written consent to the unmitigated impacts from the owner of every impacted downstream property. In addition, the project must comply with one of the following alternative requirements:

1. The project shall infiltrate on-site at least the runoff from a 2-year, 24-hour rainfall event;
2. The runoff flow rate, volume, velocity, and duration for the project's post-development condition shall not exceed the pre-development condition for the 2-year, 24-hour rainfall events; or
3. The erosion potential (Ep)[17] in the receiving water channel shall approximate one (1), as demonstrated by a hydromodification analysis study approved by the Director of Public Works.

3.3.2 Los Angeles County Drought-Tolerant Landscaping Ordinance

Title 31 of the Los Angeles County Code requires that post-construction landscape designs comply with all of the following:

[17] Erosion potential (Ep) is defined as the total effective work done on the channel boundary by stream flows. It is derived and used as a metric to predict the likelihood of channel adjustment given watershed and stream hydrologic and geomorphic variables. The index under urbanized conditions is compared to the index under pre-urban conditions, expressed as a ratio.

1. Turf areas shall not exceed 25 percent of the total landscaped area.
2. Non-invasive, drought-tolerant plant and tree species appropriate for the climate zone region shall be utilized in at least 75 percent of the total landscaped area.
3. Hydrozoning irrigation techniques shall be incorporated into the landscape design.

In addition, a water budget must be developed for landscape irrigation use that conforms to the California Department of Water Resources Model Water Efficient Landscape Ordinance.

4. POLLUTANTS OF CONCERN AND SIGNIFICANCE CRITERIA

4.1 Surface Water Pollutants of Concern

4.1.1 Pollutants of Concern

As described in the State Certified EIR, pollutants of concern consist of any pollutant that exhibits one or more of the following characteristics: current loadings or historic deposits of the pollutant are impacting the beneficial uses of a receiving water, elevated levels of the pollutant are found in sediments of a receiving water and/or have the potential to bioaccumulate in organisms therein, or the detectable inputs of the pollutant are at concentrations or loads considered potentially toxic to humans and/or flora and fauna.

As with the 2017 Approved Project, the pollutants of concern for the water quality analysis are those that are anticipated or potentially could be generated by the proposed Modified Project at concentrations, based on water quality data collected in Los Angeles County from land uses that are the same as those proposed by the Modified Project (LACDPW, 2000), that exhibit these characteristics. Pollutants of concern for the Modified Project include those pollutants that are anticipated to exceed Basin Plan water quality objectives and CTR criteria in stormwater runoff without treatment, those pollutants with current 303(d) listings and TMDLs at the Modified Project location and downgradient in the Santa Clara River, and pollutants that have the potential to cause toxicity or bioaccumulate in the receiving waters (see Section 7.2.8 for a discussion on toxicity and Section 7.2.10 for a discussion on pollutant bioaccumulation).

Consistent with the State Certified EIR, sediment, nutrients, trace metals, iron, chloride, pesticides, pathogens, petroleum hydrocarbons, trash and debris, bioaccumulation, and methylene blue activated substances are pollutants of concern for the purposes of evaluating water quality based upon the above considerations. Toxicity, selenium, and constituents of emerging concern (CECs) have been added to the evaluation in this supplemental report. Toxicity and selenium were listed as impairing downstream segments of the Santa Clara River subsequent to the analysis in the State Certified EIR. Recent advances in qualitative and quantitative analytical chemistry have allowed detection of CECs in various environmental media and have led to initiatives estimating their potential hazards; thus CECs are included in this analysis. The following describes the selected pollutants of concern:

Sediment (TSS and Turbidity): Excessive erosion, transport, and deposition of sediment in surface waters are a significant form of pollution resulting in major water quality problems. Sediment imbalances impair waters' designated uses. Excessive sediment can impair aquatic life by filling interstitial spaces of spawning gravels, impairing fish food sources, filling rearing pools, and reducing beneficial habitat structure in stream channels. In addition, excessive sediment can cause taste and odor problems in drinking water supplies and block water intake structures. Turbidity is associated with project development primarily during the construction phase.

Nutrients (Total Phosphorus and Nitrogen (Nitrate + Nitrite, Ammonia, and Total Nitrogen): Nutrients are inorganic forms of nitrogen (nitrate, nitrite and ammonia) and phosphorus. Organic forms of nitrogen are associated with vegetative matter such as particulates from sticks and leaves. Inorganic forms of nitrogen include nitrate, nitrite, and ammonia. Total Nitrogen (TN) is a measure of all nitrogen present, including inorganic and particulate forms. Phosphorus can be measured as total phosphorus (TP) or as dissolved phosphorus. Dissolved phosphorus is the more bioavailable form of phosphorus. TP is often composed mostly of soil-related particulate phosphorus. There are several sources of nutrients in urban areas, mainly fertilizers in runoff from lawns, pet wastes, failing septic systems, atmospheric deposition from industry and automobile emissions, and soil erosion. Nutrient over-enrichment is especially prevalent in agricultural areas where manure and fertilizer inputs to crops significantly contribute to nitrogen and phosphorus levels in streams and other receiving waters. Eutrophication due to excessive nutrient input can lead to changes in algae, benthic, and fish communities; extreme eutrophication can cause hypoxia or anoxia, resulting in fish kills. Surface algal scum, water discoloration, and the release of toxins from sediment can also occur. TMDLs have been developed and adopted into the Basin Plan for nitrogen compounds in the Santa Clara River, including nitrate/nitrite and ammonia.

Trace Metals (Copper, Lead, and Zinc): The primary sources of trace metals in stormwater are typically commercially available metals used in transportation (e.g., automobiles), buildings, and infrastructure. Metals are also found in fuels, adhesives, paints, and other coatings. Copper, lead, and zinc are the most prevalent metals typically found in urban runoff. Other trace metals, such as cadmium, chromium, and mercury, are typically not detected in urban runoff or are detected at very low levels (LACDPW, 2000). Metals are of concern because of the potential for toxic effects on aquatic life and the potential for ground water contamination. High metal concentrations can lead to bioaccumulation in fish and shellfish and affect beneficial uses of receiving waters. The CTR establishes the water quality objectives for metals in California.

Iron. Iron is included in the Section 303(d) List for Santa Clara River Reach 5 (see Table 3-1 above). The listing referenced exceedances from Saugus and Valencia WRP receiving water quality monitoring, based on USEPA National Recommended Water Quality Criteria (1976) iron criterion of 1.0 mg/L for freshwater aquatic life. The USEPA criterion is based on three studies that were conducted between 1948 and 1967 which observed fish toxicity effects at iron levels of 1 – 2 mg/L at low and unknown pH levels.

The presence of iron in the Santa Clara River is due to its abundance in the Earth’s crust (it is the fourth most abundant element by weight); iron silicate minerals are a component of most rocks, including basalt. Iron is an important component in soil adhesion and is additionally important biologically. Vertebrate animals utilize iron’s oxidation-reduction mechanisms to transport oxygen in the bloodstream. Iron pollution sources include industrial wastewater, mine leachate, and groundwaters with high iron content. At low pH levels (below 5.5), iron from these sources forms precipitates which can coat gills of fish and cement streambeds, making them unsuitable for spawning.

Chloride: High levels of chloride in Santa Clara River Reaches 3, 5 and 6 have caused listings for impairment. Irrigation of salt sensitive crops such as avocados and strawberries with water containing elevated levels of chloride potentially results in reduced crop yields. Chloride levels in some areas exceed water quality standards associated with groundwater recharge. Chloride TMDLs have been developed and adopted into the Basin Plan. The major sources of elevated chloride are dry-weather discharges from WRPs, contributing about 70 percent of the chloride load. Minor point sources are dewatering operations, uncontrolled swimming pool, and water ride discharges.

Pesticides: Pesticides (including herbicides, insecticides, and fungicides) are chemical compounds commonly used to control insects, rodents, plant diseases, and weeds. Excessive application of a pesticide in connection with agriculture cultivation or landscaping may result in runoff containing toxic levels of its active component. Pesticides may be classified as organochlorine pesticides or organophosphorus pesticides, the former being associated with persistent bioaccumulative pesticides (e.g., dichlorodiphenyltrichloroethane or "DDT" and other legacy pesticides), which have been banned. The Santa Clara River estuary is listed as impaired for legacy pesticides, including chlorinated pesticides. Santa Clara River Reaches 6, 3, 1, and the estuary are also listed for toxicity, which can be a byproduct of pesticides. Toxic organophosphorus pesticides include diazinon and chlorpyrifos whose uses also are being banned of restricted by USEPA. The current pesticides of concern for water quality are pyrethrums; parathyroid (bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, and permethrin); carbaryl; malathion; and imidacloprid.

Pathogens (Bacteria, Viruses, and Protozoa): Elevated pathogens are typically caused by the transport of domestic animal, wildlife, or human fecal wastes from the watershed. Runoff that flows over land such as urban runoff can mobilize pathogens, including bacteria and viruses. Even runoff from natural areas can contain pathogens (e.g., from wildlife). Other sources of pathogens in urban areas include pets, septic systems, and leaky sanitary sewer pipes. The presence of pathogens in runoff can impair receiving waters and contaminate drinking water sources. Historically, fecal indicator bacteria (FIB) such as fecal coliform have been used to indicate the presence of pathogens due to the difficulty of monitoring for pathogens directly. More recently, the scientific community has questioned the use of certain indicator organisms, as there are various confounding factors that affect the reliability of some FIB as pathogen indicators in stormwater runoff. The Basin Plan objective is now based on the use of E. Coli as a pathogen indicator in fresh waters designated for water contract recreation (REC-1) beneficial use, including the Santa Clara River. Santa Clara River Reaches 3, 5, and 7 and the Santa Clara River Estuary area are identified as impaired by high fecal coliform counts from point and nonpoint sources. An Indicator Bacteria TMDL was approved by the LARWQCB for the Santa Clara River Estuary and Reaches 3, 5, 6, and 7 on July 8, 2010.

Petroleum Hydrocarbons (Oil and Grease and PAHs): The sources of oil, grease, and other petroleum hydrocarbons in urban areas include spillage fuels and lubricants, discharge of domestic and industrial wastes, atmospheric deposition, and runoff. Runoff can be contaminated by leachate from asphalt roads, wearing of tires, and deposition from automobile exhaust. Also, do-it-yourself auto mechanics may dump used oil and other automobile-related fluids directly into storm drains. Petroleum hydrocarbons, such as polycyclic aromatic hydrocarbons (PAH), can bioaccumulate in aquatic organisms from contaminated water, sediments, and food and are toxic to aquatic life at low concentrations. Hydrocarbons can persist in sediments for long periods of time and result in adverse impacts on the diversity and abundance of benthic communities. Hydrocarbons can be measured as total petroleum hydrocarbons (TPH), oil and grease, or as individual groups of hydrocarbons, such as PAHs.

Trash & Debris: Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic debris (such as leaves, grass cuttings, and food waste) are general waste products on the landscape that can be entrained in urban runoff. The presence of trash and debris may have a significant impact on the recreational value of a water body and aquatic habitat. Excess organic matter can create a high biochemical oxygen demand (BOD) in a water body and thereby lower its water quality. Also, in areas where stagnant water exists, the presence of excess organic matter can promote septic conditions resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds such as hydrogen sulfide.

Bioaccumulation: Certain pollutants, such as pesticides, selenium, and mercury tend to bioaccumulate. The Basin Plan and the CTR criteria set forth toxicity objectives for receiving water levels of substances that bioaccumulate in aquatic resources to prohibit concentrations of toxic substances that are harmful to human health and adversely affect beneficial uses.

Methylene Blue Activated Substances (MBAS). MBAS are related to the presence of detergents in water. Positive results may indicate the presence of wastewater or be associated with urban runoff due to commercial and/or residential vehicle washing or other outdoor washing activities. Surfactants disturb the surface tension, which affects insects and can affect gills in aquatic life.

Toxicity. Certain pollutants in stormwater runoff have the potential to be highly toxic to aquatic organisms resulting in effects such as impaired reproduction or mortality. The Basin Plan water quality objective for toxicity is:

> "All surface waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life."

Santa Clara River Reaches 1, 3, 6, and 11 and the Santa Clara River Estuary area are identified as impaired by toxicity.

Selenium. Selenium is a naturally occurring element present in sedimentary rocks, shales, coal and phosphate deposits and soils. There are around 40 known selenium-containing minerals, but all are rare and generally occur together with sulfides of metals such as copper, zinc, and lead (USEPA, 2016). Selenium can be released into surface waters and groundwater by natural sources via weathering and anthropogenic sources, such as surface mining, coal-fired power plants, and irrigated agriculture. Selenium is a nutritionally essential element for animals in small amounts, but toxic at higher concentrations. Selenium bioaccumulates in the aquatic food chain and chronic exposure in fish and aquatic invertebrates can cause reproductive impairments (e.g., larval deformity or mortality) and can adversely affect juvenile growth and mortality. Selenium is also toxic to waterfowl and other birds that consume aquatic organisms containing excessive levels of selenium. Santa Clara River Reach 3 is identified as impaired by selenium.

Constituents of Emerging Concern. Constituents of emerging concern encompass a vast number of chemical substances that are generally unregulated in the U.S. or have limited regulation in environmental media (e.g., air, water, sediment, and biota) around the world (Drewes, et al., 2022). CECs may include a wide variety of substances such as pharmaceuticals, PFAS, newly registered contemporary use pesticides, and newly developed commercial products such as nanomaterials. A multitude of chemical substances that may be qualitatively identified cannot be quantified due to lack of standards or robust methods of measurement. Thus, State of California regulators have been trying to narrow the focus of chemical substance screening in the aquatic environment to compounds that have the greatest potential to pose a risk to human and ecological health.

4.1.2 Other Surface Water Constituents

Consistent with the State Certified EIR, this section discusses other constituents that are listed in the Basin Plan but, for reasons explained below, are not pollutants of concern for the Modified Project.

Aluminum. Aluminum had been identified by the Los Angeles County Department of Public Works as a constituent of concern for the Santa Clara River based on historical monitoring conducted at mass emission Station S29. In stormwater, the majority of aluminum is in the particulate phase. Its presence in stormwater is mainly due to aluminosilicate minerals found in soils because stormwater particles are largely composed of eroded soils. Aluminum is a large component of soils and is the third most common element in the earth's crust. The average aluminum soil content is about eight percent (or 80,000 mg/kg) and suspended sediments in rivers have total aluminum contents of a similar order of magnitude. Aluminosilicates include a wide range of minerals with varying properties; some are formed during the laying down of the earth's crust and some by weathering processes. They are highly insoluble and unreactive, although aluminum can be extracted and solubilized to some degree under acidic conditions. According to the USEPA, aluminum is not considered a contaminant of potential concern to fish or aquatic organisms when surrounding soil pH is greater than 5.5 or when in solution of a pH above 5.5 (USEPA, 2003) because aluminum solubility and resultant toxicity has been linked to pH values below this standard. In general, Modified Project area soils are not expected to have a pH of less than 5.5. DeClerk and Singer (2003) compared historic (1945) pH levels of agricultural soils in Southern California to 2001 conditions and found that pH levels have actually risen, from approximately 7.2 in 1945 to nearly 8.0 in 2001. As the majority of the pre-development land use consists of agriculture or open space, it is safe to assume that soil pH levels within the Modified Project area will be, for the most part, above 5.5, as shown in DeClerk and Singer (2003). In addition, pH in stormwater runoff is not expected to be below 5.5, as mean runoff concentrations in the Los Angeles County stormwater monitoring data ranged from 6.5 for mixed and single-family residential land uses to 7.0 for commercial land uses. In urban areas, aluminum building materials are a minor source of aluminum, as the metal is coated in unreactive aluminum oxide.

In addition, based on readily available data and information, the LARWQCB decided not to include aluminum on the 2014/2016 Section 303(d) list because the weight of evidence indicated that there was insufficient justification for a listing for this pollutant; aluminum has not been added to the Section 303(d) list since then. Therefore, aluminum is not a pollutant of concern for the Modified Project.

BOD and Dissolved Oxygen. Adequate levels of dissolved oxygen are necessary to support aquatic life. High levels of oxygen demanding substances discharged to receiving waters can depress oxygen levels to levels of concern. Oxygen demanding substances are compounds that can be biologically degraded through aerobic processes. The presence of oxygen demanding substances can deplete oxygen supplies in waters and can contribute to algae growth. Nutrients in fertilizers and food wastes in trash are examples of likely oxygen demanding compounds to be present on the Modified Project Site. Other biodegradable organic materials include human and animal waste and vegetative matter. Biodegradable pollutants are largely subsumed by the nutrients and trash and debris categories above, and therefore will not be discussed as a separate constituent category.

Chemical Constituents. Excessive amount of chemical constituents in drinking water are harmful to human health. The Basin Plan objective for chemical constituents states: "[s]urface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use." As the Santa Clara River is not designated with a municipal water supply designated use (see Section 2.3.3 above), chemical constituents are not a pollutant of concern for the Modified Project.

Cyanide. The information on cyanide levels in urban stormwater is relatively sparse. The incidence of detection of cyanide in urban stormwater is relatively low, except in some special cases. In the Nationwide Urban Runoff Modified Project (NURP), cyanide was detected in runoff from four cities out of a total of 15 cities that participated in the monitoring program (USEPA, 1983). Overall, cyanide was detected in 23 percent of the urban runoff samples collected (16 out of a total of 71 samples), at concentrations ranging from 2 to 33 µg/L (Cole et. al. 1984). Of the 71 samples, only 3 percent (i.e., 2) exceeded the freshwater acute guideline of 22 µg/L (USEPA 1983). The predominant sources of cyanides found in urban runoff samples were reported to be products of gasoline combustion and anti-caking ingredients in road salts (Cole et. al. 1984).

A review of highway runoff (Colman et. al. 2001) suggested that deicing salts are the main source of cyanide in highway runoff. It has been estimated that approximately two million pounds of sodium ferrocyanide, which is used as an anticaking agent in road salts during the winter in the northeastern United States, are washed off from roads into streams and storm sewers (USEPA, 1981; Gaffney et. al., 1987). Information on the quality of snowpacks and snow melt support the premise that deicing salts are the major source of cyanide in stormwater. For example, concentrations of cyanide in snowpacks ranged up to 314 µg/L in Milwaukee and Syracuse (Novotny et. al., 1999). An urban stream receiving snow melt in Milwaukee had an average cyanide concentration of 31 µg/L (<2 – 45 µg/L). Two urban streams in Syracuse had average cyanide concentrations of 8 µg/L (<2 – 27 µg/L) and 48 µg/L (<2 – 167 µg/L), respectively. Reconsidering the NURP findings, three of the four cities which detected cyanide are within the snowbelt, and may have used deicing salts containing anti-caking agents. One (Austin, Texas) presumably does not.

In contrast to these relatively high concentrations associated with deicing salts, runoff from cities which do not use deicing salts or from northern cities outside the snow season has lower concentrations of cyanides. The City of Fresno NURP study (Brown & Caldwell, 1984) found undetectable cyanide (< 10 µg/L) in 19 grab samples of stormwater runoff from four watersheds with different land uses. Highway runoff from three urban sites in Michigan had average cyanide concentrations ranging from 5.8 – 9.3 µg/L. Samples were collected from June through October, which was outside the season where deicing salts might be used. Traffic volumes were high and ranged from 40,000 to 120,000 vehicles per day.

It is highly probable that the reported concentrations which exceed the freshwater acute guideline in urban stormwater are associated with the use of deicing salts containing the anti-caking agent ferrocyanide. In situations where deicing salts are not being used, and where vehicle exhaust may be the dominant source, concentrations are much less (e.g., typically < 10 µg/L), even with high traffic volumes. Anti-caking agents will not be a source of cyanide in urban stormwater in the Modified Project’s runoff, and the forgoing discussion suggests that concentrations in stormwater runoff from the Modified Project may reach concentrations of magnitude of approximately 10 µg/L, but are highly unlikely to exceed the acute CTR criteria of 22 µg/L.

The detectable concentrations of cyanide observed in the Santa Clarita River at the mass emission station S29 (average of 10 µg/L) may be in part due to untreated urban stormwater runoff from the City of Santa Clarita. However, other sources are likely to be more significant. A potential source is cyanide from burnt catchments. For example, cyanide concentrations in run-off obtained from an area that had been burned in a wildfire that occurred in Tennessee and North Carolina averaged 49 µg/L (Barber et. al. 2003). Higher cyanide concentrations were reported in run off from a wildfire that occurred in New Mexico, with an average value of 80 µg/L.

Due to the expected relatively low level of cyanide in untreated stormwater, cyanide is not considered a pollutant of concern for the Modified Project.

Temperature. Increase in temperature can result in lower dissolved oxygen levels, impairing habitat, and other beneficial uses of receiving waters. Discharges of wastewater can also cause unnatural and/or rapid changes in temperature of receiving waters, which can adversely affect aquatic life. Elevated temperatures are typically associated with discharges of process wastewaters or non-contact cooling waters. As the beneficial uses in the receiving waters for the Modified Project Site include warm freshwater habitat to support warm water ecosystems, temperatures of stormwater runoff in the Modified Project are not of concern.

Total Residual Chlorine. Total residual chlorine can be present in wastewater treatment plant discharges or may be present in dry weather urban runoff from the emptying of swimming pools that have not been de-chlorinated. Chlorine is a strong oxidant, and therefore, is very toxic to aquatic life. Municipal and private pools in areas served by a municipal sanitary system are required to be discharged into the sanitary system, and therefore, total residual chlorine will not be present in runoff from the Modified Project. The Valencia WRP and NRSD WRP discharge permits contain effluent limitations for total residual chlorine that are protective of receiving water beneficial uses.

Color, Taste, and Odor. The Basin Plan contains narrative objectives for color, taste, or odor that causes a nuisance or adversely affects beneficial uses. Undesirable tastes and odors in water may be a nuisance and may indicate the presence of a pollutant(s). Odor associated with water can result from decomposition of organic matter or the reduction of inorganic compounds, such as sulfate. Other potential sources of odor causing substances, such as industrial processes, will not occur as part of the Modified Project. Color in water may arise naturally, such as from minerals, plant matter, or algae, or may be caused by industrial pollutants. Modified Project land uses will not include industrial land uses. Therefore, color-, taste-, or odor-producing substances are not pollutants of concern for the Modified Project.

Exotic Vegetation. Non-native (exotic) vegetation typically provides little habitat value and can out compete native vegetation that is more suitable habitat for aquatic and terrestrial organisms. The Basin Plan objective for exotic vegetation states:

> "Exotic vegetation shall not be introduced around stream courses to the extent that such growth causes nuisance or adversely affects designated beneficial uses."

The potential for non-native plant species to impact natural drainages is analyzed in the two Biological Resources Technical Reports for the Modified Project prepared by Dudek (Dudek, 2022a and 2022b).

Mineral Quality: TDS, Sulfate, Boron, and Sodium Adsorption Ratio (SAR). Mineral quality in natural waters is largely determined by the mineral assemblage of soils and rocks near the land surface. Elevated mineral concentrations could impact beneficial uses; however, the minerals listed in the Basin Plan, except chloride and nitrogen, are not believed to be constituents of concern due to the absence of river impairments and/or, as with TDS, anticipated post-development runoff concentrations well below the Basin Plan objectives (Table 4-1). Therefore, these constituents are not considered pollutants of concern for the Modified Project.

Table 4-1: Comparison of Mineral Basin Plan Objectives with Mean Measured Values in Los Angeles County

Mineral	Los Angeles Basin Plan Water Quality Objective for Santa Clara River Reach 5 (mg/L)	Range of Mean Concentration in Urban Runoff1 (mg/L) [1]
TDS	1,000	53 - 226
Sulfate	400	7 - 35
Boron	1.5	0.16 – 0.25
Sodium Absorption Ratio (SAR)[2]	10	0.4 – 1.9

[1] Source: LACDPW, 2000. Land uses include SFR, MFR, commercial, education, transportation, light industrial, and mixed residential.

[2] Sodium adsorption ratio (SAR) predicts the degree to which irrigation water tends to enter into cation-exchange reactions in soil.

pH. The hydrogen ion activity of water (pH) is measured on a logarithmic scale, ranging from 0 to 14. While the pH of "pure" water at 25 ºC is 7.0, the pH of natural waters typically ranges from between 6.5 and 8.5 (neutral range). Normal rain is slightly acidic because dissolution of carbon dioxide (CO2) from the atmosphere forms weak carbonic acid, resulting in a pH of approximately 5.6 at typical atmospheric concentrations of CO2. Receiving water pH values that deviate from the neutral range may impair water quality and adversely affect aquatic life, which can be highly sensitive to pH. The Basin Plan objective for pH is:

> "…the pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge."

Mean runoff concentrations in the Los Angeles County stormwater monitoring data ranged from 6.5 for mixed- and single-family residential land uses to 7.0 for commercial land use. Therefore, pH in the Santa Clara River is not expected to be affected by runoff discharges from the Modified Project.

PCBs. Polychlorinated biphenyls (PCBs) are highly toxic persistent chemicals that have been historically released into the environment from heavy industrial uses, such as transformers, but are no longer produced in the United States. Because of their persistence, PCBs can still be detected in urban runoff due to historic industrial sources of these chemicals. As described in Section 2.1.2 above, the historic site conditions for the Entrada South Planning Area are open space, cattle grazing, and agricultural operations. The historic site conditions for the VCC Planning Area include sand and gravel production, cattle grazing, and agricultural operations. Thus, the Modified Project Site area did not historically include PCBs-producing land uses. Therefore, PCBs are not a pollutant of concern for the Modified Project.

Radioactive Substances. Radioactive substances typically occur at very low concentrations in natural waters. Some activities such as mining or certain industrial activities (e.g., energy production, fuel reprocessing) can increase the amount of radioactive substances impairing beneficial uses. The Modified Project will not have industrial or other activities that would be a source of any radioactive substances, and development will stabilize any naturally radioactive soils, though unlikely to be present in the Modified Project Site area. Therefore, radioactive substances are not a pollutant of concern for the Modified Project.

4.2 Groundwater Pollutants of Concern

4.2.1 Pollutants of Concern

As with the 2017 Approved Project, the Modified Project will allow for incidental infiltration of urban runoff to groundwater after receiving treatment in the LID treatment control BMPs, as well as incidental infiltration of irrigation water. Research conducted on the effects on groundwater from stormwater infiltration by Pitt et. al. (1994) indicates that the potential for contamination is dependent on a number of factors including the local hydrogeology and the chemical characteristics of the pollutants of concern.

Chemical characteristics that influence the potential for groundwater impacts include high mobility (low absorption potential), high solubility fractions, and abundance in runoff, including dry weather flows. As a class of constituents, trace metals tend to adsorb[18] onto soil particles and are filtered out by the soils. This has been confirmed by extensive data collected beneath stormwater detention/retention ponds in Fresno (conducted as part of the Nationwide Urban Runoff Program (Brown & Caldwell, 1984)) that showed that trace metals tended to be adsorbed

[18] To "adsorb" means to accumulate on the surface.

in the upper few feet in the bottom sediments. Bacteria are also filtered out by soils. More mobile constituents such as chloride and nitrate would have a greater potential for infiltration.

As established in the State Certified EIR, the pollutants of concern for the groundwater quality analysis are those that are anticipated or potentially could be generated by the Modified Project at concentrations, based on water quality data collected in Los Angeles County, from land uses that are the same as those included in the Modified Project that exhibit these characteristics. Identification of the pollutants of concern for the Modified Project considered proposed land uses as well as pollutants that have the potential to impair beneficial uses of the groundwaters below the Modified Project. The Los Angeles Basin Plan contains numerical objectives for bacteria, mineral quality, nitrogen, and various toxic chemical compounds, and contains qualitative objectives for taste and odor.

As established in the State Certified EIR, nitrate-N was chosen as the pollutant of concern for purposes of evaluating groundwater quality impacts based upon the above considerations. High nitrate levels in drinking water can cause health problems in humans. Infants can develop methemoglobinemia (blue-baby syndrome). Nitrate-N was chosen because human activities and land use practices can influence nitrogen concentrations in groundwaters. For example, irrigation water containing fertilizers can increase levels of nitrogen in groundwater.

4.2.2 Other Groundwater Constituents

Consistent with the State Certified EIR, this section discusses other groundwater constituents that are listed in the Basin Plan but, for reasons explained below, are not pollutants of concern for the Modified Project.

Bacteria: The Basin Plan contains numeric criteria for bacteria in drinking water sources. As bacteria are removed through straining in soils (for example, as with septic tank discharges), infiltration of runoff in the Modified Project's water quality BMPs is not expected to affect bacteria levels in groundwater. WRP's include a disinfection process to reduce bacteria below levels of concern, and therefore bacteria in irrigation water are not expected to impact groundwater.

Chemical Constituents and Radioactivity: Drinking water limits for inorganic and organic chemicals that can be toxic to human health in excessive amounts and radionuclides are contained in Title 22 of the California Code of Regulations. These chemicals and radionuclides are not expected to occur in the Modified Project's runoff. Title 22 specifies California's Wastewater Reclamation Criteria (WRC), and recycled water must meet or exceed these criteria. These criteria apply to the treatment processes; treatment performance standards, such as removal efficiencies and effluent water quality; process monitoring programs, including type and frequency of monitoring; facility operation plans; and necessary reliability features. Due to compliance with these criteria, chemical constituents and radionuclides are not expected to occur in irrigation water in amounts that would impact groundwater; and, therefore, they are not pollutants of concern for the Modified Project.

Taste and Odor. The Basin Plan contains a narrative objective for taste and odor that cause a nuisance or adversely affect beneficial uses. Undesirable tastes and odors in groundwater may be a nuisance indicating the presence of a pollutant(s). Odor associated with water can result from natural processes, such as the decomposition of organic matter or the reduction of inorganic compounds, such as sulfate. Other potential sources of odor causing substances, such as industrial processes, will not occur as part of the Modified Project. Therefore, taste and odor-producing substances are not pollutants of concern for the Modified Project.

Mineral Quality: TDS, Sulfate, Chloride, and Boron. Mineral quality in groundwaters is largely influenced by the mineral assemblage of soils and rocks that it comes into contact with. Elevated mineral concentrations could impact beneficial uses; however, the minerals listed in the Basin Plan are not believed to be pollutants of concern due to the anticipated runoff concentrations and the expected mineral concentrations in irrigation water, which are below the Basin Plan groundwater objectives (Table 4-2). Therefore, these constituents are not considered pollutants of concern for the Modified Project.

Table 4-2: Comparison of Basin Plan Mineral Groundwater Objectives with Mean Measured Values in Los Angeles County Urban Runoff and Anticipated Irrigation Water Quality

Mineral	Los Angeles Basin Plan Groundwater Quality Objective[1] (mg/L)	Range of Mean Concentrations in Urban Runoff[2] (mg/L)	Anticipated Average Concentration in Recycled Water[3] (mg/L)
TDS	1,000	53 – 237	684
Sulfate	350	7 – 35	173
Chloride	150	4 – 50	119
Boron	1.0	0.2 – 0.3	0.57

[1] Eastern Santa Clara-Castaic Valley

[2] Source: LACDPW, 2000. Includes all monitored land uses.

[3] Source: SCVSD, 2013b. Values are average Valencia WRP effluent quality in 2011.

Perchlorate. As discussed in Section 4.3 of the State Certified EIR and the 2020 Santa Clarita Valley Urban Water Management Plan (Kennedy/Jenks Consultants, 2021), perchlorate contamination in Alluvial and Saugus aquifer water supply wells is being addressed through perchlorate treatment systems. The State Certified EIR found that the groundwater resources for the Modified Project are not considered to be at risk as a result of perchlorate contamination. As perchlorate is a legacy chemical that was used in making rocket and ammunition propellants and would not be generated by the Modified Project, perchlorate is not considered a pollutant of concern for the Modified Project.

4.3 Hydrologic Conditions of Concern (Hydromodification)

Urbanization modifies natural watershed, stream hydrologic, and geomorphic processes by introducing increased volumes and duration of flow via increased runoff from impervious surfaces and drainage infrastructure. Potential changes to the hydrologic regime may include increases in runoff volumes, frequency of runoff events, long-term cumulative duration, as well as increased peak flows. Urbanization may also introduce dry weather flows where only wet weather flows existed prior to development. These changes are referred to as "hydromodification."

Hydromodification intensifies sediment transport often leading to stream channel enlargement and loss of habitat and associated riparian species. Under certain circumstances, development can also cause a reduction in the amount of sediment supplied to the stream system, which can lead to stream channel incision and widening. These changes also have the potential to impact downstream channels and habitat integrity. A project that increases runoff due to impervious surfaces and traps sediment from upland watershed sources creates compounding effects.

Consistent with the State Certified EIR, a change to the Modified Project site's hydrologic regime would be considered a condition of concern if the change could have a new significant impact on downstream natural channels and habitat integrity, alone or in conjunction with impacts of other projects.

4.4 Significance Criteria and Thresholds for Significance

Based on Appendix G of the CEQA Guidelines and other relevant criteria, the Los Angeles County Department of Regional Planning has determined that a project would have a potentially significant impact related to water quality based on the following criteria:

- Would the project violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?
- Would the project substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?
- Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would result in a substantial erosion or siltation on- or off-site?
- Would the project conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?
- Would the project conflict with the Los Angeles County Low Impact Development Ordinance (L.A. County Code, Title 12, Ch. 12.84 and Title 22, Ch. 22.52)?
- Would the project result in point or nonpoint source pollutant discharges into State Water Resources Control Board-designated Areas of Special Biological Significance?

Areas of Special Biological Significance (ASBS) are 34 ocean areas monitored and maintained for water quality by the SWRCB.19 ASBS cover much of the length of California's coastal waters. They support an unusual variety of aquatic life, and often host unique individual species. ASBS are basic building blocks for a sustainable, resilient coastal environment and economy. The Modified Project Site is not located in close proximity to an area identified as an ASBS. The nearest ASBS is the Laguna Point to Latigo Point ASBS, which is located in both Los Angeles

[19] See: https://www.waterboards.ca.gov/water_issues/programs/ocean/asbs_map.shtml,

and Ventura counties (see Figure 2-4). The northern extent of this ASBS is Mugu Lagoon at the Point Mugu Naval Base, which is the estuary of Calleguas Creek, located south of the City of Port Hueneme. The ASBS stretches south of Mugu Lagoon approximately 24 miles along the coastline to Malibu and Santa Monica Bay. The Modified Project area is located on the Santa Clara River approximately 40 miles upstream of the Santa Clara River estuary. The northern edge of the Laguna Point to Latigo Point ASBS is approximately 15 miles south of the Santa Clara River estuary along the coastline. As such, the Modified Project would not result in point or nonpoint source pollutant discharges into an ASBS, and no further analysis of this criterion is necessary.

The 2017 Approved Project water quality impacts were previously analyzed in the State Certified EIR. This report analyzes whether the proposed Modified Project refinements give rise to any new significant impacts or result in a substantial increase in the severity of previously identified impacts to water quality based on the results of water quality modeling and qualitative assessments that take into account water quality controls or BMPs that are considered Project Design Features (PDFs). Any increases in pollutant concentrations or loads in runoff resulting from the proposed development of the Modified Project site are considered an indication of a potentially significant adverse water quality impact. If the change in loads and concentrations resulting from development are predicted to stay the same or to be reduced, it is concluded that the Modified Project will not cause a significant adverse impact to the ambient water quality of the receiving waters for that pollutant.

If pollutant loads or concentrations are expected to increase, then for both the post-development and construction phases, potential impacts are assessed by evaluating compliance of the Modified Project, including site design, source control, LID treatment control, and hydromodification control BMPs, with applicable regulatory requirements of the Regional MS4 Permit, the Construction General Permit, and the General Dewatering Permit. Further, post-development increases in pollutant loads and concentrations are evaluated by comparing the magnitude of the increase to relevant benchmarks, including receiving water TMDLs and receiving water quality objectives and criteria from the Basin Plan and CTR, as described below.

4.4.1.1 Receiving Water Benchmarks

Comparison of post-development water quality concentrations in the runoff discharge with benchmark TMDL waste load or load allocations for MS4 discharges establishes the likelihood that runoff would result in TMDL exceedances in receiving waters or would otherwise degrade receiving water quality. A TMDL, as the name suggests, is the sum of the individual load allocations for point, non-point, and natural sources that a water body may receive without exceeding the Basin Plan water quality objective. In determining load, a TMDL measures the sum of individual load allocations using pounds or tons. In contrast to load, the Basin Plan water quality objective focuses instead on concentrations in water measured in micrograms (µg) per volume of water (liter or “L”). So long as the sum of the load allocations from the source of the pollutants does not result in an exceedance of the Basin Plan water quality objective (measured in mg/L), there can be no degradation of water quality in the receiving waters, nor any contribution to potential pollutants to the receiving waters that would result in a significant water quality impact.

Comparison of post-development water quality concentrations in the runoff discharge with benchmark numeric and narrative receiving water quality criteria as provided in the Basin Plan and the CTR facilitates analysis of the potential for runoff to result in exceedances of receiving water quality standards, adversely affect beneficial uses, or otherwise degrade receiving waters.

Water quality criteria are considered benchmarks for comparison purposes only, as such criteria apply within receiving waters as opposed to applying directly to runoff discharges. Narrative and numeric water quality objectives contained in the Basin Plan apply to the Modified Project's receiving waters. Water quality criteria contained in the CTR provide concentrations that are not to be exceeded in receiving waters more than once in a three-year period for those waters designated with aquatic life or human health related uses. Projections of runoff water quality are compared to the acute form of the CTR criteria, as stormwater runoff is associated with episodic events of limited duration, whereas chronic criteria apply to 4-day exposures which do not describe typical storm events in the Modified Project area, which last approximately seven hours on average. If pollutant levels in runoff are not predicted to exceed receiving water benchmarks, it is one indication that no significant impacts will result from project development.

4.4.1.2 Regional MS4 Permit Requirements for New Development

Satisfaction of Regional MS4 Permit requirements for new development, including LID requirements, and satisfaction of construction-related requirements of the Construction General Permit and General Dewatering Permit, establish compliance with water quality regulatory requirements applicable to stormwater runoff.

The Regional MS4 Permit requires that BMPs be implemented to reduce the discharge of pollutants in stormwater to the Maximum Extent Practicable. MS4 requirements are met when new development complies with the LID treatment control requirements set forth in the Regional MS4 Permit. The effectiveness of stormwater controls is primarily based on two factors - the amount of runoff that is captured by the controls and the selection of BMPs to address identified pollutants of concern. Selection and numerical sizing criteria for new development water quality controls are included in the Regional MS4 Permit and the County LID Standards Manual. If the Modified Project BMPs meet MS4 requirements, including sizing for water quality controls and other BMPs consistent with the LID treatment control requirements, it indicates that no significant impacts will occur as the result of Regional MS4 Permit compliance.

4.4.1.3 Construction General Permit and General Dewatering Permit

The CA CGP requires the development and implementation of a Stormwater Pollution Prevention Plan that describes erosion and sediment control BMPs as well as material management/non-stormwater BMPs that will be used during the construction phase of development. The General Dewatering Permit addresses discharges from permanent or temporary dewatering operations associated with construction and development phases and includes provisions mandating notification, sampling and analysis, and reporting of dewatering and testing-related discharges. To evaluate significance of Modified Project water quality impacts during the construction phase, this report evaluates whether water quality control is achieved by implementation of BMPs consistent with Best Available Technology Economically

Achievable and Best Conventional Pollutant Control Technology (BAT/BCT) standards[20], as required by the Construction General Permit and the General Dewatering Permit. If the Modified Project BMPs meet CA CGP and General Dewatering Permit requirements, including implementation of BMPs consistent with BAT/BCT, it indicates that no significant water quality impacts will occur as a result of construction or dewatering.

4.4.2 Cumulative Impacts

CEQA requires the analysis of cumulative impacts of a project when the project's incremental effects may be significant when assessed along with the effects of past projects and the effects of other current projects, and the reasonably foreseeable effects of probable future projects. The discussion of cumulative impacts must reflect the potential severity of the impacts and their likelihood of occurrence, but the discussion and analysis need not provide as great a detail as is provided for the direct effects attributable to the project alone. This report therefore analyzes the potential for cumulative water quality impacts, cumulative groundwater quality impacts, and cumulative hydrologic impacts generally in accordance with the thresholds for direct impacts, consistent with the analysis in the State Certified EIR.

[20] BAT/BCT are CWA technology-based standards that are applicable to construction site stormwater discharges. Federal law specifies factors relating to the assessment of BAT including age of the equipment and facilities involved; the process employed; the engineering aspects of the application of various types of control techniques; process changes; the cost of achieving effluent reduction; non-water quality environmental impacts (including energy requirements); and other factors as the USEPA Administrator deems appropriate. CWA §304(b)(2). Factors relating to the assessment of BCT include: reasonableness of the relationship between the costs of attaining a reduction in effluent and the effluent reduction benefits derived; comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources; the age of the equipment and facilities involved; the process employed; the engineering aspects of the application of various types of control techniques; process changes; non-water quality environmental impact (including energy requirements); and other factors as the USEPA Administrator deems appropriate. CWA §304(b)(4). The USEPA Administrator has not issued regulations specifying BAT or BCT for construction site discharges.

5. WATER QUALITY AND HYDROMODIFICATION CONTROL BEST MANAGEMENT PRACTICES

Consistent with the State Certified EIR, best management practices (BMPs) incorporated into the Modified Project to address surface water and groundwater quality and hydromodification impacts include erosion and sediment control BMPs to be implemented during construction and post-development site design, source control, low impact development (LID) treatment control, and hydromodification control BMPs that will be incorporated into the Modified Project and are considered a part of the Modified Project for impact analysis. The State Certified EIR considered BMPs that were consistent with the National Pollutant Discharge Elimination Permit (NPDES) stormwater permits in place at the time the document was developed (2007 – 2010). The BMPs that would be incorporated into the Modified Project with its proposed design refinements have been updated to reflect the current NPDES stormwater permit requirements. The refined BMPs are described below.

5.1 Construction Phase Controls

The erosion and sediment control BMPs to be implemented during construction are similar to those described in the State Certified EIR. As part of the Modified Project, a SWPPP will be developed as required by, and in compliance with, the CA CGP and the County of Los Angeles' requirements. The CA CGP requires the SWPPP to include BMPs to be selected and implemented based on the determined project Risk Level to effectively control erosion and sediment. The following types of BMPs will be implemented as needed during construction:

5.1.1 Erosion Control

- Implement physical stabilization through hydraulic mulch, soil binders, straw mulch, bonded and stabilized fiber matrices, compost blankets, and erosion control blankets (i.e., rolled erosion control products).
- Contain and securely protect stockpiled materials from wind and rain at all times, unless actively being used.
- Roughen the soil of graded areas (through track walking, scarifying, sheepsfoot rolling, or imprinting) to slow runoff, enhance infiltration, and reduce erosion.
- Stabilize soil through temporary seeding and mulching to establish interim vegetation.
- Control wind erosion (dust) through the application of water or other dust palliatives as necessary to prevent and alleviate dust nuisance.

5.1.2 Sediment Control

- Install perimeter protection to prevent sediment discharges (e.g., silt fences, fiber rolls, gravel bag berms, sandbag barriers, and compost socks).
- Install storm drain inlet protection.
- Capture sediment and control drainage through sediment traps and sediment basins.

- Reduce stormwater velocity through check dams, sediment basins, and outlet protection or velocity dissipation devices.
- Reduce offsite sediment tracking through stabilized construction entrance/exit, construction road stabilization, and/or entrance/exit tire wash.
- Install slope interruption at prescribed intervals (e.g., fiber rolls, gravel bag berms, sandbag berms, compost socks, and biofilter bags).

5.1.3 Waste and Materials Management

- Manage the following types of materials, products, and wastes: solid, liquid, sanitary, concrete, hazardous and equipment-related wastes. Management measures include covered storage and secondary containment for material storage areas, secondary containment for portable toilets, covered dumpsters, dedicated and lined concrete washout/waste areas, proper application of chemicals, and proper disposal of all wastes.
- Protect soil, landscaping, and construction material stockpiles through covers, the application of water or soil binders, and perimeter control measures.
- Implement a spill response and prevention program as part of the SWPPP and make available spill response materials that are conspicuously located at all times onsite.

5.1.4 Non-Stormwater Management

- Implement BMPs or good housekeeping practices to reduce or limit pollutants at their source before they are exposed to stormwater, including such measures as: water conservation practices, vehicle and equipment cleaning and fueling practices, street cleaning practices, illicit connection/discharge elimination, and concrete curing and finishing. All such measures will be recorded and maintained as part of the project SWPPP.

5.1.5 Training and Education

- Employ CA CGP defined "Qualified SWPPP Developers" (QSD) and "Qualified SWPPP Practitioners" (QSP). QSDs and QSPs shall have required certifications and shall attend SWRCB-sponsored training.
- Train individuals responsible for SWPPP implementation and permit compliance, including contractors and subcontractors. CA CGP inspectors and stormwater samplers must either be the QSD, QSP, or be trained by the QSP.
- Install signage (bilingual, if appropriate) to address SWPPP-related issues (such as site cleanup policies, BMP protection, washout locations, etc.).
- Employ a trained person knowledgeable in the principles and practices of passive treatment or active treatment to oversee the installation, application, and operation of the passive or active treatment system, respectively.

5.1.6 Inspections, Maintenance, Monitoring, and Sampling

- Perform routine site inspections and inspections weekly, before (for storm events with 0.5 inches or more predicted within a 24-hour period), during (for subsequent 24-hour periods that have precipitation forecast of 0.25 inches or more), and after storm events (storm events end with two consecutive 24-hour periods with a precipitation forecast of less than 0.25 inches), when applicable.
  - Conduct weekly visual inspections to ensure that BMPs are properly installed and maintained. A pre-, during, or post-qualifying precipitation event inspection also satisfies the weekly visual inspection requirement.
  - A Pre-Qualifying Precipitation Event (QPE) inspection must be conducted by a QSP within 72 hours prior to a storm event with a 50% or greater probability of producing 0.5 inches or more within a 24-hour period.
  - A During-QPE inspection is to be conducted at least once every 24-hour period during QPE. QPEs are extended for each subsequent 24-hour period forecast to have at least 0.25 inches of precipitation.
  - A Post-QPE inspection is to be conducted within 96 hours after each QPE if 0.5 inches or more precipitation is measured during the duration of the QPE using the onsite rain gauge.
- A QSD must perform the following on-site visual inspections:
  - Within 30 days of construction activities commencing on a site.
  - Within 30 days of a discharger replacing a QSD.
  - Twice annually, once between August and October and once between January and March.
  - Within 14 calendar days after a NAL exceedance.
  - Within the time period requested in writing from RWQCB staff.
- A QSP must performs the following on-site visual inspections (a QSD may perform the work of a QSP):
  - Once every calendar month.
  - Within 72 hours prior to a forecasted QPE to inspect areas of concern to verify the status of any deficiencies, BMPs, or other identified issues at the site. If extended forecast precipitation data (greater than 72 hours) is available from the National Weather Service, the pre-precipitation event inspection may be done up to 120 hours in advance.
  - Within 14 days after a NAL exceedance the QSP will visually inspect the drainage area of exceedance and document any areas of concern.
  - Prior to the submittal of a NOT or Change of Information (for acreage changes) of all or part of a site.

- Implement maintenance and repairs of BMPs as indicated by routine weekly and storm-event inspections.
- Implement a Construction Site Monitoring Plan for non-visible pollutants if a leak or spill is detected.
- Risk Level 1 dischargers are not required to collect samples of stormwater discharge from their project site. Risk Level 2 and 3 dischargers must collect stormwater discharge grab samples for pH, turbidity, and any additional parameter required by the RWQCB, from all discharge locations incorporating runoff from project construction sites, during discharge and within site operating hours. At a minimum, one sample will be collected from each discharge location per 24-hour period of each QPE, during active discharge. Risk Level 2 and 3 dischargers may sample run-on from surrounding areas if there is reason to believe run-on may contribute to exceedance of NALs and/or NELs.

5.1.7 Construction BMP Implementation

Consistent with the State Certified EIR, during Modified Project construction, BMPs will be implemented in compliance with the CA CGP and the general waste discharge requirements (WDRs) in the General Dewatering Permit.

The Modified Project will reduce or prevent erosion and sediment transport and transport of other potential pollutants from the project site during the construction phase through implementation of BMPs meeting BAT/BCT standards in order to prevent or minimize environmental impacts and to ensure that discharges during the project construction phase will not cause or contribute to any exceedance of water quality standards in the receiving waters.

All discharges from QPEs will be sampled for pH, turbidity, and any additional parameter required by the RWQCB, and results will be compared to NALs and NELs to ensure that BMPs are functioning as intended. The NAL for pH is provided as a range, where the lower value is 6.5 pH standard units and the upper value is 8.5 pH standard units, and the NAL for turbidity is listed as 250 Nephelometric Turbidity Units (NTUs). Refer to Table H-2 in Attachment H of the CA CGP for TMDL-related pollutant NALs and NELs. Refer to Table 1 in Attachment F of the CA CGP for ATS-related NELs.

If stormwater discharge sample results fall outside of these NALs or NELs, a review of causative agents and the existing site BMPs will be undertaken, and maintenance and repair on existing BMPs will be performed and/or additional BMPs will be provided to ensure that future discharges meet these criteria.

The construction-phase BMPs will assure effective control of not only sediment discharge, but also of pollutants associated with sediments, such as nutrients, heavy metals, and certain pesticides, including legacy pesticides. In addition, compliance with BAT/BCT requires that BMPs used to control construction water quality are updated over time as new water quality control technologies are developed and become available for use. Therefore, compliance with the BAT/BCT performance standard ensures effective control of construction water quality impacts over time.

5.2 Post-Construction BMPs

5.2.1 Source Control BMPs

Table 5-1 summarizes the source control requirements of the County of Los Angeles' 2014 LID Standards Manual and the corresponding proposed source control BMPs that will be incorporated into the Modified Project.

Table 5-1: LID Standards Manual Source Control Requirements and Corresponding Modified Project Best Management Practices

Source Control Requirement	Criteria/ Description	Corresponding Modified Project BMPs
S-1: Storm Drain Message and Signage	• All storm drain inlets and catch basins within the Project area must be marked with prohibitive language and/or graphical icons to discourage illegal dumping. • Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the Project area. • Legibility of stencils and signs must be maintained.	• All storm drain inlets and water quality inlets will be stenciled or labeled. • Signs will be posted in areas where dumping could occur. • The Los Angeles County Department of Public Works and/or Homeowners Associations will maintain stencils and signs.
S-2: Outdoor Material Storage Areas	• Where proposed Project plans include outdoor areas for storage of materials that may contribute pollutants to the storm water conveyance system measures to mitigate impacts must be included.	• Pesticides, fertilizers, paints, and other high-risk materials used for maintenance of common areas, parks, commercial areas, and multifamily residential common areas will be kept in enclosed storage areas.
S-3: Outdoor Trash Storage and Waste Handling Areas	All trash containers must meet the following structural or treatment control BMP requirements: • Trash container areas must have drainage from adjoining roofs and pavement diverter around the areas. • Trash container areas must be screened or walled to prevent offsite transport of trash.	• All outdoor trash storage areas will be covered and isolated from stormwater runoff.

Source Control Requirement	Criteria/ Description	Corresponding Modified Project BMPs
S.4: Outdoor Loading/ Unloading Dock Areas	• Cover loading dock areas or design drainage to minimize run-on and runoff of stormwater • Direct connections to storm drains from depressed loading docks (truck wells) are prohibited	• Loading dock areas will be covered or designed to preclude run-on and runoff. • Direct connections to storm drains from depressed loading docks (truck wells) will be prohibited. • Drains or direct drainage from hydraulically isolated loading dock areas will be connected to an approved sediment/oil/water separator system connected a discharge location as determined by LACDPW. A manual emergency spill diversion valve upstream of will be provided upstream of the separator.
S-5: Outdoor Vehicle/ Equipment Repair/ Maintenance Areas	• Repair/maintenance bays must be indoors or designed in such a way that does not allow stormwater run-on or contact with stormwater runoff. • Design a repair/maintenance bay drainage system to capture all wash water, leaks, and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/ maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.	• Repair/maintenance bays will comply with design requirements.
S6: Outdoor Vehicle/ Equipment/ Accessory Wash Areas	• Self-contained and /or covered, equipped with a clarifier, or other pretreatment facility, and properly connected to a sanitary sewer.	• Areas for washing/steam cleaning of vehicles will be self-contained or covered with a roof or overhang; will be equipped with a wash racks and with the prior approval of the sanitary sewer agency; will be equipped with a clarifier or other pretreatment facility; and will be properly connected to a sanitary sewer.

Source Control Requirement	Criteria/ Description	Corresponding Modified Project BMPs
S7: Fuel and Maintenance Area	• The fuel dispensing area must be covered with an overhanging roof structure or canopy. The cover's minimum dimensions must be greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. • The fuel dispensing area must be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited. • The fuel dispensing areas must have a 2% to 4% slope to prevent ponding and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff. • At a minimum, the concrete fuel dispensing area must extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.	• Fueling areas will comply with design requirements.
S-8: Landscape Irrigation Practices	• Do not allow irrigation runoff from the landscaped area to drain directly to storm drain system. • Minimize use of fertilizer, pesticides, and herbicides on landscaped areas. • Plan sites with sufficient landscaped area and dispersal capacity (e.g., ability to receive irrigation water without generating runoff). • Consult a landscape professional regarding appropriate plants, fertilizer, mulching applications, and irrigation requirements (if any) to ensure healthy vegetation growth.	• Native and/or non-native/non-invasive, climate appropriate vegetation will be utilized within the development. • Landscape watering in common areas, commercial areas, multiple family residential areas, and in parks will use efficient irrigation technology utilizing evapotranspiration sensors to minimize excess watering. • The use of the parcel-based LID BMPs and regional infiltration/ biofiltration facilities will prevent the discharge of dry weather urban runoff from the Modified Project. • Landscape and irrigation system design will comply with the design requirements or approved alternatives. • An Integrated Pest Management (IPM) Program will be implemented for common area landscaping in commercial areas and multi-family residential areas.

Source Control Requirement	Criteria/ Description	Corresponding Modified Project BMPs
S-9: Building Materials Selection	• Wood that is pressure treated with arsenate, copper, and chromium compounds may be replaced with alternative building materials. • Minimize or avoid the use of copper and galvanized metals on buildings and in fencing. • Reduce the use of pesticides around foundations through the use of alternative barriers where feasible.	• Pressure treated wood that is treated with arsenate, copper, or chromium compounds may be replaced with alternative building materials. • The use of copper and galvanized metals on buildings and in fencing will be minimized or avoided. • The use of alternative barriers for termites will be considered.
S-10: Animal Care and Handling Facilities	• Site animal care and handling facilities away from the storm drain system and receiving waters. • Manage grazing to prevent impacts to receiving waters. • Manage horse access and horse waste to prevent pollutants from entering the storm drain system or receiving waters.	• The Modified Project does not include animal care facilities, grazing, or horse access.
S-11:Outdoor Horticultural Areas	• Do not allow wash water from horticulture areas to drain directly to the storm drain system or receiving waters.	• Wash water from horticultural areas will not drain directly to the storm drain system or to receiving waters.

5.2.2 Site Design Measures

The primary goals of site design and LID BMPs are to maintain a landscape functionally equivalent to pre-development hydrologic conditions, and to minimize the generation of pollutants of concern. Site design measures for the Modified Project are the same as those are described in Table 4.4-13 of the State Certified EIR, which is summarized in Table 5-2 below.

Table 5-2: Low Impact/Site Design BMPs

Spatial Scale	Corresponding Low Impact/Site Design BMP
Regional	Cluster development to provide undeveloped open areas, including community parks, prominent ridges, bluffs, slopes, creek beds, and utility and trail system easements. These areas may function as a transition between development areas and are designed to protect significant landforms and natural resources, and to provide an opportunity to integrate the proposed development within its natural context.
	The River Corridor and High Country Special Management Areas are designed to protect the existing natural resources within Los Angeles County's Significant Ecological Areas (SEA) 20 and 23.

Spatial Scale	Corresponding Low Impact/Site Design BMP
Project	Impervious areas would be minimized by incorporating landscaped areas into the Modified Project as open space or parks.
	The project-level stormwater treatment system would include the use of vegetated treatment BMPs, including bioretention and infiltration basins.
	In areas not subject to mass grading, the smallest site disturbance area possible would be delineated and flagged. Temporary storage of construction equipment would be restricted in these areas to minimize soil compaction on site. Site clearing and grading would be limited as necessary to allow development, allow access, and provide fire protection.
	Riparian buffers would be provided along the Santa Clara River corridor and major tributaries by clustering development upland and away from the River and tributary drainages.
Land Use	Streets, sidewalks, and parking lot aisles would be constructed to the minimum widths specified in the Specific Plan and in compliance with regulations for the Americans with Disabilities Act and safety requirements for fire and emergency vehicle access.
	Trails in reserve areas and some parks would be constructed with open-jointed paving materials, granular materials, or other pervious materials.
	Native and/or non-native/non-invasive vegetation that requires less watering and chemical application would be utilized within the common area landscaping in commercial areas and multi-family residential areas.
	Impervious surfaces would be minimized in common area landscape design.
	Landscape watering in common areas, commercial areas, multiple family residential areas, and parks would use efficient reclaimed water irrigation technologies with centralized irrigation controls.
Lot	Bioretention or vegetated swales may be placed within the road right-of-way in some locations.
	Runoff from most sidewalks, walkways, trails, and patios would be directed into adjacent landscaping or to vegetated swales.
	Bioretention areas or vegetated swales would collect and treat runoff from some of the industrial, commercial, and multi-family residential areas. These bioretention areas would be located in parking lot islands and other on-site landscaped areas.
	Landscape areas would be determined by zoning requirements, village setback/ parkway standards, and design objectives.
	Porous pavement would be used in some parking and low traffic areas.
	Building materials for roof gutters and downspouts would not include copper or zinc.
	Home builders would be encouraged to direct rooftop runoff through landscaped areas.

5.2.3 LID Treatment Control BMPs

5.2.3.1 LID Performance Standard

The Modified Project's LID Performance Standard complies with the provisions of the Regional MS4 Permit (R4-2021-0105) and the Newhall Ranch Sub-Regional Stormwater Mitigation Plan (Geosyntec, 2010). Where the provisions conflict, the more stringent provision has been applied. The Modified Project's LID Performance Standard (illustrated in Figure 5-1) is as follows:

Modified Project design features shall be selected and sized to retain the volume of stormwater runoff produced from a 1.1-inch storm event[21] (LID design volume). When it has been demonstrated that 100 percent of the LID design volume cannot be feasibly infiltrated, then biofiltration shall be provided for 1.5 times the portion of the LID design volume that is not retained. Runoff from all impervious area shall be treated with effective treatment control measures that are selected to address the pollutants of concern and are sized to capture and treat 80 percent of the average annual runoff volume.

The LID Performance Standard would be implemented as follows:

- Institutional, commercial, multi-family residential, recreation, and park land use parcels shall implement retention or biofiltration BMPs within the parcel footprint. Runoff from roofs, patios, and walkways in single family residential parcels shall be dispersed over landscaped areas to retain runoff. Runoff from the remaining developed area and that which is not retained within the parcel footprints shall flow through the storm drain system to the regional infiltration/biofiltration facilities.
- Based on an assessment of feasibility, one of three BMP strategies shall be applied as follows:
  a. If it is feasible to infiltrate all of the runoff produced from the 1.1-inch storm from the developed area (i.e., soil infiltration rates are at least 0.3 inches per hour, and no other technical infeasibility concerns exist), infiltration BMPs [Category 1] shall be used. Infiltration BMPs include bioretention (without an underdrain), permeable pavement, infiltration galleries, infiltration basins or trenches, or an equivalent infiltration BMP.
  b. If it has been demonstrated in the Project WQTR and Drainage Concept Report that the BMP strategy of subsection (a) of this condition is infeasible, and if the project has low soil infiltration rates (i.e., the soil infiltration rate is less than 0.3 inches per hour), but no other technical infeasibility concerns exist, bioinfiltration BMPs [Category 2] shall be used. Bioinfiltration facilities are similar to bioretention facilities with an underdrain, but they include storage below the underdrain to maximize the volume infiltrated. These facilities shall retain a portion of the runoff from the 1.1-inch design storm, then biofilter 1.5 times the remaining runoff from the 1.1-inch design storm.
  c. If it has been demonstrated in the Project WQTR and Drainage Concept Report that the BMP strategies of subsections (a) and (b) above are infeasible, then biofiltration BMPs [Category 3] shall be used. These BMPs shall biofilter the runoff produced from the 1.5 times the 1.1-inch design storm.

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[21] The 85th percentile, 24-hour storm depth is equal to 1.1 inches as determined from the Los Angeles County 85th Percentile 24-hour Rainfall Isohyetal Map (February 2004).

- Runoff from roadways shall be retained or biofiltered in retention or biofiltration BMPs sized to capture the design storm volume or flow, per the guidance in USEPA's *Managing Wet Weather with Green Infrastructure: Green Streets*.
- Regional facilities shall be implemented to infiltrate or biofilter the runoff volume from the 1.1-inch design storm volume that has not been retained or biofiltered within parcels, single family lots, or road rights-of-way. Additionally, regional facilities shall be designed to provide extended detention treatment for the additional runoff volume required to provide 80 percent capture and treatment of the average annual runoff volume for the tributary area to the regional facility.

5.2.3.2 Entrada South LID Treatment Control BMPs

An assessment of feasibility was conducted to estimate, for the Modified Project area, which one of three BMP strategies could be applied onsite and whether the proposed sub-regional/regional infiltration/ biofiltration facilities would allow for infiltration based on analysis by RTF&A (2020). The Modified Project area was analyzed using spatial data processing for infiltration feasibility for the criteria listed below:

- Locations where seasonal high groundwater is 10 feet or more from the surface.
- Locations with no potential geotechnical hazards.
- Locations with soil infiltration rates at least 0.3 inches per hour.
- Locations with fill depths less than 10 feet.

Figure 5-2 illustrates the proposed LID treatment control BMP drainage areas based on the feasibility screening. Collectively, the LID treatment control BMPs would treat the pollutants of concern in runoff from the Modified Project's developed area. The LID treatment control BMPs would be designed to receive dry weather flows, small storm flows, and the initial portion of large storm flows.

The proposed LID treatment control BMPs for Entrada South are summarized in Table 5-3 below.

Table 5-3: Entrada South Modified Project Drainage Areas and LID Treatment Control BMPs

Drainage Area	Area (acres)	LID BMP(s)
Drainage Area B	70.8	Sub-Regional Infiltration Basin B
Drainage Area C	11.8	Sub-Regional Bioinfiltration Basin C
Drainage Area D[1]	118.9	Regional Biofiltration Basin D
Drainage Area PB	49.1	Parcel-based biofiltration BMPs

Drainage Area	Area (acres)	LID BMP(s)
Drainage Area ROW 1	0.8	Right-of-Way (ROW) LID BMPs
Drainage Area ROW 2	1.7	Right-of-Way LID BMPs
Total	**253.1**	

1 The area listed is the Modified Project area that drains to Regional Facility D; additional areas within adjacent approved projects would also drain to the facility.

The proposed LID treatment control BMPs for Entrada South are illustrated in Figure 5-3 through Figure 5-9, and are described below:

- ***Parcel-based Infiltration BMPs:*** Parcel-based infiltration BMPs include bioretention (without an underdrain) (Figure 5-3), permeable pavement (Figure 5-4), infiltration galleries (Figure 5-5), infiltration basins or trenches (Figure 5-6), or an equivalent infiltration BMP.
- ***Parcel-based Bioinfiltration BMPs:*** Parcel-based bioinfiltration BMPs include bioretention (with an elevated underdrain) (Figure 5-7), vegetated swales (with combined retention and treatment mechanisms), and other BMPs that are designed to retain a portion of the runoff from the LID design storm, then biofilter the remaining runoff from the design storm.
- ***Parcel-based Biofiltration BMPs*:** Parcel-based biofiltration BMPs provide for pollutant removal (e.g., filtration, adsorption, nutrient uptake) by filtering stormwater through the vegetation and soils. These BMPs include bioretention with underdrains and planter boxes (Figure 5-8). In these BMPs, pore spaces and organic material in the soils help to retain water in the form of soil moisture, promoting the adsorption of pollutants (e.g., dissolved metals and petroleum hydrocarbons) into the soil matrix. Plants utilize soil moisture and promote the drying of the soil through evapotranspiration.
- ***Right-of-Way LID BMPs:*** Right-of-way (ROW) LID, also considered Green Streets BMPs, are retention or biofiltration BMPs sized to capture the design storm volume or flow, per the guidance in USEPA's *Managing Wet Weather with Green Infrastructure: Green Streets.* They may include bioretention, bioretention with underdrains, vegetated swales (Figure 5-9), or filter strips (Figure 5-10).
- ***Sub-Regional/Regional Infiltration/Biofiltration Facilities***: Sub-regional (treats drainage from multiple parcels within the tract map) and regional (treats drainage from more than one tract map) infiltration/biofiltration facilities would be designed to incorporate a biofilter in the bottom of a regional basin, allowing for infiltration if feasible, with detention storage above the biofilter (Figure 5-11). The regional facilities would infiltrate the SWQDv and provide 80% capture of the average annual runoff volume per the LID performance standard. The sub-regional facilities located within the Modified Project tract map are proposed as follows:

- Facility B would be located in well drained alluvial soils with greater than 10 feet separation to groundwater. This facility would be designed to fully infiltrate the design volume [Category 1].
- Facility C would be located in an area with low soil infiltration rates, but no other technical infeasibility concerns. This facility would be designed as a bioinfiltration basin [Category 2].
- Facility D would be located in an area with very high groundwater where infiltration would not possible. This facility would be designed with a vegetated media filter in the bottom to biofilter the design volume [Category 3].

The Sub-Regional/Regional Infiltration/Biofiltration facilities would provide a combination of volume reduction for the SWQDv and treatment of 80 percent of the average annual runoff volume. Volume reduction would be provided via infiltration below the lowest surface discharge of the facility and via water retained in soil pores. In biofiltration media, sediment and sediment-bound pollutants are removed by filtration. Pore spaces and organic material in the soils help to retain water in the form of soil moisture and to promote the adsorption of pollutants (e.g., dissolved metals and petroleum hydrocarbons) into the soil matrix. Plants utilize soil moisture and promote the drying of the soil. Extended detention would provide pollutant removal through settling and biological uptake of nutrients and dissolved pollutants within the vegetation that would grow within the facilities.

5.2.3.3 VCC LID Treatment Control BMPs

LID treatment control BMPs would be incorporated into VCC in compliance with the LID Performance Standard. The BMP strategies for complying with the Modified Project LID Performance Standard for VCC will be parcel-based and right-of-way biofiltration facilities, as shown in Figure 5-12. The BMPs may also be sized to meet the hydromodification control standard (see Section 5.2.4 below).

Based on testing by Leighton (2016) and infiltration feasibility assessment by Engeo (2021), the site is underlain by alluvial soils with moderate permeability. However, after corrective grading, most of the Project will lie over 5 to 30 feet of certified engineered fill. Based on the very low expected infiltration rates of engineered fill, Category 2 (bioinfiltration) or Category 3 (biofiltration) parcel-based water quality treatment facilities are recommended (Engeo, 2021).

During design of the final improvement plan, testing will be conducted at the location of proposed facilities to determine reliable infiltration rates and confirm the selection of BMP type. Use of Category 1 (infiltration) and Category 2 (bioinfiltration) facilities may be possible if the in-situ infiltration rate supports the selection and there is no other geotechnical or groundwater mounding concern at the proposed locations. Final sizing calculations will be prepared as part of final parcel improvement plans.

For Franklin Parkway and Hancock Parkway, LID BMPs within the public right-of-way (ROW) will be used to meet the LID Performance Standard. ROW LID BMPs will consist of infiltration, bioinfiltration or biofiltration BMPs based on site-specific feasibility screening conducted as part of final street improvement plans.

Table 5-4 lists the required LID volume for the VCC planning areas in the Modified Project (Geosyntec, 2023). Alternative sizing and design configurations that fully meet the LID Performance Standard may be developed as part of final parcel improvement and street improvement plans.

Table 5-4: VCC BMP Sizing

Planning Area ID	Area (acres)	Imperviousness (%)	Required LID Volume[1], cu-ft
1	9.5	91	31,100
2.1	13.0	91	42,800
2.2	10.4	91	34,014
2.3	18.4	91	60,254
3.1	19.2	91	62,951
3.2	3.8	91	12,600
3.3a	13.7	91	44,974
3.3b	11.2	91	36,716
3.3c	4.1	91	13,373
3.3d	16.8	91	55,073
Open Space – Access Road	9.3	91	30,451
Franklin Pkwy ROW	5.7	91	18,643
Hancock Pkwy ROW	6.6	91	21,571
Total	141.7		464,520

[1] Calculated based on the runoff volume for the 85th percentile, 24-hour storm using HydroCalc (Geosyntec, 2023).

5.2.4 Hydromodification Control Best Management Practices

5.2.4.1 Hydromodification Control Performance Standard

The Modified Project's Hydromodification Control Performance Standard is as follows:

- For discharges to the Santa Clara River, Castaic Creek, and Hasley Creek, the Modified Project shall incorporate site design and LID BMPs to limit impervious area and disconnect imperviousness to avoid and minimize hydromodification impacts.

5.2.4.2 Hydrologic Source Controls

Disconnecting impervious areas from the drainage network and adjacent impervious areas is a key approach to protecting channel stability. Several hydrologic source controls will be included in the Modified Project that will limit impervious area and disconnect imperviousness to avoid and minimize hydromodification impacts:

- Site Design. Site design BMPs that help to reduce runoff volume from the Modified Project include the clustering of development into village areas, leaving large amounts of undeveloped open space within the subregion; routing of stormwater runoff to vegetated areas and/or LID BMPs; use of native and/or non-native/non-invasive vegetation in landscaped areas; and the use of efficient irrigation systems in common area landscaped areas.

- LID BMPs. The Modified Project's LID BMPs will also serve as hydromodification source control BMPs. Parcel-based and sub-regional LID BMPs would provide volume reduction ranging from incidental volume reduction in biofiltration BMPs (via evaporation and infiltration) up to full volume reduction of captured water in infiltration BMPs where soil and hydrogeologic conditions permit. In addition, these facilities will also receive and eliminate dry weather flows.

5.2.4.3 Entrada South Hydromodification Control BMPs

Post-development flows will be directed to the Santa Clara River after treatment, no flows will be directed to natural onsite tributaries. A series of progressive hydromodification control measures will be used in the Modified Project to prevent and control hydromodification impacts to the Santa Clara River:

- Avoid, to the extent possible, the need to mitigate for hydromodification impacts by preserving natural hydrologic conditions and protecting sensitive hydrologic features, sediment sources, and sensitive habitats.
- Minimize the effects of development through site design practices (e.g., reducing connected impervious surfaces) and implementation of stormwater volume-reducing LID BMPs (Modified Project-based hydrologic source control).

In addition, energy dissipation at storm drain outfalls would provide erosion protection in areas where discharges have the potential to cause localized stream erosion. Energy dissipation will be provided at all storm drain outlets to the Santa Clara River.

5.2.4.4 VCC Hydromodification Control BMPs

Castaic Creek and Hasley Creek are not susceptible to hydromodification impacts (see Section 7.8.1 below). A series of progressive hydromodification control measures will be used in the Modified Project to prevent and control hydromodification impacts to the Castaic Creek and to Hasley Creek:

- Avoid, to the extent possible, the need to mitigate for hydromodification impacts by preserving natural hydrologic conditions and protecting sensitive hydrologic features, sediment sources, and sensitive habitats.
- Minimize the effects of development through site design practices (e.g., reducing connected impervious surfaces) and implementation of stormwater volume-reducing LID BMPs (Modified Project-based hydrologic source control).

In addition, energy dissipation at storm drain outfalls would provide erosion protection in areas where discharges have the potential to cause localized stream erosion. Energy dissipation will be provided at all storm drain outlets to Castaic Creek and Hasley Creek.

5.2.5 Operation and Maintenance

Depending on the type and location of the BMP, either the County, a Landscape or Local Maintenance District (LMD), Geologic Hazard Abatement District (GHAD), Home Owners Association (HOA), or other similar government or quasi-government agency will be responsible for maintenance of regional BMPs. LMD(s), GHAD(s), or other similar government or quasi-government agency would be formed prior to turnover of stormwater facilities. The HOA or commercial/business owners would be responsible for operation and maintenance of parcel based BMPs such as bioretention placed in common area landscaping or parking lot islands. Homeowners would be responsible for maintenance of HSCs on single family residential properties.

Maintenance and inspection agreements will be established as the stormwater facilities are approved and built. HOA maintenance agreements will incorporate a list of HOA responsibilities. The LMD(s), GHAD(s), or other similar government or quasi-government agency will have a mechanism and staffing to monitor, maintain, and enforce BMP maintenance. The County will have the right to inspect and maintain the BMPs that are maintained by the HOA, LMD, GHAD, or other similar agency at the expense of the HOA, LMD, GHAD, or other similar agency, if they are not being properly maintained.

Operation and maintenance activities will be conducted in compliance with maintenance requirements established in the Los Angeles County LID Manual.

5.3 State Certified EIR Water Quality Mitigation Measures

The analysis provided in the State Certified EIR determined that with implementation of applicable regulatory requirements and proposed BMPs, the 2017 Approved Project and alternatives would not result in significant water quality impacts. However, the State Certified EIR included Mitigation Measure WQ-1 to further ensure that the water quality-related impacts remain less-than-significant, and to facilitate the implementation of a mitigation monitoring program that addresses water quality-related requirements.

WQ-1 Prior to the recordation of any final subdivision map (except those maps for financing or conveyance purposes only) or the issuance of any grading or building permit (whichever comes first), a final SUSMP shall be prepared consistent with the terms and content of both the Newhall Ranch Specific Plan Sub-Regional Stormwater Mitigation Plan and Project Water Quality Technical Report that specifically identifies the BMPs to be used on site. The SUSMP shall be submitted to the DPW for review. The SUSMP shall identify, at a minimum: (1) site design BMPs (as appropriate); (2) the source control BMPs; (3) treatment control BMPs; (4) hydromodification control BMPs; and (5) the mechanism(s) by which long-term operation and maintenance of all structural BMPs would be provided. The BMPs identified in the SUSMP shall include, as applicable, but not be limited to, the PDFs set forth in Table 4.4-12 of this EIS/EIR. *(SUSMP requirements have been superseded by the requirements of the County's Low Impact Development [LID] Ordinance and LID Manual. The final SUSMP is now referred to as the LID Plan per the County LID Manual. Prior to the issuance of any rough grading or building permit (whichever comes first) and as part of the design* *level hydrology study and facilities plan, a final LID Plan will be prepared consistent with the terms and contents of this Water Quality Technical Report (Appendix XX of the SEIR), including applicable requirements in the MS4 Permit and LID Ordinance. The BMPs identified in the LID Plan will include, as applicable, but not be limited to, the BMPs set forth in Table 5-1 of the Water Quality Technical Report. The BMPs set forth in Table 5-1 therein supersede the PDFs set forth in Table 4.4-12 of the State Certified EIR.)*

Mitigation Measure WQ-2 was provided to ensure that an Integrated Pest Management program, which includes measures to protect groundwater and surface water from pesticide use, is implemented as proposed, and to facilitate the implementation of a mitigation monitoring program.

WQ-2 Prior to issuance of a building permit, and as a part of the design level hydrology study and facilities plan, the project applicant shall submit to the Department of Regional Planning a Landscape and Integrated Pest Management Plan, identified in [State Certified EIR] Section 4.4, which shall be designed to meet the standards set forth below.

A Landscape and Integrated Pest Management Plan shall be developed and implemented for common area landscaping within the Specific Plan, Entrada, and VCC Modified Project that addresses integrated pest management (IPM) and pesticide and fertilizer application guidelines. IPM is a strategy that focuses on long-term prevention or suppression of pest problems (*i.e.*, insects, diseases and weeds) through a combination of techniques, including using pest-resistant plants; biological controls; cultural practices; habitat modification (Techniques 1 – 6 below); and the limited use of pesticides according to treatment thresholds, when monitoring indicates pesticides are needed because pest populations exceed established thresholds (Technique 7). The Landscape and Integrated Pest Management Plan will address the following components:

1. Pest identification.
2. Practices to prevent pest incidence and reduce pest buildup.
3. Monitoring to examine vegetation and surrounding areas for pests to evaluate trends and to identify when controls are needed.
4. Establishment of action thresholds that trigger control actions.
5. Pest control methods - cultural, mechanical, environmental, biological, and appropriate pesticides.
6. Fertilizer management - soil assessment, fertilizer types, application methods, and storage and handling.
7. Pesticide management – safety (e.g., Material Safety Data Sheets, precautionary statements, protective equipment); regulatory requirements; spill mitigation; groundwater and surface water protection measures

associated with pesticide use; and pesticide applicator certifications, licenses, and training (*i.e.*, all pesticide applicators must be certified by the California Department of Pesticide Regulation).

6. METHODOLOGY

6.1 Surface Water Quality Analysis Model

As with the analysis conducted for the State Certified EIR, a water quality model was used to estimate pollutant loads and concentrations in Modified Project stormwater runoff for certain pollutants of concern for pre- and post-development conditions. The water quality model is one of the few models that takes into account the observed variability in stormwater hydrology and water quality. This is accomplished by characterizing the probability distribution of observed rainfall event depths, the probability distribution of event mean concentrations, and the probability distribution of the number of storm events per year. These distributions are then sampled randomly using a Monte Carlo approach to develop estimates of mean annual loads and concentrations.

The following summarizes major features of the water quality model; a detailed description of the water quality model is presented in Appendix D:

- *Rainfall Data*: The water quality model estimates the volume of runoff from storm events determined from 40 years (1969 - 2008) of hourly rainfall data measured at the National Climatic Data Center Newhall rain gage that incorporates a wide range of storm events.
- *Land Use Runoff Water Quality*: The water quality model estimates the concentration of pollutants in runoff from storm events based on existing and proposed land uses. The pollutant concentrations for various land uses, in the form of Event Mean Concentrations (EMCs), were estimated from data collected in Los Angeles County. The Los Angeles County database was chosen for use in the model because: (1) it is an extensive database that is quite comprehensive, (2) it contains monitoring data from land use specific drainage areas, and (3) the data is representative of the semi-arid conditions in southern California.
- *Pollutant Load*: The pollutant load associated with each storm is estimated as the product of the storm event runoff times the event mean concentration. For each year in the simulation, the individual storm event loads are summed to estimate the annual load. The mean annual load is then the average of all the annual loads.
- *PDFs Modeled*: The State Certified EIR model incorporated swales for the VCC Modified Project area and swales (treating ~6.5% of Modified Project area), dry extended detention basins (~53% of Modified Project area), a retention pond (~21% of Modified Project area), and media filters (treating ~0.5% of Modified Project area) for the Entrada South Modified Project area. The supplemental modeling incorporates LID treatment control BMPs (i.e., infiltration, bioinfiltration, and bioretention) sized to achieve 80% average annual volume-based capture and provide infiltration where not hazardous due to high groundwater or other physical infeasibility. Bioinfiltration BMPs provide between 25% and 35% incidental infiltration, depending on underlying soil assumptions. Where infiltration is hazardous, lined bioretention (i.e., Category 3) is assumed. These facilities capture 80% average annual runoff and provide volume reduction of approximately 2-3% of the captured volume through evaporation.

- *Treatment Effectiveness*: The water quality model estimates mean pollutant concentrations and loads in stormwater following treatment. The amount of stormwater runoff that is captured by the LID treatment control BMPs was calculated for each storm event, taking into consideration the intensity of rainfall, duration of the storm, and duration between storm events. The mean effluent water quality for treatment BMPs was based on the International Stormwater BMP Database (ASCE/USEPA, 2003).
- *Bypass Flows*: The water quality model takes into account conditions when the treatment facility is full, and flows are bypassed.
- *Representativeness to Local Conditions*: The water quality model utilizes runoff water quality data obtained from tributary areas that have a predominant land use, and as measured prior to discharge into a receiving water body. Currently such data are available from stormwater programs in LA County, San Diego County, and Ventura County, although the amount of data available from San Diego County and Ventura County is small in comparison with the LA County database. Such data is often referred to as "end-of-pipe" data to distinguish it from data obtained in urban streams, for example.

6.2 Pollutants Modeled and Qualitative Impact Analysis

The appropriate form of data used to address water quality are flow composite storm event samples, which are a measure of the average water quality during the event. To obtain such data usually requires automatic samplers that collect data at a frequency that is proportionate to flow rate. The pollutants of concern for which there are sufficient flow composite sampling data in the Los Angeles County database are:

- Total Suspended Solids (sediment)
- Total Phosphorus (TP)
- Nitrate-Nitrogen, Nitrite-Nitrogen, Ammonia, and Total Nitrogen (TN)
- Dissolved Copper
- Total Lead
- Dissolved Zinc
- Total Iron
- Chloride

Post development stormwater runoff water quality impacts associated with the following pollutants of concern were addressed based on literature information and professional judgment because available data were not deemed sufficient for modeling:

- Turbidity
- Pesticides

- Pathogens (Bacteria, Viruses, and Protozoa)
- Petroleum Hydrocarbons (Oil and Grease, Polycyclic Aromatic Hydrocarbons)
- Trash and Debris
- Methylene Blue Activated Substances (MBAS)
- Selenium
- Toxicity
- Emerging Contaminants
- Bioaccumulation

Human pathogens are usually not directly measured in stormwater monitoring programs because of the difficulty and expense involved; rather, indicator bacteria such as fecal coliform or certain strains of E. Coli are measured. Because maximum allowable holding times for bacterial samples are necessarily short, most stormwater programs do not collect flow-weighted composite samples that potentially could produce more reliable statistical estimates of indicator concentrations. Fecal coliform or E. Coli are typically measured with grab samples, making it difficult to develop reliable EMCs. Total coliform and fecal bacteria (fecal coliform, fecal streptococcus, and fecal enterococci) were detected in stormwater samples tested in Los Angeles County at highly variable densities (or most probable number, MPN) ranging between several hundred to several million cells per 100 ml (LACDPW, 2000).

Hydrocarbons are difficult to measure because of laboratory interference effects and sample collection issues (hydrocarbons tend to coat sample bottles). Hydrocarbons are typically measured with single grab samples, making it difficult to develop reliable EMCs.

Pesticides in urban runoff are often at concentrations that are below detection limits for most commercial laboratories and therefore there are limited statistically reliable data available on pesticides in urban runoff. Pesticides were not detected in Los Angeles County monitoring data for land use-based samples, except for diazinon and glyphosate which were detected in less than 15 percent and 7 percent of samples, respectively (LACDPW, 2000).

Dissolved and total selenium were monitored in runoff from all land use categories. Dissolved selenium was not detected in 371 samples; total selenium was detected in 0% - 13% of samples collected, depending on the land use. Both of these parameters were not detected at sufficient levels to produce a statistically reliable EMC. In addition, these parameters are not typically measured in BMP effectiveness studies.

Trash and debris and MBAS are not typically included in routine urban stormwater monitoring programs. Several studies conducted in the Los Angeles River basin have attempted to quantify trash generated from discrete areas, but the data represent relatively small areas or relatively short periods, or both. MBAS was included in the land use-based monitoring data, but not enough data is available for modeling purposes.

Also addressed qualitatively are compliance with waste discharge requirements (Section 7.3), potential water quality impacts from runoff and dewatering discharges during construction

(Section 7.4), dry weather runoff (Section 7.5), wastewater (Section 7.6), groundwater quality and recharge impacts (Section 7.7), hydromodification impacts (Section 7.8), and cumulative impacts (Section 7.9).

7. IMPACT ASSESSMENT

7.1 Post Development Stormwater Runoff Impact Assessment for Modeled Pollutants of Concern

In this section, model results for each pollutant are evaluated to determine if the Modified Project would result in any new significant impacts compared to the 2017 Approved Project analyzed in the State Certified EIR. Results from the water quality model are reported in a series of tables, organized by constituent, showing predicted mean annual pollutant loads (lbs/yr) and mean annual concentrations. Projections are made for the existing condition and for developed conditions, and the predicted change in load or concentration is presented. In summary, the Modified Project will not result in any new significant impacts on water quality for the modeled pollutants of concern compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.1.1 Entrada South

Table 7-1 below shows the estimated changes in stormwater runoff volume and mean annual loads for the modeled pollutants of concern for the Entrada South planning area. Table 7-2 below shows the estimated changes in concentration in stormwater runoff for the Entrada South planning area.

Table 7-1: Average Annual Runoff Volume and Pollutant Loads for the Entrada South Planning Area

Parameter	Units	Modified Project		
		Existing Conditions	Developed Condition with BMPs	Change
Runoff Volume	acre-ft	44	211	167
TSS	tons/yr	14	11	-3
Total Phosphorous	lbs/yr	24	125	101
Nitrate-N + Nitrite-N	lbs/yr	135	444	309
Ammonia-N	lbs/yr	31	145	114
Total Nitrogen - N	lbs/yr	323	1,230	907
Dissolved Copper	lbs/yr	1	4	3
Total Lead	lbs/yr	1	2	1
Dissolved Zinc	lbs/yr	18	22	4
Total Iron	lbs/yr	234	402	168
Chloride	tons/yr	0.5	8.2	7.7

Table 7-2: Average Annual Pollutant Concentrations for the Entrada South Planning Area

Parameter	Units	Modified Project		
		Existing Conditions	Developed Condition with BMPs	Change
TSS	mg/L	227	35	-192
Total Phosphorous	mg/L	0.2	0.2	0.0
Nitrate-N + Nitrite-N	mg/L	1.1	0.7	-0.4
Ammonia-N	mg/L	0.3	0.2	-0.1
Total Nitrogen - N	mg/L	2.9	2.1	-0.8
Dissolved Copper	µg/L	7	7	0
Total Lead	µg/L	8.8	2.7	-6.1
Dissolved Zinc	µg/L	196	36	-160
Total Iron	µg/L	2,317	675	-1,642
Chloride	mg/L	9	29	20

With the exception of TSS and dissolved zinc loads, runoff volume and pollutant loads were predicted to increase under proposed conditions in the State Certified EIR for the Entrada South planning area, when compared to existing conditions. TSS and dissolved zinc loads were predicted to remain the same. The supplemental analysis predicts that runoff volume and pollutant loads for all pollutants except TSS are predicted to increase; TSS load is predicted to decrease. The increase in pollutant loads is a result of the predicted increase in runoff volume in the supplemental analysis for all pollutants except chloride, total phosphorus, and dissolved copper, as the pollutant concentrations are all predicted to decrease except for these three parameters (Table 7-2). With the exception of ammonia and chloride, pollutant concentrations were predicted to decrease under the proposed conditions in the State Certified EIR, when compared to existing conditions; ammonia and chloride concentrations were predicted to increase. The supplemental analysis predicts an increase in chloride concentration and no change in total phosphorous and dissolved copper concentration.

The estimated average annual TSS, nutrient, and chloride concentrations in stormwater runoff from the modeled Entrada South planning area are compared to water quality criteria in Table 7-3 below. Concentrations of TSS, nutrients, and chloride are all predicted to be below their respective benchmark criteria and below or within the range of concentrations observed in Santa Clara River Reach 5. The Modified Project will not result in any new significant impacts on TSS, nutrient, and chloride receiving water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

Table 7-3: Comparison of Estimated TSS, Nutrient, and Chloride Concentrations with Water Quality Objectives, TMDLs, and Observed Concentrations in Santa Clara River Reach 5 for the Entrada South Planning Area

Pollutant	Estimated Developed Conditions w/ BMPs (mg/L)	Basin Plan Water Quality Objectives[1] (mg/L)	Wasteload Allocations for MS4 Discharges into the Santa Clara River Reach 5 (mg/L)	Range of Observed[2] Concentrations in Santa Clara River Reach 5 (mg/L)	Average Wet Weather[2] Concentration in Santa Clara River Reach 5 (µg/L)
TSS	35	Water shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.	NA	<0.5 – 43,400	1,660
Total Phosphorus	0.2	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.	NA	0.43 - 28	3.1
Nitrate-N + Nitrite-N	0.7	5	6.8[3]	<0.004 - 4.8[4]	1.4[4]
Ammonia-N	0.2	2.24[5]	1.75[6]	<0.005 – 4.9	0.3
Total Nitrogen	2.1	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.	NA	<0.04 – 86[7]	3.8[7]
Chloride	29	100	100	2.6 - 150	54

Notes:

1 There are no CTR criteria for TSS, total phosphorus, nitrogen compounds, or chloride.

2 Range and average of concentrations historically observed in the Santa Clara River Reach 5 during wet weather from 2002 to 2019.

3 30-day average.

4 Observed value for nitrate-N.

5 Four-day average, ELS present, 90th percentile pH and temperature pairing.
6 30-day average in Reach 5 below Valencia.
7 Observed values for TKN (ammonia plus organic nitrogen).

Comparison of the estimated runoff metal concentrations for the Entrada South planning area and the acute CTR criteria for dissolved copper, total lead, and dissolved zinc are shown in Table 7-4 below. The comparison of the post-developed with BMPs condition to the benchmark CTR values shows that all of the modeled trace metal concentrations are predicted to be below the benchmark CTR criteria. Estimated concentrations of dissolved copper, total lead, and dissolved zinc are within the range of observed concentrations in Santa Clara River Reach 5. The average annual concentration of total iron is predicted to decrease with the project development to below the National Recommended Water Quality chronic criteria of 1,000 µg/L and within the range of observed concentrations in Santa Clara River Reach 5. The Modified Project will not result in any new significant impacts on trace metals receiving water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

Table 7-4: Comparison of Estimated Trace Metal Concentrations with Water Quality Criteria and Observed Concentrations in Santa Clara River Reach 5 for the Entrada South Planning Area

Metal	Estimated Average Annual Concentration (µg/L)	CTR Criteria[1] (µg/L)	Range of Observed[2] Concentrations in Santa Clara River Reach 5 (µg/L)	Average Wet Weather[2] Concentration in Santa Clara River Reach 5 (µg/L)
Dissolved Copper	7	34	<0.036 – 85.4	7.8
Total Lead	2.7	280	<0.01 - 370	27.6
Dissolved Zinc	36	270	<0.1 - 437	32.1
Total Iron	675	NA	115 – 543,000	31,700

Notes:

1 CTR criteria are for hardness = 264 mg/L, based on the historical average observed value at in Santa Clara River Reach 5 in wet weather. Lead criteria is for total recoverable lead. There is no CTR acute criterion for total iron.
2 Range and average of concentrations historically observed in the Santa Clara River during wet weather from 2002 to 2019.

NA – not applicable

7.1.2 VCC

Table 7-5 below shows the estimated changes in stormwater runoff volume and mean annual loads for the modeled pollutants of concern for the VCC planning area. Table 7-6 below shows the estimated changes in concentration in stormwater runoff for the VCC planning area.

Table 7-5: Average Annual Runoff Volume and Pollutant Loads for the VCC Planning Area

Parameter	Units	Modified Project		
		Existing Conditions	Developed Condition with BMPs	Change
Runoff Volume	acre-ft	23	189	166
TSS	tons/yr	7	11	4
Total Phosphorous	lbs/yr	48	140	92
Nitrate-N + Nitrite-N	lbs/yr	137	301	164
Ammonia-N	lbs/yr	19	171	152
Total Nitrogen - N	lbs/yr	239	1128	889
Dissolved Copper	lbs/yr	1	5	4
Total Lead	lbs/yr	0	2	2
Dissolved Zinc	lbs/yr	6	25	19
Total Iron	lbs/yr	69	441	372
Chloride	tons/yr	0	11	11

Table 7-6: Average Annual Pollutant Concentrations for the VCC Planning Area

Parameter	Units	Modified Project		
		Existing Conditions	Developed Condition with BMPs	Change
TSS	mg/L	208	38	-170
Total Phosphorous	mg/L	0.8	0.3	-0.5
Nitrate-N + Nitrite-N	mg/L	2.1	0.6	-1.6
Ammonia-N	mg/L	0.3	0.3	0
Total Nitrogen - N	mg/L	3.9	2.1	-1.8
Dissolved Copper	µg/L	15	9	-6
Total Lead	µg/L	8	4	-4
Dissolved Zinc	µg/L	125	44	-81
Total Iron	µg/L	1,185	828	-357
Chloride	mg/L	12	44	32

With the exception of TSS load, runoff volume and pollutant loads were predicted to increase under proposed conditions in the State Certified EIR for the VCC planning area, when compared to existing conditions; TSS loads were predicted to decrease slightly. The supplemental analysis predicts a slight increase in TSS loads. The supplemental analysis predicted change in loads and concentrations are substantially similar to the 2017 Approved Project.

With the exception of ammonia and chloride, pollutant concentrations were predicted to decrease under proposed conditions in the State Certified EIR, when compared to existing conditions; ammonia and chloride concentrations were predicted to increase. The supplemental analysis also predicts that all pollutant concentrations will decrease with the exception of ammonia, which is predicted to remain the same, and chloride, which is predicted to increase.

The estimated average annual TSS, nutrient, and chloride concentrations in stormwater runoff from the total modeled VCC planning area are compared to water quality criteria in Table 7-7 below. Concentrations of TSS, nutrients, and chloride are predicted to be below all benchmark criteria. Concentrations of TSS, nutrients, and chloride are predicted to be below or within the range of concentrations observed in Santa Clara River Reach 5. The VCC Planning Area will not result in any new significant impacts on TSS, nutrient, and chloride receiving water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

Table 7-7: Comparison of Estimated TSS, Nutrient, and Chloride Concentrations with Water Quality Objectives, TMDLs, and Observed Concentrations in Santa Clara River Reach 5 for the VCC Planning Area

Pollutant	Estimated Developed Conditions w/ BMPs (mg/L)	Basin Plan Water Quality Objectives[1] (mg/L)	Wasteload Allocations for MS4 Discharges into the Santa Clara River Reach 5 (mg/L)	Range of Observed[2] Concentrations in Santa Clara River Reach 5 (mg/L)	Average Wet Weather[2] Concentration in Santa Clara River Reach 5 (µg/L)
TSS	38	Water shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.	NA	<0.5 – 43,400	1,660
Total Phosphorus	0.3	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.	NA	0.43 - 28	3.1
Nitrate-N + Nitrite-N	0.6	5	6.8[3]	<0.004 - 4.8[4]	1.4[4]
Ammonia-N	0.3	2.24[5]	1.75[6]	<0.005 – 4.9	0.3

Pollutant	Estimated Developed Conditions w/ BMPs (mg/L)	Basin Plan Water Quality Objectives[1] (mg/L)	Wasteload Allocations for MS4 Discharges into the Santa Clara River Reach 5 (mg/L)	Range of Observed[2] Concentrations in Santa Clara River Reach 5 (mg/L)	Average Wet Weather[2] Concentration in Santa Clara River Reach 5 (µg/L)
Total Nitrogen	2.1	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.	NA	<0.04 – 86[7]	3.8[7]
Chloride	44	100	100	2.6 - 150	54

Notes:
1 There are no CTR criteria for TSS, total phosphorus, nitrogen compounds, or chloride.
2 Range and average of concentrations historically observed in the Santa Clara River Reach 5 during wet weather from 2002 to 2019.
3 30-day average.
4 Observed value for nitrate-N.
5 Four-day average, ELS present, 90th percentile pH and temperature pairing.
6 30-day average in Reach 5 below Valencia.
7 Observed values for TKN (ammonia plus organic nitrogen).

Comparison of the estimated runoff metal concentrations for the VCC planning area and the acute CTR criteria for dissolved copper, total lead, and dissolved zinc are shown in Table 7-8 below. The comparison of the post-developed with BMPs condition to the benchmark CTR values shows that all of the trace metal concentrations are predicted to be below the benchmark CTR criteria. Estimated concentrations of trace metals are within the range of observed concentrations in Santa Clara River Reach 5. The average annual concentration of total iron is predicted to decrease with project development, to be less than the National Recommended Water Quality chronic criteria of 1,000 µg/L, and within the range of observed concentrations in Santa Clara River Reach 5. The VCC Planning Area will not result in any new significant impacts on trace metals receiving water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

Table 7-8: Comparison of Estimated Trace Metal Concentrations for the VCC Planning Area with Water Quality Criteria and Observed Concentrations in Santa Clara River Reach 5

Metal	Estimated Average Annual Concentration (µg/L)	CTR Criteria[1] (µg/L)	Range of Observed[2] Concentrations in Santa Clara River Reach 5 (µg/L)	Average Wet Weather[2] Concentration in Santa Clara River Reach 5 (µg/L)
Dissolved Copper	9	34	<0.036 – 85.4	7.8
Total Lead	4	280	<0.01 - 370	27.6
Dissolved Zinc	44	270	<0.1 - 437	32.1
Total Iron	828	NA	115 – 543,000	31,700

Notes:

1 CTR criteria are for hardness = 264 mg/L, based on the historical average observed value at in Santa Clara River Reach 5 during wet weather. Lead criteria is for total recoverable lead. There is no CTR criterion for total iron.

2 Range and average of concentrations historically observed in the Santa Clara River during wet weather from 2002 to 2019.

NA – not applicable

7.2 Post Development Impact Assessment for Pollutants and Basin Plan Criteria Addressed Without Modeling

7.2.1 Turbidity

Turbidity is a measure of suspended matter that interferes with the passage of light through the water or in which visual depth is restricted (Sawyer et al, 1994). Turbidity may be caused by a wide variety of suspended materials, which range in size from colloidal to coarse dispersions, depending upon the degree of turbulence. In lakes or other waters existing under relatively quiescent conditions, most of the turbidity will be due to colloidal and extremely fine dispersions. In rivers under flood conditions, most of the turbidity will be due to relatively coarse dispersions. Erosion of clay and silt soils may contribute to in-stream turbidity (see discussion of hydromodification impacts in Section 7.7 below). Organic materials reaching rivers serve as food for bacteria, and the resulting bacterial growth and other microorganisms that feed upon the bacteria produce additional turbidity. Nutrients in runoff may stimulate the growth of algae, which also contribute to turbidity.

Discharges of turbid runoff are primarily of concern during the construction phase of development. Construction-related impacts are addressed in Section 7.4 below. The Construction SWPPP must contain sediment and erosion control BMPs pursuant to the CA CGP, and those BMPs must effectively control erosion and discharge of sediment, along with other pollutants, per the BAT/BCT standards. Additionally, fertilizer control and non-visible pollutant monitoring and trash control BMPs in the SWPPP will combine to help control turbidity during the construction phase.

In the post-development condition, placement of impervious surfaces will serve to stabilize soils and to reduce the amount of erosion that may occur from the Modified Project during storm events and will therefore decrease turbidity in runoff from the Modified Project. Modified Project BMPs, including source controls (such as common area landscape management and common area litter control) and LID treatment control BMPs in compliance with the Regional MS4 Permit and LID Manual requirements, will prevent or reduce the release of organic materials and nutrients (which might contribute to algal blooms) to receiving waters. As shown in Section 7.1 above, post-development nutrients in runoff are not expected to cause significant water quality impacts. Based on implementation of the construction phase and post-construction Modified Project BMPs, runoff discharges from the Modified Project will not cause increases in turbidity which would result in adverse effects to beneficial uses in the receiving waters. Based on these considerations, the Modified Project will not result in any new significant impacts on turbidity compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.2 Pesticides

In urban settings, pesticides are commonly applied in and around buildings (structural pest control) to control ants and other pests and in vegetated areas to control insects, molds, and other vectors. The forms of pesticides used have evolved in response to regulatory actions. Organochlorine pesticides including Chlordane, Dieldrin, DDT, and Toxaphene were some of the earliest pesticides, applied generally in the 1940's to 1960's. These pesticides were found to be persistent in the environment, bioaccumulated in the food chain of various animals, and posed a health risk to humans consuming food contaminated by these pesticides. These persistent organochlorine pesticides can be of concern where past farming practices involved their application. The legacy pesticides Chlordane, Dieldrin, DDT, and Toxaphene are of particular concern for the Modified Project, as TMDLs have been established for some of these pesticides in the Santa Clara River estuary, approximately 40 miles downstream. Historical pesticides should no longer be discharged in the watershed except in association with erosion of sediments to which these pollutants may have adhered in the past. Site development involves remedial grading which will stabilize soils and prevent their transport from the Modified Project site, actually reducing the potential for discharge of sediments to which historical pesticides may have adsorbed in pre-development conditions.

In the post-developed condition, pesticides will be applied to common landscaped areas and residential lawns and gardens. The organochlorine pesticides were replaced by organophosphate pesticides, a class of pesticides that includes diazinon and chlorpyrifos, which have been commonly found in urban streams (Katznelson and Mumley, 1997). However, only 0 to 13 percent of the samples in the Los Angeles County database had detectable levels of diazinon (depending on the land use), while levels of chlorpyrifos were below detection limits for all land uses in all samples taken between 1994 and 2000 (LACDPW, 2000). Other pesticides presented in the database were seldom measured above detection limits. Furthermore, these data represent flows from areas without LID or treatment controls, unlike the proposed Modified Project, which does incorporate LID treatment control BMPs.

Diazinon and chlorpyrifos are two pesticides of concern due to their potential toxicity in receiving waters. The USEPA banned all indoor uses of diazinon in 2002 and stopped all sales for all outdoor non-agricultural use in 2003 (NPIC, 2014).[22] Monitoring data can still detect these pesticides in water and sediment samples, including the Santa Clara River (Delgado-Moreno et. al., 2011); however, state-wide sampling from 2008 to 2010 conducted as part of the California Surface Water Ambient Monitoring Program (SWAMP) Stream Pollution Trends sampling indicates that organophosphate pesticides in sediment decreased between 2008 and 2010 (Anderson et. al., 2013). For example, chlorpyrifos was detected in 12 percent of the 92 sediment sampling sites in 2008, and in none of the 95 sites sampled in 2010.

With no agricultural uses planned for the proposed Modified Project, diazinon would not be used at the Modified Project site. The USEPA has also phased out most indoor and outdoor residential uses of chlorpyrifos and has stopped all non-residential uses where children may be exposed. Use of chlorpyrifos in the proposed Modified Project area is not expected, with the possible exception of emergency fire ant eradications, until such time when reasonable alternative products are available and only with appropriate application practices in accordance with the landscape pesticide management program.

The organophosphate pesticides have been largely replaced with a third class of pesticides, pyrethroid pesticides, which are a synthetic form of naturally occurring pyrethrins. State-wide sampling conducted as part of the SWAMP indicated 55 percent of the 92 sediment sampling sites monitored in 2008 contained pyrethroid pesticides; this percentage increased to 81 percent of the 95 samples taken in 2010. A recent survey of data from approximately 80 studies that focused on pyrethroid pesticides and fipronil in receiving waters subject to urban runoff was conducted by the California Stormwater Quality Association (CASQA) (Ruby, 2013). As part of this review, over 9,200 pyrethroid sample analysis results were compiled. Overall, pyrethroids were detected in 34 percent of the sediment samples and 25 percent of the water samples. Pyrethroids were found at concentrations exceeding levels known to cause toxicity to sensitive aquatic organisms in water. Given the concerns regarding the widespread presence of synthetic pyrethroids in sediment of both agricultural and urban dominated waterways, the California Department of Pesticide Regulation (DPR) issued new regulations affecting 17 pyrethroids on July 19, 2012, limiting applications in outdoor non-agricultural settings.[23]

The CASQA report also compiled over 3,200 fipronil results. The non-pyrethroid pesticide, fipronil, is a leading replacement for pyrethroid pesticides in urban areas (SFEP, 2005), but it

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[22] Changes to the use of chlorpyrifos include reductions in the residue tolerances for agricultural use, phase out of nearly all indoor and outdoor residential uses, and disallowal of non-residential uses where children may be exposed. Retail sales of chlorpyrifos were stopped by December 31, 2001, and structural (e.g., construction) uses were phased out by December 31, 2005. Some continued uses will be allowed, for example, public health use for fire ant eradication and mosquito control is permitted by professionals.

Permissible uses of diazinon are also restricted. All indoor uses are prohibited (as of 12/2002) and retailers were required to end sales for indoor use in December 2002. All outdoor non-agricultural uses were phased out by December 31, 2004. Therefore, the USEPA ban will likely eliminate most of the use of diazinon within the Modified Project area. The use of diazinon for many agricultural crops has been eliminated (USEPA 2001), while some use of this chemical will continue to be permitted for some agricultural activities.

[23] http://www.cdpr.ca.gov/docs/legbills/rulepkgs/11-004/text_final.pdf.

and its degradates[24] are toxic and increasingly detected in water and sediment in urban watercourses. Fipronil was detected in 40 percent of the water samples and 36 percent of the sediment samples tested in studies evaluated in the CASQA report, whereas the fipronil degradates were detected in 27 percent of the water samples and 61 percent of the sediment samples. The latter results are more consistent with pyrethroids, which tend to be associated with particles and have low water solubility.

The water quality risks posed by a pesticide relate to the quantity of the pesticide used, its breakdown or degradation rate, its runoff characteristics, and its relative toxicity in water and sediment. Given that many pesticides exhibit toxicity at very low concentrations, the most effective control strategy is source control, and complying with the DPR regulations limiting outdoor applications. Source control measures such as education programs for owners, occupants, and employees about proper application, storage, and disposal of pesticides are the most promising strategies for controlling the pesticides that will be used post-development. Structural treatment controls are less practical because of the variety of pesticides and wide range of chemical properties that affect their ability to treat these compounds. However, most pesticides, including historical pesticides that may be present at the site, are relatively insoluble in water and therefore tend to adsorb to the surfaces of sediment, which will be stabilized with development, or if eroded, will be settled or filtered out of the water column in the LID treatment control BMPs. In addition, biofiltration media contains sorption sites that would promote the removal of pesticides. Thus, treatment in the LID treatment control BMPs should achieve some removal of pesticides from stormwater as TSS is reduced and stormwater is biofiltered.

For common area landscaping in commercial areas, multi-family residential areas, and parks, an Integrated Pest Management (IPM) Program will be incorporated, per Mitigation Measure WQ-2. The goal of an IPM Program is to keep pest levels at or below threshold levels, reducing risk and damage from pest presence, while eliminating the risk from the pest control methods used. IPM programs achieve these goals through the use of low risk management options by emphasizing use of natural biological methods and the appropriate use of selective pesticides. IPM programs also incorporate environmental consideration by implementing procedures that minimize intrusion and alteration of biodiversity in ecosystems.

While pesticides are subject to degradation, they vary in how long they maintain their ability to eradicate pests. Some break down almost immediately into nontoxic byproducts, while others can remain active for longer periods of time. While pesticides that degrade rapidly are less likely to adversely affect non-targeted organisms, in some instances it may be more advantageous to apply longer-lasting pesticides if it results in fewer applications or smaller amounts of pesticide use. As part of the IPM program, careful consideration will be made as to the appropriate type of pesticides for use on the Modified Project site. While pesticide use is likely to occur due to maintenance of landscaped areas, particularly in the residential portions of the development, careful selection, storage, and application of these chemicals for use in common areas per the IPM Program will help prevent adverse water quality impacts from occurring. Additionally, as

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[24] Fipronil is a phenylpyrazole insecticide. Studies show that fipronil is readily transformed into three degradates: fipronil desulfinyl, fipronil sulfone, and fipronil sulfide (Delgado-Moreno et al., 2011).

discussed above, removal of sediments in the LID treatment control BMPs will also remove sediment-adsorbed pesticides.

Mitigation Measure WQ-2 was provided to ensure that an Integrated Pest Management program, which includes measures to protect groundwater and surface water from pesticide use, is implemented as proposed, and to facilitate the implementation of a mitigation monitoring program.

Based on these considerations, the Modified Project will not result in any new significant impacts on pesticides compared to the 2017 Approved Project analyzed in the State Certified EIR.

Transport of legacy pesticides adsorbed to existing site sediments may be a concern during the construction phase of development. Construction-related impacts are addressed in Section 7.4 below. The Construction Stormwater Pollution Prevention Plan must contain sediment and erosion control BMPs pursuant to the Construction General Permit, and those BMPs must effectively control erosion and the discharge of sediment along with other pollutants per the BAT/BCT standards. Based on these sediment controls, the Modified Project will not result in any new construction-related significant impacts on pesticides compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.3 Pathogens

Pathogens are viruses, bacteria, and protozoa that can cause gastrointestinal and other illnesses in humans through body contact exposure. Fecal indicator bacteria (FIB), such as total and fecal coliform, enterococci, and E. coli, are used by regulatory agencies as indirect measures of the presence of pathogens, and by association, risk of human illness.

The SWRCB adopted new statewide bacteria water quality objectives and implementation options to protect recreational users from the effects of pathogens in California water bodies in February 2019. The objectives and implementation options are a new part 3 of the Water Quality Control Plan for the Inland Surface Waters, Enclosed Bays, and Estuaries of California, and as an amendment to the Water Quality Control Plan for Oceans Waters of California. The statewide bacteria water quality objectives use two indicators, E. Coli for fresh waters and enterococci for saline waters. In fresh waters designated for water contact recreation (REC-1), the statewide bacteria objectives are for E. Coli, in the form of geometric mean (GM) and a not to exceed limit. Specifically, the E. Coli criteria (for waters where the salinity is equal to or less than 1 part per thousand, 95 percent or more of the time during the calendar year) is that a six-week rolling geometric mean shall not exceed 100 colony forming units (cfu) per 100 milliliters (mL), calculated weekly, and a statistical threshold value (STV) of 320 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.

In the context of a TMDL, the Regional Water Board may implement the statewide bacteria objective using a “reference system/antidegradation approach” or “natural sources exclusion approach.” A reference system is defined as an area and associated monitoring point that are not impacted by human activities that may potentially affect bacteria densities in the receiving water body. Under the reference system approach, a certain frequency of exceedance of the bacteria objective is permitted on the basis of the observed exceedance frequency in the selected reference system or the targeted water body, whichever is less. Under the natural source exclusion approach, after all anthropogenic sources of bacteria have been controlled such that they do not cause or contribute to an exceedance of the bacteria objective and the natural sources have been identified and quantified, a certain frequency of exceedance of the bacteria objective is permitted based on the residual exceedance frequency in the specific water body. These approaches recognize that there are natural sources of bacteria which may cause or contribute to exceedances of the single sample objective and acknowledge that it is not the intent of the SWRCB to require treatment of natural sources of bacteria from undeveloped areas (SWRCB, 2019).

7.2.3.1 Santa Clara River Bacteria TMDL

The Regional Water Board approved a Basin Plan amendment on July 8, 2010, to incorporate a TMDL for Indicator Bacteria for Reaches 5, 6 and 7 of the Santa Clara River and for the Santa Clara River Estuary (Resolution #R10-006). The TMDL, in effect as of March 21, 2012, provides allowable exceedance day based on wasteload allocations (WLAs) for MS4 dischargers for E. coli in Reaches 3, 5, 6 and 7, and for fecal coliform, enterococcus, and total coliform in the Santa Clara River Estuary. These WLAs have been incorporated into the Regional MS4 Permit. The Indicator Bacteria TMDL MS4 WLAs are applied in the form of allowable exceedance days as illustrated along with the TMDL implementation schedule in Table 7-9.

Table 7-9: E. Coli. TMDL Implementation Schedule for Santa Clara River

Deadline	Limitations	Requirements
March 21, 2016	Receiving water limitations interim dry weather (single sample)	Annual allowable exceedance days: 17 days if daily sampling, 3 days if weekly sampling.
March 21, 2016	Receiving water limitations interim wet weather (single sample)	Annual allowable exceedance days: 61 days if daily sampling, 9 days if weekly sampling.
March 21, 2023	Effluent limitations dry weather	Daily maximum concentration not to exceed 235 MPN/cfu per 100 mL and geometric mean not to exceed 125 MPN/cfu per 100 mL.
March 21, 2023	Receiving water limitations final dry weather (single sample)	Annual allowable exceedance days: 5 days if daily sampling, 1 days if weekly sampling.
March 21, 2023	Receiving water limitations final dry weather (geometric mean)	Geometric mean not to exceed 126/100 mL
March 21, 2029	Effluent limitations wet weather	Daily maximum concentration not to exceed 235 MPN/cfu per 100 mL, and geometric mean not to exceed 125 MPN/cfu per 100 mL.
March 21, 2029	Receiving water limitations final wet weather (single sample)	Annual allowable exceedance days: 16 days if daily sampling, 3 days if weekly sampling.

Deadline	Limitations	Requirements
March 21, 2029	Receiving water limitations final wet weather (geometric mean)	Geometric mean not to exceed 126/100 mL

Note: Applicable to SCR Reach 5.

The Regional Water Board indicated in the TMDL implementation schedule that they will reconsider the TMDL if, prior to four years after the effective date of the TMDL, one of the following occurs: (1) monitoring or any voluntary local reference system studies justify a revision, or (2) USEPA publishes revised recommended bacteria criteria that affect the TMDL, or (3) the Regional Water Board adopts a separate Basin Plan amendment, suspending recreational uses in the Santa Clara River during high flows. The Regional Water Board has not reconsidered the TMDL at this time.

7.2.3.2 Factors That Affect FIB Concentrations

There are various confounding factors that affect the reliability of FIB as pathogen indicators. One primary factor is that there are numerous natural or non-anthropogenic (or "zoonotic") sources of FIB in developed watersheds and their receiving water bodies, including birds and other wildlife, soils, and plant matter. Anthropogenic sources may include domesticated animals and pets, poorly functioning septic systems, sewer system overflows or spills, cross-connections between sewer and storm drains, and the utilization of outdoor areas or storm drains for human waste disposal by people without access to indoor sanitary facilities. All of these sources can contribute to the concentrations of FIB, but there is some debate as to whether source type affects human health risk (USEPA, 2012).

A second confounding factor is that FIB can multiply in the field if the substrate, temperature, moisture, and nutrient conditions are suitable. Some research indicates that bacteria presence and growth was observed in various substrates such as beach sands, wrack line (accumulation of kelp and other vegetative debris in the inter-tidal area of beaches), inter/sub-tidal sediments, and material deposited in storm drains (MEC, 2004). FIB monitoring in the Santa Ana River indicate that the ubiquity of sources and potential regrowth far exceed the human sources of fecal bacteria generated by the entire population in the watershed (Surbeck et al, 2006). Regrowth of bacteria downstream of a package treatment plant utilizing ultraviolet (UV) radiation to disinfect dry weather flows in Aliso Creek was considered a prime factor in the rapid rebound of FIB concentrations downstream of the plant (Andersen, 2005). Research also implicates storm drain biofilms as another urban source of FIB to receiving waters (Roberts and Kolb, 2009; Skinner et al, 2010)

A third confounding factor is that the persistence of FIB may differ from those of various pathogenic viruses, bacteria, and protozoa. Viruses, for instance, are small, low in number, and difficult to inactivate, while protozoa may form protective cysts that are resistant to destruction and render them dormant but capable of reactivating in the future. Therefore, while some indicator bacteria may die off in the water column due to ultraviolet disinfection or other unfavorable environmental conditions (including predation and antagonism), pathogens occasionally may persist longer (Haile et. al., 1999). So, while the previously two described factors may result in indicator bacteria resulting in false positive indications of public health risk, there may also be instances when indicator bacteria result in false negative indications.

7.2.3.3 Epidemiological Studies

In southern California, the SCCWRP conducted three epidemiology studies between 2007 and 2009 at Doheny Beach in Dana Point, Avalon Beach on Santa Catalina Island, and at Surfrider Beach in Malibu. A key goal of these studies was to document the relationship between illness and traditional culture-based FIB (enterococcus, fecal coliform, total coliforms) and three quantitative polymerase chain reaction (qPCR) assays for enterococcus for beaches subject to urban runoff. The results from the Doheny Beach study indicated significant differences in diarrhea and other outcomes in swimmers compared to non-swimmers and in swimmers who experienced body immersion, head immersion, or swallowed water. When the source of FIB consistently exceeded water quality standards, traditional and rapid methods for enterococcus were both strongly related to illness. However, fewer significant associations were measured during periods when a beach berm prevented urban runoff from flowing into the ocean. This illustrates the difficulty of consistently predicting human health associations at urban runoff impacted beaches using currently available indicators.

7.2.3.4 Effects of Land Use and Runoff on FIB Concentrations

Dry weather, non-storm stream flows from undeveloped watersheds tend to have lower concentrations of FIB than dry weather urban flows, although water quality standard exceedances still occur. For instance, a study by SCCWRP which monitored 15 unimpaired natural southern California streams weekly during dry weather for a year showed that about 18 percent of the samples exceeded daily and monthly bacterial indicator thresholds, although concentrations from these unimpaired streams were one to two orders of magnitude lower than levels found in developed watersheds (Tiefenthaler, *et al.*, 2008). The study reported an average of the geometric means for E. coli in dry weather flows in each stream of 41 MPN/100 mL. The Santa Clara River bacteria TMDL WLAs are based on this and other SCCWRP reference stream and reference beach datasets, in acknowledgement of natural sources.

During wet weather, stormwater runoff can mobilize indicator bacteria from a number of watershed and instream sources, and, therefore, indicator bacteria concentrations tend to increase. For example, median stormwater runoff monitoring results for the open space land use category, as summarized by Stein et. al. (2007), include E. Coli concentrations of about 5,400 MPN/100 mL from the 2001-2005 Los Angeles River Watershed Wet Weather Study (Stein et. al. 2007). Similar open land use data from the National Stormwater Quality Database indicate a median concentration of 7,200 MPN/100 mL (Pitt *et al.*, 2003).

Land use type and condition also affect runoff concentrations, and most studies show higher FIB concentrations in urban runoff than in open space runoff. Runoff from residential land uses from the Los Angeles River Watershed Wet Weather Study had a median E. coli concentration of about 6,300 MPN/100 mL and about 8,300 from the National Stormwater Quality Database (Table 5-2, Stein et. al, 2007). The median value of four flow-weighted average results from the Stein et. al. (2007) study was about 6,100 MPN/100mL for E. coli for the low-density residential land use site. These data represent urban areas that in general do not have source and treatment controls, and therefore are not indicative of runoff from the proposed Modified Project.

7.2.3.5 Modified Project BMPs that Address Pathogen Indicators

The primary sources of pathogen indicators from the Modified Project development would likely be sediment, pet wastes, wildlife, and regrowth in the storm drain itself. Other sources of pathogens and pathogen indicators, such as cross connections between sanitary and storm sewers, are unlikely given modern sanitary sewer installation methods and inspection and maintenance practices.

The levels of bacteria in runoff from the Modified Project would be reduced by source controls and LID treatment control BMPs. The most effective means of controlling specific bacteria sources, such as pet and other animal wastes, is through source control. A key control is education of pet owners and providing products and disposal containers that encourage and facilitate cleaning up after pets. Education regarding feeding (and therefore attracting) of waterfowl near waterbodies may also assist in managing wildlife sources.

Although there are limited data on the effectiveness of different types of stormwater treatment to manage pathogen indicators, treatment processes that help reduce pathogen indicators include sunlight (ultraviolet light) degradation, sedimentation, and filtration.

Bioretention, an LID treatment control BMP that provides filtration through amended soils, is an effective BMP for addressing FIB. The City of Austin, Texas conducted a number of studies on the effectiveness of sedimentation/filtration treatment systems for treating stormwater runoff (City of Austin, 1990). Most of the structures were designed to treat one-half inch of runoff. Data from four sand filters indicated a range of removals from 37 percent to 83 percent for fecal coliform, and 25 percent to 81 percent for fecal streptococci. Research on the use of filtration to remove bacteria also has been conducted in Florida by the Southwest Florida Water Management District (Kurz, 1998). Significant reductions in total and fecal coliform bacteria and the other indicators were observed between inflow and outflow samples for sand filtration. Percent reductions were measured using flow-weighted sampling techniques. Total coliform bacteria removals were less than 70 percent, and fecal coliform bacteria reduction varied from 65 percent to 100 percent. Analysis of Enterococcus influent and effluent data for bioretention facilities indicate a significant difference between median influent concentrations of 605 MPN/100mL and the median effluent concentration of 234 MPN/100mL (Geosyntec Consultants and Wright Water Engineers, 2012). These types of BMPs are specified for incorporation into the Modified Project to meet the LID Performance Standard specified in Section 3 of this report.

In summary, the stormwater discharges from the Modified Project could potentially exceed the REC-1 Basin Plan standard for FIB without BMPs implementation. However, the FIB concentrations in runoff from the Modified Project would be reduced through the implementation of source control and LID treatment control BMPs. The Modified Project will incorporate a number of source controls specific to managing FIB, including education of pet owners, education regarding feeding (and therefore attracting) of waterfowl near waterbodies, and providing products and disposal containers that encourage and facilitate cleaning up after pets. The Modified Project will not include septic systems, and the sewer system will be designed to current standards which minimizes the potential for leaks. The Modified Project, consistent with the Regional MS4 Permit requirements, includes a comprehensive set of site design, source control, and LID treatment control BMPs (i.e., infiltration facilities and bioretention), selected to manage pollutants of concern, including pathogen indicators. Furthermore, the Modified Project will comply with all future Regional MS4 Permit provisions incorporating the TMDL wasteload allocations and implementation plan.

With these BMPs, the Modified Project will not result in any new significant impacts on pathogens or FIB concentrations in receiving waters compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.4 Petroleum Hydrocarbons

Hydrocarbons are a broad class of compounds, most of which are non-toxic. Hydrocarbons are hydrophobic (low solubility in water), have the potential to volatilize, and most forms are biodegradable. Polynuclear Aromatic Hydrocarbons (PAHs) are a class of hydrocarbons that can be toxic depending on the concentration levels, exposure history, and sensitivity of the receptor organisms, and are therefore of most interest in terms of impacts to water quality and beneficial uses.

Hydrocarbon sources in urban settings derive principally from transportation sources including emissions and leaks from vehicles and spill from fueling operations. These sources are located on impervious surfaces including roads and parking lots and therefore PAHs can be considered a relatively mobile source.

Concentrations in stormwater have been extensively measured and reported in the literature. Stein et al. sampled runoff at eight stations located in the Los Angeles metropolitan area from 2001 through 2004 (Stein et al., 2006). Most of the stations were located near the mouths of major channels (i.e., mass emissions stations). Samples were also obtained at fifteen land use stations. The mean flow-weighted total PAH concentration for the mass emission stations was 2,300 nanograms per liter (ng/L), compared to approximately 140 ng/L for one storm from an open space-dominated drainage. These data indicate that development may increase PAHs in runoff significantly. An analysis of selected individual PAHs indicated that the most prevalent PAHs were those having the higher molecular weights (e.g., pyrene, fluoranthene, and chrysene) and whose source is pyrogenic (related to combustion).

The majority of PAHs in stormwater adsorb to the organic carbon fraction of particulates in the runoff, including soot carbon generated from vehicle exhaust (Ribes et al, 2003), so there is concern that sediments could become contaminated with PAHs and cause toxicity to benthic organisms. In a monitoring survey conducted as part of the SWAMP Stream Pollution Trends Modified Project, average PAHs in stream sediments increased from 2008 to 2009 and then decreased in 2010 (Table 7-10). [The number of stations monitored in 2009 was about 25 percent of the number of stations monitored in 2008 and 2010, so the data for that year is less robust.] Overall these data suggest that PAHs in stream sediments subject to urban runoff may be showing a decreasing trend. An examination of the correlation between amphipod survival and PAHs indicated that PAHs were not statistically correlated with amphipod survival in 2008, 2009 and 2010, and therefore PAHs do not appear to be a cause of the observed toxicity in this data set.

Table 7-10: Trends in Urban Stream Sediment PAH Concentrations

Year	No. of Stations	Percent Detection (%)	Average Detection (ng/g)
2008	92	100	757
2009	23	100	1,457
2010	95	93	293

Source: State Water Resources Control Board SWAMP Stream Pollution Trends (SPoT) Second Year Report (Anderson et al., 2013)

PAHs in urban runoff are primarily associated with transportation activities and are expected to increase with development. Source control BMPs that address petroleum hydrocarbons include educational materials on oil disposal and recycling programs, spill control at fueling facilities, carpooling, and public transportation alternatives to driving. Supplemental to this strategy will be the utilization of LID treatment controls that will further reduce PAH concentrations in runoff. The literature indicates that PAHs tend to be adsorbed to particulates and therefore amenable to LID treatment measures that incorporate unit processes such as settlement, filtration, and/or adsorption. The Modified Project's LID BMPs would utilize these unit processes to treat runoff from parking lots and roadways and thus would further reduce concentrations in runoff.

During the construction phase of the Modified Project, hydrocarbons in site runoff could result from construction equipment/vehicle fueling or spills. Construction-related impacts are addressed in Section 7.4 below. However, pursuant to the Construction General Permit, the Construction Stormwater Pollution Prevention Plan must include BMPs that address proper handling of petroleum products on the construction site, such as proper petroleum product storage and spill response practices, and those BMPs must effectively prevent the release of hydrocarbons to runoff per the Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology standards. PAHs that are adsorbed to sediment during the construction phase would be effectively controlled via the erosion and sediment control BMPs. For these reasons, the Modified Project will not result in any new significant construction-related impacts related to hydrocarbons on water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

Based on these considerations, the Modified Project will not result in any new significant impacts on petroleum hydrocarbons in receiving waters compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.5 Trash and Debris

Urban development tends to generate significant amounts of trash and debris. Trash refers to any human-derived materials including paper, plastics, metals, glass and cloth. Debris is defined as any organic material transported by stormwater, including leaves, twigs, and grass clippings (DLWC, 1996). Debris can be associated with the natural condition. Trash and debris is often characterized as material retained on a 5-millimeter mesh screen. It contributes to the degradation of receiving waters by imposing an oxygen demand, attracting pests, disturbing physical habitats, clogging storm drains and conveyance culverts and mobilizing nutrients, pathogens, metals, and other pollutants that may be attached to the surface. Sources of trash in developed areas can be both accidental and intentional. During wet weather events, gross debris deposited on paved surfaces can be transported to storm drains, where it can be eventually discharged to receiving waters. Trash and debris can also be mobilized by wind and transported directly into waterways. Trash and debris can impose an oxygen demand on the water body as organic matter decomposes.

Urbanization could significantly increase trash and debris loads if left unchecked. However, the Modified Project's BMPs, including the installation of full trash capture devices for all priority land use areas[25], as well as source control and LID treatment control BMPs, will minimize the adverse impacts of trash and debris. Source controls such as street sweeping, public education, fines for littering, and storm drain stenciling can be effective in reducing the amount of trash and debris that is available for mobilization during wet and dry weather events. Common area litter control will include a litter patrol, covered trash receptacles, emptying of trash receptacles in a timely fashion, and noting trash violations by tenants/homeowners or businesses and reporting the violations to the owner/HOA for investigation. The full trash capture devices, source control, and LID treatment control BMPs will remove or prevent the release of floating materials, including solids, liquids, foam, or scum, from runoff discharges and will prevent impacts on dissolved oxygen in the receiving water due to decomposing debris. Based on these considerations, the water quality impact of the Modified Project on trash and debris in the Modified Project's receiving waters is considered less than significant.

During the construction phase, there is potential for an increase in trash and debris loads due to lack of proper contractor good housekeeping practices at the construction site. Per the CA CGP, the SWPPP for the site will include BMPs for trash control (catch basin inserts, good housekeeping practices, etc.).

Based on these considerations, the Modified Project will not result in any new significant impacts on trash and debris in receiving waters compared to the 2017 Approved Project analyzed in the State Certified EIR. See Section 7.4 below for a full discussion of Construction Related Impacts.

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[25] Priority land uses are defined by the Trash Amendments as follows:

(1) High-density residential: all land uses with at least ten developed dwelling units/acre.

(2) Industrial: land uses where the primary activities on the developed parcels involve product manufacture, storage, or distribution (e.g., manufacturing businesses, warehouses, equipment storage lots, junkyards, wholesale businesses, distribution centers, or building material sales yards).

(3) Commercial: land uses where the primary activities on the developed parcels involve the sale or transfer of goods or services to consumers (e.g., business or professional buildings, shops, restaurants, theaters, vehicle repair shops, etc.)

(4) Mixed urban: land uses where high-density residential, industrial, and/or commercial land uses predominate collectively (i.e., are intermixed).

(5) Public transportation stations: facilities or sites where public transit agencies' vehicles load or unload passengers or goods (e.g., bus stations and stops).

7.2.6 Methylene Blue Activated Substances (MBAS)

MBAS, which is related to the presence of detergents in runoff, may be incidentally associated with urban development due to commercial and/or residential vehicle washing or other outdoor washing activities. Surfactants disturb the surface tension which affects insects and can affect gills in aquatic life.

The presence of soap in Modified Project runoff will be controlled through the source control BMPs, including a public education program on residential and charity car washing. Other sources of MBAS, such as cross connections between sanitary and storm sewers, are unlikely given modern sanitary sewer installation methods and inspection and maintenance practices. In addition, the LID treatment control BMPs will infiltrate or evapotranspire all dry weather runoff (see Section 7.8.2 below). Based on these considerations, the Modified Project will not result in any new significant impacts on MBAS compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.7 Selenium

The Basin Plan includes a water quality objective for selenium in waters designated for use as Domestic or Municipal Supply (MUN). Santa Clara River Reach 5 is designated as having a potential MUN beneficial use in the Basin Plan. The water quality objective is based on the Maximum Contaminant Levels listed in the provisions of Title 22 of the California Code of Regulations, which is 50 µg/L.

The California Toxics Rule continuous concentration (4-day average) chronic criterion for total selenium is 5.0 µg/L and the maximum concentration (1-hour average) acute criterion is 20 µg/L.

USEPA published a final national chronic aquatic life criterion for selenium in fresh water in 2016 (USEPA, 2016a). The 2016 criterion reflects the latest scientific knowledge, which indicates that selenium toxicity to aquatic life is primarily based on organisms consuming selenium-contaminated food rather than by being exposed only to selenium dissolved in water. The final criterion is expressed both in terms of fish tissue concentration (egg/ovary, whole body, muscle) and water concentration. The recommended water concentration criterion is 1.5 µg/L average concentration over 30 days in lentic waters (i.e., lakes, ponds, and wetlands) and 3.1 µg/L average concentration over 30 days in lotic waters (i.e., flowing waters such as rivers).

Santa Clara River Reach 5 was not included on the 303(d) list as impaired for selenium, based on 180 samples collected by the Los Angeles County Sanitation District from June 2006 through May 2010. Santa Clara River Reach 3, which is 25 miles downgradient of the Modified Project on the other side of the Santa Clara River Dry Gap, is listed as impaired for selenium based on monitoring data collected by Ventura County at their Santa Clara River Mass Emission Station from 2006 through 2009.

Dissolved and total selenium were measured by Los Angeles County in their land use-based monitoring conducted from 1994 through 2000 (LACDPW, 2000). Dissolved selenium was not detected in runoff from all of the land use categories (commercial, open space, high density single family residential, transportation, light industrial, educational, multi-family residential, and mixed residential). Total selenium was detected above the detection limit of 5 µg/L in 13% of commercial runoff samples, 2% of open space and mixed residential runoff samples, and 6% of transportation and light industrial runoff samples, and was not detected in high density single family residential, educational, and multi-family residential runoff samples. Not enough data were observed above the detection limit to develop valid concentration statistics.

Ventura County states in their Annual Report (VCSQMP, 2018) that selenium is known to occur at elevated levels in Monterey Formation rocks (Miocene marine mudstone) which are common in Ventura County, although the relative contributions of anthropogenic and natural sources to observed elevated selenium concentrations are not clear at this point. A study conducted on the sources of selenium in the Newport Bay Watershed in Orange County, California (Meixner et al., 2004) points to the draining of an historic swamp which released selenium into the groundwater and from there into surface channels and eventually to Newport Bay. Results indicated that when sandy bottom streams are vegetated, they are potentially capable of removing selenium from groundwater seepage through the processes of reduction and adsorption and precipitation or by microbial and algal update processes. A study conducted by the U.S. Department of Interior (Seiler and Skorupa, 1995) on the identification of areas at risk for selenium contamination in the Western United States indicated that irrigation of areas associated with marine sedimentary rocks of the Late Cretaceous age is likely to result in harmful levels of selenium. If there is a source of selenium, the magnitude of selenium concentration in drainage-affected aquatic ecosystems is strongly related to the aridity of the area and whether there are terminal lakes and ponds where evaporation can concentrate selenium. An example of this scenario is the Kesterson National Wildlife Refuge in the western San Joaquin Valley of California, where incidents of mortality, congenital deformities, and reproductive failures in waterfowl and other water birds were discovered in 1983.

The geologic formations underneath the Modified Project area do not include marine sedimentary rocks of the Late Cretaceous age and are not expected to generate elevated levels of selenium in groundwater or surface water. The Modified Project site is underlain by Pliocene and Pleistocene age non-marine bedrock of the Saugus Formation (Leighton and Associates, 2016; RTF&A, 2013). The Saugus Formation consists of massive to well-bedded, fine to coarse sandstone interbedded with matrix-supported coarse sand and gravel conglomerate. Sandy siltstone is encountered locally. The Saugus Formation is overlain by landslides, terrace deposits, alluvium, and engineered and non-engineered fill.

It is therefore very unlikely that the concentration of selenium in the Modified Project's stormwater runoff would be an appreciable source of selenium loading to the Santa Clara River. Based on these considerations, the water quality impacts of the Modified Project on selenium in the Modified Project's receiving waters are considered less than significant. The Modified Project will not result in any new significant impacts on water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.8 Toxicity

7.2.8.1 Acute and Chronic Aquatic Toxicity

Pesticides, metals, PAHs, and other organic compounds (e.g., PCBs) can enter the aquatic food chain and cause acute or chronic toxicity in the form of lethal or sub-lethal effects, including survival, reproduction, prey avoidance, and others. Such effects are commonly measured by exposing sensitive organisms to water samples over a period of time and measuring the effects on the organisms.

The literature indicates that pesticides are a primary cause of most of the observed toxicity in receiving waters when organisms are exposed to urban runoff water samples or are exposed to sediments contaminated by urban runoff (Anderson et al., 2013; Amweg et al., 2006; Gan et al., 2005). Data from the SWAMP Stream Pollution Trends Second Year Report confirm that the primary class of pesticides causing toxicity are the pyrethroid pesticides (Anderson et al., 2013). This study also indicates that toxicity units is an effective measure of the cumulative toxicity associated with a mix of individual pyrethroids.

In a more focused evaluation of data from streams and other receiving water bodies subject to urban runoff, studies determined that pyrethroids were commonly found at concentrations exceeding levels which cause toxicity to sensitive aquatic organisms in water. The average reported concentrations of bifenthrin, cyfluthrin, cyhalothrin, cypermethrin, and permethrin in water samples range from approximately one to more than three orders of magnitude above chronic criteria values referenced in the report (Ruby, 2013). Similar conclusions were made for pyrethroid concentrations in sediment.

Thus, the literature indicates that toxicity impacts are largely related to pesticides and the potential impacts of pesticides on water quality are discussed in Section 7.2.2 above. Other pollutants that may affect toxicity (metals and PAHs) are also addressed above (Section 7.1 and Section 7.2.4, respectively). Based on the incorporation of source control, LID, and treatment control BMPs pursuant to Regional MS4 Permit and LID Manual requirements and the impact analysis results presented in these sections, potential post-development impacts associated with acute and chronic aquatic toxicity would be less than significant. The Modified Project will not result in any new significant impacts on water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.8.2 Toxic Olfactory Impacts to Southern Steelhead

In October 2007, the National Oceanic and Atmospheric Administration (NOAA) and the National Marine Fisheries Service (NMFS) produced a technical memorandum entitled "*An Overview of Sensory Effects on Juvenile Salmonids Exposed to Dissolved Copper: Applying a Benchmark Concentration Approach to Evaluate Sublethal Neurobehavioral Toxicity*" (the "NOAA Memo"). The NOAA Memo summarized various laboratory studies and from them drew conclusions about the potential for sublethal effects of copper on juvenile salmonids, which include steelhead. According to the NOAA Memo, the laboratory studies showed that, under certain conditions, dissolved copper at concentrations equal to or slightly above ambient background concentrations can disrupt salmonid behavior. Subsequent to the publication of the

State Certified EIR, commenters raised questions about the potential for copper in stormwater runoff from the RMDP/SCP area to affect steelhead salmon (*Oncorhynchus mykiss*) in the Santa Clara River.

Steelhead salmon is one of six Pacific salmon in the genus Oncorhynchus that are native to the North American coast. Steelhead, along with other species of Pacific salmon, exhibit an anadromous life history, where juveniles of the species undergo a change (smoltification) that allows them to migrate to and mature in salt water before returning to the freshwater streams where they were spawned to reproduce. Steelhead in southern California comprise a “distinct population segment” of the species (NMFS, 2012). Southern California steelhead were listed as an endangered species under the U.S. Endangered Species Act in 1977 and is a candidate for listing under the California Endangered Species Act.

Within the Santa Clara River drainage, southern steelhead historically inhabited Piru Creek, Sespe Creek, Santa Paula Creek, Hopper Creek, and possibly Pole Creek (Titus et al., 2011). Presently, southern steelhead occur in the Santa Clara River Watershed in Piru Creek between the confluence with the Santa Clara River and the Santa Felicia Dam, in Sespe Creek, in Santa Paula Creek, and possibly in Hopper and Pole Creeks (Stoeker and Kelly, 2005). As explained in the State Certified EIR, southern steelhead are not expected to occur in the Modified Project area as (1) the Modified Project Site does not support suitable spawning substrate and cool water temperatures required for spawning, and (2) the Modified Project is upstream from the “Dry Gap,” an area in which the Santa Clara River does not have surface flows except in very high flow periods, eliminating the possibility of fish migration.

Appendix E presents a detailed analysis of the Modified Project’s potential to affect southern steelhead in the Santa Clara River. The analysis finds that, consistent with the conclusions in the State Certified EIR, the Modified Project is not expected to cause adverse toxicity effects on juvenile salmonids due to dissolved copper in stormwater from the Modified Project, for the following reasons:

- As stated above, southern steelhead are not expected to occur in the Modified Project area.
- The average annual concentration in stormwater runoff from the Modified Project (directly and cumulatively) is predicted to be well below the benchmark CTR water quality criteria for aquatic life protection and is not expected to increase the concentration of dissolved copper in the Santa Clara River.
- The Santa Clara River has a DOC concentration and hardness levels that are expected to completely protect the olfactory response of juvenile steelhead from the effect of dissolved copper at the concentration predicted in the Modified Project’s discharges.
- The results of a NOAA study (Stromberg et al., 2016) found that biofiltration treatment was protective of lethal effects and sublethal symptomology caused by untreated stormwater.

Of note, the method to analyze impacts on juvenile steelhead trout, and the potential for the RMDP development to cause impacts to steelhead, have been extensively litigated. The state

Court of Appeal for the Second Appellate District has twice upheld the method of using the CTR as a benchmark for analyzing a project's impacts on juvenile steelhead trout.[26] This analysis relies on the standards under the CTR, as well as multiple studies predicting the Modified Project's projected runoff and correlating trace metal concentrations, consistent with the methodological approach upheld by the Court of Appeal. In addition, the United States District Court for the Central District of California and the Ninth Circuit Court of Appeals both upheld the Corps' determination that the development analyzed in the State Certified EIR would have "no effect" on southern steelhead, including no effect related to dissolved copper.[27]

7.2.8.3 Vehicle Tire Wear Particles

Vehicle tires wear down and release tire particles into the environment. Most of this tire wear material lands on the ground close to roads and stormwater runoff carries the tire particles to receiving waters. A compound found in rubber called 6PPD, which is used to keep tires from breaking down too quickly, was found by researchers to react with ozone and transform into multiple chemicals, including 6PPD-quinone, a toxic chemical that is responsible for killing coho salmon (Tian et al., 2020).

The State of Washington assessed which stormwater treatment BMPs are expected to reduce concentrations of 6PPD and 6PPD-quinone in stormwater runoff (Washington State Department of Ecology, 2022). Stormwater BMPs that provide for infiltration, biofiltration BMPs that use bioretention soil media or compost, and treatment BMPs that allow for sorption were identified as providing a high level of treatment. Thus the Modified Project's post-construction BMPs, which incorporate infiltration and biofiltration with compost-amended media, will remove 6PPD and 6PPD-quinone from the Modified Project's runoff. Preventive operation and maintenance, such as street sweeping and catch basin cleaning, are likely helpful in preventing the transport of tire wear debris and reducing the magnitude of treatment needed to prevent impacts to receiving waters (Washington State Department of Ecology, 2022). The Modified Project includes both of these source control measures, further addressing potential impacts from these contaminants.

With the implementation of the comprehensive site design, source control BMPs, and LID treatment control BMPs, potential impacts, after treatment via BMPs, from tire wear particles from the Modified Project are considered less than significant. The Modified Project will not

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[26] In 2014, the Court of Appeal determined the State Certified EIR's analysis of juvenile steelhead impacts and conclusion that impacts on steelhead would be less than significant was supported by substantial evidence. (*Center for Biological Diversity v. California Dept. of Fish & Game* (2014) Case No. B245131.) The State Certified EIR, according to the Court, properly analyzed copper runoff by using the CTR.

In 2015, the Court of Appeal again upheld a less-than-significant impact determination for juvenile steelhead in the Mission Village Project EIR. That EIR also utilized the CTR as a benchmark for its significance determination, as well as the requirements set forth in the Regional MS4 Permit, Standard Urban Stormwater Mitigation Plan requirements, and LID performance standards. The Court held that it was well within the lead agency's discretion to use the "federally mandated California Toxics Rule for assessing the effects of dissolved copper." (*California Native Plant Society v. County of Los Angeles* (2015) Case No. B258090, at p. 71.)

[27] *Center for Biological Diversity v. U.S. Army Corps of Eng'rs*, 2015 WL 12659937 (C.D. Cal. June 30, 2015), affirmed sub nom. *Friends of the Santa Clara River v. U.S. Army Corps of Eng'rs*, 887 F.3d 906 (9th Cir. 2018).

result in any new significant impacts on water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.2.9 Constituents of Emerging Concern

Emerging contaminant concentrations in stormwater runoff can be expected to be reduced via treatment in the Modified Project's LID BMPs, which would include unit processes to filter, sorb, and biologically transform CECs in stormwater runoff. However, expected effluent concentrations from LID BMPs are not known, nor are the effect of these concentrations on the aquatic ecosystem.

Given the thousands of chemicals that are potentially present in the aquatic environment and that information about CECs is rapidly evolving, developing a methodology to assess impacts from CECs in stormwater runoff (and wastewater) is being addressed at the state level. A Science Advisory Panel developed and recommended a risk-based screening framework to identify CECs for monitoring in California's aquatic ecosystems in 2012 (SCCWRP, 2012a). The 2012 Panel applied the framework using existing information to three representative receiving water scenarios to identify a list of appropriate CECs for initial monitoring, developed an adaptive phased monitoring approach and suggested development of bioanalytical screening and predictive modeling tools to improve assessment of the presence of CECs and their potential risk to the environment.

Considering the knowledge gained during the last decade from ongoing CEC monitoring within the State of California and from research outside the state, the SWRCB in conjunction with the Ocean Protection Council and a group of stakeholder advisors re-convened a group of leading scientists in October 2020 to address the issues associated with CECs in the State's aquatic systems (Drewes et al., 2022) . The 2022 Panel was provided with six specific charge questions, but was generally tasked to review the occurrence, relevance, and quantification of CECs with a main focus on ambient surface fresh, marine, and estuarine water ecosystems with the goal to provide recommendations for development of a monitoring program of CECs in fresh, estuarine, and oceanic water bodies of California. The 2022 Panel's report (Drewes et al., 2022) provides the results from the Panel's deliberations, including four products intended to assist the State in developing a monitoring process for CECs based on sound, up-to-date scientific principles.

The SWRCB is one of six agencies that are tasked with various environmental oversight, and each agency has a role about managing CECs in California. The SWRCB implements CEC monitoring and management strategies for permitted discharges and receiving waters. Several regional water quality control boards have monitored and continue to monitor for CECs in wastewater effluent, stormwater runoff, and ambient water through pilot studies, Regional Monitoring Programs, and permit requirements. In addition, the SWRCB has convened expert panels, funded research, and developed guidelines and regulations to monitor CECs in aquatic systems statewide. The SWRCB's CEC Program is currently developing a statewide CEC management strategy that will result in more coordinated efforts to address CECs in the environment.

Implementation of a state-level program to evaluate the occurrence and effects of CECs in stormwater will result in the development of control measures that will reduce potential water quality impacts. It is anticipated that the Modified Project will not result in substantial changes in emerging contaminant concentrations in receiving waters causing a violation of the water quality standards or waste discharge requirements or otherwise substantially degrade water quality in the receiving waters.

7.2.9.1 PFAS

Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic chemicals with past and current uses in industrial processes and consumer products (Ozekin and Fulmer, 2019). One of the most frequently used classes of PFAS are the perfluoroalkyl acids (PFAAs), whose structure consists of a completely fluorinated carbon chain of varying length and a charged functional group, such as carboxylic or sulfonic acid. The most notable PFAAs are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), but there are many others. PFAAs are extremely recalcitrant and persistent in the environment and occur ubiquitously worldwide.

PFAS are used in firefighting foams, coating for food packaging, ScotchGard™, and Teflon™, among other products (Ozekin and Fulmer, 2019). PFAS help these products resist stains, grease, or water. In industrial applications, they act as an emulsifier or surfactant. Exposure to PFAS can occur through use of products, or consumption of food or water containing PFAS. These substances do not break down easily, and therefore persist in the environment. They are also soluble in water and can enter source waters through industrial releases, discharges from wastewater treatment plants, stormwater runoff, release of firefighting foams, and land application of contaminated biosolids.

Over the last decade, there has been a move to the manufacture and use of PFAS that may be less bioaccumulative and may be less likely to cause adverse health effects in humans and the environment (USEPA, 2019). The major manufacturer of PFOS phased out U.S. production in 2002 and other major companies are working to reduce worldwide use and emissions of PFOA (Ozekin and Fulmer, 2019). However, contamination from legacy PFAS and uncertainty regarding the safety of newer, alternative, PFAS compounds in the environment are a continuing concern.

In May 2016, USEPA established drinking water health advisory levels for PFOS and PFOA of 0.07 µg/L based on lifetime exposure concerns for sensitive subpopulations (USEPA, 2016b). USEPA health advisories are non-enforceable, intended to provide information to state agencies and other public health officials, but they also include recommendations for water systems, and states may choose to adopt associated regulations. These recommendations suggest that when individual or combined concentrations of PFOS and PFOA exceed 0.07 µg/L, water utilities undertake additional sampling, notify their state agency, and inform their customers regarding concentrations found, risks of PFAS, and actions planned (USEPA, 2016).

In late March 2018, Congress passed an omnibus spending bill, which included nearly 100 million dollars for activities related to PFAS, including 10 million dollars for a nationwide health study.

In February 2019, the USEPA released the PFAS Action Plan (USEPA, 2019), which offers a path forward for communities that need help assessing and responding to their local PFAS concerns, which offers a path forward for communities that need help assessing and responding to their local PFAS concerns. The Action Plan describes priority actions the USEPA has identified to manage PFAS, which include: (1) evaluating the need for a maximum contaminant level for PFOA and PFOS in drinking water, (2) taking steps to designate PFOA and PFOS as Comprehensive Environmental Response, Compensation and Liability Act hazardous substances, (3) developing groundwater cleanup recommendations for PFOA and PFOS at contaminated sites, and (4) developing toxicity values or oral reference doses for replacement PFAS chemicals (USEPA, 2019).

In October 2021, the USEPA released the PFAS Strategic Roadmap (USEPA, 2021), which builds on and accelerates implementation of policy actions identified in the Agency's 2019 action plan. The roadmap lays out EPA's whole-of-agency approach to addressing PFAS and sets timelines by which the Agency plans to take specific actions in 2021 through 2024. EPA's integrated approach to PFAS is focused on three central directives:

- Research. Invest in research, development, and innovation to increase understanding of PFAS exposures and toxicities, human health and ecological effects, and effective interventions that incorporate the best available science.
- Restrict. Pursue a comprehensive approach to proactively prevent PFAS from entering air, land, and water at levels that can adversely impact human health and the environment.
- Remediate. Broaden and accelerate the cleanup of PFAS contamination to protect human health and ecological systems.

In December 2022, USEPA issued the memorandum "Addressing PFAS Discharges in National Pollutant Discharge Elimination System (NPDES) Permits and Through the Pretreatment Program and Monitoring Programs" (USEPA, 2022) designed to "align wastewater and stormwater NPDES permit and pretreatment program implementation activities with the goals in the [Roadmap]." In January 2023, USEPA released "Effluent Guidelines Program Plan 15", which describes analyses, studies, and rulemakings related to effluent limitation guidelines and pretreatment standards (USEPA, 2023a).

On March 14, 2023, EPA announced the proposed National Primary Drinking Water Regulation (NPDWR) for six PFAS including PFOA, PFOS, perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA, commonly known as GenX Chemicals), perfluorohexane sulfonic acid (PFHxS), and perfluorobutane sulfonic acid (PFBS). The proposed MCL for PFOA and PFOS is 4.0 ng/L. The proposed rule also would place limits on any mixture containing one or more of PFNA, PFHxS, PFBS, and/or GenX Chemicals. For these PFAS, water systems would use an approach called a hazard index[28] to determine if the

[28] The Hazard Index is a tool used to evaluate health risks of simultaneous exposure to mixtures of related chemicals. To prevent health risks from mixtures of certain PFAS in drinking water, EPA is proposing that water systems use this Hazard Index approach to regulate PFHxS, GenX Chemicals, PFNA, and PFBS. To determine the Hazard Index for these four PFAS, water systems would monitor and compare the amount of each PFAS in drinking water to its associated Health-Based Water Concentration (HBWC), which is the level at which no health

combined levels of these PFAS pose a potential risk (USEPA, 2023b). The proposed PFAS NPDWR does not require any actions until it is finalized. EPA anticipates finalizing the regulation by the end of 2023 (USEPA, 2023). EPA is also proposing health-based, non-enforceable Maximum Contaminant Level Goals (MCLGs) for these six PFAS. The proposed goal for PFOA and PFOS is zero. The proposed goal for the other four PFAS compounds is a Hazard Index of 1.0. The proposed rule would also require public water systems to:

- Monitor for these PFAS
- Notify the public of the levels of these PFAS
- Reduce the levels of these PFAS in drinking water if they exceed the proposed standards.

The USEPA is leading efforts with federal, state, tribal, and community partners to better characterize and mitigate risks related to the presence of PFAS in the environment (USEPA, 2019). USEPA is working with partners to accomplish these goals through pollution prevention, characterization and remediation of contamination in the environment, evaluation of human health and ecological risks, reducing exposures, development of treatment and remediation technologies, dissemination of risk communication materials, identification of safer alternatives, and use of enforcement authorities and regulatory approaches as appropriate.

Industry categories known or suspected to discharge PFAS include: organic chemicals, plastics & synthetic fibers; metal finishing; electroplating; electric and electronic components; landfills; pulp, paper and paperboard; leather tanning and finishing; plastics molding & forming; textile mills; paint formulating; and airports (USEPA, 2019). Due to the nature of the proposed land uses in the Modified Project, the Modified Project will not result in substantial or significant changes in PFAS concentrations in receiving waters causing a violation of the water quality standards or waste discharge requirements or otherwise substantially degrade water quality in the receiving waters.

7.2.10 Pollutant Bioaccumulation

The Basin Plan contains a narrative objective for bioaccumulation[29] which states that toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels which are harmful to aquatic life or human health. Certain toxic pollutants can bioaccumulate in fish and other organisms at levels that are harmful for both the organism as well as the organisms that prey upon these species (including humans). An important pathway into the food chain is via sediments, as many bioaccumulative pollutants of concern are adsorbed to sediments. Pollutants that are known to bioaccumulate include certain pesticides, certain metals (i.e., lead and

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effects are expected for that PFAS. Water systems would add the comparison values for each PFAS contained within the mixture. If the value is greater than 1.0, it would be an exceedance of the proposed Hazard Index MCL for these four PFAS.

[29] Bioaccumulation is the net uptake and retention of a chemical in an organism from all routes of exposure (diet, dermal, respiratory) and any source (water, sediment, food) (Weisbrod et al., 2007).

mercury), PAHs, and certain synthetic organic compounds like PCBs and dioxins (USEPA, 2014).

Bioaccumulative pollutants that are present in stormwater runoff from the Modified Project may have the potential to accumulate in LID treatment control BMP vegetation and soils, potentially increasing the risk of exposure to wildlife and the food chain. Factors that could affect the extent of potential bioaccumulation include:

- The bioavailability of the pollutant;
- Conditions in the soils (e.g., pH, acid-volatile sulfide concentration, organic content) that affect the form and bioavailability of the pollutant;
- The efficiency by which pollutants in the soils enter the plant community, the storage of these pollutants in plant tissues that are edible, and the utilization of the plants as a food source by animals;
- The type of habitats, organisms attracted to these habitats, and their feeding habits; and
- System design and maintenance.

Tests on the survival of amphipods in sediments from receiving waters in urbanized watersheds indicate that the strongest negative correlation was between amphipod survival and the sum of pyrethroid pesticides, the sum of PCBs, and the sum of DDT (Anderson et al, 2013). PAHs and metals did not show a significant negative correlation. As PCBs and DDT are not anticipated to be in the runoff from the proposed Modified Project, based on these results the major pollutant class of concern regarding bioaccumulation is pyrethroid pesticides, which are discussed in Section 7.2.2 above.

Mercury and selenium may be of concern with regard to bioaccumulation if they were present in runoff from the Modified Project. Selenium is not naturally present at levels of concern in the Modified Project's watershed, as discussed in Section 7.2.7 above. Mercury sources include fossil fuel power plant emissions and exposed tailings at former mercury mines, which are also not present at the Modified Project site. Thus, bioaccumulation of mercury and selenium are not of concern for the Modified Project.

The potential for bioaccumulation impacts from the proposed LID treatment control BMPs would be minimal. The vegetation and soil media in the LID BMPs will trap sediments and pollutants in the soils, which contain bacteria that metabolize and transform pollutants, therefore reducing the potential for these pollutants to enter the food chain. The facilities would not provide open water areas and are not likely to attract waterfowl. Bioaccumulation of pollutants in the Santa Clara River is not of concern due to the low concentrations of pollutants, below the benchmark Basin Plan objectives and CTR criteria, predicted in the treated runoff.

Based on these considerations, the Modified Project will not result in any new significant impacts on pollutant bioaccumulation compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.3 Waste Discharge Requirements

Modified Project BMPs include site design, source control, LID treatment control BMPs in compliance with the Regional MS4 Permit and the LID Manual requirements, as described in Section 3. LID treatment control BMPs will collect and retain and/or biotreat runoff from the entire developed portion of the Modified Project. Sizing criteria contained in the Regional MS4 Permit and LID Manual will be met for all LID BMPs.

In summary, the proposed site design, source control, and LID treatment control BMPs have been selected based on:

- Effectiveness for addressing pollutants of concern in Modified Project runoff, resulting in insignificant water quality impacts;
- Sizing and design consistent with the Regional MS4 Permit, LID Ordinance, and LID Manual requirements;
- Additional design guidance consistent with the LID Manual, other literature, and best professional judgment;
- Hydrologic and water quality modeling to verify performance; and
- Providing specific O&M requirements to inspect and maintain the facilities.

On this basis, the proposed BMPs meet the Regional MS4 Permit, LID Ordinance, and LID Manual requirements for new development and the Modified Project would comply with all waste discharge requirements for surface water runoff.

Compliance with Los Angeles County Code and Regional MS4 Permit requirements would preclude standing water conditions that could increase habitat for mosquitoes and other vectors. The Modified Project's water quality BMPs would also be designed to preclude the potential for standing water to occur within the Modified Project Site. Additionally, any water features that may be introduced as part of the Modified Project would comply with all regulatory requirements related to standing water limitations. As a result, the Modified Project would not add water features or create conditions in which standing water can accumulate that would result in conditions necessitating increased pesticide use. On this basis, the Modified Project's impact related to mosquito and other vector habitat would be less than significant. Further discussion of water quality impacts related to pesticides is provided in Section 7.2.2 above.

In summary, the Modified Project will not result in any new significant impacts on compliance with waste discharge requirements compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.4 Construction-Related Impacts

The analysis of potential impacts of construction activities, construction materials, and non-stormwater runoff on water quality during the construction phase focuses primarily on sediment (TSS and turbidity) and certain non-sediment related pollutants. Construction-related activities that are primarily responsible for sediment releases are related to exposing previously stabilized soils to potential mobilization by rainfall/runoff and wind. Such activities include removal of vegetation from the site, grading of the site, and trenching for infrastructure improvements. Environmental factors that affect erosion include topographic, soil, and rainfall characteristics. Non-sediment related pollutants that are also of concern during construction relate to construction materials and non-stormwater flows and include construction materials (e.g., paint, stucco, etc.); sanitary/septic waste; chemicals, liquid products, and petroleum products used in building construction or the maintenance of heavy equipment; and concrete-related pollutants.

Construction impacts due to Project development will be minimized through compliance with the CA CGP. This permit requires the discharger to perform a risk assessment of the proposed development (with differing requirements based upon the determined Risk Level), prepare and implement a SWPPP according to the determined Project Risk Level, which must include BMPs for erosion and sediment control and management of other potential construction-related pollutants. A Construction Site Monitoring Program that identifies monitoring and sampling requirements during construction is a required component of the SWPPP.

Preliminary analysis indicates that the Project will most likely be categorized as a Risk Level 2. BMPs required by the CA CGP will be incorporated assuming this level of risk; if final design analysis indicates that the Project will fall under Risk Level 3, the additional Level 3 permit requirements will be implemented as necessary.

7.4.1 Compliance with Construction Permit and Construction Impacts

Prior to the issuance of preliminary or precise grading permits, the landowner or subsequent Project applicant will provide the County with evidence that a NOI has been filed with the SWRCB. Such evidence will consist of a copy of the NOI from the SWRCB or RWQCB, or a letter from either agency stating that the NOI has been filed and a copy of the Project's applicable Waste Discharge Identification (WDID) number.

Construction at the Project may require dewatering. For example, dewatering may be needed if water has been standing onsite and needs to be removed for construction, vector control, or other reasons. Further, dewatering may be necessary if groundwater is encountered during grading, or to allow discharges associated with testing of water lines, sprinkler systems and other facilities.

The CA CGP includes specific construction site dewatering provisions designed to eliminate or reduce pollutant impacts on receiving waters from these activities. Dischargers with dewatering activities not subject to a separate NPDES permit (e.g., de minimis and low threat discharges) shall comply with the following dewatering discharge requirements listed in Attachment J of the CA CGP:

(a) The discharge complies with receiving water limitations in Section IV.D of the CA CGP;

(b) The discharge is absent of pollutants in quantities that threaten to cause pollution or a nuisance;

(c) The dewatering activity takes place in an area without known (including, but not limited to information from: Geotracker, local permitting authorities, Water Boards, etc.) soil and/or groundwater contamination where that contamination could cause an exceedance of receiving water limitations;

(d) The discharger shall utilize outlet structures that withdraw water from the surface when conducting dewatering activity from sediment basins or similar impoundments, unless infeasible; and,

(e) The discharger shall cease discharge if necessary, as follows:

(i) Through an automated sampling device capable of ceasing the discharge if a single sample concentration/level exceeds the NAL(s); or,

(ii) By a QSP or trained delegate who is present during the operation of the mechanical pumping and/or syphoning of the dewatering activity and is able to halt dewatering if a NAL is exceeded for a single sample.

Additional BMPs will be implemented to protect receiving waters from dewatering and construction related non-stormwater discharges. Such discharges will be implemented in compliance with LARWQCB Order No. R4-2018-0125 governing construction-related dewatering discharges within the Project development areas. Typical BMPs for construction dewatering include infiltration of clean groundwater; on-site treatment using suitable treatment technologies; on-site or transport offsite for sanitary sewer discharge with local sewer district approval; or use of a sedimentation bag for small volumes of localized dewatering.

Based on these considerations, the Modified Project will not result in any new significant impacts from construction-related runoff compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.5 Dry Weather Runoff

Pollutants in dry weather flows could also be of concern because dry weather flow conditions occur throughout a large majority of the year, and because some of the TMDLs in downstream reaches of the Santa Clara River are applicable for dry weather conditions (e.g., nutrients and chloride).

Dry weather flows are typically low in sediment because the flows are relatively low and coarse suspended sediment tends to settle out or is filtered out by vegetation. As a consequence, pollutants that tend to be associated with suspended solids (e.g., phosphorus, some bacteria, some trace metals, and some pesticides) are typically found in very low concentrations in dry weather flows. The focus of the following discussion is therefore on constituents that tend to be dissolved, e.g., nitrate and trace metals, or constituents that are small or hydrophobic as to be effectively transported, e.g., pathogens or oil and grease.

In order to minimize the potential generation and transport of dissolved constituents, landscaping in public and common areas will utilize drought-tolerant vegetation that requires little watering and chemical application. Landscape watering in common areas, commercial areas, multiple family residential areas, and in parks will use efficient irrigation technology utilizing evapotranspiration sensors to minimize excess watering.

In addition, educational programs and distribution of materials (source controls) will emphasize appropriate car washing locations (at commercial car washing facilities or the car wash pad in the multi-family residential areas) and techniques (minimizing usage of soap and water), encourage low impact landscaping and appropriate watering techniques, appropriate swimming pool dechlorination and discharge procedures, and discourage driveway and sidewalk washing. Illegal dumping will be discouraged by stenciling storm drain inlets and posting signs that illustrate the connection between the storm drain system and the receiving waters and natural systems downstream.

The parcel-based and regional LID treatment control BMPs will provide treatment for and infiltrate dry weather flows and small storm events. Water cleansing is a natural function of vegetation and biologically active media, offering a range of treatment mechanisms. Sedimentation of particulates is the major removal mechanism. However, the performance is enhanced as plant materials allow pollutants to come in contact with vegetation and soils containing bacteria that metabolize and transform pollutants, especially nutrients and trace metals. Plants also take up nutrients in their root system. Pathogens would be removed through infiltration. Any oil and grease will be effectively adsorbed by the vegetation and soil within LID treatment control BMPs. Dry weather flows and small storm flows will infiltrate into the bottom of the LID treatment control BMPs after receiving treatment in the vegetation.

The LID treatment control BMPs will infiltrate or evapotranspire all expected dry weather runoff. It is expected that no dry weather discharge from the Modified Project site to the Santa Clara River will occur. Based on these considerations, the Modified Project will not result in any new significant impacts from dry weather runoff compared to the 2017 Approved Project analyzed in the State Certified EIR..

7.6 Wastewater Impacts

7.6.1 Chloride

The Regional Water Board has determined that high levels of chloride (salt) harm salt-sensitive avocado and strawberry crops along SR-126 downstream of the Modified Project. The Regional Water Board has developed and adopted a chloride TMDL, which is part of the Basin Plan.

7.6.1.1 Upper Santa Clara River Chloride TMDL

The Regional Water Board first adopted a TMDL for chloride in the USCR in October 2002 (Resolution No. 2002-018). The Regional Water Board amended the USCR Chloride TMDL to revise the interim WLAs and implementation schedule (Resolution 04-004). The amended TMDL was approved by the State Water Resources Control Board, Office of Administrative Law, and the USEPA, and became effective on May 4, 2005. The chloride TMDL requires that chloride levels in WRP effluent not exceed 100 mg/L.

When the TMDL was adopted and approved, there were key scientific uncertainties regarding the sensitivity of crops to chloride and the complex interactions between surface water and groundwater in the USCR watershed. The TMDL recognized the possibility of revised chloride water quality objectives (WQO) and included mandatory reconsiderations by the Regional Water Board to consider Site Specific Objectives (SSO). The TMDL required the LACSD to implement special studies and actions to reduce chloride loadings from the Saugus and Valencia WRPs. The TMDL included the following special studies to be considered by the Regional Water Board:

- Literature Review and Evaluation (LRE) - review agronomic literature to determine a chloride threshold for salt sensitive crops.
- Extended Study Alternatives (ESA) - identify agricultural studies, including schedules and costs, to refine the chloride threshold.
- Endangered Species Protection (ESP) - review available literature to determine chloride sensitivities of endangered species in the USCR.
- Groundwater and Surface Water Interaction Study (GSWI) - determine chloride transport and fate from surface waters to groundwater basins underlying the USCR.
- Conceptual Compliance Measures - identify potential chloride control measures and costs based on different hypothetical WQO and final WLA scenarios.
- Site-Specific Objectives and Antidegradation Analysis - consider a site-specific objective for chloride based on the results of the agricultural chloride threshold study and the GSWI.

The TMDL special studies were conducted in a facilitated process in which stakeholders participated in scoping and reviewing the studies. This process resulted in an alternative TMDL implementation plan that addressed chloride impairment of surface waters and degradation of groundwater. The Alternative Water Resources Management (AWRM) program was first set forth by the Upper Basin water purveyors and United Water Conservation District (UWCD), the management agency for groundwater resources in the Ventura County portions of the USCR watershed. The AWRM program increased chloride WQOs in certain groundwater basins and reaches of the USCR watershed, decreased the chloride objectives in the eastern Piru Basin, and resulted in an overall reduction in chloride loading as well as water supply benefits (LARWQCB, 2008).

The AWRM program, which is described in detail in the GSWI Task 2B-2 Report (Geomatrix, 2008), consisted of advanced treatment for a portion of the recycled water from the Valencia WRP; construction of a well field in the eastern Piru basin to pump out higher chloride groundwater; discharging the blended pumped groundwater and advanced treated recycled water to Reach 4A at the western end of the Piru basin at a chloride concentration not to exceed 95 mg/L; and conveyance of supplemental water and advanced treated recycled water to the Santa Clara River.

A GSWI model was developed to assess the linkage between chloride sources and instream water quality, and to quantify the assimilative capacity of Santa Clara River Reaches 4A, 4B, 5, and 6 and the groundwater basins underlying those reaches (LARWQCB, 2008). GSWI was then used to predict the effects of WRP discharges on chloride loading to surface water and groundwater under a variety of future hydrology, land use, and water use assumptions to determine appropriate WLAs and load allocations. The GSWI model was used to assess the ability of the AWRM to achieve compliance with proposed conditional SSOs under future water use scenarios within the USCR watershed. The model was based on design capacities at Valencia WRP and Saugus WRP of 27.6 mgd and 6.5 mgd, for a total system design capacity of 34.1 mgd by year 2027 (LARWQCB, 2008). The model predicted that the AWRM could achieve the proposed conditional SSOs for chloride under both drought and non-drought conditions. In

December 2008, the Regional Water Board revised the USCR Chloride TMDL with the conditional chloride SSOs (Resolution No. R4-2008-012). This TMDL revision became effective on April 6, 2010.

Existing Chloride Concentration at Valencia WRP

The SCVSD completed a detailed and comprehensive study of the sources of chloride loading in the Santa Clarita Valley (Geomatrix, 2008). Subsequently, the Regional Water Board and County Sanitation Districts staff analyzed chloride sources in the USCR watershed (LARWQCB, 2008). These analyses utilized mass balance techniques to identify and quantify chloride loads from imported water and residential, commercial, industrial, and WRP sources.

These reports found that the chloride in Valencia WRP effluent is comprised of two primary sources: chloride present in the potable water supply and chloride added by residents, businesses, and institutions in the Valencia WRP service area. Potable water in the Santa Clarita Valley is derived from two sources: imported water delivered under the State Water Modified Project (SWP) and local groundwater. The chloride concentration in these two sources varies depending on several factors, most notably rainfall patterns. The chloride concentrations in Santa Clarita Valley water supplies that include SWP water are variable and, during times of extended dry weather or drought, exceed the 100 mg/L Basin Plan objective for the Santa Clara River. Chloride concentrations in Santa Clarita Valley water supplies ranged from 52 mg/L to 85 mg/L from 2002 to 2010 (LACSD, 2010).

The chloride load added by users can be further divided into two parts: brine discharge from self-regenerating water softeners (SRWS) and all other loads added by users. Excluding chloride concentration in the water supply, non-SRWS sources of chloride include residential, commercial, industrial, infiltration, and wastewater disinfection. Based on the SCVSD's 2002 chloride source study, once this water was delivered to homes and businesses for interior use, the use of SRWS added 78 mg/L of chloride concentration to the water supply before it was disposed of in the sewer for treatment. This high chloride addition suggested that source controls could significantly improve water quality in the Santa Clara River. Based on the results of the 2002 study, the SCVSD adopted an ordinance prohibiting the installation and use of new SRWS in 2003. Further, SCVSD implemented Automatic Softener Rebate Programs in 2005 (Phase I) and 2007 (Phase II), followed by the 2009 Ordinance that required removal and disposal of all SRWS installed in the SCVSD's service area. These efforts have resulted in significant reduction of chloride generated by SRWS. Based on the SCVSD's "2010 Chloride Source Identification/Reduction, Pollution Prevention, and Public Outreach Plan," (November 2010), concentration of chloride produced by SRWS was 6 mg/L in the SCVSD final effluent in the first half of 2010. SCVSD's goal is to completely eliminate SRWS from the SCVSD's service area; the community has removed more than 8,000 SRWS (SCVSD, 2017).

Other residential sources of chloride include human waste, laundering, other cleaning activities, and swimming pool filter backwash. This loading adds approximately 22 mg/L of chloride in the SCVSD final effluent (LACSD, 2010). The combined chloride load from commercial, industrial and hauled non-industrial waste represents approximately seven percent of the overall chloride concentration in the SCVSD's final effluent (which corresponds to 10 mg/L chloride) (LACSD, 2010). Disinfection practices at the SCVSD's Valencia WRP contribute about 12 mg/L, representing approximately nine percent of the total effluent chloride concentration (LACSD, 2010). The Modified Project is expected to produce wastewater chloride concentrations similar to those in the existing SCVSD service area.

TMDL Compliance

In order to comply with the USCR Chloride TMDL, the SCVSD will need to add facilities because the existing treatment processes do not provide chloride removal. The Valencia WRP NPDES Permit (Order No. R4-2015-0071) includes requirements and deadlines for several implementation actions related to adding chloride removal facilities, including the preparation of a Wastewater Facilities Plan and Programmatic Environmental Impact Report for facilities to comply with the final permit effluent limit of 100 mg/L and start-up of the facilities by July 1, 2019. During this period, an interim effluent limitation for chloride, which is equal to the sum of the State Water Project treated water supply chloride concentration plus 134 mg/L, expressed as a 12-month rolling average but not to exceed a daily maximum of 230 mg/L, is in effect. The Valencia WRP discharges have been in compliance with this interim effluent limitation.

The SCVSD prepared the Wastewater Facilities Plan and Programmatic Environmental Impact Report in 2013 (SCVSD, 2013). The SCVSD Board of Directors certified the Environmental Impact Report and adopted the Final Chloride Compliance Facilities Plan on October 29, 2013. The Facilities Plan documented the technical studies completed to identify the most cost-effective and environmentally-sound methods for meeting the chloride limit. The Board approved Alternative No. 2 in the Facilities Plan, a project consisting of UV disinfection, advanced treatment using reverse osmosis, and deep well injection for brine disposal.

The SCVSD prepared a Final Recirculated Santa Clarita Valley Sanitation District Chloride Compliance Project Environmental Impact Report – Separation of Recycled Water Project (Final Recirculated EIR) in 2017 (LACSD, 2017). The Final Recirculated EIR, as discussed below, updated prior analysis of impacts of a plan to comply with the State-mandated chloride limit (Chloride Compliance Project) and includes multiple components:

- The Chloride Compliance Project was studied previously in an EIR certified by SCVSD in 2013 (2013 EIR). The 2013 EIR was decertified pursuant to an order by the Los Angeles County Superior Court (Court), but the analysis contained in the 2013 EIR was, for the most part, upheld by the Court. The Final Recirculated EIR updated the analysis contained in the 2013 EIR and 2016 Trucking Supplemental EIR, where necessary, to address new information or changed circumstances, including the SCVSD's subsequent decision to abandon plans to dispose of brine through deep well injection and also to separately pursue plans for the eventual reuse of the treated water (Recycled Water Modified Project).
- The Chloride Compliance Project is unchanged from the projects analyzed in the 2013 EIR, reproduced at Section 11 of the Final Recirculated EIR, and the 2016 Trucking SEIR, reproduced at Section 12 of the Final Recirculated EIR, except that the SCVSD plans to proceed with the Chloride Compliance Project separately from the Recycled Water Project[30]. The Chloride Compliance Project is comprised of UV

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[30] Unrelated to the chloride compliance solutions, the SCVSD also considered a plan to reduce the discharge of treated water from the water reclamation plants to the SCR (SCVSD, 2017). The 2013 EIR described this activity as "Support

disinfection at the Saugus and Valencia WRPs, advanced water treatment (for chloride compliance and brine concentration) at the Valencia WRP, and brine disposal by limited trucking to the Joint Water Pollution Control Plant in Carson, California, which is owned and operated by the LACSD.

- The SCVSD Board of Directors (Board) approved and certified the Final Recirculated EIR on August 30, 2017. The Board also decertified the 2013 EIR and 2016 Trucking SEIR, as the Final Recirculated EIR became the operative California Environmental Quality Act document for the Chloride Compliance Modified Project, including the plan for brine management.

Construction of the UV disinfection systems began in November 2018 with startup in August 2021 at the Valencia WRP, and July 2021 at the Saugus WRP. Construction of the advanced water treatment at the Valencia WRP began in April 2019 and is anticipated to be complete in October 2023. The LARWQCB issued a Time Schedule Order (Order No. R4-2019-0055-A03) in December 2022 that extends the interim effluent limitation for chloride in the Valencia WRP effluent to October 31, 2023.

The Valencia WRP must comply with its NPDES wastewater discharge permit which contains a chloride effluent limitation that is protective of water quality and beneficial uses in the Santa Clara River and will not result in the impairment of surface or groundwater quality. Additionally, the SCVSD has adopted an implementation plan and schedule that incorporates chloride source reduction actions and chloride load reduction through advanced treatment (i.e., reverse osmosis) of the Valencia WRP effluent which will mitigate the effect of chloride accumulation in surface and groundwater. Therefore, the Modified Project will not result in any new significant impacts to chloride from treated wastewater discharges compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.6.2 Constituents of Emerging Concern

Although thousands of substances may be detected in the environment, only a small percentage of known chemicals are currently regulated and/or routinely monitored in California receiving waters. The much larger group of chemicals that remain largely unregulated and/or unmonitored in the aquatic environment, known as CECs, may originate from a wide range of point and non-point sources (SCCWRP, 2012a). The largest class of CECs is industrial chemicals, followed by

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for Municipal Reuse of Recycled Water" (Recycled Water Project) and analyzed the potential environmental impacts to biological resources (including an endangered fish known as the unarmored three-spine stickleback, or UTS) that could occur from a proposed approximate one-third reduction in discharge associated with that project. The technical analysis that supported the 2013 EIR concluded that no significant impact would occur from the Recycled Water Project. The Recycled Water Project would permit the direction of treated wastewater (recycled water) to community reuse such as landscape irrigation. Even though the Chloride Compliance Project and the Recycled Water Project are independent efforts (i.e., implementation of one does not require or necessitate implementation of the other), both projects were addressed in the 2013 EIR. The Recycled Water Project is discretionary, and the Chloride Compliance Project is a State-mandated project to improve water quality in the Santa Clara River.

ingredients in personal care products, food additives, pharmaceuticals, and pesticides (SCCWRP, 2012b).

In response to the lack of knowledge about the effects of CECs on aquatic resources, the State Water Resource Control Board in conjunction with the David and Lucile Packard Foundation and a group of stakeholder advisors tasked a group of leading scientists (the Panel) to address the issues associated with CECs in California's aquatic systems that receive discharge of treated municipal wastewater effluent.

The Southern California Coastal Water Research Project (SCCWRP) determined that effluent discharged from municipal wastewater treatment plants is a major source of CECs to receiving waters (SCCWRP, 2012a). Although most CECs occur in trace concentrations in wastewater treatment plant effluent, the large volume (e.g., close to one billion gallons per day into the southern California Bight alone) discharged to receiving waters in California throughout the year can results in total mass loadings that are comparable to regulated environmental contaminants (e.g., heavy metals). No systematic and comprehensive work has described the dimensions of CEC issues in wastewater treatment, including origins, distributions, fate and transport. (SCCWRP, 2012a.)

Removal of CECs in a wastewater treatment plant depends on their biodegradability and physicochemical properties, such as water solubility, hydrophobicity, and volatility. These properties influence whether a CEC will remain in the dissolved phase (like many pharmaceuticals) or adsorb to particles that end up as biosolids (e.g., estrogens or certain antibiotics). Multiple studies have demonstrated that sorption, aerobic and anaerobic biotransformation, abiotic degradation via hydrolysis, and volatilization are the primary attenuation mechanisms for CECs in wastewater treatment plants. (SCCWRP, 2012a.)

Treatment of synthetic organic compounds in wastewater treatment plants has been widely studied. While many studies agree that conventional wastewater treatment is not adequate to remove these compounds, a number of advanced treatment methods are effective at removing compounds by more than 90 percent, to very low (nanogram per liter (ng/L)) levels (Kim, 2007; Snyder et al., 2007; Kosutic, 2007; Ozaki, 2008; Radjenovic, 2008).

Reverse osmosis (RO) and nanofiltration membrane processes have shown excellent removal rates for a variety of CECs in two studies, with one study demonstrating that membrane bioreactors followed by RO effectively removed all compounds analyzed in the study to ng/L levels or lower (Kim, 2007; Snyder, 2007). Additional studies conducted recently have shown similarly high removal efficiencies of CECs, with typical measured removal efficiencies of 90 percent or greater (Kosutic, 2007; Ozaki, 2008; Radjenovic, 2008). A widely used example of a water reclamation plant that employs RO membrane technology with good success is the Orange County Groundwater Replenishment System.

Based on the studies referenced herein, the Valencia WRP treatment processes, including the RO that will be installed to comply with the Chloride TMDL, will have good removal efficiencies of CECs that might arise in the Modified Project's wastewater. Additionally, the Valencia NPDES Permit (Order No. R4-2015-0071) is protective of beneficial uses and water quality and aquatic life in the Santa Clara River. The permit has provisions for acute and chronic toxicity along with prohibitions against all discharges of contaminants at concentrations which cause detrimental physiological responses in human, animal, or aquatic life.

Extensive monitoring is required to ensure that all discharged WRP effluent would meet the NPDES Permit provisions; additionally, the NPDES Permit terms effectively require the WRP to address all known toxic concentrations of contaminants that could be found in the effluent. Thus, as further studies are concluded and more is known regarding chronic toxicity effects of CECs, the WRP must ensure that the treatment processes are adequate to meet protective treatment standards.

An evaluation of water quality impacts from CECs in wastewater and recycled water requires implementation of a state-level program to evaluate the occurrence and effects of CECs (such as through the SWAMP program). This is also consistent with the strategy to address control of CECs in the Recycled Water Policy. As discussed in Section 7.2.9 above, the SWRCB's 2022 CEC Panel produced four products intended to assist the State in developing a monitoring process for CECs based on sound, up-to-date scientific principles. Implementation of a phased monitoring approach at the state level, with evaluation and adaptive management, is the current methodology established by the State of California to address CECs.

In summary, based on the fact that the Valencia WRP treatment processes will have good removal efficiencies of CECs that might arise in the Modified Project's wastewater and required compliance with the Valencia NPDES Permit, as discussed and analyzed above, potential impacts from the wastewater discharges on CECs in the receiving water are less than significant.

The Modified Project will not result in any new significant impacts from wastewater on water quality compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.7 Groundwater Impacts

7.7.1 Groundwater Quality Impacts

As described in the State Certified EIR, discharge from the Modified Project's developed areas to groundwater will occur in three ways: (1) through general infiltration of irrigation water, (2) through infiltration of urban runoff in the proposed LID treatment control BMPs after treatment, and (3) infiltration of urban runoff, after treatment in the Modified Project BMPs, in the Santa Clara River, which is the primary recharge zone for groundwater in the Santa Clara Valley. Groundwater quality will be fully protected through implementation of the Modified Project's site design, source control, and LID treatment control BMPs prior to discharge of Modified Project runoff to groundwater.

Stormwater infiltration poses few significant risks to underlying aquifers, as most pollutants carried by typical urban stormwater sorb to soils, accumulating in the upper layers. Metals, pathogens, hydrocarbons, and numerous organic compounds will either: 1) sorb to soil particles, 2) volatilize at the surface, or 3) degrade by microbial processes in surface and sub-surface soil layers (LASGRWC, 2005).

The pollutant of concern with respect to groundwater is nitrate plus nitrite. The Basin Plan groundwater quality objective for nitrate plus nitrite-nitrogen is 10 mg/L (which is more stringent than the objective for nitrate-nitrogen alone (10 mg/L) and for nitrite-nitrogen alone (1 mg/L)). The predicted nitrate plus nitrite concentration in runoff after treatment in the BMPs is 0.7 mg/L, which is well below the groundwater quality objective. Therefore, infiltration of post-development stormwater runoff would not cause significant adverse groundwater quality impacts.

Treated effluent from the Valencia WRP will be used to supply the distribution of recycled water to the Modified Project for irrigation of landscaping and other approved uses. The effluent limitation contained in the Valencia WRP NPDES Permit for nitrate plus nitrite-N is 6.8 mg/L and the limitation for nitrite-N is 0.9 mg/L (average monthly). As the Basin Plan groundwater quality objective for nitrate plus nitrite-nitrogen is 10 mg/L or 1 mg/L for nitrite-nitrogen, the WRP irrigation water supply that will serve the Modified Project will be well below the groundwater quality objectives. On this basis, the Modified Project will not result in any new significant impacts from infiltration of irrigation water compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.7.2 Groundwater Recharge Impacts

Modified Project groundwater recharge was calculated as a combination of three sources: 1) precipitation on pervious areas, 2) LID treatment control BMP infiltration, and 3) irrigation. Precipitation-based recharge from pervious Modified Project areas was estimated as 25 percent of the pervious area infiltration estimated in the water quality model results. LID treatment control BMP recharge was estimated as the difference between the model results for the developed condition with BMPs and the developed condition without BMPs. This difference is the average annual amount assumed to be captured and retained by the BMP. All retained volume in the BMPs is assumed to be recharged. For the Entrada South portion of the Modified Project, this value is 56 acre feet per year (afy). Since Valencia Commerce Center was modeled with lined parcel based BMPs, the average annual recharge volume is 0 afy. Irrigation recharge was estimated based on the total area in each land use category, multiplied by the estimated recharge in inches per acre of irrigated land use type.

The results of the recharge analysis for existing and developed conditions, calculated as the sum of the three recharge sub-totals is provided in Table 7-11 below for the Entrada South and VCC planning areas.

Table 7-11: Entrada South Average Annual Groundwater Recharge

Average Annual Recharge Estimate	Entrada South		VCC	
	Existing (afy)	Developed (afy)	Existing (afy)	Developed (afy)
Precipitation Recharge	130	73	120	77
LID BMP Recharge	0	56	0	0
Irrigation Recharge	0	37	0	10
Total Recharge	130	166	120	87

The recharge of precipitation is predicted to decrease in the developed condition by 100 afy due to the increase in impervious area as a result of Modified Project development. The predicted increase in recharge due to infiltration of stormwater runoff in the LID BMPs (56 afy) partially offsets the predicted decrease in precipitation recharge. Recharge associated with irrigation of landscaped areas is predicted to increase by 47 afy. Overall, based on this analysis, the Modified Project would increase groundwater recharge by 3 afy. On this basis, the Modified Project will not result in any new significant impacts on groundwater recharge compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.8 Hydromodification Impacts

Development typically increases impervious surfaces on formerly undeveloped (or less developed) landscapes, thereby reducing the capture and infiltration of rainfall. The result is that, as a watershed develops, a larger percentage of rainfall becomes runoff during any given storm. In addition, runoff reaches the stream channel more efficiently due to the development of storm drain systems, so that the peak discharge rates for rainfall events and floods are higher for an equivalent event than they were prior to development. Further, the introduction of irrigation and other dry weather flows can change the seasonality of runoff reaching natural receiving waters. These changes, in turn, affect the stability and habitat of natural drainages, including the physical and biological character of these drainages. This process, called "hydromodification" (SCCWRP, 2005), is addressed in this section.

The Santa Clara River and Castaic Creek will receive flows from developed areas within the Modified Project. Therefore, this analysis addresses the potential for hydromodification impacts to the Santa Clara River and Castaic Creek.

The physical alteration of natural drainages, such as bank protection, energy dissipaters, and bridge abutments, are not impacts created by changes in runoff volume, duration, or flow associated with development. Instead, these types of alterations are physical alterations to the stream bed and bank, with associated effects on stream habitat and species. These types of effects are analyzed in the State Certified EIR, as well as SEIR Section 5.2 (Biological Resources) and Section 5.5 (Hydrology and Water Quality – Hydrology).

7.8.1 Wet Weather Flows

The Regional MS4 Permit exempts projects from hydromodification control requirements that discharge directly or via a storm drain into a waterway with a 100-year peak flow (Q_{100}) of 25,000 cfs or more or other receiving waters that are not susceptible to hydromodification impacts. The Q_{100} in the Santa Clara River at the Modified Project location is 58,207 cfs (CDFW, 2017), and therefore, the Entrada South planning area is not required to incorporate hydromodification controls for direct discharges to the Santa Clara River. Furthermore, direct and indirect discharges to the Santa Clara River from the Modified Project are not expected to cause channel instability (Balance Hydrologics, 2005, see further *Cumulative Impacts* in Section 5.10.2 below).

As described in Catalyst, 2023 (see Appendix F), Castaic Creek is not susceptible to hydromodification impacts because:

- The reach of Castaic Creek through the Modified Project functions together and concurrently with the reset events of the Santa Clara River, and together the system is not susceptible to hydromodification.
- Castaic Creek downstream from the Interstate 5 and Old Road bridges to the Santa Clara River is subject to the fluvial geomorphology controlled by releases from Castaic Dam and the local subwatershed. This subwatershed is in highly erodible sediments and even in the controlled state has sediment production rates second only to Sespe Creek in the lower Santa Clara River watershed. As such, the reset events caused by approximately decadal spills from Castaic Dam overprint any morphological effects during lower flows, resulting in a reach that is not susceptible to hydromodification.

Projects that discharge directly or through a storm drain into concrete or otherwise engineered channel (i.e., channelized or armored with riprap, shotcrete), which, in turn, discharge into receiving water that is not susceptible to hydromodification impacts are also exempt from hydromodification control requirements by the Regional MS4 Permit. The Modified Project includes engineering and stabilization of Hasley Creek (PACE, 2022). The proposed channel stabilization on Hasley Creek includes adding grade control structures and soil-cement bank stabilization, which will reduce erosion potential of the channel up to the 100-year storm.

Additionally, the Modified Project's changes to the floodplain extents within Castaic Creek and Hasley Creek are environmentally beneficial, as the changes serve to preserve substantially more existing streambed, preserve more jurisdictional area, and provide stable systems for conveyance and flood protection through the subject reaches of both Castaic Creek and Hasley Creek (Catalyst, 2023).

The Modified Project will not result in any new significant wet weather hydromodification impacts compared to the 2017 Approved Project analyzed in the State Certified EIR. Consistent with the State Certified EIR, the increase in impervious surface within the Modified Project area is predicted to increase the average annual stormwater runoff volume from the Modified Project area by approximately 323 acre-feet per year, after accounting for the estimated volume reductions in the LID treatment control BMPs (see Table 7-1 and Table 7-5). The LID treatment control BMPs are estimated to reduce the increase in average annual stormwater runoff volume by approximately 56 acre-feet per year, an approximately 21 percent reduction of the predicted average annual post-development stormwater runoff volume without the LID treatment control BMPs.

Energy dissipation at storm drain outfalls would provide erosion protection in areas where discharges have the potential to cause localized stream erosion. Erosion protection will be provided at all storm drain outlets to the receiving waters.

Consistent with the State Certified EIR, although Modified Project runoff volumes, flow rates, and durations will increase, potential impacts of hydromodification (i.e., the potential to cause erosion, siltation, or channel instability) will be minimized by the Modified Project BMPs. The Modified Project's site design and LID treatment control BMPs will minimize increases in runoff volume from the development area, the preferred method for controlling hydromodification impacts from new development (SCCWRP, 2005). Potential in-stream impacts of increased volumes, rates, and flow durations will be managed and mitigated with energy dissipaters at the discharge points to the Santa Clara River. For these reasons, the Modified Project will not result in any new significant wet weather hydromodification impacts compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.8.2 Dry Weather Runoff

Source control and LID treatment control BMPs will prevent the discharge of dry weather urban runoff from the Modified Project. These BMPs include:

- The use of native and/or non-invasive, climate appropriate vegetation and smart irrigation controls.
- The use of the parcel-based LID BMPs, including, but not limited to, infiltration, bioinfiltration, and biofiltration BMPs placed in common area landscaping in commercial, multi-family residential, institutional, recreational, and park areas, roadway median strips, and parking lot islands (where applicable) and regional infiltration/biofiltration facilities incorporating natural vegetation.

Consistent with the State Certified EIR, Modified Project LID treatment control BMPs, which also provide hydrologic source control, will be designed to incorporate specific features to prevent or capture and infiltrate dry weather flows in compliance with the Basin Plan and the Regional MS4 Permit. The Modified Project will include numerous source controls that will reduce or eliminate dry weather flow generation at the source, such as education programs, use of native and/or non-invasive, climate appropriate vegetation, and smart irrigation systems in multi-family residential areas. The Modified Project will not result in any new significant impacts on dry weather runoff compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.9 Cumulative Impacts

7.9.1 Cumulative Surface Water Impacts

Consistent with the State Certified EIR, the anticipated quality of effluent from the Modified Project BMPs will not contribute concentrations of pollutants of concern that would be expected to cause or contribute to a violation of the water quality objectives for the Modified Project's surface receiving waters. Therefore, the Modified Project's incremental effects on surface water quality and hydromodification would be less than significant.

The Modified Project's surface runoff water quality with implementation of BMPs during the construction and post-construction phases is predicted to comply with adopted regulatory requirements that are designed by the SWRQCB and LARWQCB to assure that regional development does not adversely affect water quality in receiving waters, including the Regional MS4 Permits; Construction General Permit and General Dewatering Permit requirements; and benchmark Basin Plan water quality objectives, CTR criteria, and CWA 303(d) listings. Any future similar development occurring in the USCR watershed must also comply with these regulatory requirements.

By extrapolating the results of the direct impact analysis modeling done for this report, it can be presumed that analysis of other proposed development combined with existing conditions would have similar water quality results.

Therefore, cumulative impacts to surface receiving water quality resulting from the Modified Project and any future development similar to the Modified Project in the watershed are addressed through compliance with the Regional MS4 Permit; CA CGP; and benchmark Basin Plan water quality objectives, CTR criteria, and CWA 303(d) listings, which are intended to be protective of beneficial uses of the receiving waters. Further, the changes associated with the Modified Project compared to the 2017 Approved Project would not contribute to a cumulatively considerable change in surface water impacts. For these reasons, and based on compliance with these requirements designed to protect beneficial uses, the Modified Project will not result in any new significant cumulative water quality impacts compared to the 2017 Approved Project analyzed in the State Certified EIR

7.9.1.1 Climate Change

It is unequivocal that human-induced climate change is occurring, although effects differ regionally (IPCC, 2021). Climate changes – caused by carbon dioxide emissions from human activities have warmed the atmosphere, ocean, and land and altered precipitation patterns – are very likely already affecting ecosystems and natural resources in the United States. Warming also is very likely to continue in the United States during the next 25 to 50 years, regardless of reductions in greenhouse gas emissions, due to emissions that have already occurred.

A warming climate is, in general, expected to increase water temperatures and modify regional patterns of precipitation, and these changes can have direct effects on water quality (IPCC, 2021). However, a major challenge in attributing altered water quality to climate change is the fact that water quality is sensitive to other human activities. In general, water quality is sensitive to temperature and water quantity. Higher temperatures enhance rates of biogeochemical transformation and physiological processes of aquatic plants and animals. As temperatures increase, the ability of water to hold dissolved oxygen declines, and as the dissolved oxygen declines, animal species begin to experience suboptimal conditions. Nutrients in the water enhance biological productivity of algae and plants, which increases oxygen concentration by day, but at night these producers consume oxygen; oxygen sags can impose suboptimal conditions. Increased stream flows during extreme events can dilute nutrient concentrations and thus diminish excessive biological production; however, higher flows can also flush excess nutrients from sources of origin in a stream and the watershed. The overall balance of these competing effects in a changing climate is not yet known (Lettenmaier et al., 2008).

As discussed in Section 2.1.3 above, while precipitation projections do not show a clear trend in the future, an ensemble of twelve climate models shows a trend of decreasing runoff for Southern California between the end of the twentieth and twenty first centuries (CDM, 2011). A decrease in runoff would increase the percent of runoff that is captured and treated in stormwater BMPs that are sized per the current Regional MS4 Permit requirements.

7.9.2 Cumulative Groundwater Impacts

As discussed above and in the State Certified EIR, the anticipated quality of stormwater runoff discharges from the Modified Project's developed areas and irrigation to groundwater will not contribute loads or concentrations of pollutants of concern that would be expected to cause or contribute to a violation of the groundwater quality standards. By extrapolating these results to existing and proposed development throughout the watershed and based on a review of adapted plans and projections, it is concluded that no adverse cumulative effects would occur to groundwaters. Therefore, the Modified Project will not result in incremental effects on groundwater quality when considered together with the effects of other projects in the area compared to the 2017 Approved Project analyzed in the State Certified EIR.

The Modified Project's discharges to groundwater, both during construction and post-development, is predicted to comply with adopted regulatory requirements that are designed by the Regional Water Board to assure that regional development does not adversely affect water quality, including Regional MS4 Permit and LID Manual requirements; CA CGP requirements; General Dewatering Permit requirements; and benchmark Basin Plan groundwater quality objectives. Any future urban development occurring in the Santa Clara River watershed must also comply with these requirements. Therefore, cumulative impacts on groundwater quality from the proposed Modified Project and future urban development in the Santa Clara Watershed are addressed through compliance with the Regional MS4 Permit and LID Manual requirements, CA CGP requirements, General Dewatering Permit requirements, and benchmark Basin Plan groundwater quality objectives, which are intended to be protective of beneficial uses of the groundwater. Further, the changes associated with the Modified Project compared to the 2017 Approved Project would not contribute to a cumulatively considerable change to groundwater impacts. For these reasons, the Modified Project will not result in any new significant cumulative groundwater impacts compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.9.2.1 Groundwater Recharge Cumulative Impacts

As described above, groundwater in the Santa Clara River watershed is primarily available in two aquifers known as the Alluvial aquifer and Saugus Formation aquifer. The Alluvial aquifer is shallow, unconfined, very permeable, and generally restricted to beneath and locally adjacent to the Santa Clara River. The Saugus Formation is a permeable geologic unit at depth that is generally confined and up to several thousand feet thick. Unlike the Alluvial aquifer, the Saugus Formation is not primarily recharged directly through infiltration of precipitation over its extent because it occurs at depth. It is recharged locally by direct infiltration where it is exposed at the surface, which is generally in elevated locations around the edges of the watershed and is largely recharged through leakage from the overlying Alluvial aquifer.

The majority of groundwater production within the USCR watershed is from the Alluvial aquifer, but the Saugus Formation has the capacity to provide more than double its normal year water supply during an extended drought period (Kennedy/Jenks Consultants and Luhdorff & Scalmanini Consulting Engineers, 2017). Changes in water demand are met with a corresponding increase or decrease in the use of imported water while groundwater use has generally remained unchanged, ranging from about 42,000 to 50,000 acre-feet per year from 2011 through 2015, comprising 41 percent to 55 percent of the total municipal water supply (Kennedy/Jenks Consultants and Luhdorff & Scalmanini Consulting Engineers, 2017). Because of the importance of groundwater to both Santa Clara River flows and to water supply, recharge of the Alluvial aquifer, in particular, is critical.

The Alluvial aquifer has two segments that behave differently. The eastern portion of the Alluvial aquifer, primarily underlying Santa Clara River Reach 7, tends to have variable groundwater levels that can drop on the order of 100 feet during a succession of dry years. This is due to the combined effects during dry years of very little or no recharge from runoff (Santa Clara River Reach 7 is generally dry except during and immediately after significant storm events), and increased pumping for water supply in order to make up for the reduced State Water Project deliveries. Groundwater levels quickly return to normal once precipitation returns to average or particularly after an above average wet season. This cycle of dropping water levels and subsequent recharge of the aquifer has been well documented by the USCR water purveyors and is incorporated into the management strategies for water supply (Kennedy/Jenks Consultants and Luhdorff & Scalmanini Consulting Engineers, 2017).

The western segment of the Alluvial aquifer, generally underlying Santa Clara River Reach 5 (the Modified Project location) and Reach 6 and their tributaries, has over the past several decades had relatively stable groundwater levels with seasonal variations on the order of a few tens of feet, and is less susceptible to successive dry year impacts. The reason for the relatively constant water levels for this western segment of the Alluvial aquifer is because nearly perennial flows provide constant recharge. Notable contributors to the nearly perennial flows at the Modified Project location include upwelling groundwater, discharges from the Valencia and Saugus WRPs, bank seepage[31], upstream agricultural and urban runoff (including irrigation runoff), perennial flows from Castaic Creek, and periodic releases of SWP water from Castaic Lake through Castaic Creek. As urban growth has increased demand for SWP water supply, discharge from the WRPs has also increased. The increased importation of state water has resulted in reduced reliance on local groundwater supplies (CH2M-HGL, 2008) and provided an additional source of groundwater recharge.

The overall budget of groundwater in storage for the period 1980 through 2011 is plotted in Figure 7-1. Declines in groundwater storage correspond to successive dry years and are followed by increase in storage through rapid recharge during the following normal and wet years.

Natural Recharge

Precipitation-based recharge occurs in the Alluvial aquifer when the vadose zone is saturated during rainfall events and excess infiltrated rainfall is recharged. This recharge requires the upper most soil zones to become saturated before recharge can occur, and therefore in arid areas such as the Santa Clarita Valley, is dependent on seasonal rain storms of sufficient size and frequency. The connection of the Alluvial aquifer to the Santa Clara River and its tributaries is a critical component of the recharge of this aquifer. Stormwater runoff finds its way to tributaries and

[31] Bank seepage consists of water stored in stream banks during high-water flows that seeps back into the stream during low-water flow conditions.

ultimately to the Santa Clara River where, because of the coarse-grained nature of the sediments of the riverbed, this runoff readily infiltrates directly to the Alluvial aquifer.

Irrigation-Derived and Development-Derived Recharge

Irrigation-derived recharge occurs when soil in landscaped areas becomes saturated and irrigation water is not retained in the vadose zone. This is related to irrigation efficiency. Irrigation efficiency can be optimized by accounting for landscape palette evapotranspirative properties as well as climate information. Modified Project BMPs, which are also required of all new development projects, include the use of native and drought tolerate plants in landscaped areas and the use of efficient irrigation systems in common area landscaped areas. A small amount of irrigation-derived recharge is likely to occur even with these BMPs.

Of larger importance is the issue of the soil moisture deficit in natural open space areas versus developed landscape areas. Because landscaping in developed areas is irrigated throughout the dry season in contrast to native open space, these landscaped areas will not develop dry season soil moisture deficits that need to be replenished with precipitation prior to any groundwater recharge occurring to the extent that natural open space does. For this reason, on an acre for acre basis, groundwater recharge will be more efficient in landscaped areas that receive even minimal irrigation (CH2M Hill, 2004).

The primary difference in developed areas is the increase in impervious area compared with pre-developed condition. While this issue is addressed through the Modified Project's LID BMPs, which are also required of all new development projects by the Regional MS4 Permit, historical development tends to have high levels of directly connected imperviousness. This resulted in engineered control of stormwater to minimize flooding which corresponded to hard bottom flood control channels that directed excess stormwater runoff to the Santa Clara River.

Because the Alluvial aquifer is generally restricted to the area beneath and locally adjacent to the Santa Clara River riverbed, stormwater runoff directed to the River is directly available for recharge of this primary aquifer. Over the period of historical development within the Santa Clarita Valley, neither the Alluvial aquifer nor the Saugus Formation has experienced any significant long-term impacts to groundwater levels (Luhdorff and Scalmanini, 2009; CH2M Hill, 2006; Kennedy/Jenks Consultants, 2021). The reasons for this are varied, but likely include:

- Conversion of agricultural land use to urban land use with consequent reduction in groundwater requirements for irrigation;
- Successful long-term groundwater management strategies by local water purveyors;
- Development occurring generally in areas not underlain by directly recharged Alluvial aquifer;
- Increasing SWP water supply imports and consequent increasing WRP discharge; and
- Increased urban stormwater runoff directed to areas that directly recharge the Alluvial aquifer (i.e., the Santa Clara River).

Change in Recharge
As mentioned above, there have been a number of studies of Santa Clara River watershed groundwater quantity and quality. One of the more comprehensive recent studies resulted in an extensive groundwater-surface water interaction (GSWI) numerical model of water quantity and water quality for the purpose of understanding chloride fate and transport within the watershed (CH2M-HGL, 2008). The GSWI study incorporated climate, water resources, and development within the USCR watershed to produce a calibrated model of water quantity and quality for the period 1975-2005. This calibrated model of the USCR watershed is important for understanding impacts that development may have had on groundwater during this period of growth. Using this calibrated model, a forward analysis of likely impacts between 2005 and 2030 that incorporated all proposed development within the valley, including the Modified Project, was performed.

The calibrated GSWI model for the period 1975 to 2005 modeled the water budget for the USCR watershed with the conclusion that the overall storage of groundwater, while variable, was balanced over the entire period (Figure 7-1). The future scenarios for the period 2005 to 2030 use the calibrated model as the basis for investigating a number of different scenarios. The scenarios primarily related to different strategies for managing chloride impacts to the Santa Clara River but incorporated all expected growth within the Santa Clarita Valley based on the Santa Clarita Valley Area Plan (One Valley One Vision) urban growth estimates. The resulting changes to groundwater levels, particularly the western half of the USCR watershed aquifers, is minimal, with water levels cycling through dry and wet seasonal changes of a few tens of feet, but without any long-term changes in overall storage, even during a modeled succession of several dry years.

Comparison of actual water use, water reclamation discharge, and urban growth for the initial years of the future scenarios modeled by GSWI indicate that the model is conservative in its estimates and that actual growth and consequent water use and water reclamation discharge are less than predicted by the model. This is likely due in large part to the several years of economic recession, with the result that the GSWI model overestimates impacts to the watershed from future growth scenarios.

Summary
In summary:

- A number of studies, including those by the USCR watershed water purveyors, have documented long term stability of groundwater levels in both the Alluvial aquifer and the Saugus Formation aquifer.
- This long term (several decades) stability of the USCR aquifers has occurred simultaneously with urban growth, as well as two extended periods of successive dry years.
- A calibrated model of surface water and groundwater interactions for the period 1975 to 2005 confirms that even with growth and increased water use, groundwater levels in the USCR aquifers have been relatively stable, indicating that recharge of the aquifers has kept pace with groundwater extraction.

- Future GSWI model scenarios incorporating planned development, including the Modified Project and cumulative impact analysis area projects, through 2030 indicate continued long-term stability of aquifer water levels.

Further, the changes associated with the Modified Project compared to the 2017 Approved Project would not contribute to a cumulatively considerable change in groundwater recharge impacts. For these reasons, the Modified Project will not result in any new significant cumulative groundwater recharge impacts compared to the 2017 Approved Project analyzed in the State Certified EIR.

7.9.3 Cumulative Hydromodification Impacts

As discussed above and in the State Certified EIR, the Modified Project will include a number of hydrologic source control BMPs that will substantially lessen any potential contribution to cumulative hydromodification impacts to the Santa Clara River. Further, other future projects within the watershed reflected in adopted plans and projections will implement hydromodification controls to meet the Regional MS4 Permit requirements. These measures are designed to mitigate and prevent direct and cumulative hydromodification impacts.

Within the Santa Clara River watershed, major perturbations (urbanization, dam construction, levee construction, decadal changes in climate, and increases in woody vegetation) do not appear to have had a significant impact on the geomorphic expression of the Santa Clara River. Large "re-set" events (those which are typically not as affected by increases in impervious area) have episodically completely altered the form of the Santa Clara River channel. These events, occurring on average once every ten years, are a dominant force in defining channel characteristics. The geomorphic dominance of "re-set" events determines the geomorphic character of the Santa Clara River and the Santa Clara River's response to anthropogenic perturbations, including hydromodification impacts associated with development, is expected to be minimal in light of the "reset" driven nature of the Santa Clara River channel. Due to these episodic "re-sets," "unraveling" of the Santa Clara River mainstem due to hydromodification associated with cumulative urban development within the watershed, as is seen in many smaller southern California watersheds, is not expected to occur. The "re-set" events appear to adequately buffer changes that may occur in short-term sediment transport. These conclusions are confirmed by the PACE Fluvial Study (2006) with respect to development of the Modified Project.

Based upon the above discussion, that the Modified Project includes hydromodification source BMPs, that future development projects within the watershed will control flow in compliance with the Regional MS4 Permit, and that large-scale changes naturally occur in the Santa Clara River in response to major episodic events. Further, the changes associated with the Modified Project compared to the 2017 Approved Project would not contribute to a cumulatively considerable change in hydromodification impacts. For these reasons, the Modified Project will not result in any new significant cumulative hydromodification impacts compared to the 2017 Approved Project analyzed in the State Certified EIR.

8. CONCLUSIONS

As described herein, the Modified Project would not result in any new significant water quality impacts as compared to the 2017 Approved Project analyzed in the State Certified EIR.

8.1 Surface Water Quality Impacts

The Modified Project would not result in any new significant impact related surface water quality impacts as compared to the 2017 Approved Project. Like the 2017 Approved Project, CA CGP- and Dewatering General Permit-compliant BMPs would be incorporated into the Modified Project to address pollutants of concern in the construction phase. Regional MS4 Permit-compliant site design, source control, and hydromodification control BMPs would be incorporated to address pollutants of concern in the developed condition. Unlike the 2017 Approved Project, Regional MS4 Permit-compliant LID BMPs, which are more effective BMPs than those included in the 2017 Approved Project, would be incorporated into the Modified Project to address all of the pollutants of concern and to provide hydromodification source control, as required by the 2021 Regional MS4 Permit. The following are the specific conclusions regarding the potential significance of impacts for the pollutants of concern under wet and dry weather conditions:

- ***Sediments*****:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on sediments. Average annual total suspended solids load and concentration are predicted to be less or unchanged in the post-development condition than in the existing condition for the Entrada South planning area, consistent with the conclusions of the State Certified EIR. For VCC, TSS load is predicted to increase slightly, while the concentration is predicted to decrease. The State Certified EIR predicted that TSS load and concentrations would decrease. The predicted slight increase in average annual TSS load in stormwater runoff from the VCC planning area of the Modified Project would result in a less than significant impact to receiving waters because the concentration of TSS is predicted to be below all benchmark criteria and to be within the range of concentrations observed in Santa Clara River Reach 5.
- ***Nutrients (Phosphorus and Nitrogen (Nitrate plus Nitrite, Ammonia, and Total Nitrogen))***: The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on nutrients. Average annual nutrient loads were predicted to increase in stormwater runoff from the 2017 Approved Project and the Modified Project due to the increased average annual runoff volume. For the Entrada South Planning Area, average annual concentrations of nutrients, except for ammonia-N, were predicted to decrease in the 2017 Approved Project, while for the Modified Project all nutrient concentrations were predicted to decrease or remain the same. For VCC, all nutrient concentrations were predicted to decrease for the 2017 Approved Project and to decrease or remain the same in the Modified Project. Average concentrations were predicted to be within the range of observed wet weather values for Santa Clara River Reach 5 for all nutrients and to be below Los

Angeles Basin Plan objectives and TMDL wasteload allocations for both the 2017 Approved Project and the Modified Project. As with the 2017 Approved Project, the predicted nutrient concentrations are not expected to cause increased algae growth for either project. On this basis, the impact of the Modified Project on nutrients is considered less than significant.

- ***Metals*****:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on metals. For both the 2017 Approved Project and the Modified Project, post-development metals loads were predicted to increase compared to pre-development conditions, while average annual concentrations were predicted to decrease or remain the same. Predicted average annual metals concentrations are below benchmark Basin Plan objectives and CTR criteria and within the range of observed concentrations in Santa Clara River Reach 5. On this basis, the impact of the Modified Project on metals is considered less than significant.
- ***Chloride*****:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on chloride. The mean predicted concentration and load of chloride in stormwater runoff was predicted to increase with development in both the 2017 Approved Project and the Modified Project, although the predicted concentration is well below the Los Angeles Basin Plan objective and is below the average observed concentration in Santa Clara River Reach 5. On this basis, the impact of the Modified Project's stormwater discharges on chloride is considered less than significant.
- ***Pesticides*****:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on pesticides. As with the 2017 Approved Project, pesticides in runoff may or may not increase in the post-development phase as a result of applications in and around buildings and in vegetated areas. Proposed pesticide management practices, including source control, sediment removal in LID treatment control BMPs, and advanced irrigation controls, in compliance with the requirements of the Regional MS4 Permit and the LID Manual, will minimize the presence of pesticides in runoff. During the construction phase of the Modified Project, erosion and sediment control BMPs implemented per CA CGP and General Dewatering Permit requirements will prevent pesticides associated with sediment from being discharged. Final site stabilization will limit mobility of legacy pesticides that may be present in pre-development conditions. Stormwater discharges from the Modified Project are not expected to increase the in-stream concentration of pesticides. On this basis, the impact of the Modified Project on pesticides is considered less than significant.
- ***Pathogens*****:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on pathogens. As with the 2017 Approved Project, post-development pathogen sources include both natural and anthropogenic sources.

The natural sources include bird and mammal excrement. Anthropogenic sources include leaking septic and sewer systems and pet wastes. Removal of agricultural and ranching operations and a reduction in open space within the Modified Project area would reduce the bacteria produced by livestock and wildlife. The Modified Project will not include septic systems and the sewer system will be designed to current standards which minimizes the potential for leaks. Thus, pet wastes are the primary source of concern. The BMPs will include source controls and LID-compliant BMPs which in combination should help to reduce pathogen indicator levels in post-construction stormwater runoff. Pathogens are not expected to occur at elevated levels during the construction-phase of the Modified Project. On this basis, the Modified Projects impact on pathogens and pathogen indicators is considered less than significant.

- ***Hydrocarbons*:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on hydrocarbons. As with the 2017 Approved Project, hydrocarbon concentrations will likely increase post-development because of vehicular emissions and leaks. In stormwater runoff, hydrocarbons are often associated with soot particles that can combine with other solids in the runoff. Such materials are subject to treatment in the proposed LID-compliant BMPs. Source control BMPs, incorporated in compliance with the Regional MS4 Permit and the LID Manual requirements, will also minimize the presence of hydrocarbons in runoff. During the construction phase of the Modified Project, pursuant to the CA CGP, the Construction Stormwater Pollution Prevention Plan must include BMPs that address proper handling of petroleum products on the construction site, such as proper petroleum product storage and spill response practices, and those BMPs must effectively prevent the release of hydrocarbons to runoff per the Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology standards. On this basis, the impact of the Modified Project on hydrocarbons is considered less than significant.

- ***Trash and Debris*:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on trash and debris. As with the 2017 Approved Project, trash and debris in runoff are likely to increase in post-development if left unchecked. However, the Modified Project BMPs, including full trash capture, source control and LID-compliant BMPs incorporated in compliance with the Regional MS4 Permit, the LID Manual requirements, and the LID Performance Standard will minimize the adverse impacts of trash and debris. Source controls such as street sweeping, public education, fines for littering, covered trash receptacles, and storm drain stenciling are effective in reducing the amount of trash and debris that is available for mobilization during wet weather. Trash and debris will be captured in full trash capture devices and in the LID treatment control BMPs. During the construction phase of the Modified Project, BMPs implemented per CA CGP and General Dewatering Permit requirements will remove trash and debris through the use of BMPs such as catch basin inserts and by general good housekeeping practices.

Trash and debris are expected to have a less than significant impact on receiving waters due to the implementation of the Modified Project BMPs.

- ***Methylene Blue Activated Substances (MBAS):*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on MBAS. As with the 2017 Approved Project, in the post-development phase, the presence of soap in runoff from the Modified Project will be controlled through the source control BMPs, including a public education program on residential and charity car washing. Other sources of MBAS, such as cross connections between sanitary and storm sewers, are unlikely given modern sanitary sewer installation methods and inspection and maintenance practices. In addition, the LID treatment control BMPs will infiltrate or evapotranspire all dry weather runoff. During the construction phase of the Modified Project, equipment and vehicle washing will not use soaps or any other MBAS sources. Therefore, MBAS are expected to have a less than significant impact on the receiving waters of the proposed Modified Project.
- ***Selenium.*** As with the 2017 Approved Project, it is very unlikely that the concentration of selenium in the Modified Project's stormwater runoff would be an appreciable source of selenium loading to the Santa Clara River based on the underlying geology. Therefore, selenium is expected to have a less than significant impact on the receiving waters of the Modified Project.
- ***Toxicity.*** As with the 2017 Approved Project, the available literature indicates that acute and chronic aquatic toxicity impacts are largely related to pesticides, and as discussed above, the Modified Project's water quality impact associated with pesticides would be less than significant. Impacts from other pollutants that may affect acute and chronic toxicity (i.e., metals and petroleum hydrocarbons) would also be less than significant. Based on the incorporation of source control, LID and treatment control BMPs pursuant to Regional MS4 Permit and LID Manual requirements to address pollutants that may cause acute and chronic toxicity, Project impacts associated with toxicity would be less than significant.
- ***Constituents of Emerging Concern:*** As with the 2017 Approved Project, the Valencia WRP treatment processes, including the RO that will be installed to comply with the Chloride TMDL, will have good removal efficiencies of CECs that might arise in the Modified Project's wastewater. Additionally, the WRPs' NPDES Permits are protective of beneficial uses and water quality and aquatic life in the Santa Clara River. Therefore, potential impacts associated with CECs are less than significant.
- ***Bioaccumulation*:** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on bioaccumulation. As with the 2017 Approved Project, in the literature, the primary pollutants that are of concern with regard to bioaccumulation are mercury and selenium. Selenium is not naturally present at levels of concern in the Modified Project's watershed, as discussed above. Mercury sources include fossil fuel power plant emissions and exposed tailings at former mercury

mines, which are also not present at the Modified Project site. Thus, bioaccumulation of selenium and mercury is also not expected to result either during the construction or post-development Modified Project phases. On this basis, the potential for bioaccumulation in the Modified Project BMPs or in the Santa Clara River and adverse effects on waterfowl and other species is considered less than significant.

- ***Dry Weather Runoff:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on dry weather runoff. As with the 2017 Approved Project, Regional MS4 Permit, CA CGP, Dewatering General Permit, and LID-compliant BMPs will be incorporated into the Modified Project to address dry weather flows. It is expected that no dry weather discharge will occur to the Modified Project's receiving waters. On this basis, impacts from dry weather flows are considered less than significant.
- ***Wastewater:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts from wastewater discharges. As with the 2017 Approved Project, the Valencia WRP must comply with its NPDES wastewater discharge permit which contains effluent limitations that are protective of water quality and beneficial uses in the Santa Clara River and will not result in the impairment of surface water quality. Additionally, the SCVSD has adopted an implementation plan and schedule that incorporates chloride source reduction actions and chloride load reduction through advanced treatment (i.e., reverse osmosis) of the Valencia WRP effluent which will mitigate the effect of chloride accumulation in surface and groundwater. Therefore, the Modified Project's chloride contribution to treated wastewater discharges would pose a less than significant impact to water quality or beneficial uses.
- ***Construction Impacts:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts during construction. As with the 2017 Approved Project, construction impacts on water quality are generally caused by soil disturbance and subsequent suspended solids discharge. These impacts will be minimized through implementation of construction BMPs that will meet or exceed measures required by the CA CGP, as well as BMPs that control the other potential construction-related pollutants (PAHs, metals). A SWPPP will be developed as required by, and in compliance with, the CA CGP and County of Los Angeles Standard Conditions. Erosion control BMPs, including but not limited to hydro-mulch, erosion control blankets, and energy dissipaters will be implemented to prevent erosion, whereas sediment controls, including but not limited to silt fence, sedimentation ponds, and secondary containment on stockpiles, will be implemented to trap sediment once it has been mobilized. On this basis, the construction-related impact of the Modified Project on water quality is considered less than significant.
- ***Regulatory Requirements:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance

determinations for compliance with regulatory requirements. As with the 2017 Approved Project, the Modified Project satisfies Regional MS4 Permit requirements for new development; satisfies Los Angeles County's LID requirements and the Modified Project LID Performance Standard and satisfies construction-related requirements of the Construction General Permit and General Dewatering Permit, and therefore complies with water quality regulatory requirements applicable to stormwater runoff.

8.2 Groundwater Impacts

As described herein, the Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for groundwater quality and recharge impacts; it would not result in the identification of a new significant impact. The following are the specific conclusions regarding the significance of groundwater impacts:

- ***Groundwater Quality Impacts (Nitrate + Nitrite)***: The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for impacts on groundwater quality. As with the 2017 Approved Project, Regional MS4 Permit, Construction General Permit, Dewatering General Permit, and LID-compliant BMPs will be incorporated into the Modified Project to address nutrients in both the construction phase and post-development. Nitrate-nitrogen plus nitrite-nitrogen concentrations are predicted to decrease in the post-developed condition. The predicted nitrate-nitrogen plus nitrite-nitrogen concentration in stormwater runoff after treatment in the Modified Project BMPs and irrigation water is well below the groundwater quality objective. On this basis, the potential for adversely affecting groundwater quality is considered less than significant.
- ***Modified Project Groundwater Recharge Impacts***: The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on groundwater recharge. As with the 2017 Approved Project, although precipitation recharge would decrease in the developed condition due to the increase in impervious area, the predicted increase in recharge due to infiltration of stormwater runoff in the LID BMPs and irrigation of landscaped areas would offset this decrease. Based on this analysis, the Modified Project's impact on groundwater recharge is considered less than significant.

8.3 Hydromodification Impacts

The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for hydromodification impacts; it would not result in the identification of a new significant impact. The following are the specific conclusions regarding the significance of hydromodification impacts under wet and dry weather conditions:

- ***Wet Weather Modified Project Impacts:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for surface water quality impacts on wet weather hydromodification. As with the 2017 Approved Project, the Regional MS4 Permit exempts projects from hydromodification control requirements that discharge directly or via a storm drain into the Santa Clara River and other non-susceptible channels such as Castaic Creek and Hasley Creek within the Modified Project. Nevertheless, the Modified Project site design and LID treatment control BMPs, especially open space retention and infiltration BMPs, will avoid and/or minimize increases in runoff volume from the development area, the preferred method for controlling hydromodification impacts from new development. For these reasons, direct hydromodification impacts of the Modified Project on the Santa Clara River, Halsey Creek, and Castaic Creek are considered less than significant.

- ***Dry Weather Hydromodification Impacts:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for dry weather hydromodification impacts. As with the 2017 Approved Project, it is predicted that all dry weather flows will be removed in the LID treatment control BMPs, which also provide hydrologic source control. As a result, no appreciable change in the seasonality of flows is anticipated to result from development. Based on the comprehensive site planning, source control, and LID treatment control strategy and the fact that no dry weather flows are predicted to be discharged, the impact of the Modified Project on dry weather water quality and seasonality of flow in the Santa Clara River, Halsey Creek, and Castaic Creek is considered less than significant.

8.4 Cumulative Impacts

- ***Cumulative Surface Water Impacts:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for cumulative surface water quality impacts. As with the 2017 Approved Project, cumulative impacts to surface receiving water quality resulting from the Modified Project and any future development similar to the Modified Project in the watershed are addressed through compliance with the Regional MS4 Permit; CA CGP; and benchmark Basin Plan water quality objectives, CTR criteria, and CWA 303(d) listings, which are intended to be protective of beneficial uses of the receiving waters. Based on compliance with these requirements designed to protect beneficial uses, the cumulative water quality impacts would be less than significant.

- ***Cumulative Groundwater Quality Impacts***: The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for cumulative groundwater quality impacts. As with the 2017 Approved Project, the cumulative impacts on groundwater quality from the proposed Modified Project and future urban development in the Santa Clara Watershed are addressed through compliance with the Regional MS4 Permit and LID Manual requirements, CA CGP requirements, General Dewatering Permit requirements, and benchmark Basin Plan groundwater quality objectives, which are intended to be protective of beneficial uses of the groundwater. Based on compliance with these requirements designed to protect beneficial uses, cumulative groundwater quality impacts would be less than significant.

- ***Cumulative Groundwater Recharge Impacts***: The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for cumulative groundwater recharge impacts. As with the 2017 Approved Project, a number of studies have documented long term stability of groundwater levels in both the Alluvial aquifer and the Saugus Formation aquifer despite urban growth and two extended periods of successive dry years. Future model scenarios incorporating planned development, including the Modified Project and cumulative impact analysis area projects, through 2030 indicate continued long-term stability of aquifer water levels. On this basis, the cumulative impact on groundwater recharge is considered less than significant.

- ***Cumulative Hydromodification Impacts:*** The Modified Project would not result in any new or more severe significant impacts compared to the State Certified EIR's significance determinations for cumulative hydromodification impacts. As with the 2017 Approved Project, the Modified Project includes hydromodification control BMPs, future development projects within the watershed will control flow in compliance with the sub-regional program, and large-scale changes naturally occur in the Santa Clara River in response to major episodic events, therefore, the Modified Project's contribution to cumulative hydromodification impacts to the Santa Clara River and its tributaries will be less than significant and consistent with the requirements of the Regional MS4 Permit.

8.5 Overall Conclusion

With the implementation of governing regulations, relevant permits, adopted BMPs, and other control measures, the Modified Project will have a similar level of potential impact to water quality as the 2017 Approved Project as analyzed in the State Certified EIR. The Modified Project does not result in any new significant adverse impacts related to water quality.

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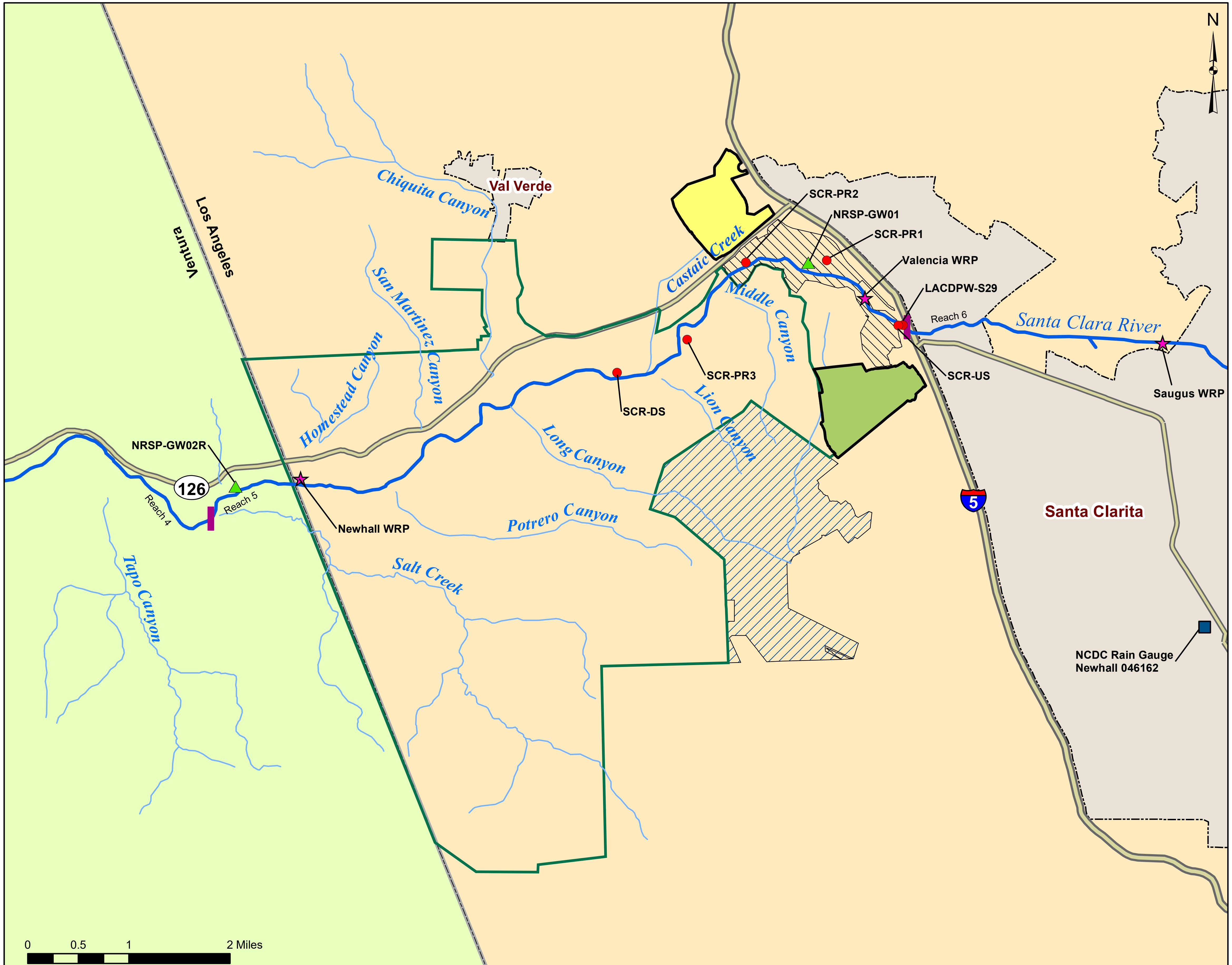
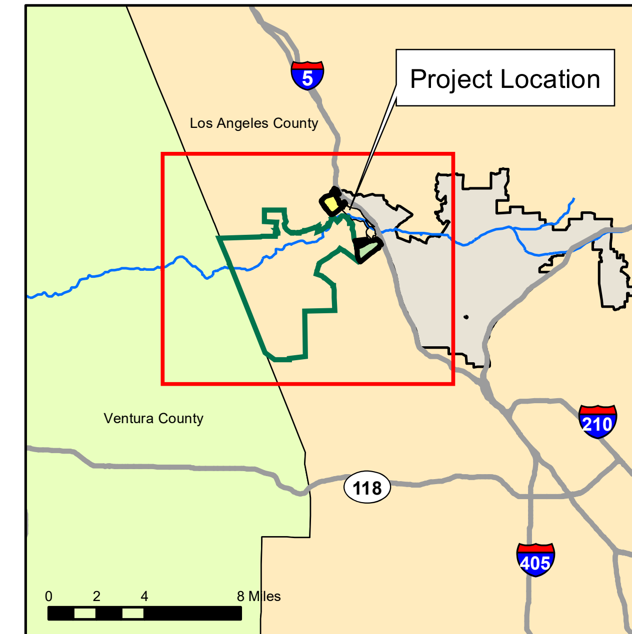
FIGURES





Legend

- NRSP Groundwater Monitoring Well
- Surface Water Quality Monitoring Stations
- Santa Clara River Reach 5
- Water Reclamation Plant
- RainGage
- Major Tributaries
- Santa Clara River
- Entrada North Project Boundary
- VCC Project Boundary
- ES Project Boundary
- Newhall Ranch Specific Plan
- Legacy Village Boundary
- City Boundaries
- Los Angeles County
- Ventura County

Figure 2-1
Modified Project Vicinity

Entrada South and Valencia Commerce Center Supplemental Water Quality Analysis

November 2023

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Prepared By: G.Yao

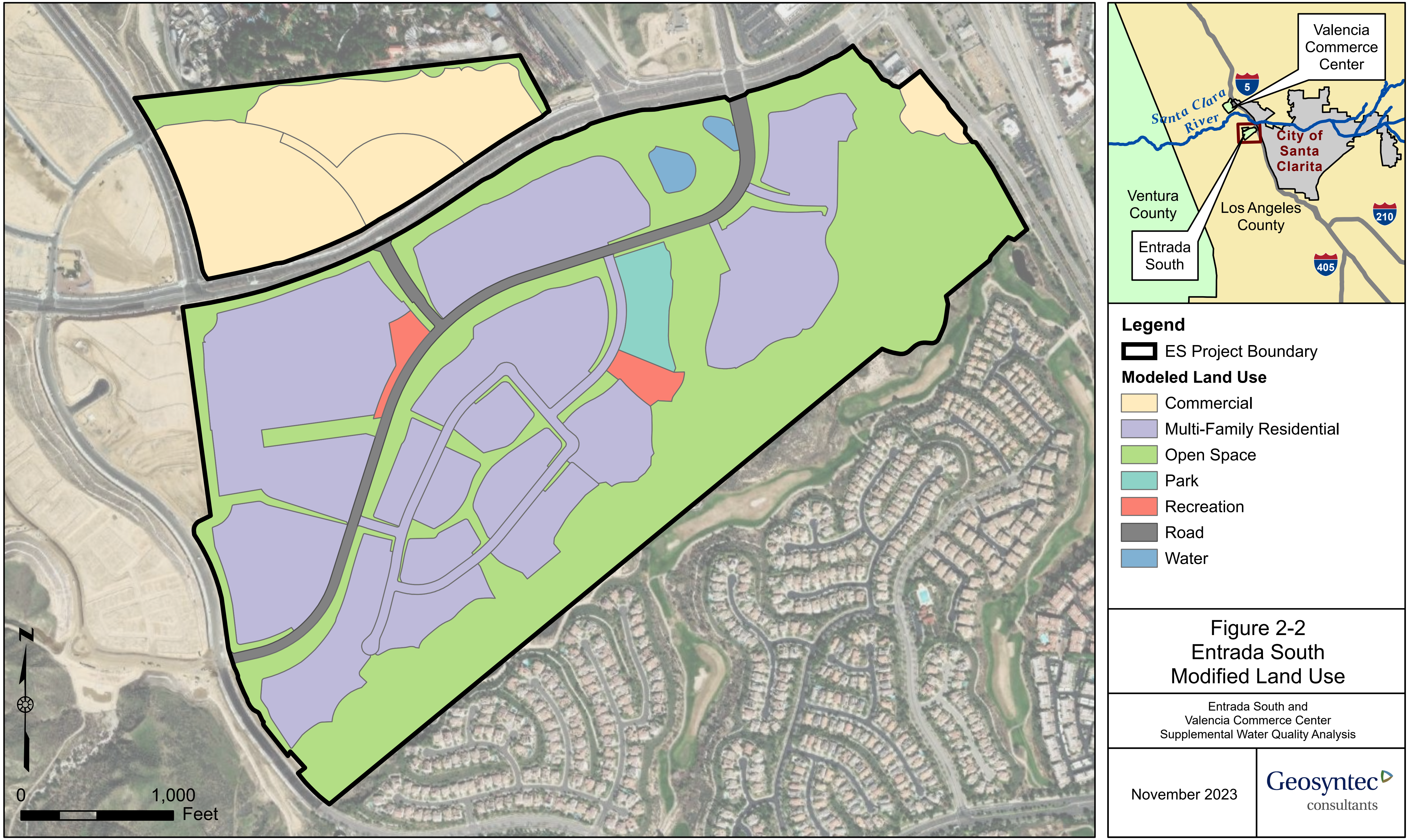
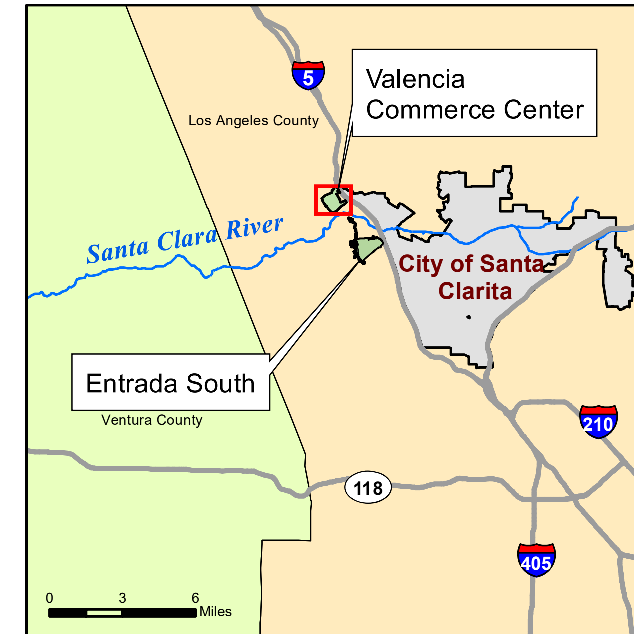


Figure 2-2
Entrada South
Modified Land Use

Entrada South and
Valencia Commerce Center
Supplemental Water Quality Analysis

November 2023

Geosyntec consultants



Legend

VCC Project Boundary

Modified Land Use

- Commercial
- Open Space
- Open Space - Access Road
- Public Road

Figure 2-3
Valencia Commerce Center Modified Land Use

Entrada South and
Valencia Commerce Center
Supplemental Water Quality Analysis

November 2023

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Prepared By: G.Yao

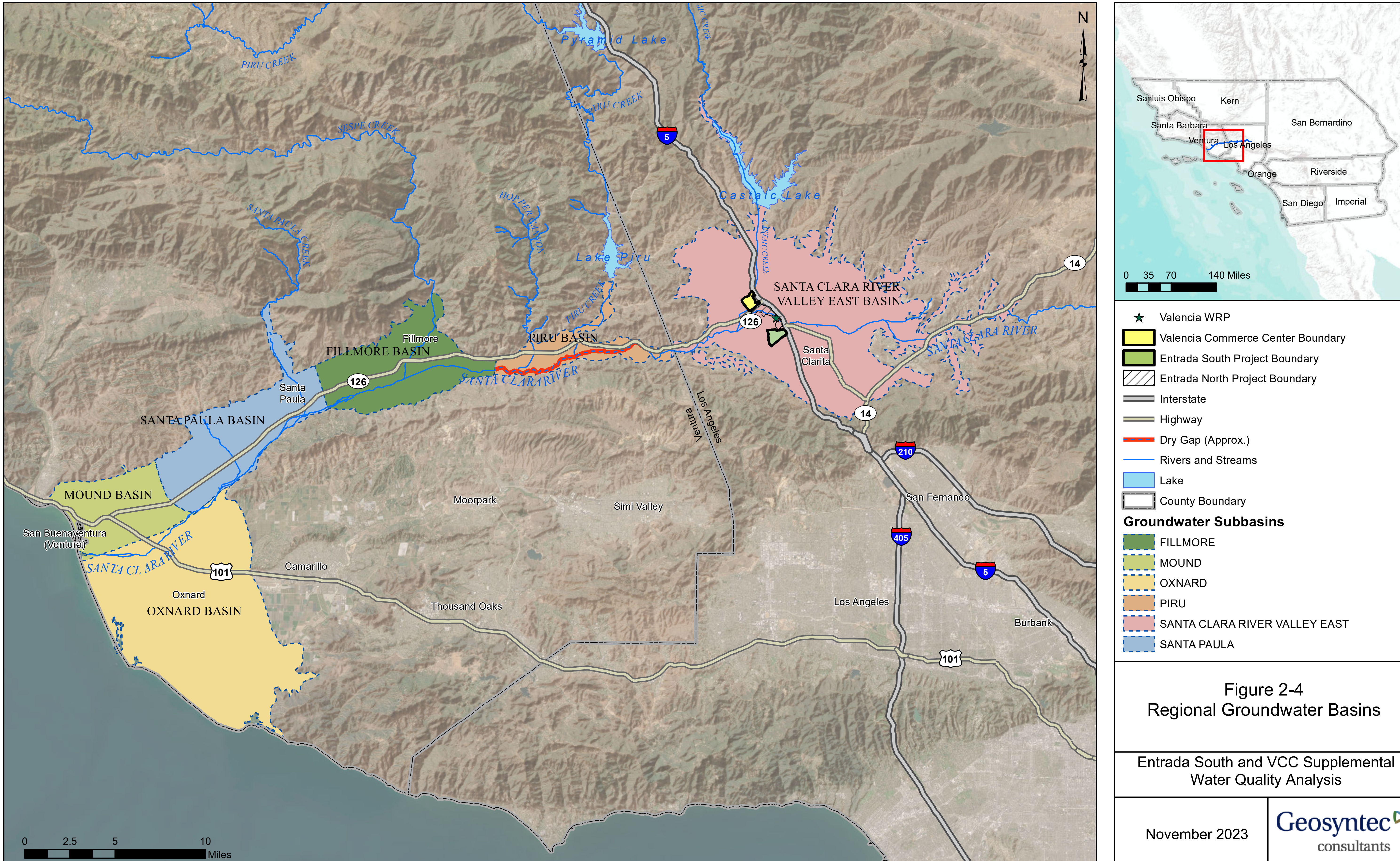

Figure 2-4
Regional Groundwater Basins

Entrada South and VCC Supplemental Water Quality Analysis

November 2023

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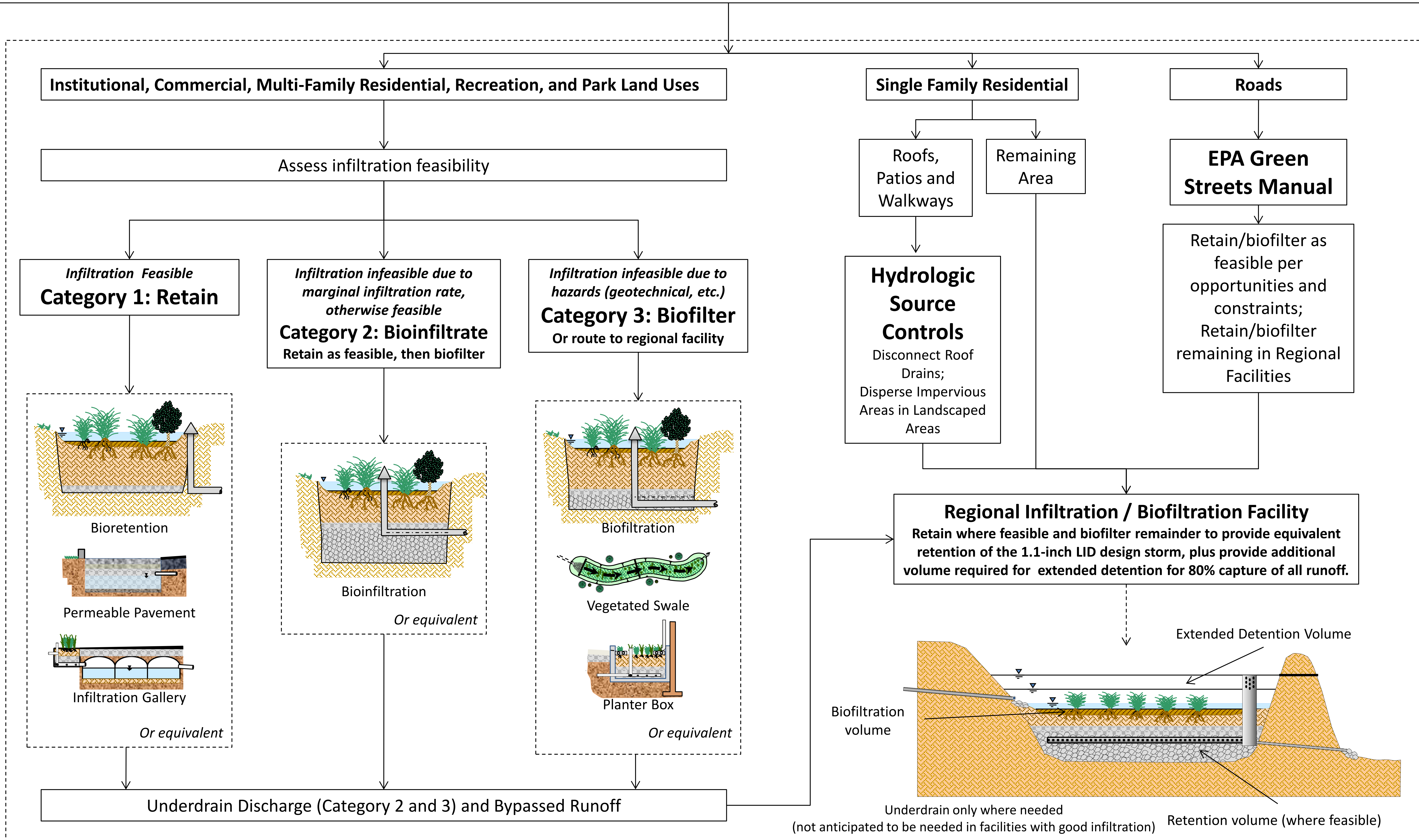
Prepared By: A. Orr

LID PERFORMANCE STANDARD

LID project design features (PDFs) shall be selected and sized to retain the volume of stormwater runoff produced from the 1.1-inch design storm event (LID design volume). When it has been demonstrated that 100 percent of the LID design volume cannot be feasibly infiltrated, then biofiltration shall be provided for 1.5 times the portion of the LID design volume that is not retained. Runoff from all impervious area shall be treated with effective treatment control measures that are selected to address the pollutants of concern and are sized to capture and treat 80 percent of the average annual runoff volume.



LID Performance Standard

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Figure 5-1

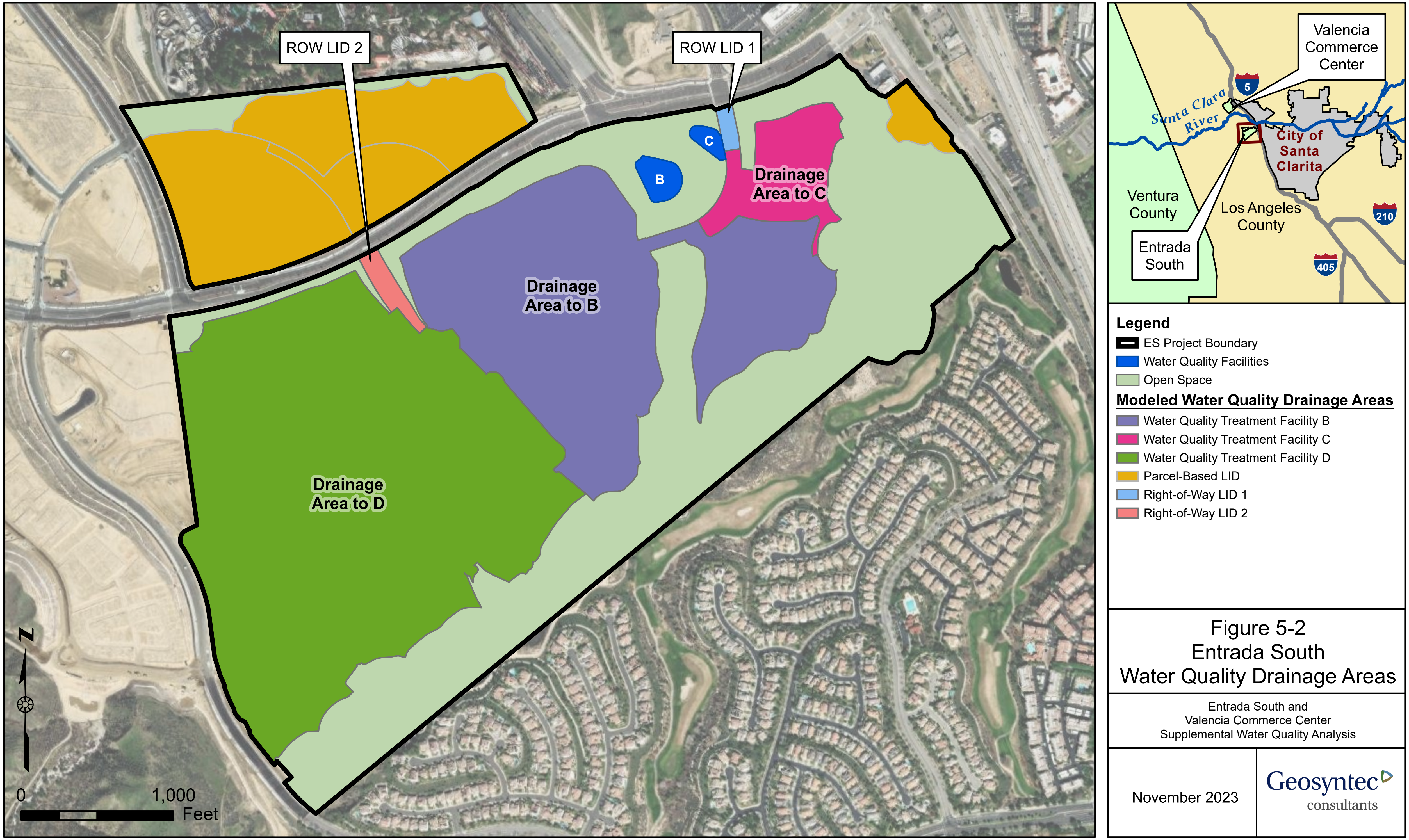

Figure 5-2
Entrada South
Water Quality Drainage Areas

Entrada South and
Valencia Commerce Center
Supplemental Water Quality Analysis

November 2023

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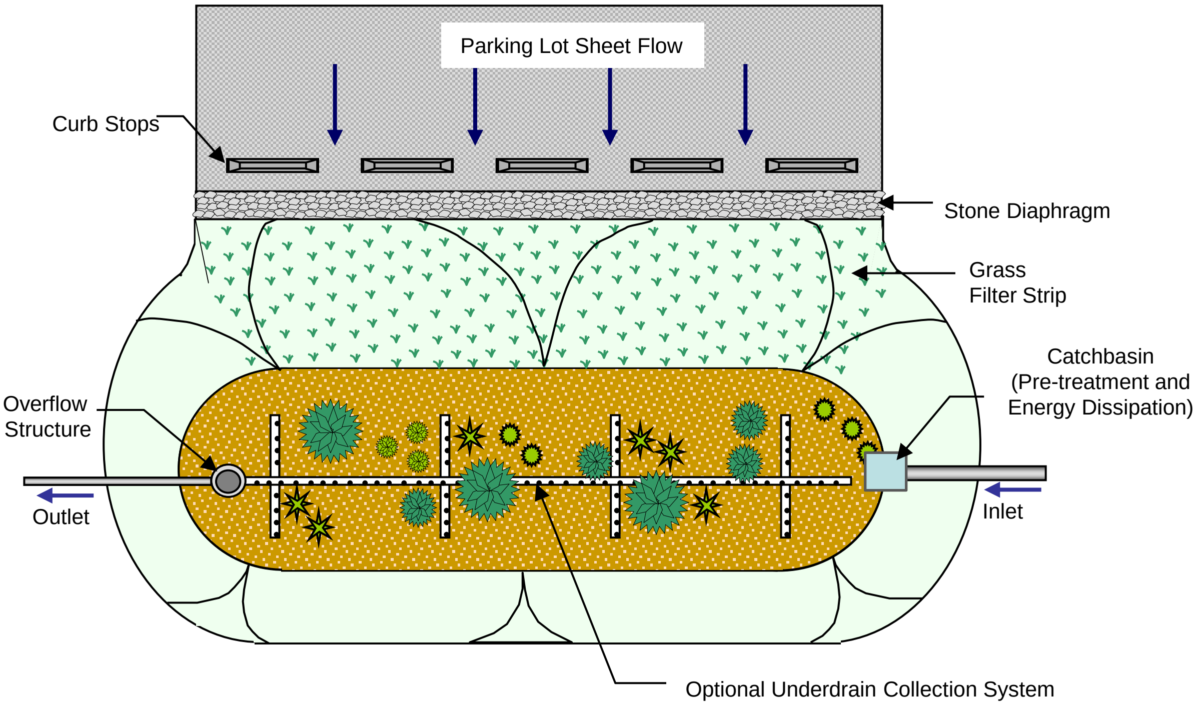
Plan View



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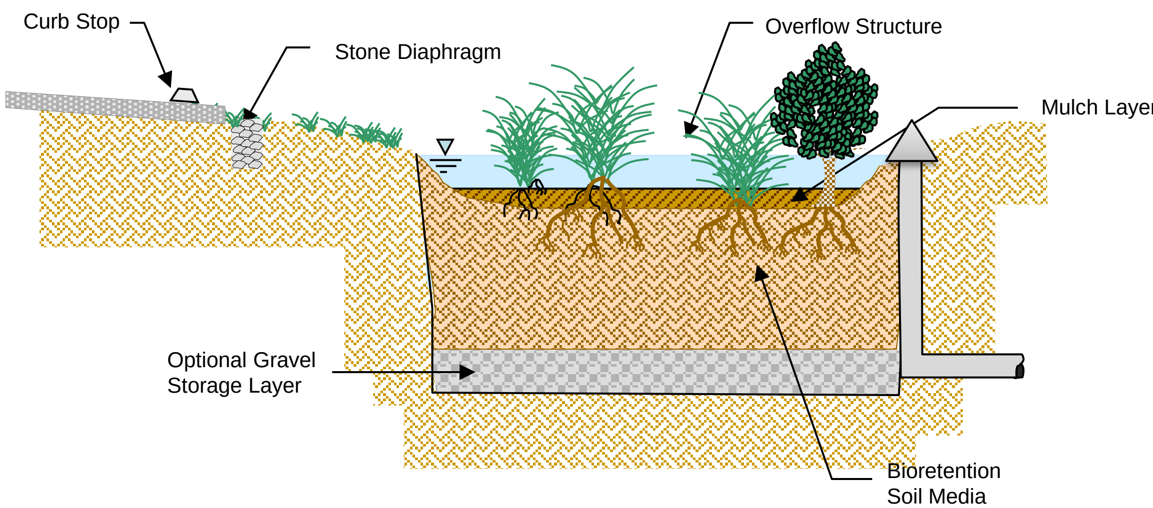

Conceptual Illustration of a Bioretention Facility

Entrada South and Valencia Commerce Center
Supplemental Water Quality Analysis

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Figure 5-3

Oakland | November 2023

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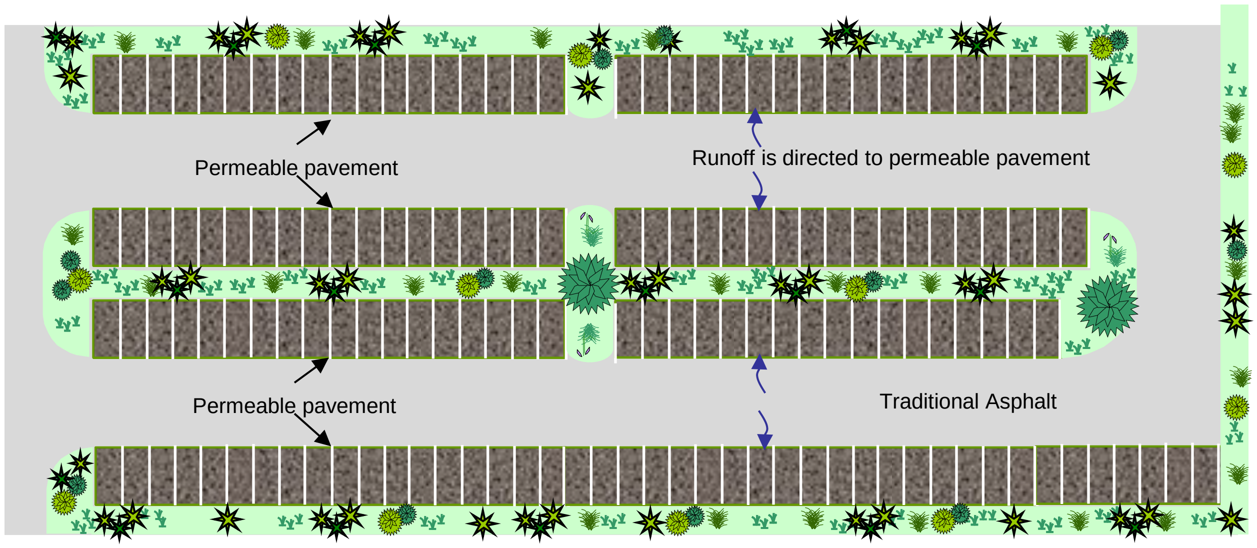
Plan View



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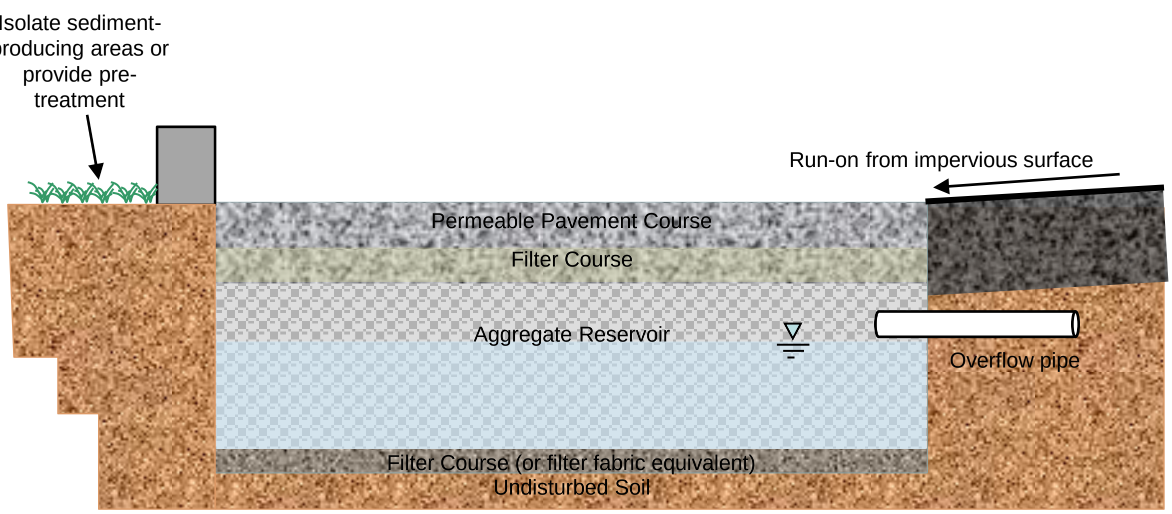

Conceptual Illustration of Permeable Pavement

Entrada South and Valencia Commerce Center
Supplemental Water Quality Analysis

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Figure 5-4

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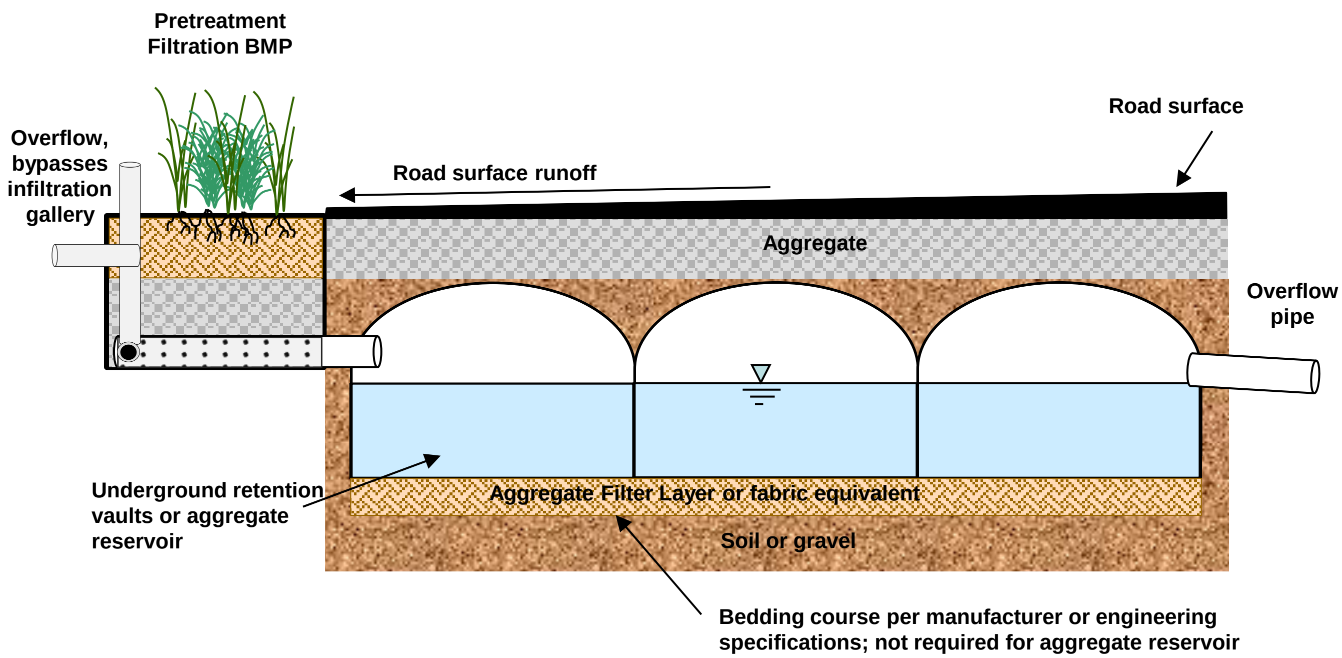

Conceptual Illustration of an Infiltration Gallery **Entrada South and Valencia Commerce Center Supplemental Water Quality Analysis**		
Geosyntec consultants		Figure 5-5
Oakland	November 2023	

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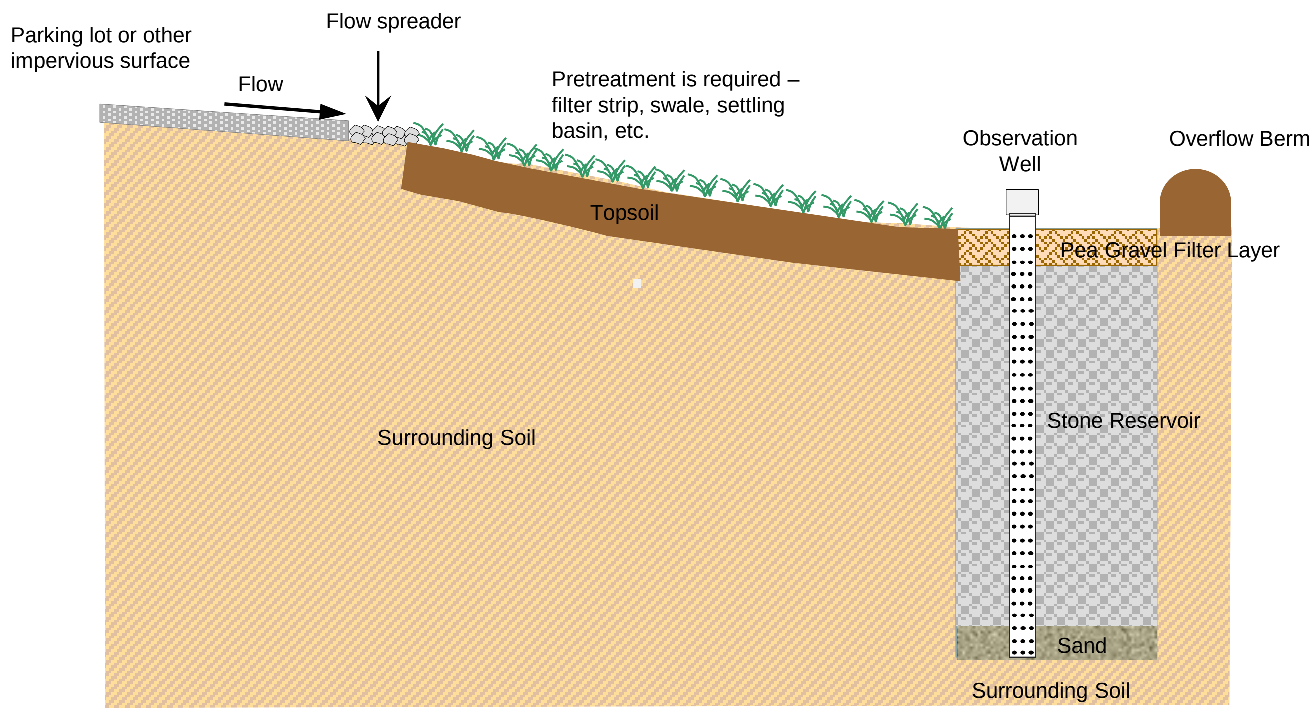

Conceptual Illustration of an Infiltration Trench

Entrada South and Valencia Commerce Center Supplemental Water Quality Analysis

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Figure 5-6

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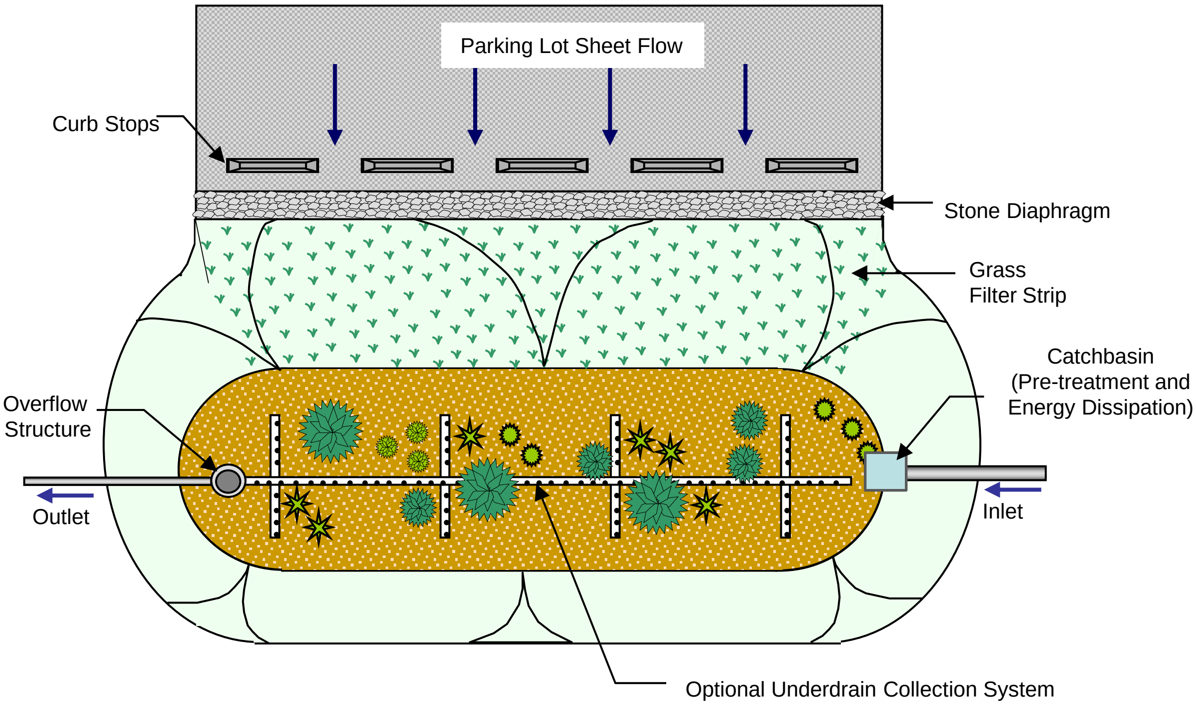
Plan View



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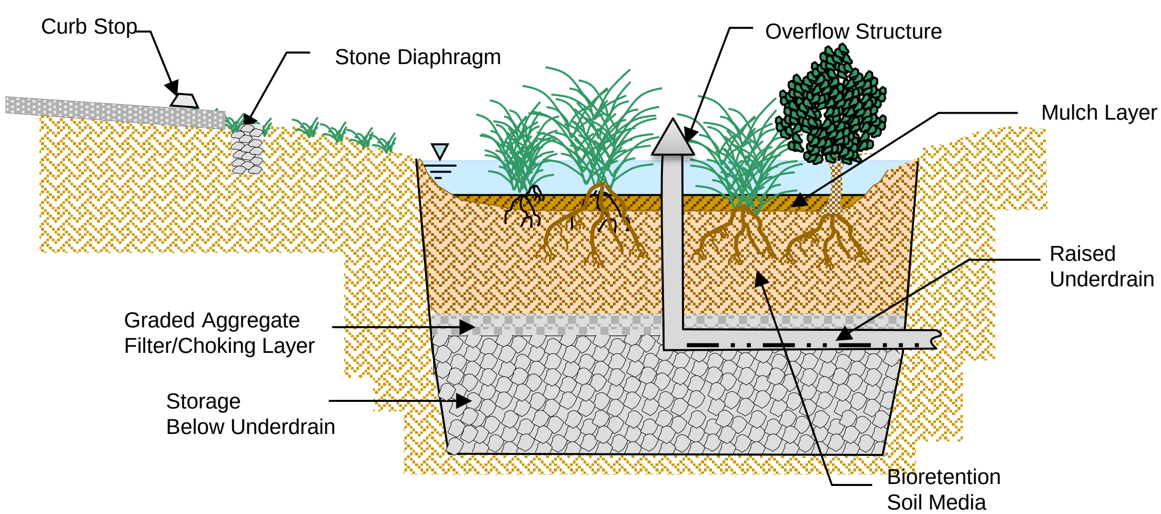

Conceptual Illustration of a Bioinfiltration Facility

Entrada South and Valencia Commerce Center
Supplemental Water Quality Analysis

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Figure

5-7

Oakland	November 2023

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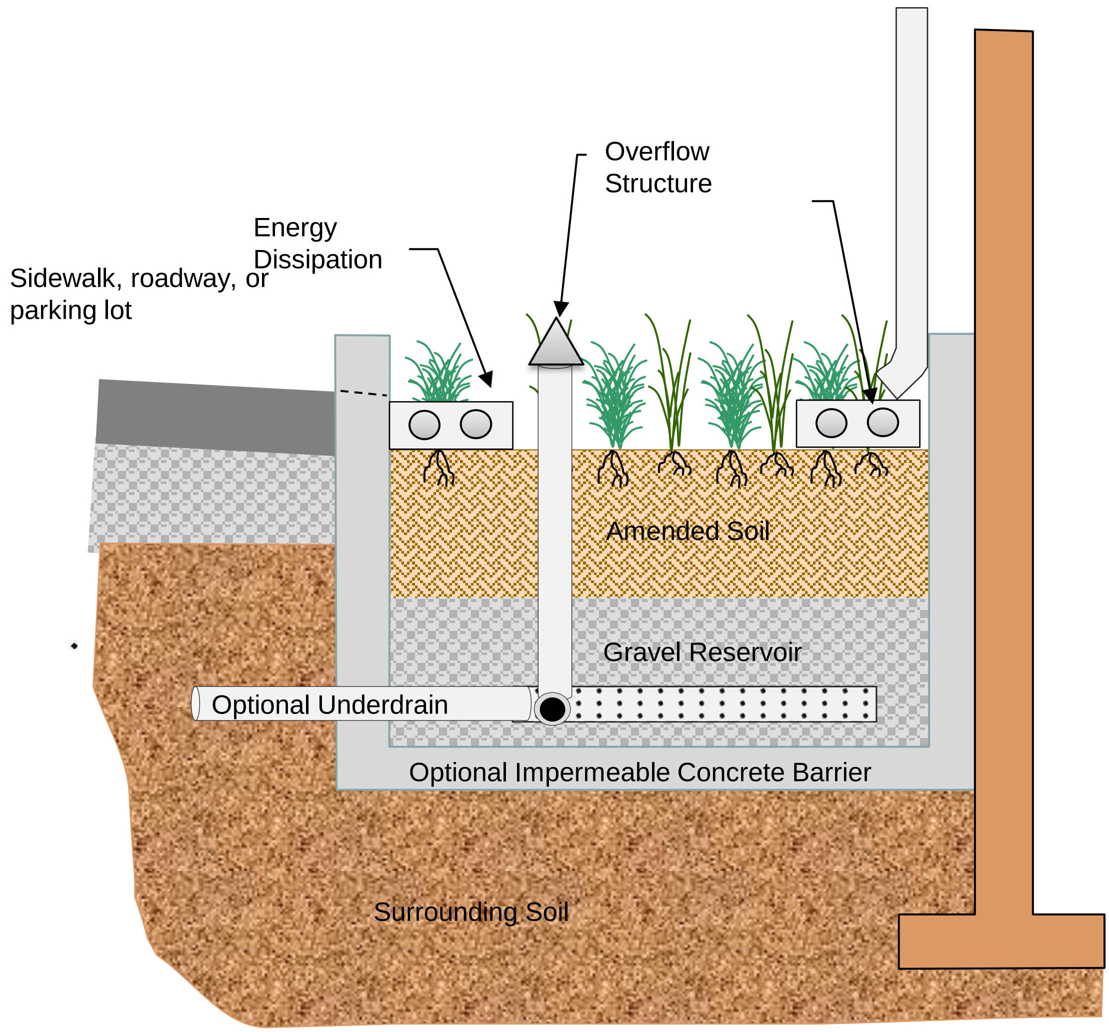
Profile



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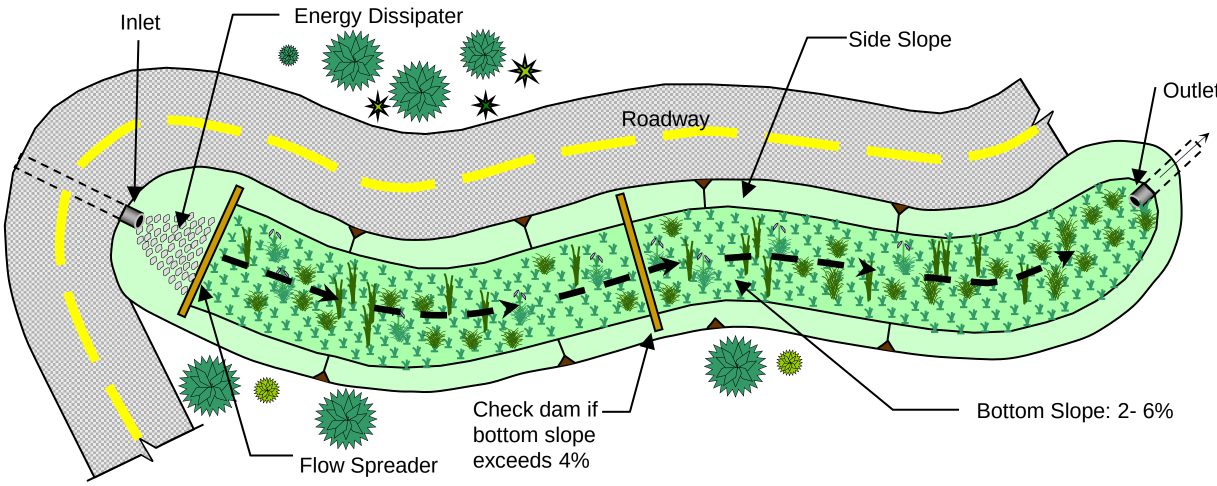
Conceptual Illustration of a Planter Box Entrada South and Valencia Commerce Center Supplemental Water Quality Analysis		
Geosyntec consultants		Figure 5-8
Oakland	November 2023	

Plan View



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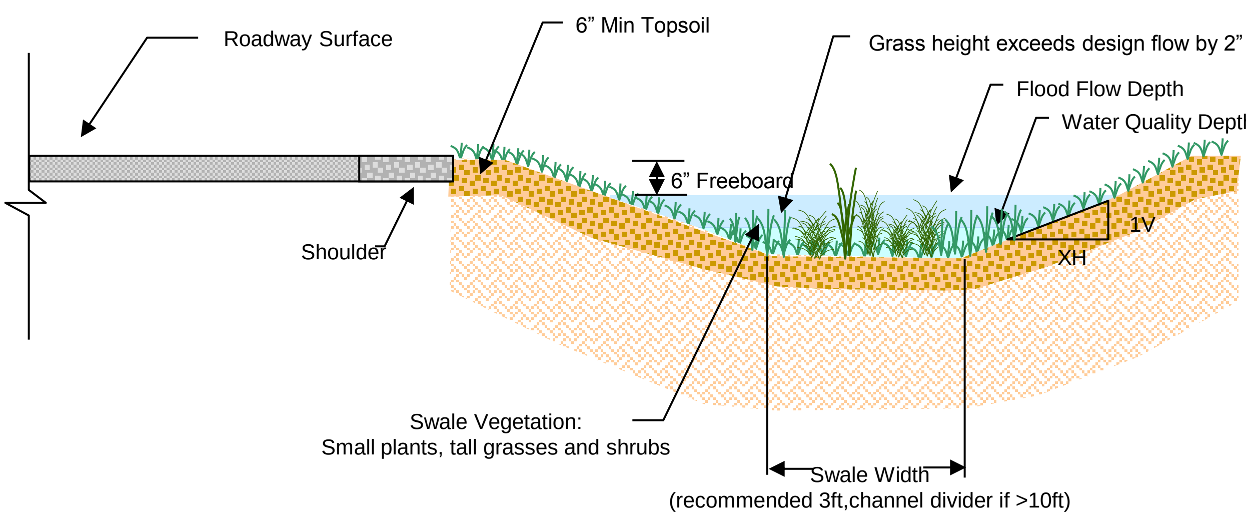

Conceptual Illustration of a Vegetated Swale Entrada South and Valencia Commerce Center Supplemental Water Quality Analysis		
Geosyntec consultants		Figure 5-9
Oakland	November 2023	

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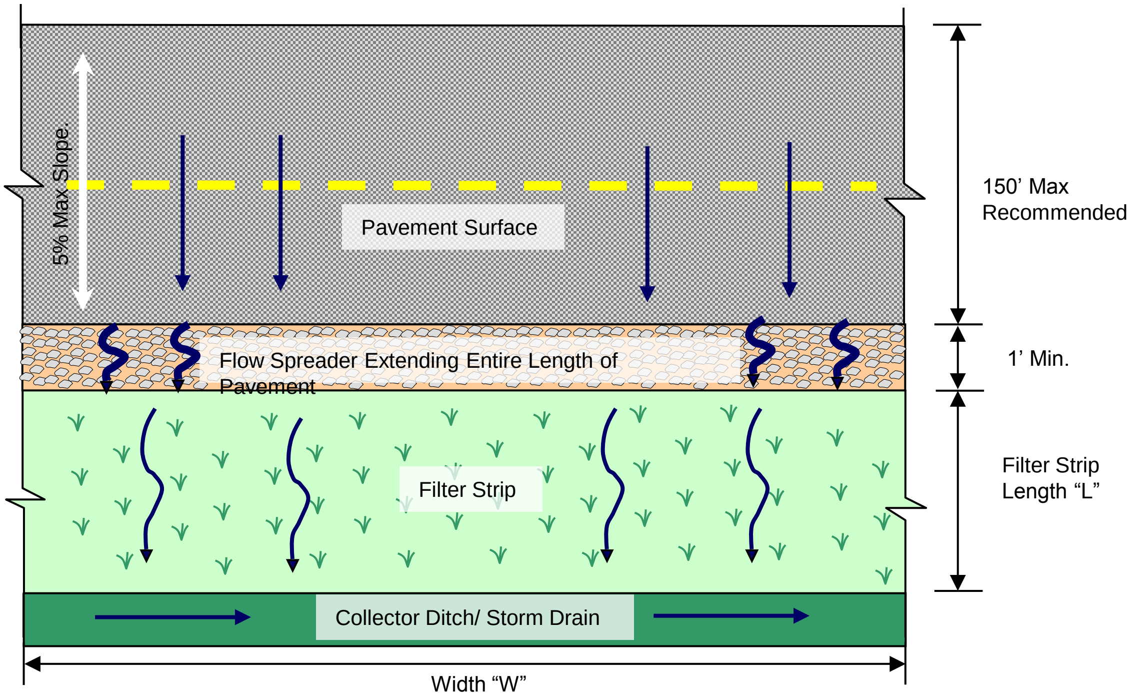
Plan View



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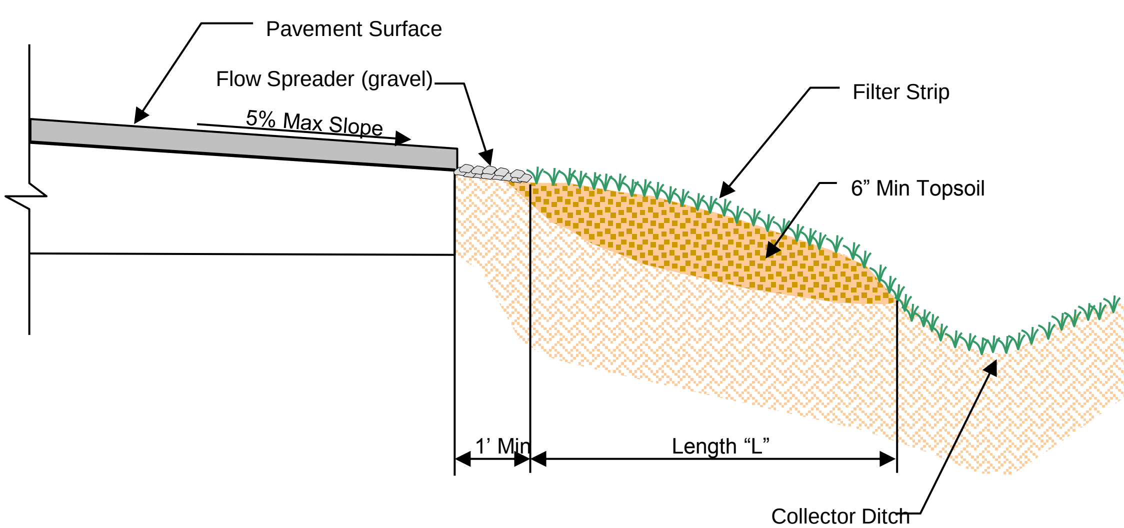

Conceptual Illustration of a Vegetated Filter Strip

Entrada South and Valencia Commerce Center
Supplemental Water Quality Analysis

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Figure 5-10

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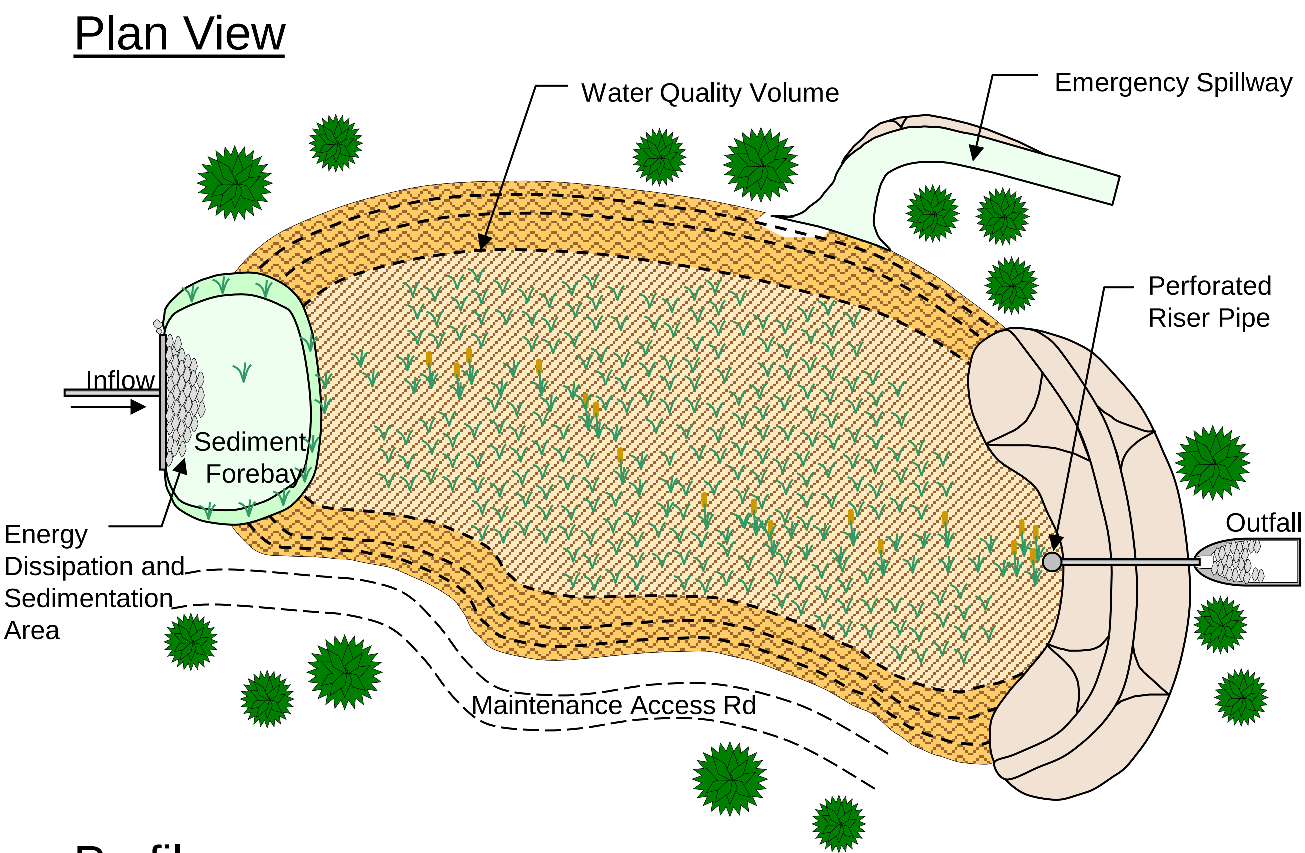

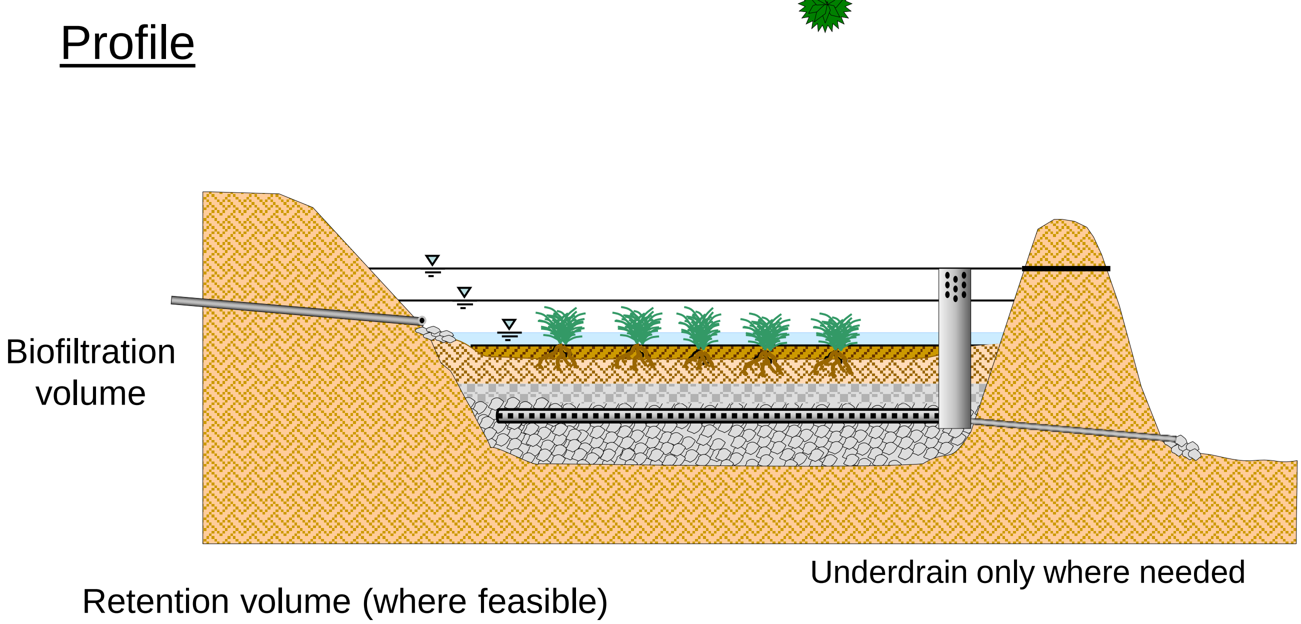

Conceptual Illustration of a Regional Infiltration Facility
Entrada South and Valencia Commerce Center
Supplemental Water Quality Analysis

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Figure 5-11

Oakland | November 2023

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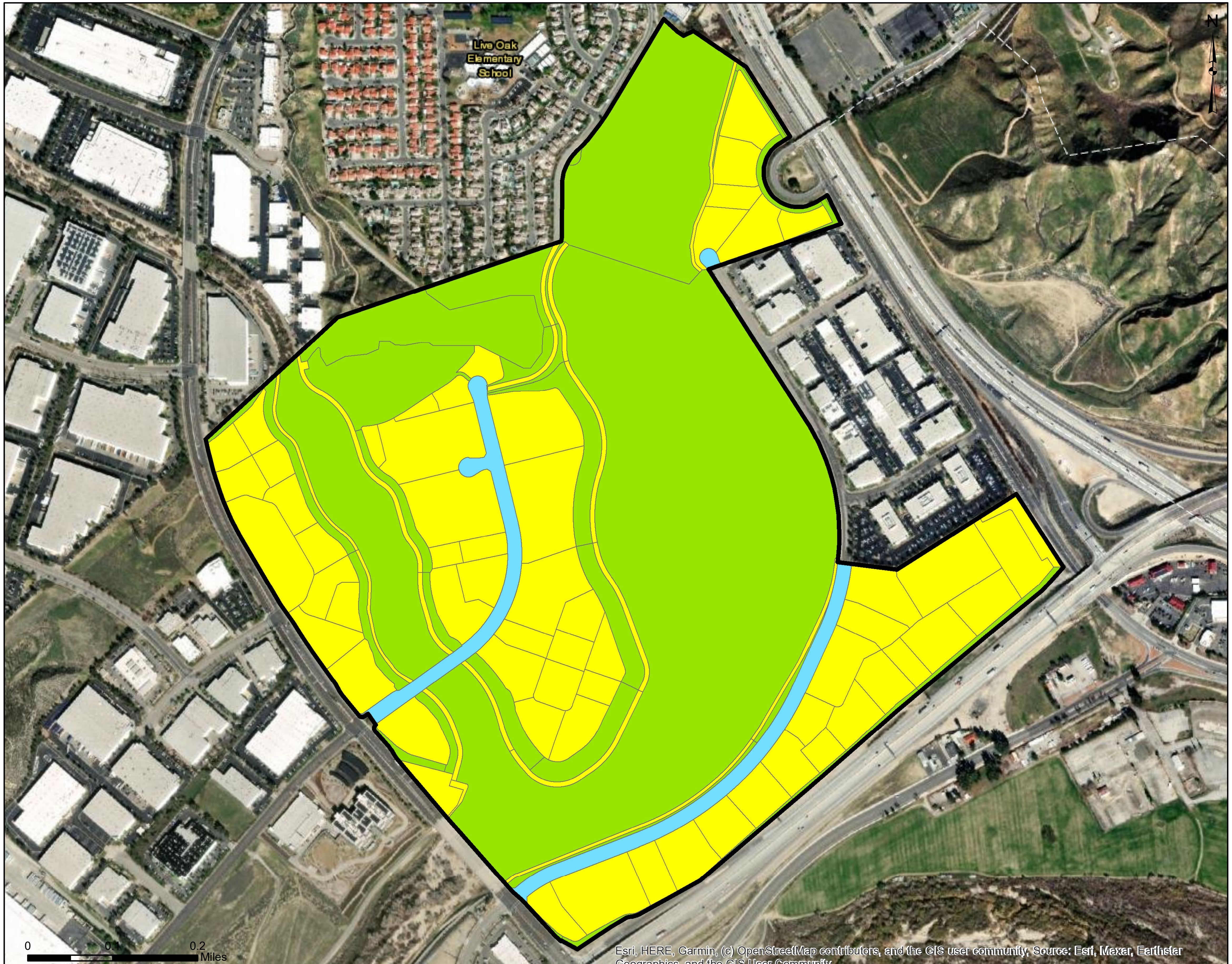

Legend

VCC Project Boundary

Water Quality Treatment Types

Open Space Not Requiring Treatment

Parcel Based LID

ROW LID

Figure 5-12
Valencia Commerce Center
Water Quality Drainage Areas

Entrada South and
Valencia Commerce Center
Supplemental Water Quality Analysis

November 2023

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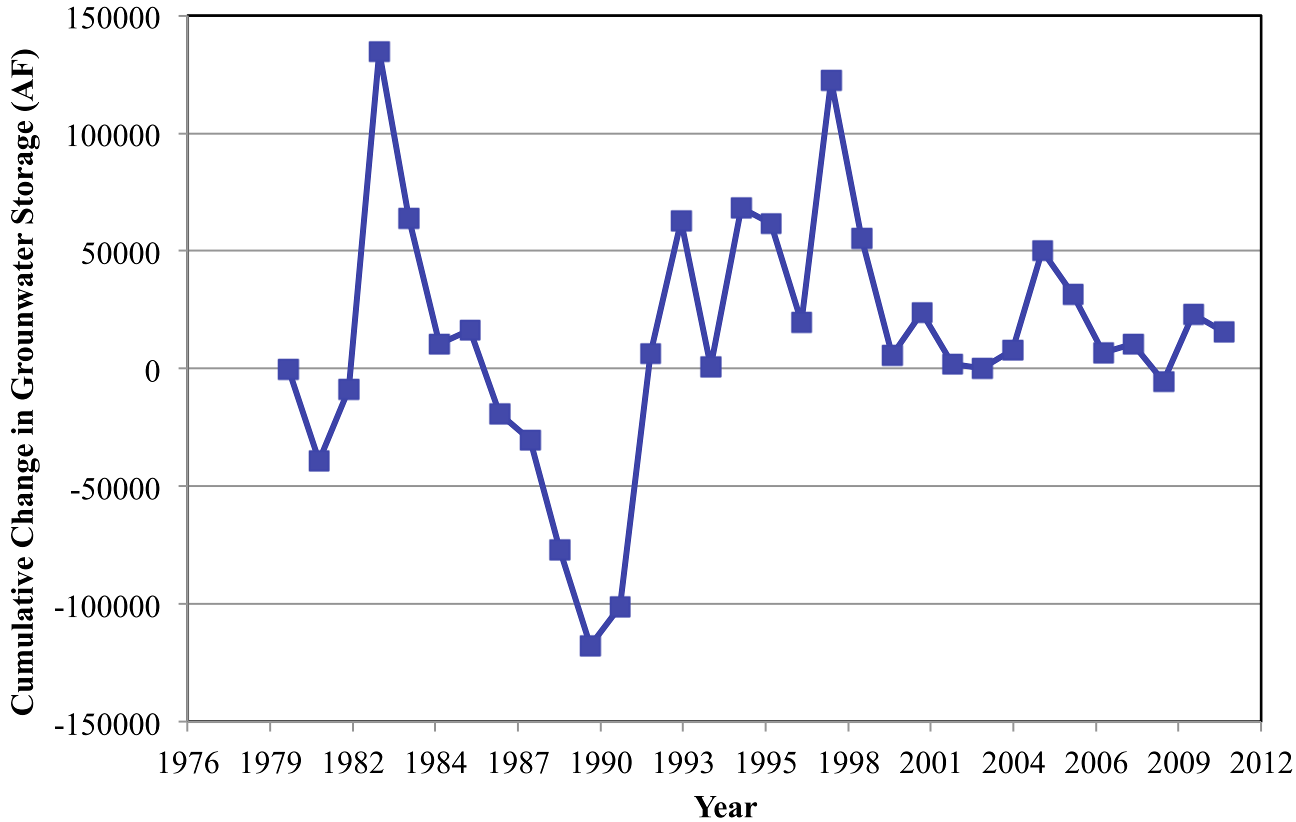
Prepared By: G.Yao



Data for period 1979 – 2000 from Draft Task 2b-2 Report – Assessment of Alternatives for Compliance Options Using the Groundwater/Surface Water Interaction Model Upper Santa Clara River Chloride TMDL Collaborative Process; prepared for the Santa Clarita Valley Sanitation District of Los Angeles County; prepared by Geomatrix Consultants, Inc., June 17, 2008. Data for period 2001-2011 from Draft Salt and Nutrient Management Plan Santa Clara River Valley East Subbasin; prepared For Upper Santa Clara River Regional Water Management Group; prepared by Geoscience Support Services Inc., August 12, 2013.

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Cumulative Groundwater in Storage for the Santa Clara River Watershed

Entrada South

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Figure 7-1

Oakland | November 2023

APPENDIX A
Basis of Design: Unnamed Canyon 2

Technical Memorandum

Date: July 16, 2013

To: Craig Whitteker, PE – Alliance Land Planning & Engineering, Inc.

From: Jose Cruz, PE

Re: Entrada South Drainage Channel – Preliminary Hydraulic Analysis # A373

1.0 Introduction/Purpose

The purpose of this technical memorandum is to provide a brief summary of the hydraulic analysis performed for the drainage corridor associated with the Entrada South (TTM 53295) development project. Currently, flows enter the drainage corridor from the neighboring Westridge golf course development via overland flow and from an existing 48-inch storm drain pipe. The drainage corridor navigates in a northerly direction approximately 3,000 linear feet where it enters an existing culvert at Magic Mountain parkway, ultimately discharging to the Santa Clara River.

As part of the Entrada South development plan, the drainage corridor will be bisected by the proposed 'A' Street alignment. The channel reach downstream of 'A' street will be completely developed and a storm drain culvert will be installed to convey flows to the existing culvert downstream. The upstream reach will remain as natural open space, with some minor grading to stabilize the stream banks and channel bed. The magnitude of the stabilization for this reach is based on a preliminary hydraulic analysis of the drainage corridor, as discussed in this document.

2.0 Summary of Channel Hydraulics

The existing drainage corridor has a bed slope of approximately 2%, with varying bottom widths, ranging from areas as narrow as 20-ft and as wide as 100-ft. Analysis of aerial photography indicates sinuous drainage patterns and signs of lateral erosion of the bed and channel banks. In order to stabilize the drainage corridor and prevent future potential erosion, the proposed design will include a series of grade control structures that will maintain a stable bed slope of 0.5% throughout the length of the proposed channel. Bank stabilization measures will also be incorporated into the proposed design to prevent further lateral erosion of the channel banks. Side slopes were assumed to be at a 3:1 (H:V) ratio for this analysis.

Based on a hydrologic analysis performed by Alliance Land Planning & Engineering, the discharge rate in the drainage corridor is estimated to be approximately 750-cfs at the upstream end of the reach, and roughly 800-cfs at the 'A' Street crossing for the 50-year burned (Q_{50b}) storm event. For purposes of the preliminary hydraulic analysis, a discharge rate of 800-cfs was used to determine the estimated depths and flow velocities in the channel. Hydraulic calculations for the proposed drainage channel were performed using Flowmaster hydraulic modeling software.

Hydraulic calculations were performed using several values for manning's roughness to determine the range of flow depths and velocities based on LACDPW requirements. For the bank stabilization design, hydraulic data based on calculations using manning's roughness values of 0.085 and 0.025 are used to determine the top of bank and toe of bank, respectively. Hydraulic calculations using a manning's value of 0.060 is often used to determine extents of flooding for mapping purposes. Lastly, the calculations performed for a manning's roughness value of 0.035 provide hydraulic data for the channel based on actual roughness values present at the site. A summary of results of the preliminary hydraulic analysis are presented in Table 1 for the various scenarios analyzed.

Table 1 – Hydraulic Analysis Summary

	Base Width = 60-ft		Base Width = 120-ft	
Manning's Roughness Value	Flow Depth (ft)	Flow Velocity (ft/s)	Flow Depth (ft)	Flow Velocity (ft/s)
n = 0.025	2.0	6.2	1.3	5.0
n = 0.035	2.4	5.0	1.6	4.0
n = 0.060	3.3	3.5	2.2	2.9
n = 0.085	4.0	2.8	2.7	2.3

3.0 Proposed Flood Protection

The proposed design for the drainage corridor will incorporate a series of grade control structures used to maintain a stable bed slope of 0.5%, which will reduce flow velocities within the channel and reduce the potential for erosion of the channel bed. Additionally, bank stabilization measures will also be provided along the channel banks to prevent the potential for lateral erosion of the channel. A conceptual layout of the proposed channel design is shown in Figure 1.

As shown in Figure 1, there are a total of six grade control structures spaced at intervals of approximately 175-ft, and bank stabilization along both banks for the channel. The two structures located near the upstream end of the channel have a net drop height of six feet, and the remaining four structures have a net drop height of four feet. The proposed bank stabilization design was estimated using LACDPW requirements for bank top and bank toe design. The top of bank elevation was determined using the flow depths resulting from the modeling using a manning's roughness of 0.085, and minimum freeboard of 2.5-ft. The toe of bank elevation was determined using the cutoff depth table from the LACDPW Flood Control District Hydraulic Design Manual based on flow velocities resulting from modeling using a manning's roughness of 0.025.

For most of the channel (Sta. 11+50 to Sta. 21+50), the total bank height is 12-ft, with 6-ft of bank stabilization above and below the proposed channel bed elevation. Between Sta. 21+50 and Sta. 24+00, the channel is not as wide as the downstream areas and water surface elevations and velocities are expected to be slightly higher, therefore the top of bank is 6.5-ft above the bed, and the toe of bank is 8-ft above the bed. Upstream of Sta. 24+00, the toe of bank remains at 8-ft below the proposed bed, and the top of bank increases from 6.5-ft to nearly 16-ft in order to tie-in to the existing concrete slope lining from the existing storm drain outlet structure.

In addition to providing stabilization measures for both the channel bed and banks, there is an existing 34-inch gas line that will require relocation. Currently, nearly 80 linear feet of the high pressure gas line that crosses the drainage corridor is exposed. The proposed design requires the gas line to be dropped nearly 15-ft vertically to be below the toe elevation for the proposed bank stabilization. In order to protect the gas line from future exposure, a grade control structure will be installed just downstream of gas line crossing, which will prevent potential erosion of the channel bed in this area.

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
P: (714) 481-7300 | www.pacewater.com

FIGURE 1 - ENTRADA SOUTH PRELIMINARY CHANNEL DESIGN

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	60.00	ft
Discharge	800.00	cfs

Results		
Depth	1.96	ft
Flow Area	129.3	ft^2
Wetted Perim	72.41	ft
Top Width	71.78	ft
Critical Depth	1.72	ft
Critical Slope	0.007883	ft/ft
Velocity	6.19	ft/s
Velocity Head	0.59	ft
Specific Energ	2.56	ft
Froude Numb	0.81	
Flow Type	Subcritical	

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.035	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	60.00	ft
Discharge	800.00	cfs

Results		
Depth	2.39	ft
Flow Area	160.6	ft^2
Wetted Perim	75.12	ft
Top Width	74.34	ft
Critical Depth	1.72	ft
Critical Slope	0.015453	ft/ft
Velocity	4.98	ft/s
Velocity Head	0.39	ft
Specific Energ	2.78	ft
Froude Numb	0.60	
Flow Type	Subcritical	

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.060	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	60.00	ft
Discharge	800.00	cfs

Results		
Depth	3.27	ft
Flow Area	228.3	ft²
Wetted Perim	80.68	ft
Top Width	79.62	ft
Critical Depth	1.72	ft
Critical Slope	0.045413	ft/ft
Velocity	3.50	ft/s
Velocity Head	0.19	ft
Specific Energ	3.46	ft
Froude Numb	0.36	
Flow Type	Subcritical	

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.085	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	60.00	ft
Discharge	800.00	cfs

Results		
Depth	4.00	ft
Flow Area	287.7	ft^2
Wetted Perim	85.28	ft
Top Width	83.98	ft
Critical Depth	1.72	ft
Critical Slope	0.091140	ft/ft
Velocity	2.78	ft/s
Velocity Head	0.12	ft
Specific Energ	4.12	ft
Froude Numb	0.26	
Flow Type	Subcritical	

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	120.00	ft
Discharge	800.00	cfs

Results		
Depth	1.31	ft
Flow Area	162.6	ft^2
Wetted Perim	128.30	ft
Top Width	127.87	ft
Critical Depth	1.10	ft
Critical Slope	0.008925	ft/ft
Velocity	4.92	ft/s
Velocity Head	0.38	ft
Specific Energ	1.69	ft
Froude Numb	0.77	
Flow Type	Subcritical	

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.035	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	120.00	ft
Discharge	800.00	cfs

Results		
Depth	1.60	ft
Flow Area	200.0	ft²
Wetted Perim	130.14	ft
Top Width	129.62	ft
Critical Depth	1.10	ft
Critical Slope	0.017494	ft/ft
Velocity	4.00	ft/s
Velocity Head	0.25	ft
Specific Energ	1.85	ft
Froude Numb	0.57	
Flow Type	Subcritical	

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.060	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	120.00	ft
Discharge	800.00	cfs

Results		
Depth	2.21	ft
Flow Area	279.7	ft^2
Wetted Perim	133.97	ft
Top Width	133.25	ft
Critical Depth	1.10	ft
Critical Slope	0.051418	ft/ft
Velocity	2.86	ft/s
Velocity Head	0.13	ft
Specific Energ	2.34	ft
Froude Numb	0.35	
Flow Type	Subcritical	

Entrada South Drainage Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.085	
Channel Slope	005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	120.00	ft
Discharge	800.00	cfs

Results		
Depth	2.72	ft
Flow Area	347.9	ft²
Wetted Perim	137.17	ft
Top Width	136.29	ft
Critical Depth	1.10	ft
Critical Slope	0.103213	ft/ft
Velocity	2.30	ft/s
Velocity Head	0.08	ft
Specific Energ	2.80	ft
Froude Numb	0.25	
Flow Type	Subcritical	

APPENDIX B

Assessment of Potential Impacts Resulting from Cumulative Hydromodification Effects, Selected Reaches of the Santa Clara River, Los Angeles County, California

Assessment of potential impacts resulting from cumulative hydromodification effects, selected reaches of the Santa Clara River, Los Angeles County, California

Report prepared for:

GeoSyntec Consultants

Prepared by:

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October 2005

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Assessment of potential impacts resulting from cumulative hydromodification effects, selected reaches of the Santa Clara River, Los Angeles County, California

Balance Project Assignment 205018

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1. INTRODUCTION

1.1 Background and purpose

The Newhall Ranch Specific Plan projects will urbanize a portion of the Santa Clarita Valley in Los Angeles County during the coming decades. The project is an extension of prior community growth, which commenced in earnest during the 1960s, in accordance with the adopted General Plan and adopted growth projections. Concern has been expressed that future urbanization may result in changes in the Santa Clara River, a stream of regional scale draining westward from northern Los Angeles County through Ventura County, flowing into the Pacific Ocean near Oxnard. Prior analysis by Geosyntec Consultants (2005) indicates that cumulative future urbanization in the upper watershed of the Santa Clara River, of which Newhall ranch will contribute a portion, will reach approximately 9 percent at “built-out” conditions. A survey of the literature (reviewed in GeoSyntec, 2002) shows that many western-state streams begin to exhibit effects when impervious areas exceed a threshold of about 10 percent, with some considerable site-by-site variability. Additional studies by GeoSyntec in the San Francisco Bay area (2004) and a recent Southern California regional study (Coleman and others, 2005) indicate that, for watersheds smaller than about 25 square miles, channels in granular, non-cohesive sediments may become unstable downstream from urbanizing areas when impervious coverage reaches as little as 2 to 3 percent.

This report uses an empirical approach to assess the potential effects of urbanization on channel morphology associated with the implementation of the Newhall Ranch Specific Plan, combined with other existing and future development in the upper watershed of the Santa Clara River as described in the adopted General Plan. We use historical changes in the Santa Clara River channel pattern to help bracket potential morphological effects on the river of hydromodification due to accumulated urban development. We note that historical changes (both natural and human-induced) in the three factors most likely to affect the Santa Clara River stability (magnitude and frequency of stormflow events, sediment supply and caliber, and channel vegetation) are very large relative to the effects, if any, of the Newhall Ranch project and other planned future urban development. We hypothesize that it will prove useful to learn from history, and to assess the nature and general degree of change that may result from future urbanization by applying these insights.

Much of what is learned from this analysis may be applicable in other aspects of planning and managing the Santa Clara River in the Newhall Ranch reach and reaches downstream. It is not, however, an immediate objective of this report to develop management plans, to assess potential changes in tributary channels, or to explore how habitat conditions might be changed by potential hydromodification, beyond that which is related to the physical channel form and dynamics.

1.2 Technical approach

The history of the Santa Clara River in the Santa Clarita Valley and eastern Ventura County allows us to explore the three factors most likely to affect the stability and morphology of the river downstream from existing and future development in the Santa Clarita Valley (including Newhall Ranch):

- High streamflows, including increased peak flows, volumes, and/or durations of stormflows,
- Coarse-sediment supply, including sharp curtailment of sediment entering the river following completion of Castaic (1974) and Santa Felicia-Piru (1958) Dams.
- Mature riparian vegetation, with interpenetrating roots, which can stabilize the banks and maintain the channel pattern.

We consider the 'pre-urban' condition to be the form and functions of the river during the 1950s and 1960s, prior to significant urban growth and modification of the flow and sediment regimes due to the construction of the Castaic and Santa Felicia-Piru Dams. Historic deviations from the pre-urban condition can be evaluated using the geomorphic evidence left by a period of floods and high flows from 1938 to about 1945. The effects of sediment supply can be evaluated by quantifying effects of eliminating coarse-sediment delivery from Castaic Creek (with a drainage area of 155 square miles, approximately 25 percent of the Santa Clara watershed at the L.A./Ventura County line. Supporting evidence can also be obtained similarly at Piru Creek (approximately 40 percent of the watershed at its confluence with the Santa Clara River at Piru).

1.3 Report organization

The analysis begins with an overview of the factors affecting the form and geomorphic history of the Santa Clara River (Chapter 2). The larger events and fluctuations, and manner in which they may have affected the river, are considered in Chapter 3. The fourth chapter explains the source materials and methods used to quantify the river's response to these perturbations, which are summarized in Chapter 5. Chapter 6 is a discussion of what we have learned from this study, and Chapter 7 draws conclusions as to how these findings relate to potential hydromodification effects in response to anticipated future watershed urbanization.

2. GEOMORPHIC SETTING

2.1 Channel pattern influences

Several previous reports have described the overall and geomorphic histories of the Santa Clara River (c.f., Schwarzberg and Moore, 1995; SCREMP 2005). In each case, authors have noted that the forms and functions of the river have varied with climatic cycles and with episodes such as floods and fires. It is this variability that is characteristic of the river. In the this report, we utilize the study of historic influences of some of the more pronounced events and cycles to better understand the impacts of drainage changes, if any, that can be expected to result from the anticipated future development in the Santa Clarita Valley, including Newhall Ranch.

2.1.1 Physiography

The Santa Clara River flows through a complex, tectonically-active trough generally bounded by reverse faults on the San Cayetano Mountain and South Mountain fronts. Some of the most rapid rates of geologically-current uplift in the world are reported from the Ventura anticline and San Gabriel Mountains, just to the northwest and southeast, respectively, of the river. Slopes are very steep, with local relief of 3000 to 4000 feet being common. These faults bring harder, more resistant sedimentary rocks over softer and younger sedimentary formations, but all formations are fundamentally soft and erodible. On either side of the faults, sandstone (generally multi-cyclic and fine-grained) and mudstones prevail. The northeastern and southeastern corners of the watershed are underlain by deeply-weathered granitic and schistose rocks, which produce sands that are coarser than those of other rock units when they weather and erode. The San Gabriel fault crosses the valley near the county line, bringing slightly more resistant rock to the surface and creating a local base level reflected as a slight rise or 'bump' on the river's longitudinal profile.

Most geologic materials in the watershed decompose mainly to silts and clays and to sand, with some coarser materials. Rhea Williams and his colleagues at the U. S. Geological Survey found that most sediment moved by the Santa Clara River and its main tributaries are quite fine, with less than 5 percent bedload-sized material (>0.25 mm, or about 0.01 inches in diameter). Some gravels and cobbles do occur within the beds of the streams and in their alluvium. Nonetheless, both the bed and the sediment transported by the river tend to be finer than in most Southern California watersheds (c.f., Knudsen and others, 1992).

The Santa Clara River watershed drains a watershed of 1,600 square miles, of which 625 square miles are within Los Angeles County, upstream of the "county-line gage" (USGS No. 11108500), near the western edge of the Newhall Ranch Specific Plan area.

2.1.2 Climate

Much of the watershed upstream of the Newhall Ranch Specific Plan area receives rainfall averaging about 18 to 25 inches per year (NOAA). As throughout Southern California, rainfall in the Santa Clara watershed alternates between wet and dry periods, a variation that is central to understanding the cultural and geomorphic histories of the upper watershed (Schwarzberg and Moore, 1995; Lynch, 1931; Reichard, 1981). Wet cycles tend to persist for several years, sometimes for periods of 6 or 8 years, during which rainfall, although variable, may average about 140 to 150 percent of the long-term average. For the woody riparian vegetation along the banks and on islands in the braided channels, these are crucial periods for establishment and growth. During dry cycles, the roots of the riparian vegetation must grow downward to the water table or perched zones, and where it cannot do so, this band of vegetation will die back.

2.1.3 Flows

Flows in the Santa Clara River, as in most southern California streams, are highly episodic. For the gaged period between 1953 and 1996 annual flow at the Los Angeles/Ventura County line gage ranged between 253,000 acre-feet (1969) and 561 acre-feet (1961). In general, however, streamflow, and especially dry-season streamflow, has increased over the past few decades primarily due to discharges from two wastewater treatment plants. Mean annual flow at the County Line increased from 25,700 acre-feet in 1972 (averaged over a 20-year record) to 35,360 acre-feet in 1988 (36-year record), with a significant decrease in the number of very low years over that period (UWCD and CLWA, 1996). Downstream of the County line, however, the Santa Clara River flows through the Piru groundwater basin, which represents a "Dry Gap" where dry-season streamflow is lost to groundwater.

Annual peak flows at the County line between 1953 and 1996 ranged from 68,800 cfs (1969) to 109 cfs (1960). Of note is that the second highest annual peak, 32,000 cfs in 1966, was less than half of the highest peak (68,800 in 1969). Both of these events occurred in the late pre-urban to early-urbanization stages within the Santa Clarita Basin and no consistent increase in peak flow is evidence since this time. Flow data for the 2005 flood event are not yet available, however the peak flow at the County line may have approached the flow observed in 1969. As discussed below these large episodic events have a significant impact on the geomorphic characteristics of the Santa Clara River mainstem.

2.1.4 Ground-water supported riparian vegetation

The Santa Clara River is underlain by several distinct alluvial ground-water basins—the Piru, Fillmore, and Santa Paula Basins (Reichard and others, 1999; SCREMP 2005). These basins are divided longitudinally by sills or ridges of bedrock that support areas of locally-high ground water, including the area upstream from the County line (above the Piru Basin), and upstream from the mouth Sespe Creek (the transition between the Piru and Fillmore Basins). This locally-high ground water sustains summer baseflow and riparian vegetation within the Santa Clara River corridor even through relatively dry climatic cycles.

3. PERTURBATIONS

This section describes several major perturbations (those with the potential to affect channel- and floodplain-form) that occurred in the Santa Clara River watershed since the early 1900s (summarized in Figure 1). Aerial photographs were selected to bracket these events and analyzed, both qualitatively and quantitatively, to try to discern and quantify responses of the Santa Clara River channel to:

(1) changes in flow regime during wet and dry multi-year cycles,

(2) sediment supply, notably describing the channel's adjustments to construction of large dams, and

(3) development of mature riparian vegetation with interpenetrating roots.

3.1 Streamflow cycles and events

As described above, streamflow within the Santa Clara watershed is highly episodic, and can vary drastically from year to year. However, decade-scale patterns of wet and dry periods have been identified in the historic record—as early as the 1700s. Previous wet periods (with associated high flows) are reported from 1810 to 1817, 1831 to 1840, 1883 and 1893, and 1903 to 1916, during each of which periods the area received a total of an additional 60 to 80 inches above the mean annual rainfall over the duration of the wet cycle. Prolonged static or drying periods similar to that observed between 1945 and 1977 also occurred from 1780 to 1810, 1842 to 1882, and 1919 to 1935 (with associated reductions in streamflow). The river is likely to have remained most stable during the latter periods, with the notable exceptions of a few major storms of record, such as 1862 (c.f., Lynch, 1931; Reichard, 1981; Schwartzberg and Moore, 1995). The primary wet periods in this study occurred between 1938 and 1946, and 1978 to 1983 (Figures 1 and 2). Other large storm events occurred in 1966, 1969, 1972, 1983, 1998, and 2005. Notable dry periods occurred between 1946 and the late 1960s, and 1983 and 1991.

3.2 Dam construction

Castaic Dam was completed on Castaic Creek (a tributary of the Santa Clara River just upstream of the Newhall project) in 1974. The watershed area above the dam is approximately one-quarter of the watershed area of the Santa Clara River at the L.A./Ventura County line, downstream of the Castaic confluence, and therefore the dam effectively reduced the sediment contributing area by about 25 percent. For comparison purposes, we also considered the effects of the construction of the Santa Felicia Dam (Lake Piru), which resulted in an approximate 38 percent decrease in sediment contribution area below the confluence of Piru Creek and the Santa Clara River[1].

3.3 Urbanization

Settlement of the Los Angeles County portion of the watershed transitioned from rural to mixed-use suburban during the mid- to late-1960s. This change initiated a period of ongoing urban expansion, with associated increases in the area of impervious or compacted surfaces as homes, commercial and industrial centers, highways and diverse infrastructure have developed throughout the Santa Clarita Valley. Future General Plan urbanization within the upper watershed, inclusive of Newhall Ranch, will bring the percent of urban area west of the County line to about nine percent (GeoSyntec, 2005).

3.4 Treated effluent discharge

Since the 1960's, treated effluent from two water reclamation plants (Saugas and Valencia) has been released directly to the Santa Clara River. This, combined with an increase in applied, imported agricultural water, has led to increased summer baseflows in the Santa Clara River at the County line, which had only rarely occurred under pre-urban conditions. This led to an increase in available water to support woody riparian vegetation. The increase in baseflow is evident in the USGS gaging record at the county line (Figure 2). In some stream corridors, vegetation growth in response to increased baseflow can provide additional bank cohesiveness and reduce erosion; though in others heavy in-channel vegetation growth (riparian encroachment) can serve to destabilize the stream and induce lateral erosion by directing flows toward the banks.

Newhall Ranch has proposed an additional plant that would ultimately treat approximately 5.8 million gallons per day at project build-out. However discharge from the plant in the summer is not expected, as this water will be re-used for irrigation purposes, and we therefore do not expect further change in riparian vegetation growth as a result.

3.5 Saint Francis Dam Breach

On March 12, 1928 the Saint Francis Dam, located in San Francisquito Canyon upstream of the Newhall project, failed and released approximately 30,000 acre-feet of water over the course of a few hours, with an estimated peak discharge of up to 800,000 cubic feet per second (Newhall,

[1] Drainage area calculations were based on USGS gaging station watershed data at Piru and Castaic Dams, and gages on the Santa Clara River at the L.A./Ventura County line and near Piru.

1928; and SCREMP, 2005). This event had drastic effects on the stream reaches downstream, as the resulting flows were much higher than anticipated from any natural event. Aerial photograph coverage during this time period is limited, however, and therefore an assessment of this event was not feasible. In addition, because of the extreme size of the event, it is unlikely that an assessment would be beneficial for assessing hydromodification impacts.

4. METHODS

We analyzed aerial photographs from 1927, 1947, 1957, 1966/67, 1989, 2002, and 2005 to describe channel change in response to the major episodes described above. The main criteria described were the width of the active braiding area (or meander belt width if there was no braiding), bank vegetation, number of channels, and width of the active channel. Also described, where they could be identified, were the width and length of "islands" (vegetated mid-channel bars) within the stream. Islands were typically easier to identify where vegetation was heavy, as the color of the vegetation highlighted the differences between channel and meta-stable islands.

The aerial photographs were analyzed in two different ways. First, a qualitative comparison of the alluvial corridor shown in the different years' photos was made, describing general differences in channel pattern and vegetation on a reach-wide scale. Second, specific cross sections were defined and the above parameters measured for each year with photo coverage in that area to provide a quantitative comparison of channel change at these standard locations along the Santa Clara River (Figure 3).

4.1 Descriptions of analysis criteria

4.1.1 Width of active braiding corridor

For braided reaches, the active channel width was identified primarily by noting the extent of active channels or recent sediment deposition. In many cases the active corridor was bounded by a significant change in vegetation or sediment deposition characteristics.

4.1.2 Relict channel corridor

The relict channel corridor is the portion of the flood plain that does not appear to have been active in the recent past (within the last 5 years or so). Typically the relict corridor is identified by areas of heavy or scattered vegetation containing no or few distinct channels, or areas that do not appear to have experienced recent sediment deposition. Alternatively, identification was based on the width between farmed fields[2]. Measurements of this feature were made from outside bank to outside bank, and include the active corridor.

[2] The total width of the former channel migration corridor is difficult to identify in aerial photographs due to past and present agricultural field reclamation following major perturbations. Where necessary, we used the width between agricultural fields as a estimate of the relict corridor.

4.1.3 Channel width

Where a distinct channel or channels could be identified, the widths of the individual channels were measured. The number of individual channel threads was also recorded, where threads could be distinguished. In some cases, measurement of these features was complicated by poor photo resolution or contrast, and difficulty in distinguishing major channels from minor ones (where a full spectrum was present).

4.1.4 Vegetation

Vegetation was described qualitatively as bare, scattered, moderate, and heavy. The location of specific areas of vegetation, such as vegetated islands, vegetation within the relict corridor, or vegetation along banks, was also described. Where the resolution was adequate, the growth form of vegetation, or state of maturity, was also described (trees or shrubs).

4.1.5 Number of vegetated islands

The number of distinct vegetated islands (mid-channel bars) was also recorded at each cross-section, where the resolution of the photographs was adequate. Where islands could be identified, measurements of width and length were recorded.

5. RESULTS

5.1 Qualitative descriptions

Initial inspection of the series of aerial photographs showed that significant changes in channel planform have occurred throughout the 1900s, as would be expected in a large, braided stream in southern California. Vegetation within the relict corridor (see definition above) near the Newhall Ranch planning area appears to become progressively heavier through time, likely due to the increase in agricultural water and discharge of treated effluent to the channel through the summer months.

The photos show many areas of net deposition, and corresponding channel shifts in major depositional areas. Single-thread, dominant channel segments are rarely present, especially in years following large events. Even when there is one main channel, secondary channels are often present within the active channel corridor.

Portions of the stream have been altered for flood control purposes, including stabilization of banks bounded by orchards and fields, or construction of levees within the active corridor. These levees are most prominent in the 1989 photographs (upstream of the L.A./Ventura County line), where the substantial segments of the main channel are confined in a flood control channel approximately 225 feet wide. By 2002, however, little evidence can be discerned in the aerial photographs of these levees.

The 2005 flood events caused significant changes within the Santa Clara River. Vegetation within the channel was almost all completely washed out (compared to 2002 conditions), and many areas of significant bank-widening were identified, even in areas of heavy bank vegetation (Figure 4).

There appears to be little change in agricultural constriction of the Santa Clara River over the span of photographs reviewed. Through the Newhall reach, the agricultural areas appear to be well buffered by the relict channel and the vegetation supported there. There were only a few places identified where the active channel cut into agricultural areas rather than staying within the relict corridor. In contrast, within the Piru Basin (downstream of the Newhall reach), significant agricultural constriction and subsequent channel widening occurred over the time span of the photos reviewed.

Areas of shallow ground water between Piru and Sespe Canyon[3], which support denser riparian vegetation than typical for the river between Valencia and Fillmore, show little if any significant change for all years in the studied photo-sets. Both the density and extent of vegetation in these areas does not appear to change over time (despite significant differences in climate and other watershed factors) nor does the amount of vegetation appear to significantly affect channel planform, compared to upstream and downstream reaches (the braided channel does not shift to a single-threaded channel through the wetted reach).

5.2 Quantitative results

For the quantitative portion of the aerial photograph analysis we looked at four different types of criteria to identify physical changes to the Santa Clara River channel (Table 1; see also section 4.1.1 for descriptions of criteria). Because of difficulties in identifying and measuring the width/number of channels and number/dimensions of vegetated islands, because of the varying resolutions and contrasts of the photographs, we concluded that analysis of these two criteria were less meaningful for this study. In other words, there was more variation due to the ability to identify the features for the varying quality of the photos than there was actual variation in the system. While we believe that these criteria may be a valid indicator of channel change, more study would be needed to adequately quantify these features so they were used a supplementary qualitative metric.

For this study we found that measurement of the "active corridor" (see section 4.1.1) was the most useful and easiest to work with to identify channel changes. In most cases there is enough vegetation along the banks that the active braiding corridor is easily identified, and changes in the width of the corridor can be tracked from year-to-year.

Figure 5 summarizes the changes in active corridor width over the time span of the reviewed photos. Within the Newhall reach, the width of the "active corridor" at the four measured cross-sections varies from year-to-year by as much as 500 feet, though most of the variation is considerably less. One station, in the narrows above the Piru Basin, has a very consistent channel width, varying by less than about 50 feet from year to year.

To provide additional analysis, we looked at a series of recent photos (1994, 2000, and 2002-2005) at one cross section downstream of the Castaic confluence. For this photo set, the channel widened significantly between 1994 and 2000 (probably in response to the 1995 or 1998 large

[3] See Reichard and others (1999) for a discussion of the hydrogeology of these shallow ground water areas; although downstream from the Los Angeles County line, results are applicable to the upstream as well, as discussed later in this report.

storms), but showed almost no change between 2000 and 2004 (Figure 6). The channel then widened considerably again in response to the high-flow events in 2005.

As a secondary check of the numbers derived for the measured standardized cross sections, we also measured active channel widths at approximately twenty different locations through the Newhall Reach on three different photo sets—1967, 2004, and 2005. From these measurements an average active braiding corridor width was calculated and compared with the other years. In 1967, the average channel width was approximately 580 feet, which was significantly wider than the average width in 2002 (392 feet). However, after the 2005 storms, the active width was approximately 560 feet, similar to the 1967 conditions.

The "relict corridor" (see section 4.1.2 for definition) also proved useful as a secondary criterion, providing a measurement of potential changes due to agricultural encroachment or constriction of the flood corridor. Measurement of the "relict corridor" at the standard cross sections showed that while there was some variation between photos, there is no consistent trend of agricultural constriction to the Santa Clara River flood corridor. These measurements, along with qualitative observations that within the Newhall reach agricultural activities were generally restricted to outside the active corridor, suggest that agricultural encroachment has not historically affected the geomorphology of the Santa Clara River within the Newhall Reach.

6. DISCUSSION

The Santa Clara River is a dynamic, episodic system. The above analyses highlight the magnitude of geomorphic change over the course of recent history, in response to natural and human disturbances in the watershed. Understanding the magnitude of past response is a key factor in assessing the potential response to future urbanization within the watershed.

The construction of Castaic Dam in 1974, regulating approximately 25 percent of the watershed at the L.A./Ventura County line, cut off a significant supply of sediment to the Santa Clara River. This change, however, does not appear to have had an effect on the channel dimensions of the Santa Clara River mainstem. The width of the active corridor, as well as the general form of the channel, are generally consistent both before and after construction of the dam. It appears that the Santa Clara River adjusted without morphological expression to absorb this change. One factor contributing to the lack of change is the seemingly large volume of sediment stored in the tectonic basin above the county line—a result of bedrock control associated with movement along the San Gabriel fault, which supports the large extent of semi-consolidated and alluvial deposits adjoining the drainage net.

The amount of vegetation within the Santa Clara River corridor appears to have increased since the 1960s, likely due to the increased summer return flows from agricultural water and to year-round augmentation of baseflows due to treated effluent discharge to the river. However, this vegetation does not seem to provide enough erosion resistance to maintain a "stable" channel capable of withstanding regular 're-sets', which occur at intervals averaging about a decade – or much less than the expected lifetime of the riparian woodlands which do get established. Despite heavy vegetation on the active channel banks near Newhall ranch and in areas of shallow ground-water, the stream still responds to large events by a general widening and/or shift of the channel. The role of vegetation in large-channel stability and morphology in Southern and Central California does fundamentally differ from that of smaller streams and streams elsewhere in the country. The geomorophic and historical record shows that resets have been occurring throughout the recent geologic past in basins exceeding a certain size. One partial explanation may be that 're-set' flood events in these larger channels exert stresses beneath or around the riparian vegetation exceeding the vegetation's threshold of stability[4].

[4] Sedimentologists note that crossbeds in the alluvium of the Santa Clara River are often 8 to 12 feet high, equal or greater than the depth to which roots can interpenetrate in most riparian settings in the region.

As stated above, the Santa Clara River, as with many streams in semi-arid southern California, is highly episodic. Concepts of “normal” or “average” sediment-supply and flow conditions have limited value in this “flashy” environment where episodic storm and wildfire events have enormous influence on sediment and stormflow conditions. Many of these channels are actively adjusting to lower flows than the last major event, which may have occurred some years before[5] (Hecht, 1993). In these streams, a large portion of the sediment movement events can occur in a matter of hours or days. In many of these channels most sediment is moved—and most bed changes occur—during the large flow events resulting from storms that may be expected approximately every 5 to 15 years (c.f., Capelli and Keller, 1993; Hecht,1993; Inman and Jenkins, 1999; Knudsen and others, 1992; Kroll and Porterfield, 1969).

Evidence of episodic channel changes can be seen in the Newhall reach of the Santa Clara River. Based on aerial-photograph interpretation of a near-yearly sequence of aerial photographs from within the last decade, the channel appears to maintain a consistent planform during average or dry rainfall years (such as between 2000 and 2004). Large events, however, (such as that which occurred in February 1998 and January 2005) can significantly modify this channel form. This widened and/or shifted channel (like that which was present after the 1998 or 2005 stormflow events) then sets the geomorphic template for subsequent normal to dry years. This model, similar to that described for the Ventura River by Capelli and Keller (1993), suggests that the geomorphology of the Santa Clara River is primarily driven by these large events.

Other perturbations which potentially affect channel geometry appear to have transitory or minor manifestations. For example, effects on the channel width due to 1980s levee construction are barely discernible by the first few years of the 21st century, probably mostly due to morphologic compensation associated with the mid- to late-1990s storm events.

[5] Actively adjusting channels may be aggrading, incising, expanding or otherwise changing channel dimensions, depending on the magnitude, type, and various effects of the episodic event.

7. CONCLUSIONS

Based on the study of historic aerial photographs described above we conclude that:

- Major perturbations within the Santa Clara River watershed (dam construction, levee construction, changes in flows in response to decadal-scale climatic patterns, and increases in woody vegetation) do not appear to have had a significant impact on the geomorphic expression of the Santa Clara River, as quantified from measurements made from a series of historical aerial photographs flown during the years 1927 through 2005.

- Large events (those which are typically not as affected by increases in impervious area and associated increases in stormwater peaks and runoff volume) can completely alter the form of the Santa Clara River channel. We call these events "re-set" events. These events, perhaps occurring on average once every ten years, are a dominant force in defining channel characteristics.

- The geomorphic dominance of "re-set" events overwhelms geomorphic effects of hydromodification on smaller events. Due to these episodic "re-sets" we do not expect hydromodification feedback "unraveling" of the Santa Clara River mainstem, as is seen in many smaller southern California watersheds[6]. The "re-set" events appear to adequately buffer changes that may occur in short-term sediment transport.

- While there is no expected increase in summer flows due to additional treated effluent discharge to the Santa Clara River, even if summer baseflow do increase we would not expect a significant change within the channel. Additional growth in the extent or density of vegetation is not anticipated, as the reach near Newhall already appears to have enough flow to support summer vegetation, and the existing vegetation does not appear to affect channel form for durations longer than the "re-set" interval. Further, re-sets occur at intervals significantly shorter than the period required for maturation of riparian vegetation, such that full development of bank-holding properties is frequently interrupted.

- Given that the channel morphology of the Santa Clara River mainstem has not adjusted significantly to much larger perturbations in flow, sediment yield, and riparian

[6] In many smaller streams, hydromodification of moderate events can induce incision of the stream bed, which reduces the connection of the stream to the floodplain. This disconnect, in turn, increases the erosive forces of the flows (concentrating more flow in the channel) and causing further erosion, and thus a positive feedback response.

vegetation growth factors, within the Newhall reach, we do not expect a significant geomorphic impact to the Santa Clara River mainstem due to the anticipated increase in 'urban area' from four to nine percent.

8. LIMITATIONS

The analyses in this report were designed to help bracket the range of likely effects on the geomorphology of the Santa Clara River due to proposed urban expansion under the General Plan, inclusive of the Newhall Ranch Specific Plan projects. It does not consider specific elements of the project or of evolving mitigation measures; rather, it focuses upon the susceptibility to perturbation of the Santa Clara River corridor as a whole. We believe that it conforms with the standard of care applicable to reconnaissance studies of this nature; no other warranty, expressed or implied, is made.

The above analyses and discussion were intended to assess the potential cumulative impacts to the Santa Clara River *mainstem* (not tributaries) due to the anticipated urban expansion in the watershed. While we conclude that urban expansion from approximately four- to nine-percent urbanized (not 'impervious') will not significantly affect the channel geomorphology of the Santa Clara River, we do expect that there might be a response to urbanization on a larger scale. However, further study would be required to define what the likely threshold and magnitude of response might be.

We ask readers to note that this is a reconnaissance report. It is intended to bracket likely future conditions, to identify factors which must be better known, and to help guide initial planning. This report should *not* be used to site or design individual facilities without further site-specific investigations. Similarly, it is *not* intended to serve as basis for flood management or detailed floodplain planning, both of which should be conducted by well-defined and site-specific procedures, and which frequently require multiple lines of evidence.

The application of geomorphic history to inferring future channel and corridor change has a long and respected record in the earth sciences. As with all history or archival analysis, the better the record is known and understood, the more relevant and predictive the analysis can be. We do encourage readers who have knowledge of other events or processes which may have affected the river to let the authors know at the first available opportunity. The authors and their contacts via several different media are given on the signature page of this report.

9. REFERENCES

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TABLES

Table 1. Aerial photograph cross section data at selected locations near Newhall Ranch, Los Angeles County, CA. See text for explanation and interpretation of data. Locations of cross section are labeled on Figure 2. Photo sources are listed in Appendix A.

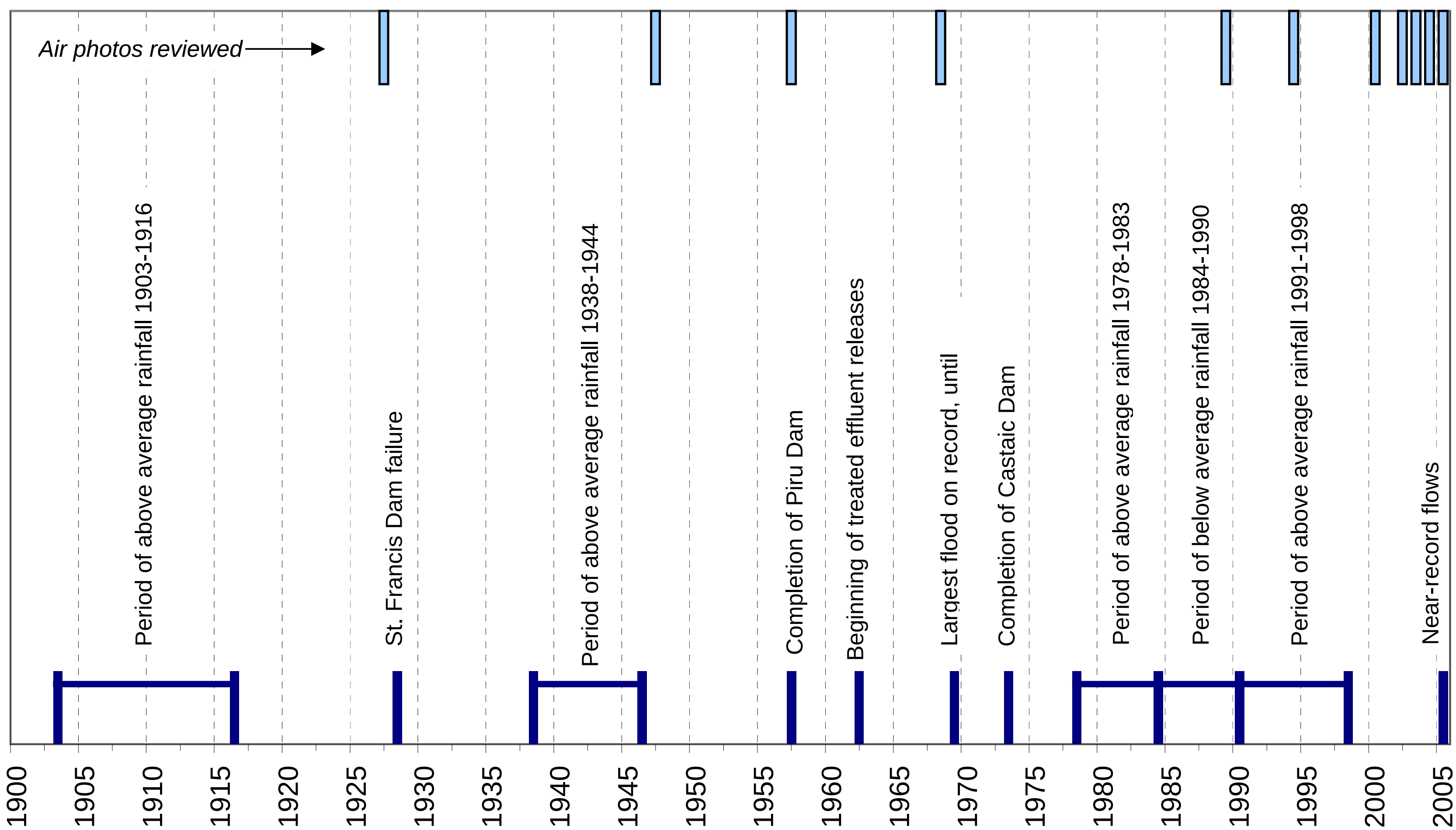
Cross section	location description	photo date	width of active braiding corridor (feet)	width of relict braiding corridor (feet)	is there one primary channel visible?	width of main channel (feet)	number of identifiable channels	total width of channels (including main) (feet)	number of islands	length of islands encountered (feet)	width of islands (feet)	vegetation	other descriptions
X1	downstream of Castaic	8/16/1947	570	1247	yes?	71	3?	107	can't define	n/a	n/a	moderately vegetated with some portions of relict corridor heavily vegetated	Just downstream a heavily vegetated bar is cut by a very distinct secondary channel
		7/20/1966	729	1173	yes	27	1	27	1	497	86	almost no vegetation within primary corridor except two areas near the primary channel and scattered small patches, only scattered vegetation on relict corridor	while there is only one main channel the rest of the primary corridor is section is almost deltaic in planform, spreading out from constriction upstream (possibly high sediment load coming in from Castaic)
		5/26/1989	173	1171	yes, but small	43	1	43	0	n/a	n/a	banks of meander corridor have scattered vegetation (less than 2000) with very little within braiding corridor	meander corridor is very distinct and straight, could be from flood control dredging;
		6/1/1994	337	1167	yes	72	2	97	1	551	171	light to moderate vegetation on braiding corridor banks	very little vegetation within braiding corridor
		2/1/2002	505	984	yes	42	2	50	poorly defined	n/a	n/a	relict braiding corridor is well-vegetated; meander belt/bar is lightly to moderately vegetated; at least one main channel bank is well-vegetated (alternates w/ meanders)	secondary channel essentially cuts off meander
		4/1/2004	505	978	no	n/a	3	87	2	929, 251	248, 56	heavy vegetation along former primary channel; relict corridor also heavily vegetated	there are two distinct channels, approximately the same size
		3/1/2003	510	965	yes	75	1	45	0	n/a	n/a	heavy vegetation on northern bank; some scattered vegetation within active corridor and surrounding low-flow channel	channel branches just downstream of cross section; very similar to 2002 and 2004 photos
		2/1/2005	601	999	no	n/a	3	106	poorly defined	n/a	n/a	no vegetation in main portion of channel; right bank has heavy tree cover, left bank has few trees	the main channel is about 340 feet wide with an obvious overbank deposition area (with very little vegetation)
X2	Upstream of County line	8/16/1947	532	1197	yes	89	2	133	1	355	133	vegetation is heavy (probably trees) on relict corridor; moderate (probably scrub) within active corridor (difficult to distinguish)	very distinguishable difference between active and relict corridor within this reach
		3/6/1963	491	1352	no	n/a	difficult to define	n/a	6	252, 283, 82, 441, 94, 410	44, 57, 52, 76, 38,63	several well-defined islands behind established vegetation (individual shrubs or small trees); relict corridor has moderate to heavy tree cover	very braided planform; switches to predominately single-thread channel just downstream
		5/26/1989	651	651	yes	43	3	108	1	2385	477	relict corridor has scattered trees with moderate to heavy shrub or grass cover; central island (along levee) has similar vegetation	well-defined flood control channel, but has been breached and there is a significant secondary channel to the north of the levees; included a portion of the island between the flood control channel and the secondary channel in the relict channel (no sign of recent deposition)

Cross section	location description	photo date	width of active braiding corridor	width of relict braiding corridor	is there one primary channel visible?	width of main channel	number of identifiable channels	total width of channels (including main)	number of islands	length of islands encountered	width of islands	vegetation	other descriptions
			(feet)	(feet)		(feet)		(feet)		(feet)	(feet)		
		6/1/2002	608	1258	yes	131	1	131	0	n/a	n/a	relict corridor on north bank has heavy tree cover; meander bends are eroding tree bank vegetation in places	stream has meandering planform, though meander belt (400' wide) has high sediment deposition and little vegetation; no evidence of flood control levees (meanders have widened to erode levees); active channel includes meander belt and area of significant recent sediment deposition to the north of the meander belt
		2/1/2005	674	1240	yes	97	3	192	1	475	155	almost no vegetation within active channel; relict corridor on both banks has moderate tree cover; much vegetation eroded away since 2002	numerous very small channels present as well
X3	downstream of county line	8/16/1947	362	805	yes, at this xs	80	2	121	can't define	n/a	n/a	outer banks of braiding corridor seem heavily vegetated	there seems to be one main channel through this reach, with extensive deposition of sediment outside of the channel
		7/20/1966	140	714	yes	51	2	77	0	n/a	n/a	banks of braiding corridor are heavily vegetated	
		5/26/1989	273	864	yes	91	2	114	1	136	23	only scattered vegetation on banks of braiding corridor	braiding corridor looks as though it may be a leveed flood control channel
		2/1/2002	249	1466	yes	41	3	79	2	344, 219	66, 36	scattered vegetation on u/s ends of islands; some recent deposition of sediment within relict braiding corridor (which is predominately heavily vegetated	
		2/1/2005	587	1472	yes	97	3	145	1	543	110	no vegetation in active corridor; right bank has heavy shrub cover with some trees, left bank has light shrub cover	
X4	upstream of Piru Basin	8/16/1947	282	885	yes	121	1	121	can't define	n/a	n/a	little to no vegetation within braiding corridor; relict braiding corridor has heavy tree/shrub cover	
		7/20/1966	281	383	no	n/a	3	26	poorly defined	n/a	n/a		
		5/26/1989	318	591	yes	68	1	68	1	91	23	meander belt banks lined with trees; meander belt itself covered with shrubs	"braiding corridor" is actually the meander belt; meander belt outside of channel is heavily vegetated
		2/1/2002	266	426	yes	35	3	45	1	340	36		secondary channels may be present in other photos, but resolution is poor, esp. 1948
		2/1/2005	281	495	yes	44	1	44	0	n/a	n/a	vegetation on right bank of main channel has diverted some flow over the relict corridor, though conditions are similar in 2002; moderate to heavy trees and shrubs on both banks	conditions are very similar to 2002, but with slightly wider and much clearer channel

Cross section	location description	photo date	width of active braiding corridor (feet)	width of relict braiding corridor (feet)	is there one primary channel visible?	width of main channel (feet)	number of identifiable channels	total width of channels (including main) (feet)	number of islands	length of islands encountered (feet)	width of islands (feet)	vegetation	other descriptions
X5	upstream of Piru confluence	4/1/1927	1834	3191	no	n/a	many	n/a	3	3060, 1170, 468	540, 450, 90	sparse scrub vegetation within active corridor, but enough to define the complex channel pattern; only slightly more vegetation (or possibly just less recent sediment deposition) in relict corridor	relict channel is mainly an artifact of flow deflection by several long levees just upstream; typical braided stream with channels of varying widths and scales (can not define number of channels due to complexity and scale variation of channels); only measured large islands
		8/16/1947	1449	3066	no	n/a	0	n/a	1	1282	279	island appears heavily vegetated; relict channel has moderate vegetation, possibly some farming	active channel is very burnt in; no evidence of levees, but would be difficult to see
		11/10/1966	957	3051	no	n/a	complex channel pattern	n/a	too complex to define	n/a	n/a	no vegetation within active corridor; sparse scrub vegetation within relict corridor, but very patchy (may be due to clearing)	flood control channel is present down middle of active corridor (196' wide); stream has complex braiding pattern, even with flood control channel present
		6/20/1989	1796	2993	no	n/a	complex channel pattern	n/a	too complex to define	n/a	n/a	light scrub vegetation within active corridor; vegetation is obviously stabilizing small islands, at least until the next big event; relict corridor is sparsely vegetated	little evidence of flood control channel but may have been some excavation in middle of active corridor (~300' wide);
		6/1/2002	1730	2452	no	n/a	5	1000	3	1200, 1085, 1520	384, 406, 400	moderate scrub vegetation on islands within active channel, similar to 1989 but slightly heavier	channels were relatively easy to pick out due to moderate scrub vegetation; channel width does not necessarily correlate to other measurements (where the only measurable parameter was wetted width)
X6	downstream of Piru confluence	4/1/1927	1713	1983	yes	18	1	18	0	n/a	n/a	no vegetation within braiding corridor; only scattered vegetation on relict corridor; heavy trees along portions of the south bank of relict corridor	very wide braided corridor with little definition (too burnt-in to define secondary channels)
		8/16/1947	1767	1983	no	n/a	0	n/a	0	n/a	n/a	looks similar to 1927 conditions	
		9/1/1957	1220	1449	yes	25	3	51	2	875, 1750	325, 425	very sparse scrub vegetation in active corridor; some small trees on relict corridor (where corridor is present)	well-defined flood control channel through this reach (136' wide), but there are several secondary channels outside the levees; diversion ponds present near the north bank; larger island cut by flood control channel
		11/10/1966	1132	1563	yes	32	4	388	2	2125, 750	850, 250	large island is moderately vegetated with scrub and one line of heavy vegetation; relict braiding corridor is similarly vegetated	braiding corridor has been confined on both sides by levees (especially on the northern portion); looks like the southern levee was recently overtopped (that area was included in the relict corridor); main channel divides in two in some areas
		6/20/1989	1082	1082	no	n/a	n/a	n/a	1	685	180	sparse scrub vegetation growing on poorly-defined islands within channel and near piers	lots of recent grading within the channel, several levees in the middle of the corridor and a series of piers on the southern bank
		6/1/2002	1050	1245	no	n/a	none	n/a	0	n/a	n/a	very little vegetation in this portion of the stream; some scattered scrub on relict corridor, even less within active channel	217-foot wide flood control channel begins just d/s of xs (poorly defined, though)

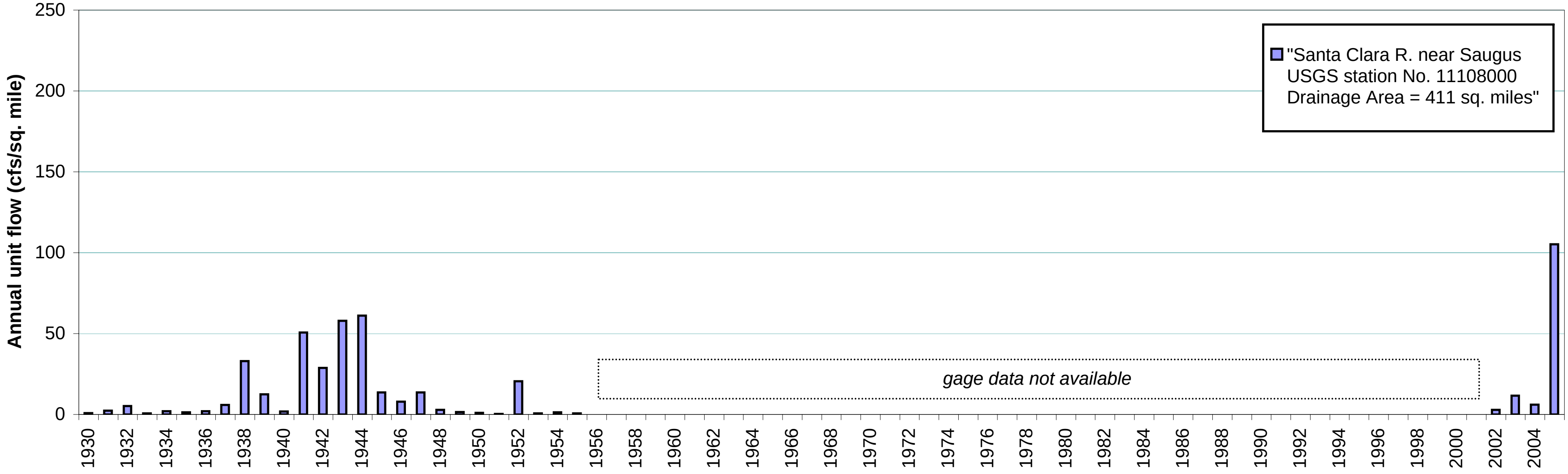
Cross section	location description	photo date	width of active braiding corridor (feet)	width of relict braiding corridor (feet)	is there one primary channel visible?	width of main channel (feet)	number of identifiable channels	total width of channels (including main) (feet)	number of islands	length of islands encountered (feet)	width of islands (feet)	vegetation	other descriptions
X7	between Piru and Sespe (ground-water upwelling)	8/16/1947	1694	2472	no	n/a	4	difficult to define the widths	can't define	n/a	n/a	this area is heavily vegetated; difficult to distinguish active braiding corridor from relict corridor	looks like there has been some flood control work in this area, two very straight channels through here, but masked some by vegetation
		9/1/1957	1446	2253	yes	168	4	370	2	4624, 8500	272, 408	northern portion of the corridor (including flood control channels) have heavy vegetation outside of the channels; the southern portion of the corridor has sparse vegetation	the main channel, and possibly the secondary channel, have been altered for flood control
		6/20/1989	749	2697	yes	37	2	150	1	1386	449	thick vegetation (with trees) along main channel; very little vegetation otherwise within active braiding corridor; moderate vegetation in northern portion of relict corridor, but only scattered brush in southern	no evidence of flood control alteration; downstream the corridor has been severely constrained by encroaching agriculture
		6/1/2002	551	2767	yes	42	2	65	1	396	108	heavy vegetation (trees) along secondary channel along north bank; scattered shrub (with some trees) vegetation within active corridor, some defining the edges of bars; heavy scrub vegetation on south relict corridor with scattered trees; heavy trees and scrub on northern relict corridor	just upstream there is a distinct main active corridor and an overbank area of deposition; the main active corridor has portions lined with heavy trees, but becomes less distinct further upstream (no vegetation)
X8	just downstream of Sespe Creek	8/20/1947	2003	2003	no	n/a	6	601	can't define	n/a	n/a	limited, if any	photo very burnt in, but channels less well-defined than in other photos
		8/13/1967	701	2203	yes	100	3	250	1	2804	401	limited, if any	one single-thread channel with one minor channel
		6/20/1989	1532	1723	yes, but less so than 1967	153	5	306	poorly defined; small and well-vegetated	n/a	n/a	islands are more heavily vegetated away from main channel; main channel bank is ~75 vegetated w/ thin vegetation line; more vegetation than in other photos	
		6/1/2002	670	1820	no	n/a	3	170	1	801	216	islands are moderately well-vegetated; relict corridor has scattered vegetation, Sespe mainstem has heavy vegetation along low-flow channels	interpretation complicated by Sespe confluence, but looks very similar to 1989 photo

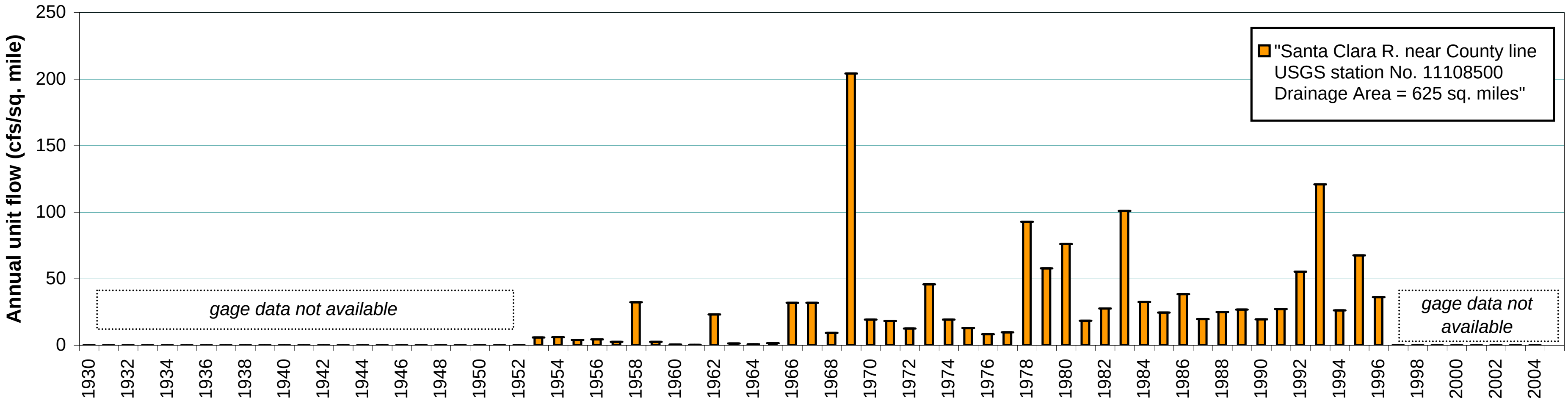
FIGURES



Balance Hydrologics, Inc.

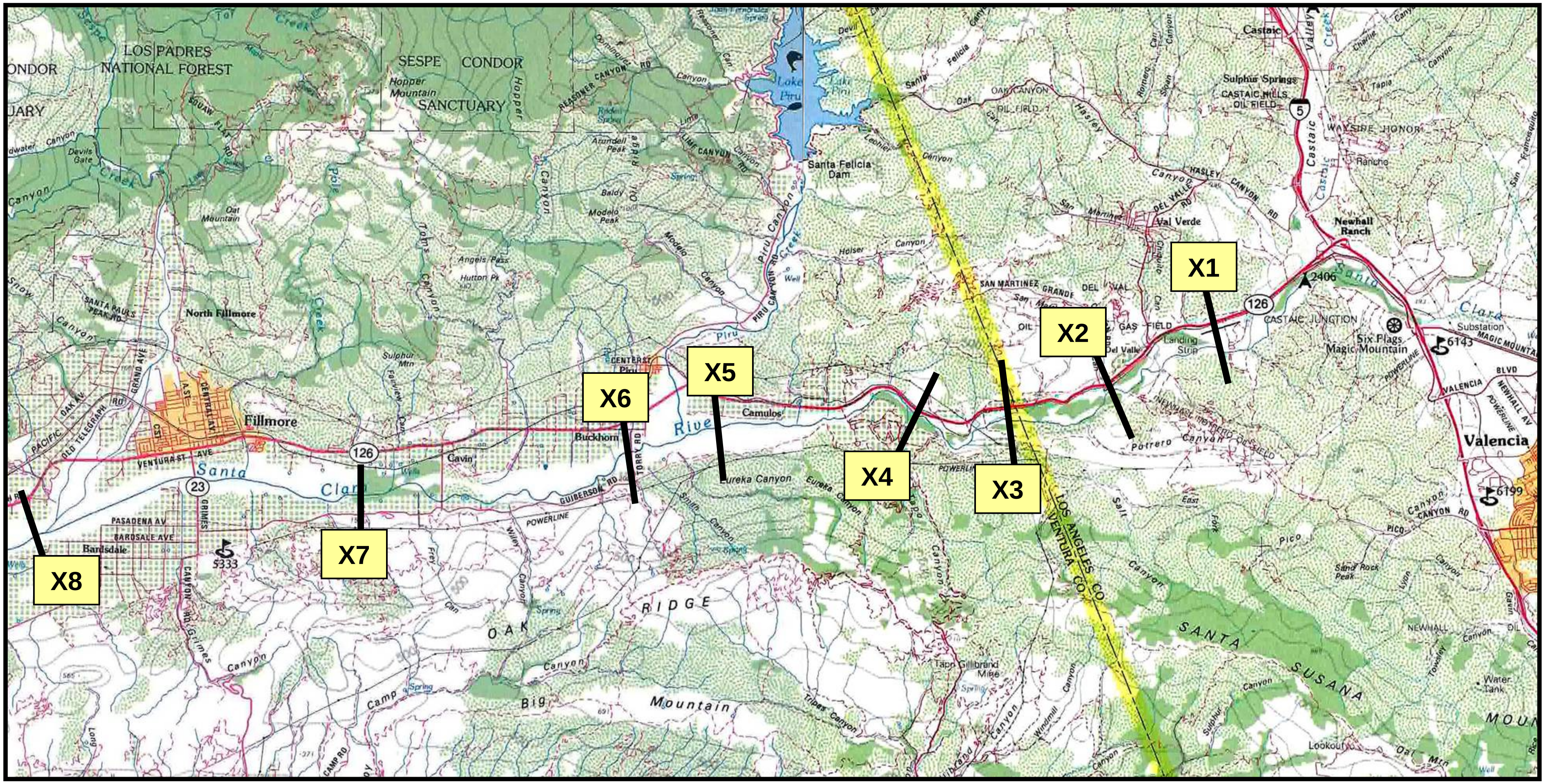
Figure 1. Timeline of selected major events in the upper Santa Clara River, California. Also shown (at top) are the years for which aerial photographs were analyzed.





Balance Hydrologics, Inc.

Figure 2. Annual unit runoff (annual flow per square mile) for the Santa Clara River near Newhall at two separate gaging stations. Note that flow in drier years has increased since the 1960s, most likely due to release of treated effluent to the River.

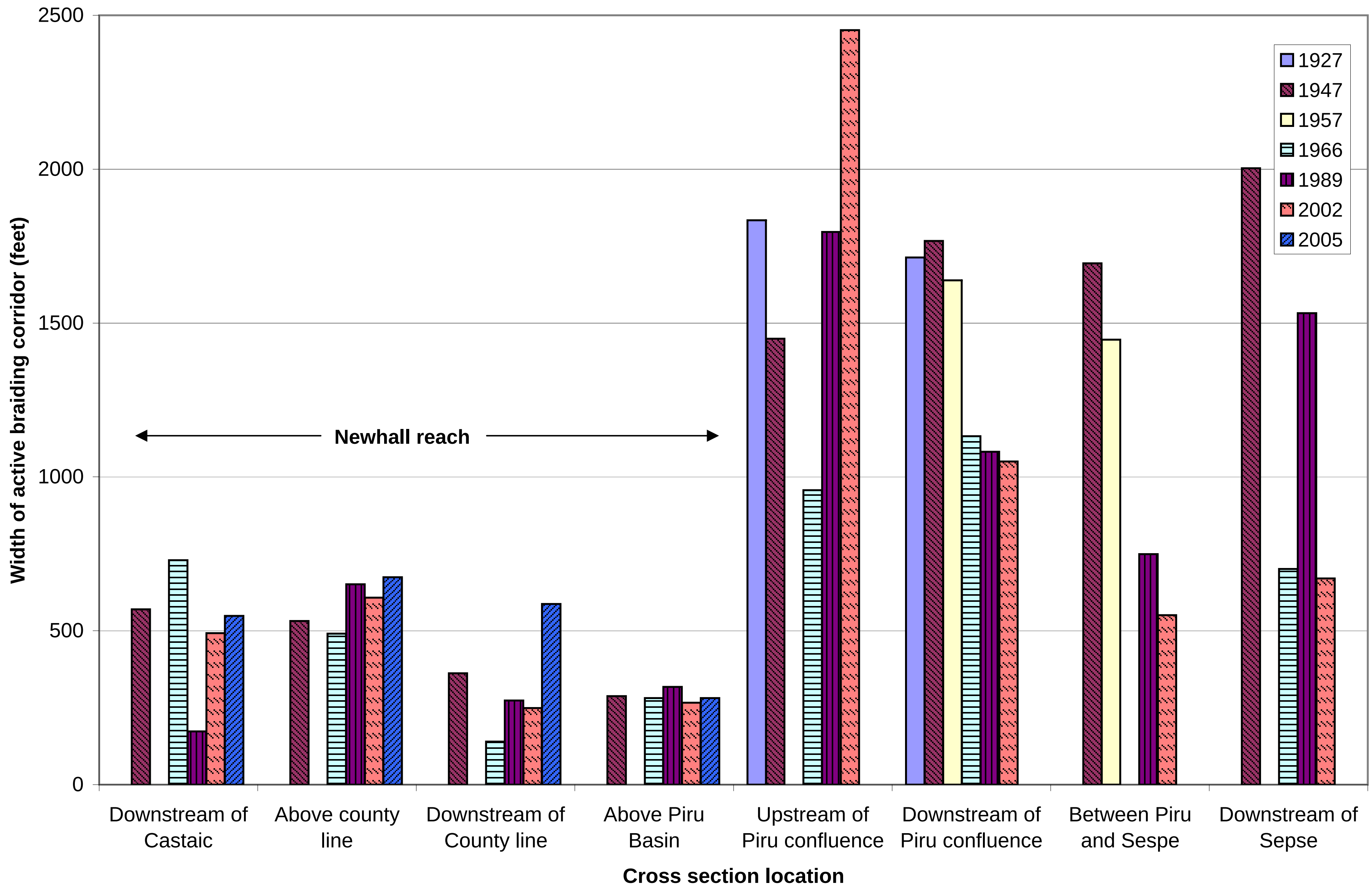


Balance Hydrologics, Inc.

Figure 3. Location of channel cross sections on the Santa Clara River, measured on aerial photographs.

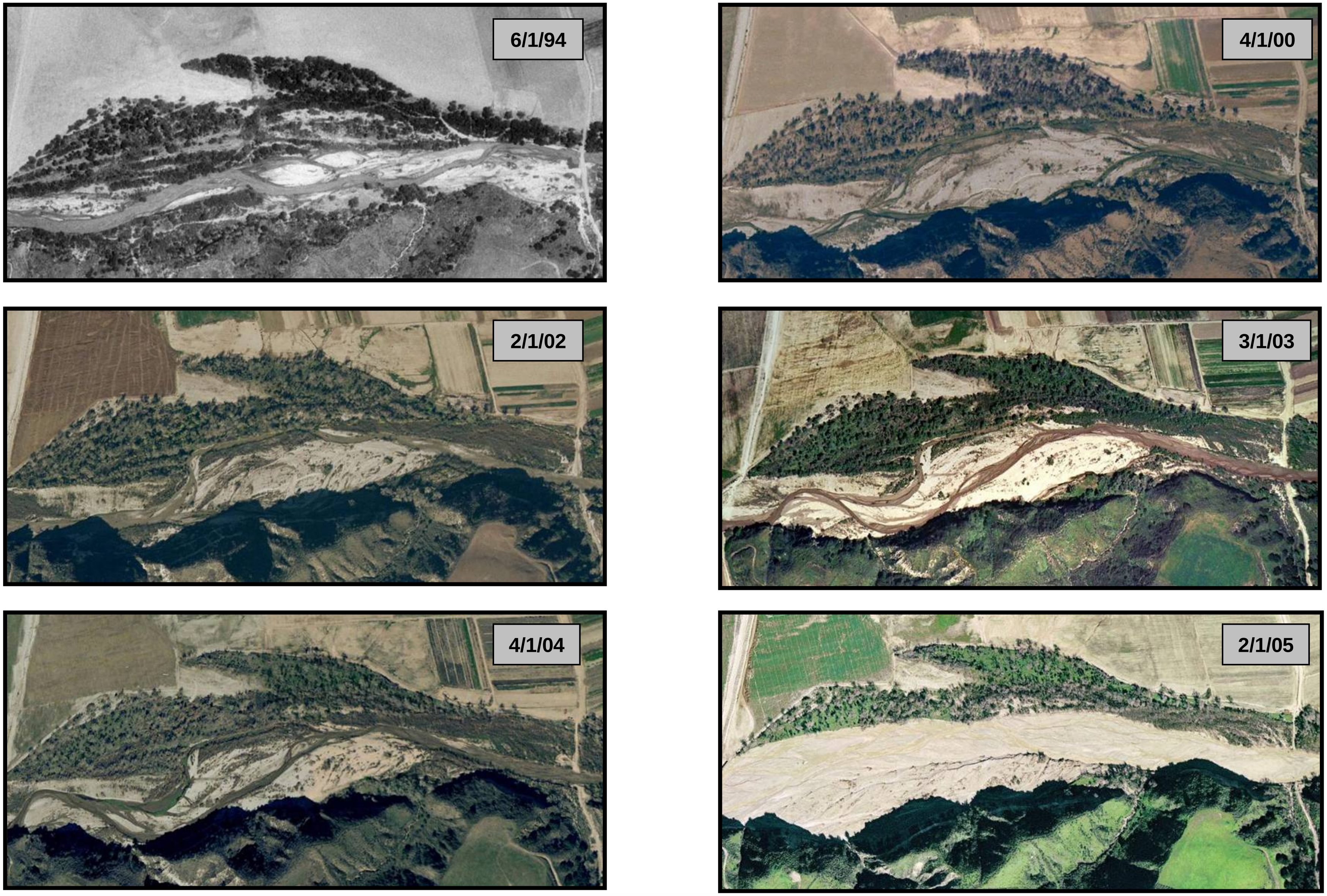
Balance Hydrologics, Inc.

Figure 4. Comparison of 2004 and 2005 conditions on the Santa Clara River, just downstream of the L.A./Ventura County line. Note that significant channel widening occurred in response to the 2005 events, even in heavily vegetated areas. See appendix A for photo sources.



Balance Hydrologics, Inc.

Figure 5. Measurements of active braiding corridor width from aerial photographs, for cross sections on the Santa Clara River.



Balance Hydrologics, Inc.

Figure 6. Progression of aerial photographs downstream of Castaic Canyon, showing channel change between 1993 and 2005. Note that there was little change between 2000 and 2004, but the active corridor widened significantly in response to the 2005 events, and that channel traces within the active corridor were effectively erased. See appendix A for photo sources.

APPENDICES

Appendix A: Summary of aerial photographs used for assessment of potential hydromodification effects on the Santa Clara River, Newhall, California.

Date	Number of photos	Nominal Scale	Hard Copy?	Electronic copy?	Image Type	Source/Vendor	Remarks
1927	6	2000	yes	yes	b/w	Whittier College: 80, 82, 84, F27, F28, F31	Only available photography prior to the March 1928 collapse of the Saint Francis Dam. Photos show area near Piru confluence
August 16, 1947	34	24000	no	yes	b/w - Vert Cart	USGS_GS-EM, Rolls 3, 5, 7	Previews downloaded already are sufficient.
1957	2	2000	yes	yes	b/w	Whittier College: 109, 123	1957 photos are for justdownstream of Piru Creek. Piru Dam was closed in 1957.
March 6, 1963	1 (2)	21670	no	yes	b/w - Vert Recon	USGS_ARMC630001L0049 a,b	high resolution scans
July 20, 1966	2 (4)	21670	no	yes	b/w - Vert Recon	USGS_ARM6625001L1362 a,b USGS_ARM6625001R1357 a,b	high resolution scans
August 19, 1966	1 (2)	21670	no	yes	b/w - Vert Recon	USGS_ARM6628502L1314 a,b	high resolution scans
September 13, 1966	1 (2)	21670	no	yes	b/w - Vert Recon	USGS_ARM6631405R1165 a,b	high resolution scans
November 10, 1966	2 (4)	21670	no	yes	b/w - Vert Recon	USGS_ARM6638605L1238 a,b USGS_ARM6638605L1242 a,b	high resolution scans
August 13, 1967	1	30000	no	yes	b/w - Vert Cart	USGS_AR1VBUK00010110	Preview already obtained. Downstream of Sespe Creek
May 26, 1989	5	31680	yes	yes	b/w	WAC-89CA, 27-42	LA County
						WAC-89CA, 27-62	LA County
						WAC-89CA, 27-84	LA County
						WAC-89CA, 27-109	LA County
						WAC-89CA, 27-135	LA County
May 1, 1989	6	2000	yes	yes	Color	PAS_89 06-20 PW VEN 7-229	Ventura County
						PAS_89 06-20 PW VEN 7-231	Ventura County
						PAS_89 06-20 PW VEN 7-233	Ventura County
						PAS_89 06-20 PW VEN 7-235	Ventura County
						PAS_89 06-20 PW VEN 7-269	Ventura County
						PAS_89 06-20 PW VEN 7-237	Ventura County
June 1, 1994	n/a	unknown			b/w, georeferenced	GlobeXplorer	downloaded select sections from LA and Ventura County
April 1, 2000	n/a	unknown	no	yes	color, georeferenced	GlobeXplorer	downloaded select sections from LA and Ventura County
February 1, 2002	4	Unknown	no	yes	Color, georeferenced	AirPhotoUSA (from GeoSyntec)	Covers all of Newhall project area

Date	Number of photos	Nominal Scale	Hard Copy?	Electronic copy?	Image Type	Source/Vendor	Remarks
July 23, 2002	n/a	unknown	no	yes	Color, georeferenced	GlobeXplorer	downloaded select sections from LA and Ventura County
March 1, 2003	n/a	unknown	no	yes	Color, georeferenced	GlobeXplorer	downloaded select sections from LA and Ventura County
April 1, 2004	n/a	unknown	no	yes	Color, georeferenced	GlobeXplorer	downloaded select sections from LA and Ventura County
October 13, 2004	n/a	unknown	no	yes	Color, georeferenced	GlobeXplorer	downloaded select sections from LA and Ventura County
February 1, 2005	n/a	unknown	no	yes	Color, georeferenced	GlobeXplorer	only avaialable for LA County

APPENDIX C
Water Quality Data

Table 1. Water Quality Monitoring Data for Permanent Water Quality Monitoring SitesAlong the Santa Clara River
Water Quality Monitoring Progress Report, Reporting Period - November 29, 2017 to January 31, 2018
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
SCR-US	11/29/2017	7.54	17.01	7.86	--	0.33
	11/30/2017	7.04	16.10	9.59	<10	0.50
	12/1/2017	8.20	13.96	5.75	<10	1.20
	12/4/2017	8.09	15.58	10.28	<10	0.60
	12/5/2017	--	--	--	--	--
	12/6/2017	--	--	--	--	--
	12/7/2017	--	--	--	--	--
	12/8/2017	8.17	14.91	8.88	<10	0.30
	12/12/2017	8.15	13.77	8.75	<10	0.70
	12/13/2017	8.24	13.25	8.73	<10	0.50
	12/14/2017	7.40	21.27	6.85	<10	0.00
	12/15/2017	8.08	12.29	9.14	<10	0.20
	12/16/2017	8.14	13.22	8.56	<10	1.70
	12/21/2017	7.85	10.98	9.41	<10	1.20
	12/27/2017	7.67	17.06	8.20	<10	13.2
	1/3/2018	7.82	14.84	10.48	<10	0.00
	1/9/2018	7.58	13.66	9.93	**5,300**	**2,800**
	1/17/2018	7.93	16.75	8.02	<10	175
	1/24/2018	7.98	13.58	9.52	<10	6.50
SCR-PR1	11/29/2017	7.77	23.72	6.15	--	0.82
	11/30/2017	7.68	21.45	7.71	<10	1.30
	12/1/2017	7.65	19.60	5.29	<10	8.30
	12/4/2017	7.78	20.98	5.60	<10	7.20
	12/5/2017	7.94	18.09	6.26	<10	8.20
	12/6/2017	--	--	--	--	--
	12/7/2017	--	--	--	--	--
	12/8/2017	8.03	20.57	6.14	<10	9.80
	12/12/2017	7.59	21.89	5.40	<10	2.87
	12/13/2017	7.96	21.54	6.86	<10	6.00
	12/14/2017	7.40	21.27	6.85	<10	10.0
	12/15/2017	7.64	20.91	6.24	<10	19.5
	12/16/2017	7.48	21.38	5.89	**34.0**	55.0
	12/21/2017	7.63	19.97	6.65	<10	21.6
	12/27/2017	7.31	20.32	6.63	<10	19.2
	1/3/2018	7.58	21.31	6.48	<10	17.3
	1/9/2018	6.60	13.08	9.39	**3,100**	**1,700**
	1/17/2018	7.71	22.86	6.71	<10	24.7
	1/24/2018	7.62	20.99	5.88	<10	32.1

Table 1. Water Quality Monitoring Data for Permanent Water Quality Monitoring SitesAlong the Santa Clara River
Water Quality Monitoring Progress Report, Reporting Period - November 29, 2017 to January 31, 2018
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
SCR-PR2	11/29/2017	7.70	22.81	6.49	--	3.17
	11/30/2017	7.58	20.65	6.05	<10	8.00
	12/1/2017	7.90	19.60	6.93	<10	8.30
	12/4/2017	7.85	21.10	7.43	<10	10.4
	12/5/2017	7.52	17.87	5.16	<10	6.80
	12/6/2017	--	--	--	--	--
	12/7/2017	--	--	--	--	--
	12/8/2017	7.88	20.86	6.88	<10	5.00
	12/12/2017	7.93	20.73	6.65	<10	4.40
	12/13/2017	8.12	20.16	7.43	<10	9.40
	12/14/2017	7.41	19.53	7.44	<10	12.2
	12/15/2017	7.77	18.75	7.19	<10	15.3
	12/16/2017	7.71	20.14	6.25	<10	10.3
	12/21/2017	7.31	18.19	7.32	<10	21.6
	12/27/2017	7.57	18.38	8.21	<10	15.5
	1/3/2018	7.76	20.61	7.60	<10	16.6
	1/9/2018	6.32	13.30	8.82	**11,000**	**6,500**
	1/17/2018	7.31	22.30	7.49	<10	15.8
	1/24/2018	7.25	20.20	6.97	<10	47.8
SCR-DS	11/29/2017	7.91	21.87	7.25	--	1.88
	11/30/2017	8.25	20.71	10.63	<10	2.60
	12/1/2017	8.31	16.59	7.16	<10	6.30
	12/4/2017	8.55	18.80	8.26	<10	6.50
	12/5/2017	8.29	17.44	8.50	<10	2.50
	12/6/2017	--	--	--	--	--
	12/7/2017	--	--	--	--	--
	12/8/2017	8.14	17.14	8.04	<10	8.20
	12/12/2017	8.03	19.98	7.69	<10	12.5
	12/13/2017	8.05	16.65	8.73	<10	17.3
	12/14/2017	8.02	16.83	8.49	<10	8.30
	12/15/2017	8.19	16.71	7.68	<10	14.0
	12/16/2017	8.26	17.49	8.09	<10	7.60
	12/21/2017	7.92	15.77	8.04	<10	16.6
	12/27/2017	8.05	11.12	9.42	<10	0.00
	1/3/2018	8.03	18.16	9.00	<10	16.3
	1/9/2018	5.84	13.66	9.17	**160**	**200**
	1/17/2018	6.36	20.70	7.86	<10	44.7
	1/24/2018	6.07	17.58	7.96	<10	25.3

Notes:

"--" Not Sampled

Bold indicates lab analysis data is used in place of field monitoring data where stream depth was too shallow for water quality monitor or turbidity and/or Total Suspended Solids was out of range of handheld water quality monitor.

Table 2. Water Quality Monitoring Data for Tributary Monitoring Sites During Discharge on January 9, 2018
Water Quality Monitoring Progress Report, Reporting Period - November 29, 2017 to January 31, 2018
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
UNC2-TUS	1/9/2018	**7.00**	--	**10.00**	**1,800**	**1,400**
UNC2-TPR	1/9/2018	7.10	13.53	9.46	**2,500**	**1,600**
UNC2-TDS	1/9/2018	**7.80**	--	**10.00**	**910**	**1,200**
SCR-US*	1/9/2018	7.58	13.66	9.93	**5,300**	**2,800**
UNC2-RC	1/9/2018	7.36	13.65	9.89	**8,800**	**3,200**
UNC2-RDS	1/9/2018	7.46	13.70	9.39	**9,300**	**3,200**
SD-TDS	1/9/2018	**8.00**	--	**9.40**	**620**	**610**
SD-RUS	1/9/2018	7.55	13.15	8.94	**2,800**	**2,900**
SD-RC	1/9/2018	7.89	12.64	10.29	**8,900**	**3,000**
SD-RDS	1/9/2018	7.48	12.82	9.78	**4,700**	**1,800**

Notes:

* Upstream of UNC2 confluence sample locationand is the same location as SCR-US

"--" Not Sampled

Bold indicates lab analysis data is used in place of field monitoring data where stream depth was too shallow for water quality monitor or turbidity was out of range of handheld water quality monitor.

Water Quality Monitoring Data for Permanent Water Quality Monitoring Sites Along the Santa Clara River

Water Quality Monitoring Progress Report, November 30, 2018 to February 28, 2019

Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
SCR-US	11/9/2018	7.9	16.1	15.5	3	1.4
	11/14/2018	8.1	15.5	11	4	1.4
	11/21/2018	8	14.1	9.5	1	0.6
	11/28/2018	7.7	15.1	14.6	1	0.8
	12/5/2018	7.4	15	8	1	0
	12/12/2018	7.5	13	10	1	2
	12/19/2018	7.6	16	10	3	2
	12/26/2018	7.5	19	9	1	1
	1/2/2019	7.8	13	10	2	2
	1/9/2019	7.6	14	6	3	3
	1/16/2019	7.4	15	12	11	10
	1/23/2019	7.6	17	14	3	5
	1/30/2019	7.9	16	10	4	4
	2/4/2019	8	14	18	>2000	>1000
	2/7/2019	7.8	14	11	202	102
	2/13/2019	7.7	14	10	3	2
	2/14/2019	8.1	15	10	>2000	>1000
	2/20/2019	7.6	13	13	1385	847
	2/27/2019	7.5	16	9	3	37
SCR-PR1	11/9/2018	7.6	24.6	13.3	1	8.2
	11/14/2018	7.8	24.2	11.9	1	0.5
	11/21/2018	7.8	23.9	9.5	2	1
	11/28/2018	7.9	23	6.1	3	2.9
	12/5/2018	7.5	23	7	2	2
	12/12/2018	7.5	22	9	3	4
	12/19/2018	7.5	23	8	4	2
	12/26/2018	7.3	22	8	2	2
	1/2/2019	7.4	22	10	2	2
	1/9/2019	7.4	21	9	6	5
	1/16/2019	7.8	19	15	15	14
	1/23/2019	7.4	21	11	4	4
	1/30/2019	7.6	22	12	4	4
	2/4/2019	8.1	14	15	>2000	>1000
	2/7/2019	7.8	19	11	88	34
	2/13/2019	7.7	20	14	16	11
	2/14/2019	8	15	8	>2000	>1000
	2/20/2019	7.4	17	13	772	438
	2/27/2019	7.4	21	12	7	6

Data Collected on 1/16/19; 2/4/19 and 2/14/19 were during active rain events

Water Quality Monitoring Data for Permanent Water Quality Monitoring Sites Along the Santa Clara River

Water Quality Monitoring Progress Report, November 30, 2018 to February 28, 2019

Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
SCR-PR2	11/9/2018	7.9	22.9	15.1	3	1.7
	11/14/2018	8	23.1	8.8	3	2.9
	11/21/2018	7.8	22.5	8.5	2	2.5
	11/28/2018	7.7	24.1	6.2	1	1
	12/5/2018	7.6	22	7	4	4
	12/12/2018	7.6	20	8	4	4
	12/19/2018	7.6	22	7	3	2
	12/26/2018	7.5	21	11	2	2
	1/2/2019	7.4	20.0	10	4	4
	1/9/2019	7.4	21.0	10	8	7
	1/16/2019	7.8	20.0	12	19	17
	1/23/2019	7.5	20.0	13	11	11
	1/30/2019	7.7	21.0	12	9	8
	2/4/2019	7.9	14.0	15	>2000	>1000
	2/7/2019	7.8	19.0	10	55	30
	2/13/2019	7.8	19.0	11	30	16
	2/14/2019	7.9	15.0	9	>2000	>1000
	2/20/2019	7.6	16.0	9	1411	824
	2/27/2019	7.6	20.0	12	35	21
SCR-DS	11/9/2018	8.1	21.7	10.6	4	3.8
	11/14/2018	8.3	21.2	10.3	4	3.8
	11/21/2018	8.2	21.0	7.7	4	3.6
	11/28/2018	8.2	22.0	5.8	4	3.9
	12/5/2018	7.9	21.0	6	8	7
	12/12/2018	7.8	21.0	9	4	5
	12/19/2018	7.8	21.0	7	4	3
	12/26/2018	7.7	21.0	12	2	3
	1/2/2019	7.5	18.0	8	2	2
	1/9/2019	7.6	21.0	7	10	9
	1/16/2019	7.9	19.0	15	23	22
	1/23/2019	7.7	17.0	13	15	12
	1/30/2019	8	16.0	13	6	6
	2/4/2019	7.9	14.0	15	>2000	>1000
	2/7/2019	7.9	19.0	14	204	130
	2/13/2019	7.8	17.0	10	32	21
	2/14/2019	8	15.0	8	>2000	>1000
	2/20/2019	7.7	12.0	14	>2000	>1000
	2/27/2019	7.6	14.0	16	38	24

Data Collected on 1/16/19; 2/4/19 and 2/14/19 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 1, 2019 to February 26, 2020
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
SCR-US	3/1/2019	7.4	17.5	14	<5	<5
	3/6/2019	7.6	15.6	13	>2,000	>1,000
	3/13/2019	7.6	13.8	12	11	8
	3/20/2019	7.7	18.0	15	<5	<5
	3/27/2019	7.2	15.9	13	<5	<5
	4/1/2019	7.6	18.9	18	<5	<5
	4/3/2019	7.5	16.8	13	<5	<5
	4/10/2019	7.5	17.5	18	<5	<5
	4/17/2019	7.5	18.2	15	<5	<5
	4/24/2019	7.6	21.6	10	<5	<5
	5/1/2019	7.6	20.0	11	<5	<5
	5/8/2019	7.5	20.3	9	<5	<5
	5/15/2019	7.8	23.4	15	<5	<5
	5/22/2019	7.6	21.8	10	<5	<5
	5/29/2019	7.7	23.0	7	<5	<5
	6/3/2019	7.2	23.7	9	<5	<5
	6/5/2019	7.6	21.2	15	7	<5
	6/12/2019	7.5	23.9	11	<5	<5
	6/19/2019	7.4	23.3	14	<5	<5
	6/26/2019	8.0	21.5	16	<5	<5
	7/1/2019	7.5	21.3	15	<5	<5
	7/3/2019	7.9	22.3	16	<5	<5
	7/10/2019	7.4	22.4	12	<5	<5
	7/17/2019	7.8	22.8	22	<5	<5
	7/24/2019	7.9	24.5	12	<5	<5
	7/31/2019	7.0	23.7	16	<5	<5
	8/1/2019	7.8	23.4	18	<5	<5
	8/7/2019	7.6	23.8	23	<5	<5
	8/14/2019	7.3	23.2	17	<5	<5
	8/21/2019	7.5	22.2	7	<5	<5
	8/28/2019	7.5	22.8	12	<5	<5
	9/3/2019	7.5	21.2	13	<5	<5
	9/4/2019	8.1	22.9	20	<5	<5
	9/11/2019	7.3	20.3	16	<5	<5
	9/18/2019	7.9	20.0	28	<5	<5
	9/25/2019	7.5	19.7	33	<5	<5
	10/1/2019	7.5	15.1	25	<5	<5
	10/2/2019	7.1	16.4	27	<5	<5
	10/9/2019	7.7	16.7	37	<5	<5
	10/16/2019	8.2	17.0	34	<5	<5
	10/23/2019	7.8	18.3	24	<5	<5
	10/30/2019	7.8	15.2	33	<5	<5
	11/1/2019	7.7	13.2	31	<5	<5
	11/6/2019	7.9	15.1	27	<5	<5

Data Collected on 3/6/19, 11/27/19, 12/4/19, 12/23/19, and 12/26/19 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River

Water Quality Monitoring Progress Report, March 1, 2019 to February 26, 2020

Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	11/13/2019	7.8	15.5	28	<5	<5
	11/20/2019	7.4	15.3	19	109	62
	11/27/2019	7.6	13.6	24	302	239
	12/3/2019	7.3	15.4	21	<5	<5
	12/4/2019	8.0	13.8	16	1342	921
	12/12/2019	7.5	16.8	13	<5	<5
	12/18/2019	7.5	14.6	18	<5	<5
	12/23/2019	7.2	11.8	12	547	375
	12/26/2019	7.6	11.9	18	170	145
	1/2/2020	7.6	16.8	18	<5	<5
	1/8/2020	7.3	16.6	16	<5	<5
	1/15/2020	7.6	15.9	22	<5	<5
	1/22/2020	7.7	17.5	15	<5	<5
	1/29/2020	7.4	16.2	23	<5	<5
	2/3/2020	7.7	15.0	22	<5	<5
	2/5/2020	7.7	16.6	23	<5	<5
	2/12/2020	7.6	15.1	18	<5	<5
	2/19/2020	7.5	16.2	15	<5	<5
	2/26/2020	7.2	20.3	15	<5	<5
SCR-PR1	3/1/2019	7.1	21.1	12	7	6.3
	3/6/2019	7.9	16.3	20	813	197
	3/13/2019	7.3	19.9	14	23	20
	3/20/2019	7.4	21.1	7	5	<5
	3/27/2019	6.8	20.9	9	<5	<5
	4/1/2019	6.9	20.4	12	<5	<5
	4/3/2019	7.2	20.4	11	<5	<5
	4/10/2019	7.3	22.3	13	<5	6
	4/17/2019	7.2	22.3	16	<5	<5
	4/24/2019	7.5	24.8	11	<5	<5
	5/1/2019	7.4	22.6	10	<5	<5
	5/8/2019	7.3	23.1	9	<5	<5
	5/15/2019	7.6	23.5	15	<5	<5
	5/22/2019	7.2	23.9	10	<5	<5
	5/29/2019	7.4	24.5	10	<5	6
	6/3/2019	6.8	24.3	8	<5	<5
	6/5/2019	7.4	22.9	13	<5	<5
	6/12/2019	7.4	25.7	13	<5	<5
	6/19/2019	7.1	24.9	11	<5	<5
	6/26/2019	7.8	23.6	11	<5	<5
	7/1/2019	7.4	23.8	12	<5	<5
	7/3/2019	7.7	25.8	9	<5	<5
	7/10/2019	7.2	25.1	11	<5	<5
	7/17/2019	7.5	26.8	7	<5	<5
	7/24/2019	7.1	26.1	14	<5	<5

Data Collected on 3/6/19, 11/27/19, 12/4/19, 12/23/19, and 12/26/19 were during active rain events

ENGEO Expect Excellence

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 1, 2019 to February 26, 2020
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^oC)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	7/31/2019	6.8	26.5	9	<5	<5
	8/1/2019	7.5	24.6	15	<5	<5
	8/7/2019	7.3	26.4	16	<5	<5
	8/14/2019	7.4	25.8	13	<5	<5
	8/21/2019	7.5	25.4	8	<5	<5
	8/28/2019	8.1	25.5	13	<5	<5
	9/3/2019	7.1	24.2	25	<5	<5
	9/4/2019	7.8	25.7	10	<5	<5
	9/11/2019	7.1	23.9	15	<5	<5
	9/18/2019	7.6	23.7	15	<5	<5
	9/25/2019	8.2	23.5	11	<5	<5
	10/1/2019	7.9	19.8	25	<5	<5
	10/2/2019	8.0	21.0	13	<5	<5
	10/9/2019	8.4	19.3	43	<5	<5
	10/16/2019	6.9	20.1	39	<5	<5
	10/23/2019	7.3	24.2	12	5	6
	10/30/2019	7.1	22.7	35	<5	<5
	11/1/2019	7.6	22.5	34	<5	<5
	11/6/2019	7.4	22.5	29	<5	<5
	11/13/2019	7.4	22.6	32	<5	<5
	11/20/2019	7.2	20.3	17	75	59
	11/27/2019	7.5	17.4	13	346	269
	12/3/2019	7.1	20.9	20	<5	<5
	12/4/2019	7.5	14.7	13	>2,000	>1,000
	12/12/2019	7.3	21.2	12	<5	<5
	12/18/2019	7.2	20.3	17	7	5.6
	12/23/2019	7.1	14.0	14	402	283
	12/26/2019	7.4	15.2	15	124	107
	1/2/2020	7.4	19.9	14	<5	<5
	1/8/2020	7.0	20.0	16	<5	5.3
	1/15/2020	7.4	19.4	17	<5	<5
	1/22/2020	7.3	20.5	9	<5	<5
	1/29/2020	7.1	19.8	21	<5	<5
	2/3/2020	7.3	19.6	21	<5	6
	2/5/2020	7.5	19.8	15	<5	<5
	2/12/2020	7.3	19.8	15	<5	<5
	2/19/2020	7.4	20.8	16	<5	<5
	2/26/2020	7.1	20.9	10	<5	<5
SCR-PR2	3/1/2019	7.5	21.1	9	16	14
	3/6/2019	7.9	16.0	18	>2,000	>1,000
	3/13/2019	7.4	17.5	17	23	12
	3/20/2019	7.5	20.6	11	17	15
	3/27/2019	7.2	18.8	9	6	<5
	4/1/2019	7.0	19.6	12	7	<5

Data Collected on 3/6/19, 11/27/19, 12/4/19, 12/23/19, and 12/26/19 were during active rain events

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Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 1, 2019 to February 26, 2020
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	4/3/2019	7.4	19.8	14	8	<5
	4/10/2019	7.5	22.3	13	7	8
	4/17/2019	7.4	20.8	18	6	7
	4/24/2019	7.6	24.6	15	<5	<5
	5/1/2019	7.4	21.3	13	5	<5
	5/8/2019	7.3	22.3	14	<5	<5
	5/15/2019	7.6	22.7	14	<5	<5
	5/22/2019	7.3	23.1	10	7	11
	5/29/2019	7.6	24.9	15	5	<5
	6/3/2019	6.9	23.9	10	7	7
	6/5/2019	7.5	22.8	15	10	9
	6/12/2019	7.4	26.1	11	5	<5
	6/19/2019	7.3	24.6	8	<5	<5
	6/26/2019	8.0	24.0	10	<5	<5
	7/1/2019	7.8	23.2	14	<5	<5
	7/3/2019	7.7	26.2	11	<5	<5
	7/10/2019	7.3	25.6	7	<5	<5
	7/17/2019	7.2	27.0	12	<5	<5
	7/24/2019	7.2	26.3	10	<5	<5
	7/31/2019	7.1	26.3	11	<5	<5
	8/1/2019	7.7	24.5	12	<5	<5
	8/7/2019	7.6	27.0	14	<5	<5
	8/14/2019	7.6	26.4	13	<5	<5
	8/21/2019	7.8	25.5	10	<5	<5
	8/28/2019	8.0	26.0	16	<5	<5
	9/3/2019	7.5	25.4	14	<5	<5
	9/4/2019	7.9	26.3	13	<5	<5
	9/11/2019	7.5	24.8	12	<5	<5
	9/18/2019	7.8	23.9	13	<5	<5
	9/25/2019	8.1	24.8	18	<5	<5
	10/1/2019	8.1	20.4	27	<5	<5
	10/2/2019	7.9	21.8	27	<5	<5
	10/9/2019	8.1	22.6	33	<5	<5
	10/16/2019	7.5	23.0	16	<5	<5
	10/23/2019	7.6	24.0	28	<5	<5
	10/30/2019	7.7	21.8	34	<5	<5
	11/1/2019	7.7	21.7	33	<5	<5
	11/6/2019	7.7	21.6	27	<5	<5
	11/13/2019	7.7	21.8	27	<5	<5
	11/20/2019	7.4	17.8	16	372	236
	11/27/2019	7.6	16.1	17	1089	827
	12/3/2019	7.5	20.5	20	13	15
	12/4/2019	7.7	14.6	25	>2,000	>1,000
	12/12/2019	7.6	21.3	14	<5	9

Data Collected on 3/6/19, 11/27/19, 12/4/19, 12/23/19, and 12/26/19 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 1, 2019 to February 26, 2020
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	12/18/2019	7.4	19.8	10	27	28
	12/23/2019	7.2	13.2	11	1270	993
	12/26/2019	7.4	15.2	16	322	280
	1/2/2020	7.6	19.6	12	13	10
	1/8/2020	7.2	19.2	15	12	10
	1/15/2020	7.5	19.5	18	6	8
	1/22/2020	7.5	20.0	16	5	6
	1/29/2020	7.2	20.1	18	<5	<5
	2/3/2020	7.6	18.5	23	<5	<5
	2/5/2020	7.7	19.9	16	<5	<5
	2/12/2020	7.5	19.8	18	5	<5
	2/19/2020	7.7	20.8	9	<5	<5
	2/26/2020	7.4	21.6	15	<5	<5
SCR-DS	3/1/2019	7.8	18.7	11	31	27
	3/6/2019	7.7	14.5	15	>2,000	>1,000
	3/13/2019	8.1	10.4	23	477	269
	3/20/2019	8.1	15.0	20	74	64
	3/27/2019	8.4	13.9	13	258	147
	4/1/2019	7.6	14.6	31	82	36
	4/3/2019	8.5	14.7	22	88	31
	4/10/2019	8.0	18.6	16	73	50
	4/17/2019	8.3	14.8	28	56	37
	4/24/2019	8.4	21.5	17	54	30
	5/1/2019	8.2	16.1	17	30	26
	5/8/2019	8.1	17.4	14	20	17
	5/15/2019	8.2	19.9	11	8	9
	5/22/2019	7.5	19.3	14	12	12
	5/29/2019	8.3	26.5	14	12	18
	6/3/2019	7.5	22.3	8	6	7
	6/5/2019	7.8	21.0	5	10	9
	6/12/2019	7.4	27.8	8	6	7
	6/19/2019	7.8	23.3	11	6	8
	6/26/2019	8.3	22.5	14	5	6
	7/1/2019	7.7	21.6	14	<5	<5
	7/3/2019	8.0	27.0	7	5	<5
	7/10/2019	7.6	24.7	16	5	7
	7/17/2019	7.5	28.1	6	<5	<5
	7/24/2019	7.7	25.5	12	<5	<5
	7/31/2019	7.4	25.8	11	<5	<5
	8/1/2019	8.0	22.4	13	<5	<5
	8/7/2019	7.5	26.5	17	<5	<5
	8/14/2019	7.7	25.3	16	<5	<5
	8/21/2019	7.5	23.4	15	<5	<5
	8/28/2019	7.7	25.1	13	<5	<5

Data Collected on 3/6/19, 11/27/19, 12/4/19, 12/23/19, and 12/26/19 were during active rain events

<u>Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River</u>
Water Quality Monitoring Progress Report, March 1, 2019 to February 26, 2020
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^{o}C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	9/3/2019	7.7	24.0	11	<5	<5
	9/4/2019	7.5	25.3	12	<5	<5
	9/11/2019	7.8	22.8	9	<5	<5
	9/18/2019	6.8	21.4	20	<5	<5
	9/25/2019	7.9	22.3	16	<5	<5
	10/1/2019	7.6	19.7	23	<5	<5
	10/2/2019	8.2	19.2	12	<5	<5
	10/9/2019	7.7	20.6	34	<5	<5
	10/16/2019	7.8	20.5	25	<5	<5
	10/23/2019	7.8	22.8	22	<5	<5
	10/30/2019	7.5	20.7	30	<5	<5
	11/1/2019	8.0	20.3	21	<5	5
	11/6/2019	7.7	20.7	23	<5	<5
	11/13/2019	7.8	20.7	23	<5	<5
	11/20/2019	7.8	20.4	14	13	9
	11/27/2019	7.8	13.7	17	>2,000	>1,000
	12/3/2019	7.5	19.2	13	17	17
	12/4/2019	8.2	14.5	18	>2,000	>1,000
	12/12/2019	7.8	21.1	9	5	15
	12/18/2019	7.8	19.0	13	13	14
	12/23/2019	7.4	11.8	25	1282	993
	12/26/2019	7.5	13.4	15	898	881
	1/2/2020	7.9	19.4	15	26	10
	1/8/2020	7.3	17.6	14	15	12
	1/15/2020	7.8	17.7	14	12	10
	1/22/2020	7.9	18.4	18	13	14
	1/29/2020	7.6	19.8	18	5	7
	2/3/2020	7.8	16.4	20	<5	8
	2/5/2020	8.0	19.1	16	<5	<5
	2/12/2020	7.9	19.9	15	<5	<5
	2/19/2020	8.0	21.2	15	<5	<5
	2/26/2020	7.7	21.9	17	5	5

Data Collected on 3/6/19, 11/27/19, 12/4/19, 12/23/19, and 12/26/19 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^oC)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
SCR-US	3/2/2020	7.5	18.0	19	<5	<5
	3/4/2020	7.6	18.5	20	<5	7
	3/11/2020	7.7	19.7	19	9	8
	3/16/2020	7.7	14.5	24	6	6
	3/18/2020	7.9	18.7	23	15	14
	3/23/2020	7.4	16.8	13	87	72
	3/25/2020	7.7	18.9	23	<5	6
	4/1/2020	7.7	21.3	10	<5	<5
	4/6/2020	8.2	12.3	17	>2,000	>1,000
	4/8/2020	8.0	12.9	14	773	614
	4/15/2020	7.4	21.8	14	<5	<5
	4/22/2020	7.9	22.6	15	<5	<5
	4/29/2020	7.2	21.6	13	<5	<5
	5/1/2020	7.8	21.7	12	<5	<5
	5/6/2020	6.8	23.8	8	<5	<5
	5/13/2020	8.0	22.9	7	<5	<5
	5/20/2020	7.4	22.8	7	<5	<5
	5/27/2020	7.0	24.4	5	<5	<5
	6/1/2020	7.8	21.2	8	<5	<5
	6/3/2020	7.4	22.6	9	<5	<5
	6/10/2020	7.9	19.8	10	<5	14
	6/17/2020	7.8	24.0	9	<5	<5
	6/24/2020	7.8	25.5	7	<5	<5
	7/1/2020	7.9	21.6	12	<5	<5
	7/8/2020	8.0	21.5	8	<5	<5
	7/15/2020	8.0	22.6	8	<5	<5
	7/22/2020	8.0	21.5	6	<5	<5
	7/29/2020	8.0	22.8	7	<5	<5
	8/3/2020	8.0	23.2	7	<5	<5
	8/5/2020	8.0	20.2	9	<5	<5
	8/12/2020	8.0	23.8	6	<5	<5
	8/19/2020	8.0	20.7	10	<5	<5
	8/26/2020	7.9	21.8	7	<5	<5
	9/1/2020	8.0	20.0	8	<5	<5
	9/9/2020	7.9	19.6	9	<5	<5
	9/16/2020	8.0	18.5	8	<5	<5
	9/23/2020	8.1	18.6	9	<5	<5
	10/1/2020	8.0	18.7	9	<5	<5
	10/7/2020	8.0	17.8	10	<5	<5
	10/14/2020	8.0	16.8	9	<5	<5
	10/21/2020	8.2	19.6	9	<5	<5
	10/28/2020	7.6	17.9	8	<5	<5
	11/2/2020	7.9	16.8	10	<5	<5
	11/4/2020	7.9	15.8	9	<5	<5

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River

Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021

Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	11/11/2020	7.6	17.7	10	<5	<5
	11/18/2020	7.8	15.6	9	<5	6
	11/25/2020	8.1	13.5	9	<5	<5
	12/2/2020	8.1	14.7	10	<5	<5
	12/9/2020	7.9	16.4	11	<5	<5
	12/16/2020	8.1	15.8	8	<5	<5
	12/23/2020	8.1	14.3	10	<5	<5
	12/28/2020	7.8	10.9	11	507	401
	12/31/2020	8.1	15.4	11	6	6
	1/6/2021	8.2	14.9	7	<5	<5
	1/13/2021	8.3	15.7	8	<5	<5
	1/20/2021	8.2	15.3	8	<5	<5
	1/27/2021	8.1	13.9	8	<5	<5
	1/29/2021	7.4	10.1	10	484	454
	2/1/2021	8.3	15.0	8	6	<5
	2/3/2021	8.3	15.9	9	<5	<5
	2/10/2021	7.9	18.1	9	<5	<5
	2/17/2021	7.7	17.4	9	<5	<5
	2/24/2021	7.9	17.7	8	<5	<5
SCR-PR1	3/2/2020	7.2	20.6	6	<5	<5
	3/4/2020	7.2	21.1	17	<5	<5
	3/11/2020	7.4	21.8	23	10	9
	3/16/2020	7.4	19.7	24	30	29
	3/18/2020	7.6	20.5	25	15	13
	3/23/2020	7.2	15.4	18	115	54
	3/25/2020	7.3	21.2	20	10	6
	4/1/2020	7.3	22.2	15	<5	<5
	4/6/2020	8.0	13.7	15	>2,000	>1,000
	4/8/2020	7.6	16.0	16	344	270
	4/15/2020	7.1	23.5	9	<5	6
	4/22/2020	7.7	24.1	13	<5	<5
	4/29/2020	6.9	22.1	13	<5	6
	5/1/2020	7.3	22.8	13	5	<5
	5/6/2020	7.3	23.1	7	<5	<5
	5/13/2020	7.6	23.9	6	<5	<5
	5/20/2020	7.0	24.3	7	<5	<5
	5/27/2020	6.8	25.5	5	<5	<5
	6/1/2020	7.4	23.3	8	<5	<5
	6/3/2020	7.4	23.5	7	<5	<5
	6/10/2020	7.6	24.8	7	<5	<5
	6/17/2020	7.5	24.6	9	5	<5
	6/24/2020	7.6	26.7	7	<5	<5
	7/1/2020	7.5	23.3	8	<5	<5
	7/8/2020	7.7	23.3	7	<5	<5

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

ENGEO
Expect Excellence

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^oC)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	7/15/2020	7.6	23.5	8	<5	<5
	7/22/2020	7.7	24.6	5	<5	<5
	7/29/2020	7.7	23.6	7	<5	<5
	8/3/2020	7.7	25.8	7	<5	<5
	8/5/2020	7.6	24.7	6	<5	<5
	8/12/2020	7.7	25.0	7	<5	<5
	8/19/2020	7.6	26.1	6	<5	<5
	8/26/2020	7.5	25.1	5	<5	<5
	9/1/2020	7.7	24.4	5	<5	<5
	9/9/2020	7.5	25.1	6	<5	<5
	9/16/2020	7.7	24.0	8	<5	7
	9/23/2020	7.8	24.3	7	5	<5
	10/1/2020	7.7	24.6	7	<5	<5
	10/7/2020	7.8	24.2	7	<5	<5
	10/14/2020	7.6	23.3	6	5	10
	10/21/2020	7.8	24.6	8	<5	<5
	10/28/2020	8.0	23.4	9	<5	<5
	11/2/2020	7.7	22.8	7	<5	<5
	11/4/2020	7.7	22.4	7	<5	<5
	11/11/2020	7.5	21.8	8	<5	<5
	11/18/2020	7.9	21.3	8	<5	<5
	11/25/2020	7.7	19.0	6	<5	7
	12/2/2020	7.8	20.7	7	<5	<5
	12/9/2020	7.8	20.8	8	<5	<5
	12/16/2020	7.8	20.1	7	<5	<5
	12/23/2020	7.8	20.3	8	<5	<5
	12/28/2020	8.0	10.0	13	306	220
	12/31/2020	7.9	20.3	10	12	11
	1/6/2021	8.1	19.7	7	<5	<5
	1/13/2021	8.0	20.3	7	<5	<5
	1/20/2021	7.7	20.2	7	10	11
	1/27/2021	7.8	19.4	7	7	7
	1/29/2021	7.4	13.1	9	349	318
	2/1/2021	8.0	18.4	7	17	16
	2/3/2021	7.8	20.2	7	8	7
	2/10/2021	7.7	21.0	8	7	<5
	2/17/2021	7.4	20.3	7	5	<5
	2/24/2021	7.5	19.9	7	<5	<5
SCR-PR2	3/2/2020	7.5	20.2	9	7	8
	3/4/2020	7.5	21.6	16	<5	<5
	3/11/2020	7.6	21.7	25	38	25
	3/16/2020	7.6	19.2	25	50	50
	3/18/2020	7.9	20.6	23	46	40
	3/23/2020	7.0	17.1	19	286	233

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

ENGEO
Expect Excellence

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^oC)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	3/25/2020	7.5	21.3	22	32	27
	4/1/2020	7.6	22.8	20	7	10
	4/6/2020	8.1	13.1	16	>2,000	>1,000
	4/8/2020	7.7	16.5	15	477	370
	4/15/2020	7.4	23.3	14	24	17
	4/22/2020	7.8	24.0	10	12	12
	4/29/2020	7.2	21.0	12	8	12
	5/1/2020	7.5	21.6	11	6	9
	5/6/2020	7.4	22.6	7	7	7
	5/13/2020	8.1	24.2	6	21	25
	5/20/2020	7.3	24.7	8	5	5
	5/27/2020	6.8	25.4	6	5	<5
	6/1/2020	7.7	22.5	8	<5	8
	6/3/2020	7.6	22.4	8	<5	7
	6/10/2020	7.7	25.2	7	5	14
	6/17/2020	7.8	24.4	9	8	9
	6/24/2020	7.8	26.4	8	12	10
	7/1/2020	7.9	23.3	9	<5	<5
	7/8/2020	7.8	23.0	9	5	7
	7/15/2020	7.8	22.7	9	5	6
	7/22/2020	7.9	24.0	6	7	7
	7/29/2020	7.9	23.1	6	<5	5
	8/3/2020	7.7	25.8	8	<5	<5
	8/5/2020	7.9	24.1	7	6	<5
	8/12/2020	7.8	24.7	7	<5	<5
	8/19/2020	7.7	24.6	7	5	7
	8/26/2020	7.7	23.9	8	<5	8
	9/1/2020	7.8	23.7	7	<5	7
	9/9/2020	7.6	24.6	8	<5	11
	9/16/2020	7.8	22.9	7	<5	8
	9/23/2020	7.9	23.1	7	5	5
	10/1/2020	7.9	24.1	7	<5	<5
	10/7/2020	7.9	23.4	9	<5	6
	10/14/2020	7.9	21.9	8	8	10
	10/21/2020	7.9	24.4	8	7	7
	10/28/2020	8.0	23.1	9	<5	<5
	11/2/2020	7.8	22.0	9	<5	<5
	11/4/2020	7.9	21.2	8	<5	<5
	11/11/2020	7.6	21.1	9	7	7
	11/18/2020	7.8	20.2	8	<5	8
	11/25/2020	7.9	17.5	7	<5	7
	12/2/2020	8.0	19.8	8	5	<5
	12/9/2020	8.0	20.7	9	<5	<5
	12/16/2020	8.0	20.1	7	<5	<5

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^oC)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	12/23/2020	8.0	20.1	7	<5	<5
	12/28/2020	7.8	11.9	10	770	562
	12/31/2020	8.1	19.5	12	17	28
	1/6/2021	8.1	19.5	6	10	8
	1/13/2021	8.1	19.5	7	10	7
	1/20/2021	7.8	19.0	7	9	7
	1/27/2021	7.8	18.6	7	9	10
	1/29/2021	7.6	12.6	9	409	373
	2/1/2021	8.0	19.5	7	8	8
	2/3/2021	7.8	19.6	8	18	12
	2/10/2021	7.8	20.4	8	10	8
	2/17/2021	7.5	19.6	8	9	6
	2/24/2021	7.7	18.9	8	<5	5
SCR-PR3	3/2/2020	7.8	20.9	16	<5	5
	3/4/2020	7.8	22.4	20	8	9
	3/11/2020	7.6	21.6	23	43	34
	3/16/2020	7.6	17.1	23	27	14
	3/18/2020	7.8	19.8	27	57	49
	3/23/2020	7.3	16.5	19	335	281
	3/25/2020	7.6	21.2	18	28	25
	4/1/2020	7.7	23.5	7	11	9
	4/6/2020	8.3	13.8	14	>2,000	>1,000
	4/8/2020	8.1	14.1	15	660	297
	4/15/2020	7.4	23.6	9	20	18
	4/22/2020	7.9	25.3	10	14	11
	4/29/2020	7.2	22.2	11	8	11
	5/1/2020	7.8	23.2	11	13	12
	5/6/2020	7.6	23.7	7	5	<5
	5/13/2020	7.8	25.1	6	30	26
	5/20/2020	7.5	24.7	9	10	8
	5/27/2020	6.9	24.4	7	11	5
	6/1/2020	7.4	25.5	8	<5	8
	6/3/2020	7.5	25.7	8	<5	7
	6/10/2020	8.3	19.0	7	<5	<5
	6/17/2020	7.9	26.3	8	9	9
	6/24/2020	7.9	27.6	8	9	7
	7/1/2020	8.1	24.9	10	6	5
	7/8/2020	8.0	23.9	9	7	8
	7/15/2020	8.1	23.3	8	8	8
	7/22/2020	8.1	24.4	6	10	9
	7/29/2020	8.1	23.7	8	<5	<5
	8/3/2020	7.6	23.8	8	8	7
	8/5/2020	8.1	22.3	9	<5	<5
	8/12/2020	8.1	26.7	8	<5	<5

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

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Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^oC)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	8/19/2020	8.0	25.3	8	6	7
	8/26/2020	7.9	26.0	6	<5	5
	9/1/2020	8.1	24.4	6	<5	9
	9/9/2020	7.9	24.9	8	<5	9
	9/16/2020	8.1	24.0	8	<5	6
	9/23/2020	8.3	24.2	9	5	5
	10/1/2020	8.3	24.9	9	<5	<5
	10/7/2020	8.1	23.8	9	<5	5
	10/14/2020	8.2	22.5	8	8	11
	10/21/2020	7.9	24.3	9	<5	6
	10/28/2020	8.1	22.9	9	6	5
	11/2/2020	8.0	22.7	8	<5	<5
	11/4/2020	8.1	22.1	8	<5	7
	11/11/2020	7.9	21.1	10	9	8
	11/18/2020	7.9	20.7	8	<5	8
	11/25/2020	8.2	18.3	7	<5	8
	12/2/2020	8.1	19.8	8	10	12
	12/9/2020	8.1	20.5	9	<5	<5
	12/16/2020	8.1	19.9	7	8	10
	12/23/2020	8.1	19.3	9	<5	<5
	12/28/2020	7.7	13.5	10	771	710
	12/31/2020	8.2	19.4	11	16	28
	1/6/2021	8.1	19.0	7	15	12
	1/13/2021	8.4	19.4	8	10	7
	1/20/2021	8.1	18.8	8	15	13
	1/27/2021	7.8	17.8	8	6	7
	1/29/2021	6.8	8.9	12	1023	>1,000
	2/1/2021	8.3	18.5	8	29	26
	2/3/2021	8.2	18.9	8	16	19
	2/10/2021	8.0	20.5	9	12	9
	2/17/2021	7.7	19.6	8	11	8
	2/24/2021	7.8	20.5	9	<5	6
SCR-DS	3/2/2020	7.9	17.6	20	6	6
	3/4/2020	7.4	20.1	22	5	35
	3/11/2020	7.8	22.0	24	42	43
	3/16/2020	7.8	16.3	22	38	33
	3/18/2020	7.7	20.6	24	39	30
	3/23/2020	7.2	14.6	26	857	623
	3/25/2020	7.6	20.9	21	38	32
	4/1/2020	7.8	22.2	13	31	35
	4/6/2020	8.1	13.2	17	>2,000	>1,000
	4/8/2020	7.9	15.8	15	529	408
	4/15/2020	7.5	24.0	8	29	23
	4/22/2020	8.2	24.2	11	74	55

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	4/29/2020	7.6	19.4	12	42	32
	5/1/2020	7.8	18.8	12	61	36
	5/6/2020	8.1	20.1	10	24	16
	5/13/2020	7.1	22.5	8	32	25
	5/20/2020	7.9	24.4	10	7	6
	5/27/2020	6.9	25.6	6	6	6
	6/1/2020	8.1	20.9	9	6	11
	6/3/2020	8.2	21.5	9	5	10
	6/10/2020	8.3	25.8	8	10	12
	6/17/2020	8.1	23.0	9	13	13
	6/24/2020	8.1	26.2	8	15	15
	7/1/2020	8.2	21.4	10	7	7
	7/8/2020	8.2	21.6	8	11	12
	7/15/2020	8.3	21.9	9	11	10
	7/22/2020	8.2	21.8	7	12	10
	7/29/2020	8.2	21.1	9	6	7
	8/3/2020	8.3	25.6	8	9	8
	8/5/2020	8.3	22.9	8	5	<5
	8/12/2020	8.2	22.2	10	8	7
	8/19/2020	7.9	24.3	8	6	7
	8/26/2020	8.0	23.0	8	<5	<5
	9/1/2020	8.2	22.6	7	<5	7
	9/9/2020	7.8	23.3	8	<5	8
	9/16/2020	8.0	21.5	8	<5	<5
	9/23/2020	8.2	21.6	9	6	<5
	10/1/2020	8.2	22.3	9	5	<5
	10/7/2020	7.9	20.7	9	<5	<5
	10/14/2020	7.8	20.1	8	<5	11
	10/21/2020	7.5	23.9	9	5	7
	10/28/2020	7.8	21.6	9	9	8
	11/2/2020	8.0	19.0	9	<5	6
	11/4/2020	8.1	19.5	9	<5	6
	11/11/2020	7.9	19.7	10	10	10
	11/18/2020	8.0	18.0	9	<5	9
	11/25/2020	8.2	17.1	9	<5	7
	12/2/2020	8.2	17.9	10	6	8
	12/9/2020	8.3	19.5	10	7	5
	12/16/2020	8.2	19.4	8	<5	5
	12/23/2020	8.3	19.1	9	5	5
	12/28/2020	8.0	11.8	11	981	766
	12/31/2020	8.3	18.0	11	17	23
	1/6/2021	8.0	19.2	7	12	10
	1/13/2021	8.1	18.2	8	9	7
	1/20/2021	7.7	17.3	8	6	<5

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

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Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 2, 2020 to February 24, 2021
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (^oC)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	1/27/2021	7.7	17.4	8	8	<5
	1/29/2021	7.9	11.9	10	550	540
	2/1/2021	7.8	17.3	8	19	17
	2/3/2021	7.6	19.6	8	19	17
	2/10/2021	8.0	19.5	8	10	7
	2/17/2021	7.8	18.3	8	12	8
	2/24/2021	7.9	16.9	10	6	7

Data collected on 3/11/20, 3/16/20, 3/23/20, 4/6/20, 12/28/20, and 1/29/21 were during active rain events

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 1, 2021 to February 23, 2022
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Suspended Solids (mg/L)
SCR-US	3/1/2021	16.7	7.9	10	<5	<5
	3/3/2021	14.8	7.9	10	<5	<5
	3/10/2021	15.9	7.7	6	5	7
	3/12/2021	14.9	7.9	10	7	10
	3/17/2021	18.5	7.7	8	<5	<5
	3/24/2021	18.7	7.9	10	<5	<5
	3/31/2021	18.2	7.8	9	<5	<5
	4/7/2021	20.9	7.8	10	<5	<5
	4/14/2021	17.8	7.8	9	<5	9
	4/21/2021	16.7	7.7	9	<5	7
	4/28/2021	20.7	7.8	9	<5	<5
	5/5/2021	18.6	7.7	8	<5	<5
	5/12/2021	19.1	7.8	7	<5	<5
	5/19/2021	23.2	7.8	9	<5	<5
	5/26/2021	21.1	7.8	9	<5	<5
	6/1/2021	18.4	7.7	8	<5	<5
	6/9/2021	20.4	7.8	8	<5	<5
	6/16/2021	19.2	7.6	9	<5	<5
	6/23/2021	25.8	7.8	8	<5	<5
	7/1/2021	22.6	7.7	8	<5	<5
	7/7/2021	22.0	7.7	9	<5	<5
	7/14/2021	22.2	7.7	9	<5	<5
	7/21/2021	23.7	7.6	8	<5	<5
	7/28/2021	19.9	7.5	9	<5	<5
	8/4/2021	21.2	7.5	8	<5	5
	8/11/2021	20.6	7.6	9	<5	<5
	8/18/2021	19.2	7.8	14	<5	<5
	8/25/2021	18.3	7.8	8	<5	<5
	9/1/2021	21.4	7.7	9	<5	6
	9/8/2021	25.9	8.0	8	<5	<5
	9/15/2021	19.8	7.7	10	<5	<5
	9/22/2021	19.8	7.8	10	<5	<5
	9/29/2021	18.5	8.0	12	<5	<5
	10/6/2021	18.9	7.9	10	<5	<5
	10/13/2021	15.3	7.9	11	<5	<5
	10/20/2021	21.8	7.7	11	<5	<5
	10/27/2021	17.2	7.3	13	<5	6
	11/1/2021	17.3	7.6	11	<5	<5
	11/10/2021	17.2	7.7	10	5	<5
	11/17/2021	16.8	7.5	10	<5	<5
	11/24/2021	16.4	7.7	11	<5	<5
	12/1/2021	16.6	7.6	11	<5	<5
	12/8/2021	16.6	7.8	11	<5	<5
	12/14/2021	12.5	7.7	11	401	681
	12/22/2021	15.6	7.7	9	<5	<5

Data collected on 3/12/21, 12/14/21, 12/23/21, and 12/30/21 were during active rain events.

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River

Water Quality Monitoring Progress Report, March 1, 2021 to February 23, 2022

Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Suspended Solids (mg/L)
	12/23/2021	12.7	7.4	10	735	632
	12/30/2021	8.2	7.7	13	>1,000	>2,000
	1/3/2022	12.9	7.7	13	<5	6
	1/12/2022	15.6	7.6	12	<5	<5
	1/19/2022	15.5	7.6	12	<5	5
	1/26/2022	14.8	7.7	10	<5	<5
	2/1/2022	16.1	7.7	13	<5	<5
	2/9/2022	16.5	7.8	10	<5	<5
	2/16/2022	16.5	7.9	8	<5	<5
	2/23/2022	14.7	7.5	7	10	9
SCR-PR1	3/1/2021	20.5	7.6	8	<5	<5
	3/3/2021	19.8	7.6	8	<5	<5
	3/10/2021	20.3	7.6	5	8	9
	3/12/2021	19.9	7.6	8	7	10
	3/17/2021	21.0	7.6	6	<5	6
	3/24/2021	20.9	7.7	8	<5	5
	3/31/2021	21.3	7.5	7	<5	<5
	4/7/2021	23.2	7.6	9	<5	<5
	4/14/2021	21.3	7.6	6	<5	7
	4/21/2021	21.6	7.5	8	<5	5
	4/28/2021	23.0	7.6	7	<5	<5
	5/5/2021	22.8	7.3	6	5	<5
	5/12/2021	23.0	7.5	7	<5	5
	5/19/2021	23.9	7.6	8	<5	5
	5/26/2021	24.0	7.6	8	<5	<5
	6/1/2021	23.2	7.5	7	<5	6
	6/9/2021	24.7	7.5	5	5	<5
	6/16/2021	24.7	7.4	9	16	6
	6/23/2021	26.1	7.6	7	<5	<5
	7/1/2021	25.9	7.5	6	7	<5
	7/7/2021	25.7	7.5	7	13	<5
	7/14/2021	26.3	7.6	7	<5	<5
	7/21/2021	27.6	7.5	7	7	9
	7/28/2021	26.0	7.2	7	13	15
	8/4/2021	26.5	7.4	6	<5	<5
	8/11/2021	27.4	7.4	7	<5	<5
	8/18/2021	26.2	7.7	7	20	8
	8/25/2021	25.3	7.3	8	32	7
	9/1/2021	26.8	7.5	6	7	<5
	9/8/2021	27.0	7.7	7	<5	<5
	9/15/2021	25.9	7.5	7	<5	6
	9/22/2021	26.8	7.5	6	9	8
	9/29/2021	26.1	7.8	8	13	8
	10/6/2021	24.5	7.6	7	<5	<5
	10/13/2021	23.7	7.3	10	18	11

Data collected on 3/12/21, 12/14/21, 12/23/21, and 12/30/21 were during active rain events.

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 1, 2021 to February 23, 2022
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Suspended Solids (mg/L)
	10/20/2021	24.1	7.5	8	6	5
	10/27/2021	23.6	7.6	6	11	8
	11/1/2021	24.5	7.5	6	<5	6
	11/10/2021	22.8	7.6	9	6	<5
	11/17/2021	15.8	7.4	8	<5	<5
	11/24/2021	22.2	7.6	7	<5	<5
	12/1/2021	21.4	7.5	7	<5	<5
	12/8/2021	22.4	7.5	6	21	5
	12/14/2021	12.5	7.8	10	913	>2,000
	12/22/2021	21.4	7.7	9	13	9
	12/23/2021	12.5	7.6	11	74	83
	12/30/2021	8.3	7.4	13	460	1,165
	1/3/2022	18.0	7.5	8	35	12
	1/12/2022	19.2	7.5	10	8	12
	1/19/2022	18.6	7.4	8	<5	6
	1/26/2022	20.2	7.7	10	7	6
	2/1/2022	19.5	7.6	11	8	6
	2/9/2022	20.7	7.7	8	<5	<5
	2/16/2022	20.6	7.8	6	8	8
	2/23/2022	12.4	7.8	7	<5	13
SCR-PR2	3/1/2021	19.5	7.7	9	<5	7
	3/3/2021	18.8	7.7	8	<5	8
	3/10/2021	20.0	7.7	6	8	9
	3/12/2021	19.3	7.7	9	13	14
	3/17/2021	21.0	7.8	7	11	12
	3/24/2021	18.3	7.8	10	110	108
	3/31/2021	20.2	7.4	9	5	5
	4/7/2021	23.0	7.8	10	5	6
	4/14/2021	20.3	7.7	8	<5	8
	4/21/2021	21.0	7.3	7	<5	6
	4/28/2021	22.4	7.8	8	<5	<5
	5/5/2021	21.3	7.5	6	5	<5
	5/12/2021	22.1	7.5	6	<5	<5
	5/19/2021	22.8	7.7	9	6	7
	5/26/2021	23.1	7.7	8	9	9
	6/1/2021	21.8	7.6	6	<5	13
	6/9/2021	24.0	7.8	7	<5	5
	6/16/2021	23.4	7.2	7	10	6
	6/23/2021	25.8	7.8	8	<5	6
	7/1/2021	24.7	7.8	8	<5	<5
	7/7/2021	24.6	7.7	8	<5	8
	7/14/2021	25.3	7.8	8	<5	7
	7/21/2021	27.2	7.7	9	8	13
	7/28/2021	24.4	7.0	8	12	7
	8/4/2021	25.6	7.7	7	<5	6

Data collected on 3/12/21, 12/14/21, 12/23/21, and 12/30/21 were during active rain events.

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
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Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Suspended Solids (mg/L)
	8/11/2021	26.5	7.6	8	<5	8
	8/18/2021	24.9	7.5	8	21	13
	8/25/2021	23.9	7.4	7	22	<5
	9/1/2021	25.7	7.7	9	7	12
	9/8/2021	25.9	7.7	8	10	8
	9/15/2021	25.6	7.7	8	<5	7
	9/22/2021	25.5	7.8	8	7	8
	9/29/2021	24.9	7.8	10	14	8
	10/6/2021	25.0	8.0	8	6	8
	10/13/2021	21.1	7.1	8	15	9
	10/20/2021	22.5	7.8	10	7	8
	10/27/2021	22.1	7.7	7	15	7
	11/1/2021	22.9	7.7	5	<5	7
	11/10/2021	17.8	7.7	12	<5	7
	11/17/2021	21.9	7.4	9	7	<5
	11/24/2021	21.3	7.8	10	<5	6
	12/1/2021	22.0	7.7	9	<5	<5
	12/8/2021	21.5	7.8	7	14	5
	12/14/2021	12.3	7.8	11	530	718
	12/22/2021	20.2	7.7	9	16	9
	12/23/2021	16.4	7.2	9	54	40
	12/30/2021	8.8	7.7	14	>1,000	1987
	1/3/2022	16.8	7.6	9	32	24
	1/12/2022	19.3	7.7	12	11	9
	1/19/2022	20.0	7.6	11	7	10
	1/26/2022	19.8	7.8	10	12	9
	2/1/2022	19.7	7.7	9	9	8
	2/9/2022	20.8	7.8	8	<5	<5
	2/16/2022	20.4	8.0	7	9	9
	2/23/2022	17.8	7.6	7	19	22
SCR-PR3	3/1/2021	20.6	7.9	9	6	7
	3/3/2021	18.2	7.9	8	7	9
	3/10/2021	19.4	7.8	5	12	13
	3/12/2021	18.4	7.8	9	17	20
	3/17/2021	21.0	7.9	7	11	13
	3/24/2021	20.6	8.0	10	34	42
	3/31/2021	22.1	7.9	9	6	8
	4/7/2021	23.8	8.0	9	<5	6
	4/14/2021	21.1	8.0	9	9	8
	4/21/2021	20.2	7.8	9	6	6
	4/28/2021	23.6	7.9	8	<5	<5
	5/5/2021	22.2	7.7	8	9	11
	5/12/2021	22.3	7.9	8	9	<5
	5/19/2021	24.0	8.0	10	<5	6
	5/26/2021	24.0	7.9	9	6	11

Data collected on 3/12/21, 12/14/21, 12/23/21, and 12/30/21 were during active rain events.

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
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Site ID	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Suspended Solids (mg/L)
	6/1/2021	21.9	7.8	8	12	16
	6/9/2021	24.7	8.0	7	11	7
	6/16/2021	23.9	7.7	10	6	9
	6/23/2021	26.6	8.0	8	14	11
	7/1/2021	26.8	8.0	8	<5	<5
	7/7/2021	25.9	8.0	10	<5	<5
	7/14/2021	25.5	8.0	8	<5	8
	7/21/2021	27.9	7.7	7	8	11
	7/28/2021	24.4	7.6	12	21	10
	8/4/2021	23.0	7.6	8	7	7
	8/11/2021	22.4	7.6	8	<5	<5
	8/18/2021	24.3	7.7	9	16	11
	8/25/2021	22.6	7.8	7	11	10
	9/1/2021	25.7	7.9	8	13	7
	9/8/2021	26.0	8.2	8	12	11
	9/15/2021	25.6	7.9	8	6	9
	9/22/2021	26.0	8.0	8	6	8
	9/29/2021	24.9	8.2	11	15	12
	10/6/2021	24.6	8.1	9	14	11
	10/13/2021	20.2	7.8	13	14	9
	10/20/2021	22.3	7.9	11	6	7
	10/27/2021	21.3	7.9	8	16	10
	11/1/2021	22.7	7.8	9	8	9
	11/10/2021	19.7	7.9	9	19	17
	11/17/2021	20.1	6.6	8	<5	7
	11/24/2021	20.7	7.9	11	<5	7
	12/1/2021	21.8	7.9	10	8	7
	12/8/2021	20.8	7.8	7	16	<5
	12/14/2021*	-	-	-	-	-
	12/22/2021	19.7	7.9	9	36	10
	12/23/2021*	-	-	-	-	-
	12/30/2021*	-	-	-	-	-
	1/3/2021	17.4	7.7	8	52	29
	1/12/2022	19.2	7.8	12	14	15
	1/19/2022	19.4	7.8	12	16	17
	1/26/2022	19.8	7.9	13	8	7
	2/1/2022	19.8	8.0	13	9	7
	2/9/2022	19.5	7.9	10	<5	<5
	2/16/2022	20.1	8.1	8	8	9
	2/23/2022	16.6	7.6	9	9	24
SCR-DS	3/1/2021	16.8	8.0	10	6	8
	3/3/2021	16.4	8.0	9	7	9
	3/10/2021	19.0	8.0	6	8	13
	3/12/2021	19.7	7.5	10	18	19
	3/17/2021	21.0	8.0	7	13	14

*Sampling team attempted to sample SCR-PR3 on December 14, 23, and 30, 2021, but were unable to sample due to unsafe conditions.

Data collected on 3/12/21, 12/14/21, 12/23/21, and 12/30/21 were during active rain events.

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River

Water Quality Monitoring Progress Report, March 1, 2021 to February 23, 2022

Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Suspended Solids (mg/L)
	3/24/2021	20.9	8.1	10	27	34
	3/31/2021	18.1	7.8	9	6	8
	4/7/2021	22.5	8.0	10	7	8
	4/14/2021	18.9	7.7	9	<5	10
	4/21/2021	20.2	7.7	8	<5	7
	4/28/2021	21.0	8.0	9	<5	7
	5/5/2021	19.8	6.8	7	<5	7
	5/12/2021	20.7	7.1	7	<5	5
	5/19/2021	21.3	7.9	10	7	11
	5/26/2021	21.4	7.9	10	<5	8
	6/1/2021	20.9	7.4	7	<5	7
	6/9/2021	23.0	7.9	8	<5	8
	6/16/2021	22.2	6.8	8	<5	14
	6/23/2021	25.4	8.1	10	8	8
	7/1/2021	23.2	8.0	9	<5	<5
	7/7/2021	22.5	8.0	10	<5	7
	7/14/2021	23.8	7.9	9	5	8
	7/21/2021	26.2	8.0	8	15	22
	7/28/2021	23.3	7.9	9	8	14
	8/4/2021	23.8	8.0	9	7	11
	8/11/2021	23.3	8.1	9	8	13
	8/18/2021	24.2	7.6	9	<5	11
	8/25/2021	21.9	6.9	8	11	6
	9/1/2021	24.4	7.8	10	6	10
	9/8/2021	23.8	7.9	9	7	7
	9/15/2021	23.3	8.0	9	<5	7
	9/22/2021	22.7	8.0	10	<5	7
	9/29/2021	22.7	8.0	14	9	14
	10/6/2021	23.2	8.2	9	7	9
	10/13/2021	18.8	6.8	11	5	7
	10/20/2021	20.4	7.9	14	<5	6
	10/27/2021	19.5	7.2	9	7	15
	11/1/2021	21.5	7.9	10	<5	9
	11/10/2021	18.5	7.8	12	<5	5
	11/17/2021	20.9	7.7	11	9	9
	11/24/2021	18.3	8.0	11	<5	7
	12/1/2021	20.4	7.7	10	<5	5
	12/8/2021	20.6	7.5	8	<5	6
	12/14/2021	13.7	7.8	10	551	709
	12/22/2021	19.4	7.7	9	8	9
	12/23/2021	14.7	7.1	10	221	177
	12/30/2021	9.0	7.8	15	>1,000	>2,000
	1/3/2022	16.2	7.7	9	14	16
	1/12/2022	17.5	7.8	13	6	12
	1/19/2022	19.8	7.7	11	<5	10

Data collected on 3/12/21, 12/14/21, 12/23/21, and 12/30/21 were during active rain events.

Water Quality Monitoring Data for Water Quality Monitoring Sites Along the Santa Clara River
Water Quality Monitoring Progress Report, March 1, 2021 to February 23, 2022
Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Suspended Solids (mg/L)
	1/26/2022	19.0	8.0	11	<5	6
	2/1/2022	17.7	8.0	13	<5	8
	2/9/2022	20.0	8.1	9	<5	5
	2/16/2022	20.3	8.2	9	<5	8
	2/23/2022	16.3	7.7	8	<5	<5

Data collected on 3/12/21, 12/14/21, 12/23/21, and 12/30/21 were during active rain events.

Water Quality Data for Water Quality Monitoring Sites Along the Santa Clara River

Water Quality Monitoring Progress Report, March 1, 2022 to Feburary 28, 2023

Waste Discharge Requirements (WDR) Order No. R4-2012-0139

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
SCR-US	3/1/2022	7.6	16.8	9	<5	<5
	3/9/2022	7.7	16.7	8	5	<5
	3/16/2022	7.9	17.7	15	<5	<5
	3/23/2022	7.6	18.6	8	<5	<5
	3/28/2022	8.0	17.1	9	>2,000	834
	4/1/2022	7.7	15.7	8	<5	<5
	4/6/2022	7.5	16.9	9	<5	<5
	4/13/2022	7.4	15.9	8	<5	<5
	4/20/2022	7.5	17.6	9	<5	<5
	4/27/2022	6.9	16.8	7	<5	6
	5/2/2022	6.4	17.9	8	<5	6
	5/11/2022	6.4	17.8	10	<5	<5
	5/18/2022	7.0	18.3	9	<5	<5
	5/25/2022	6.4	17.7	11	<5	<5
	6/1/2022	6.5	17.7	9	<5	<5
	6/8/2022	7.3	19.4	10	<5	15
	6/15/2022	7.8	18.6	12	<5	<5
	6/22/2022	7.8	19.3	12	5	<5
	7/1/2022	7.8	18.7	8	<5	<5
	7/6/2022	7.9	21.1	10	5	<5
	7/13/2022	7.8	19.6	9	<5	<5
	7/20/2022	7.9	21.3	11	<5	<5
	7/27/2022	7.9	21.5	15	<5	<5
	8/1/2022	7.7	20.2	10	<5	<5
	8/10/2022	7.7	19.9	8	<5	<5
	8/17/2022	7.4	19.5	10	<5	<5
	8/24/2022	7.2	18.8	10	<5	<5
	9/1/2022	7.3	19.3	8	15	<5
	9/7/2022	7.6	19.9	8	<5	<5
	9/14/2022	7.5	18.9	8	<5	<5
	9/21/2022	7.7	18.6	8	<5	<5
	9/28/2022	7.8	18.9	12	<5	<5
	10/3/2022	7.9	18.4	11	<5	<5
	10/12/2022	7.4	17.9	7	<5	<5
	10/19/2022	7.5	16.8	8	<5	<5
	10/26/2022	7.6	15.4	8	<5	<5
	10/31/2022	7.7	17.1	8	<5	<5
	11/8/2022	7.2	15.1	8	>2,000	767
	11/16/2022	7.6	15.4	9	<5	<5

Gray shading denotes that data was collected during an active rain event

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	11/23/2022	7.5	15.2	7	<5	<5
	12/1/2022	7.8	15.7	7	<5	<5
	12/2/2022	6.7	15.6	7	11	<5
	12/7/2022	7.9	15.6	8	<5	<5
	12/12/2022	7.6	12.8	9	280	219
	12/21/2022	7.4	13.4	7	<5	<5
	12/28/2022	7.6	14.5	7	15	<5
	1/3/2023	7.5	15.3	7	6	<5
	1/5/2023	7.8	13.4	9	>2,000	>1,000
	1/9/2023	7.6	12.2	9	>2,000	>1,000
	1/10/2023	7.1	12.7	10	>2,000	>1,000
	1/17/2023	7.9	10.4	11	1741	>1,000
	1/25/2023	7.3	15.4	9	14	<5
	2/1/2023	7.6	15.8	8	7	<5
	2/8/2023	7.4	15.3	8	<5	<5
	2/15/2023	7.0	12.5	10	<5	<5
	2/22/2023	7.7	14.4	8	96	8
	2/24/2023	7.4	8.4	10	>2,000	>1,000
	2/27/2023	7.3	10.4	9	>2,000	>1,000
SCR-PR1	3/1/2022	7.5	20.5	8	<5	<5
	3/9/2022	7.5	20.3	7	8	8
	3/16/2022	7.8	22.0	11	6	9
	3/23/2022	7.4	22.3	8	<5	<5
	3/28/2022	8.0	15.2	10	>2,000	>1,000
	4/1/2022	7.3	20.5	8	5	6
	4/6/2022	7.3	20.2	7	12	<5
	4/13/2022	7.1	20.5	7	9	<5
	4/20/2022	7.3	22.9	7	7	<5
	4/27/2022	7.2	21.8	7	9	<5
	5/2/2022	7.5	23.0	7	<5	<5
	5/11/2022	7.2	21.5	9	8	<5
	5/18/2022	7.7	24.0	8	5	<5
	5/25/2022	7.2	23.7	8	8	<5
	6/1/2022	7.3	23.7	7	6	<5
	6/8/2022	6.7	23.8	8	<5	16
	6/15/2022	7.8	24.6	8	7	7
	6/22/2022	7.6	22.2	9	5	9
	7/1/2022	7.8	25.0	7	13	16
	7/6/2022	7.8	26.5	9	6	6
	7/13/2022	7.7	25.4	7	5	10
	7/20/2022	7.7	27.2	7	5	17
	7/27/2022	7.8	27.6	9	<5	5
	8/1/2022	7.9	28.0	7	6	5

Gray shading denotes that data was collected during an active rain event

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	8/10/2022	7.6	26.6	6	<5	14
	8/17/2022	7.5	26.9	6	<5	20
	8/24/2022	7.5	26.2	9	5	8
	9/1/2022	7.4	26.7	6	<5	17
	9/7/2022	7.6	27.7	6	13	14
	9/14/2022	7.6	27.4	6	<5	14
	9/21/2022	7.6	26.4	6	<5	14
	9/28/2022	7.7	26.6	8	9	15
	10/3/2022	7.8	26.2	9	9	13
	10/12/2022	7.5	25.4	6	<5	15
	10/19/2022	7.6	25.5	7	<5	17
	10/26/2022	7.5	24.4	6	<5	11
	10/31/2022	7.7	25.1	6	<5	12
	11/8/2022	7.9	17.3	10	>2,000	>1,000
	11/16/2022	7.6	22.3	8	<5	9
	11/23/2022	7.6	22.8	7	<5	<5
	12/1/2022	7.8	22.7	7	<5	10
	12/2/2022	7.3	15.7	9	54	15
	12/7/2022	7.9	20.9	7	5	<5
	12/12/2022	7.3	16.6	8	226	230
	12/21/2022	7.5	19.3	6	<5	9
	12/28/2022	7.7	20.1	7	12	6
	1/3/2023	7.6	18.5	7	9	11
	1/5/2023	7.8	12.2	7	1925	>1,000
	1/9/2023	-	-	-	-	-
	1/10/2023	-	-	-	-	-
	1/17/2023	7.6	12.9	8	672	649
	1/25/2023	7.2	17.8	7	9	8
	2/1/2023	7.4	19.0	7	7	<5
	2/8/2023	7.1	17.9	7	<5	<5
	2/15/2023	7.4	16.6	7	<5	5
	2/22/2023	7.4	18.9	6	107	18
	2/24/2023	-	-	-	-	-
	2/27/2023	7.8	9.8	10	393	417
SCR-PR2	3/1/2022	7.7	19.5	8	8	<5
	3/9/2022	7.7	20.0	10	9	10
	3/16/2022	8.0	21.7	12	8	11
	3/23/2022	7.1	22.0	8	10	6
	3/28/2022	8.1	14.7	11	>2,000	>1,000
	4/1/2022	6.9	18.9	7	12	7
	4/6/2022	7.1	19.0	8	13	<5
	4/13/2022	6.6	18.1	7	12	7
	4/20/2022	7.0	22.0	8	6	<5

Gray shading denotes that data was collected during an active rain event

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	4/27/2022	6.8	19.7	7	9	7
	5/2/2022	7.2	21.7	7	8	<5
	5/11/2022	6.9	19.8	9	10	6
	5/18/2022	7.7	22.5	8	6	8
	5/25/2022	7.1	21.5	8	8	30
	6/1/2022	7.0	21.9	8	12	5
	6/8/2022	6.3	22.1	7	6	<5
	6/15/2022	7.9	22.2	9	9	10
	6/22/2022	7.9	19.8	11	6	8
	7/1/2022	7.8	22.5	8	9	10
	7/6/2022	7.3	25.5	10	10	8
	7/13/2022	7.8	23.7	8	<5	10
	7/20/2022	7.8	24.8	9	9	13
	7/27/2022	7.9	27.3	10	33	25
	8/1/2022	8.1	27.2	8	6	<5
	8/10/2022	7.5	24.7	7	7	15
	8/17/2022	7.7	25.7	8	8	19
	8/24/2022	7.4	23.9	9	8	14
	9/1/2022	7.7	25.3	7	<5	20
	9/7/2022	7.8	26.4	7	<5	20
	9/14/2022	7.8	25.7	7	<5	22
	9/21/2022	7.8	25.2	7	<5	18
	9/28/2022	7.7	25.1	9	10	14
	10/3/2022	7.8	24.3	10	12	9
	10/12/2022	7.8	24.4	7	16	30
	10/19/2022	7.8	23.3	8	<5	21
	10/26/2022	7.8	22.4	7	<5	15
	10/31/2022	7.9	23.9	7	<5	19
	11/8/2022	7.5	16.1	7	>2,000	767
	11/16/2022	7.8	21.4	9	6	18
	11/23/2022	7.8	21.2	8	7	18
	12/1/2022	8.0	21.3	8	<5	20
	12/2/2022	7.5	20.0	7	13	9
	12/7/2022	7.9	20.9	8	10	9
	12/12/2022	6.9	15.1	9	739	685
	12/21/2022	7.7	18.3	7	914	678
	12/28/2022	7.8	19.9	7	15	18
	1/3/2023	7.7	19.5	7	9	17
	1/5/2023	7.8	12.6	9	>2,000	>1,000
	1/9/2023	7.6	12.6	9	>2,000	>1,000
	1/10/2023	-	-	-	-	-
	1/17/2023	7.8	14.3	9	917	>1,000
	1/25/2023	7.5	19.1	10	16	40

Gray shading denotes that data was collected during an active rain event

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	2/1/2023	7.5	19.8	8	10	10
	2/8/2023	7.2	18.5	7	24	34
	2/15/2023	7.6	17.4	9	27	25
	2/22/2023	7.5	17.9	7	126	31
	2/24/2023	7.4	9.0	9	>2,000	>1,000
	2/27/2023	7.4	11.6	9	>2,000	>1,000
SCR-PR3	3/1/2022	8.1	21.2	11	14	6
	3/9/2022	8.0	19.5	10	9	11
	3/16/2022	8.2	21.9	12	6	12
	3/23/2022	8.0	22.0	8	6	<5
	3/28/2022	7.9	17.0	9	>2,000	669
	4/1/2022	8.0	20.8	8	19	<5
	4/6/2022	7.7	18.8	8	15	6
	4/13/2022	7.6	17.4	7	9	<5
	4/20/2022	7.8	21.6	8	6	<5
	4/27/2022	7.8	19.0	8	6	<5
	5/2/2022	6.5	19.9	10	10	<5
	5/11/2022	6.4	18.6	10	5	<5
	5/18/2022	7.0	20.4	9	7	<5
	5/25/2022	6.4	20.9	9	7	<5
	6/1/2022	6.5	20.2	8	21	<5
	6/8/2022	7.7	22.7	9	7	6
	6/15/2022	7.7	21.1	9	8	<5
	6/22/2022	7.5	20.8	12	8	<5
	7/1/2022	8.2	22.7	10	15	10
	7/6/2022	8.2	25.3	8	13	14
	7/13/2022	8.1	22.8	9	<5	8
	7/20/2022	8.1	23.3	9	9	8
	7/27/2022	8.1	27.2	9	37	32
	8/1/2022	8.1	24.9	9	23	12
	8/10/2022	8.1	23.6	7	15	13
	8/17/2022	7.0	23.3	8	6	6
	8/24/2022	7.0	23.2	8	10	<5
	9/1/2022	7.0	24.4	8	6	11
	9/7/2022	7.5	24.9	7	<5	<5
	9/14/2022	7.2	23.6	8	14	<5
	9/21/2022	7.7	22.6	8	7	<5
	9/28/2022	8.1	23.5	9	20	19
	10/3/2022	8.1	23.6	10	9	9
	10/12/2022	6.7	22.4	7	<5	<5
	10/19/2022	7.0	21.5	8	6	<5
	10/26/2022	7.2	19.8	8	18	<5
	10/31/2022	7.4	20.5	8	12	16

Gray shading denotes that data was collected during an active rain event

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	11/8/2022	-	-	-	-	-
	11/16/2022	7.6	19.2	7	9	11
	11/23/2022	7.3	18.5	8	6	9
	12/1/2022	7.8	19.4	8	<5	6
	12/2/2022	-	-	-	-	-
	12/7/2022	8.2	19.5	8	8	10
	12/12/2022	-	-	-	-	-
	12/21/2022	7.3	17.1	7	7	14
	12/28/2022	7.0	18.4	7	16	9
	1/3/2023	7.2	18.0	7	15	19
	1/5/2023	-	-	-	-	-
	1/9/2023	6.7	12.6	9	>2,000	>1,000
	1/10/2023	-	-	-	-	-
	1/17/2023	7.6	14.3	8	391	495
	1/25/2023	7.0	18.1	9	6	<5
	2/1/2023	7.0	16.5	7	<5	<5
	2/8/2023	7.6	17.3	9	<5	<5
	2/15/2023	--	15.3	8	<5	<5
	2/22/2023	7.8	16.5	6	106	16
	2/24/2023	7.9	7.8	9	>2,000	>1,000
	2/27/2023	-	-	-	-	-
SCR-DS	3/1/2022	7.7	16.9	10	7	<5
	3/9/2022	7.9	14.5	11	20	14
	3/16/2022	8.4	19.5	15	53	24
	3/23/2022	6.5	19.8	8	8	<5
	3/28/2022	8.2	14.4	11	>2,000	>1,000
	4/1/2022	6.1	18.2	8	14	<5
	4/6/2022	6.4	18.6	8	9	<5
	4/13/2022	5.8	17.6	8	8	<5
	4/20/2022	6.2	20.8	9	8	<5
	4/27/2022	5.9	18.8	8	8	<5
	5/2/2022	7.8	21.1	8	8	<5
	5/11/2022	7.8	18.3	10	7	<5
	5/18/2022	8.1	22.0	12	6	<5
	5/25/2022	7.6	21.4	9	11	7
	6/1/2022	7.7	21.3	11	9	<5
	6/8/2022	8.0	23.0	9	6	<5
	6/15/2022	8.2	21.6	11	7	<5
	6/22/2022	8.2	20.7	11	<5	9
	7/1/2022	7.9	21.9	8	11	6
	7/6/2022	8.0	22.0	10	26	12
	7/13/2022	7.7	22.1	9	9	<5
	7/20/2022	7.9	22.3	9	<5	<5

Gray shading denotes that data was collected during an active rain event

Site ID	Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTUs)
	7/27/2022	7.8	26.8	10	55	59
	8/1/2022	8.3	26.8	9	13	13
	8/10/2022	7.3	22.8	8	7	<5
	8/17/2022	8.1	23.7	9	6	<5
	8/24/2022	7.9	23.7	10	9	10
	9/1/2022	8.0	24.6	8	8	13
	9/7/2022	8.1	25.2	8	5	<5
	9/14/2022	8.1	23.6	8	8	12
	9/21/2022	8.1	23.4	8	10	10
	9/28/2022	7.7	22.4	10	6	<5
	10/3/2022	7.9	22.0	10	13	6
	10/12/2022	8.1	22.2	8	9	8
	10/19/2022	8.2	21.3	9	6	11
	10/26/2022	8.1	19.6	9	5	13
	10/31/2022	8.2	22.5	7	5	8
	11/8/2022	7.7	14.9	7	>2,000	816
	11/16/2022	8.1	19.1	11	10	12
	11/23/2022	8.1	18.5	9	6	6
	12/1/2022	8.2	19.5	8	5	14
	12/2/2022	7.8	18.9	8	13	6
	12/7/2022	8.0	18.0	9	10	16
	12/12/2022	6.4	14.5	10	627	564
	12/21/2022	7.9	16.9	7	<5	19
	12/28/2022	8.1	18.5	8	14	16
	1/3/2023	7.9	18.7	7	17	23
	1/5/2023	7.8	12.9	9	>2,000	>1,000
	1/9/2023	7.9	11.7	9	>2,000	>1,000
	1/10/2023	7.6	13.4	10	>2,000	>1,000
	1/17/2023	7.9	14.1	9	1092	828
	1/25/2023	7.8	18.7	10	22	56
	2/1/2023	7.5	18.0	9	19	23
	2/8/2023	7.1	10.9	10	385	444
	2/15/2023	8.0	11.8	12	142	120
	2/22/2023	7.3	11.1	9	322	470
	2/24/2023	7.6	9.0	9	>2,000	>1,000
	2/27/2023	-	-	-	-	-

Gray shading denotes that data was collected during an active rain event

Matrix	Station	Date Sampled	Weather	Analyte	Result	Units	Detect	Method	MDL	CAS
Surface Water	LACDPW_S29	1/12/2017	wet	Ammonia Nitrogen	0.198	mg/l	1	SM 4500-NH3 C	0.1	7664-41-7
Surface Water	LACDPW_S29	1/18/2017	dry	Ammonia Nitrogen	0.1	mg/l	0	SM 4500-NH3 C	0.1	7664-41-7
Surface Water	LACDPW_S29	1/20/2017	wet	Ammonia Nitrogen	0.121	mg/l	0	SM 4500-NH3 C	0.121	7664-41-7
Surface Water	LACDPW_S29	7/18/2017	dry	Ammonia Nitrogen	0.1	mg/l	0	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	1/9/2018	wet	Ammonia Nitrogen	0.35	mg/l	1	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	1/16/2018	dry	Ammonia Nitrogen	0.1	mg/l	0	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	3/10/2018	dry	Ammonia Nitrogen	0.19	mg/l	1	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	3/21/2018	wet	Ammonia Nitrogen	0.13	mg/l	1	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	7/10/2018	dry	Ammonia Nitrogen	0.1	mg/l	0	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	11/29/2018	wet	Ammonia Nitrogen	0.33	mg/l	1	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	1/12/2019	wet	Ammonia Nitrogen	0.16	mg/l	1	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	1/22/2019	dry	Ammonia Nitrogen	0.1	mg/l	0	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	1/31/2019	dry	Ammonia Nitrogen	0.23	mg/l	1	EPA 350.1	0.048	7664-41-7
Surface Water	LACDPW_S29	1/12/2017	wet	Calcium Hardness as CaCO3	135	mg/l	1	SM 2340C	2	CaHard
Surface Water	LACDPW_S29	1/18/2017	dry	Calcium Hardness as CaCO3	475	mg/l	1	SM 2340C	2	CaHard
Surface Water	LACDPW_S29	1/20/2017	wet	Calcium Hardness as CaCO3	100	mg/l	1	SM 2340C	2	CaHard
Surface Water	LACDPW_S29	7/18/2017	dry	Calcium Hardness as CaCO3	494	mg/l	1	EPA 200.7	0.0894	CaHard
Surface Water	LACDPW_S29	1/9/2018	wet	Calcium Hardness as CaCO3	149	mg/l	1	EPA 200.7	0.0894	CaHard
Surface Water	LACDPW_S29	1/16/2018	dry	Calcium Hardness as CaCO3	507	mg/l	1	EPA 200.7	0.0894	CaHard
Surface Water	LACDPW_S29	3/10/2018	dry	Calcium Hardness as CaCO3	135	mg/l	1	EPA 200.7	0.0894	CaHard
Surface Water	LACDPW_S29	3/21/2018	wet	Calcium Hardness as CaCO3	91.2	mg/l	1	EPA 200.7	0.0894	CaHard
Surface Water	LACDPW_S29	7/10/2018	dry	Calcium Hardness as CaCO3	512	mg/l	1	EPA 200.7	0.0894	CaHard
Surface Water	LACDPW_S29	11/29/2018	wet	Calcium Hardness as CaCO3	232	mg/l	1	EPA 200.7	0.179	CaHard
Surface Water	LACDPW_S29	1/12/2019	wet	Calcium Hardness as CaCO3	183	mg/l	1	EPA 200.7	0.179	CaHard
Surface Water	LACDPW_S29	1/22/2019	dry	Calcium Hardness as CaCO3	404	mg/l	1	EPA 200.7	0.0894	CaHard
Surface Water	LACDPW_S29	1/31/2019	dry	Calcium Hardness as CaCO3	306	mg/l	1	EPA 200.7	0.179	CaHard
Surface Water	LACDPW_S29	1/12/2017	wet	Chloride	26.5	mg/l	1	EPA 300.0	1	16887-00-6
Surface Water	LACDPW_S29	1/18/2017	dry	Chloride	73	mg/l	1	EPA 300.0	1	16887-00-6
Surface Water	LACDPW_S29	1/20/2017	wet	Chloride	16.9	mg/l	1	EPA 300.0	1	16887-00-6
Surface Water	LACDPW_S29	7/18/2017	dry	Chloride	81	mg/l	1	EPA 300.0	0.5	16887-00-6
Surface Water	LACDPW_S29	1/9/2018	wet	Chloride	21	mg/l	1	EPA 300.0	0.1	16887-00-6
Surface Water	LACDPW_S29	1/16/2018	dry	Chloride	94	mg/l	1	EPA 300.0	0.6	16887-00-6
Surface Water	LACDPW_S29	3/10/2018	dry	Chloride	10	mg/l	1	EPA 300.0	0.1	16887-00-6
Surface Water	LACDPW_S29	3/21/2018	wet	Chloride	9.3	mg/l	1	EPA 300.0	0.1	16887-00-6
Surface Water	LACDPW_S29	7/10/2018	dry	Chloride	96	mg/l	1	EPA 300.0	0.2	16887-00-6
Surface Water	LACDPW_S29	11/29/2018	wet	Chloride	15	mg/l	1	EPA 300.0	0.1	16887-00-6
Surface Water	LACDPW_S29	1/12/2019	wet	Chloride	13	mg/l	1	EPA 300.0	0.13	16887-00-6
Surface Water	LACDPW_S29	1/22/2019	dry	Chloride	74	mg/l	1	EPA 300.0	0.1	16887-00-6
Surface Water	LACDPW_S29	1/31/2019	dry	Chloride	13	mg/l	1	EPA 300.0	0.2	16887-00-6
Surface Water	LACDPW_S29	1/12/2017	wet	Copper	39.5	µg/l	1	EPA 200.8	0.5	7440-50-8
Surface Water	LACDPW_S29	1/18/2017	dry	Copper	2.06	µg/l	1	EPA 200.8	0.2	7440-50-8
Surface Water	LACDPW_S29	1/20/2017	wet	Copper	198	µg/l	1	EPA 200.8	0.2	7440-50-8
Surface Water	LACDPW_S29	7/18/2017	dry	Copper	1.3	µg/l	1	EPA 200.8	0.13	7440-50-8
Surface Water	LACDPW_S29	1/9/2018	wet	Copper	60	µg/l	1	EPA 200.8	0.13	7440-50-8
Surface Water	LACDPW_S29	1/16/2018	dry	Copper	1.2	µg/l	1	EPA 200.8	0.13	7440-50-8
Surface Water	LACDPW_S29	3/10/2018	dry	Copper	54	µg/l	1	EPA 200.8	0.13	7440-50-8
Surface Water	LACDPW_S29	3/21/2018	wet	Copper	83	µg/l	1	EPA 200.8	0.26	7440-50-8
Surface Water	LACDPW_S29	7/10/2018	dry	Copper	3.1	µg/l	1	EPA 200.8	0.13	7440-50-8
Surface Water	LACDPW_S29	11/29/2018	wet	Copper	110	µg/l	1	EPA 200.8	0.26	7440-50-8
Surface Water	LACDPW_S29	1/12/2019	wet	Copper	63	µg/l	1	EPA 200.8	0.26	7440-50-8
Surface Water	LACDPW_S29	1/22/2019	dry	Copper	1.7	µg/l	1	EPA 200.8	0.13	7440-50-8
Surface Water	LACDPW_S29	1/31/2019	dry	Copper	120	µg/l	1	EPA 200.8	0.52	7440-50-8
Surface Water	LACDPW_S29	1/12/2017	wet	Copper (dissolved)	2.91	µg/l	1	EPA 200.8	0.5	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	1/18/2017	dry	Copper (dissolved)	2.05	µg/l	1	EPA 200.8	0.2	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	1/20/2017	wet	Copper (dissolved)	0.2	µg/l	0	EPA 200.8	0.2	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	7/18/2017	dry	Copper (dissolved)	0.94	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	1/9/2018	wet	Copper (dissolved)	5	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	1/16/2018	dry	Copper (dissolved)	1.1	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	3/10/2018	dry	Copper (dissolved)	2.2	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	3/21/2018	wet	Copper (dissolved)	2.5	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	7/10/2018	dry	Copper (dissolved)	2.1	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	11/29/2018	wet	Copper (dissolved)	4.4	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	1/12/2019	wet	Copper (dissolved)	2.5	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	1/22/2019	dry	Copper (dissolved)	1.8	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	1/31/2019	dry	Copper (dissolved)	3	µg/l	1	EPA 200.8	0.13	7440-50-8 (dissolved)
Surface Water	LACDPW_S29	7/18/2017	dry	Dissolved Oxygen	6.1	mg/l	1	Field - EPA 360.1	-9999	DO
Surface Water	LACDPW_S29	1/9/2018	wet	Dissolved Oxygen	10.15	mg/l	1	Field - EPA 360.1	-9999	DO
Surface Water	LACDPW_S29	1/16/2018	dry	Dissolved Oxygen	5.6	mg/l	1	Field - EPA 360.1	-9999	DO
Surface Water	LACDPW_S29	3/11/2018	wet	Dissolved Oxygen	10.21	mg/l	1	Field - EPA 360.1	-9999	DO
Surface Water	LACDPW_S29	3/21/2018	wet	Dissolved Oxygen	9.75	mg/l	1	Field - EPA 360.1	-9999	DO
Surface Water	LACDPW_S29	7/10/2018	dry	Dissolved Oxygen	5.58	mg/l	1	Unknown Field Analy	-9999	DO
Surface Water	LACDPW_S29	11/29/2018	wet	Dissolved Oxygen	10.8	mg/l	1	Unknown Field Analy	-9999	DO
Surface Water	LACDPW_S29	1/12/2019	wet	Dissolved Oxygen	11.3	mg/l	1	Unknown Field Analy	-9999	DO
Surface Water	LACDPW_S29	1/22/2019	dry	Dissolved Oxygen	6.09	mg/l	1	Unknown Field Analy	-9999	DO
Surface Water	LACDPW_S29	1/31/2019	dry	Dissolved Oxygen	9.8	mg/l	1	Unknown Field Analy	-9999	DO
Surface Water	LACDPW_S29	1/12/2017	wet	E. Coli	8800	MPN/100 ml	1	SM 9223B	1	EColi
Surface Water	LACDPW_S29	1/18/2017	dry	E. Coli	25.9	MPN/100 ml	1	SM 9223B	1	EColi
Surface Water	LACDPW_S29	1/20/2017	wet	E. Coli	7170	MPN/100 ml	1	SM 9223B	1	EColi
Surface Water	LACDPW_S29	7/18/2017	dry	E. Coli	690	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	1/11/2018	wet	E. Coli	310	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	1/16/2018	dry	E. Coli	63	MPN/100 ml	1	SM 9223B	-9999	EColi

Surface Water	LACDPW_S29	3/11/2018	wet	E. Coli	8200	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	3/21/2018	wet	E. Coli	13000	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	7/10/2018	dry	E. Coli	2419.6	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	10/2/2018	dry	E. Coli	23	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	10/9/2018	dry	E. Coli	1600	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	10/16/2018	dry	E. Coli	540	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	10/23/2018	dry	E. Coli	920	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	10/30/2018	dry	E. Coli	920	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	11/6/2018	dry	E. Coli	49	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	11/13/2018	dry	E. Coli	70	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	11/20/2018	dry	E. Coli	33	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	11/27/2018	dry	E. Coli	21	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	11/29/2018	wet	E. Coli	20000	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	12/4/2018	dry	E. Coli	110	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	12/11/2018	dry	E. Coli	49	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	12/18/2018	dry	E. Coli	33	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	12/26/2018	dry	E. Coli	7.8	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	1/2/2019	dry	E. Coli	170	MPN/100 ml	1	SM 9221F	18	EColi
Surface Water	LACDPW_S29	1/8/2019	wet	E. Coli	110	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	1/12/2019	wet	E. Coli	4900	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	1/15/2019	wet	E. Coli	920	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	1/22/2019	dry	E. Coli	44	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	1/29/2019	dry	E. Coli	2	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	1/31/2019	dry	E. Coli	3400	MPN/100 ml	1	SM 9223B	-9999	EColi
Surface Water	LACDPW_S29	2/5/2019	wet	E. Coli	3500	MPN/100 ml	1	SM 9221F	18	EColi
Surface Water	LACDPW_S29	2/12/2019	wet	E. Coli	49	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	2/19/2019	dry	E. Coli	170	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	2/26/2019	dry	E. Coli	70	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	3/5/2019	wet	E. Coli	110	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	3/12/2019	dry	E. Coli	46	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	3/19/2019	dry	E. Coli	6.1	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	3/26/2019	dry	E. Coli	49	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	4/2/2019	dry	E. Coli	9.3	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	4/9/2019	dry	E. Coli	79	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	4/16/2019	dry	E. Coli	17	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	4/23/2019	dry	E. Coli	130	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	4/30/2019	dry	E. Coli	14	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	5/7/2019	dry	E. Coli	170	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	5/14/2019	dry	E. Coli	240	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	5/21/2019	dry	E. Coli	79	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	5/28/2019	dry	E. Coli	130	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	6/4/2019	dry	E. Coli	350	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	6/11/2019	dry	E. Coli	540	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	6/18/2019	dry	E. Coli	540	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	6/25/2019	dry	E. Coli	350	MPN/100 ml	1	SM 9221F	1.8	EColi
Surface Water	LACDPW_S29	1/12/2017	wet	Iron	70.5	mg/l	1	EPA 200.8	0.05	7439-89-6
Surface Water	LACDPW_S29	1/18/2017	dry	Iron	0.263	mg/l	1	EPA 200.7	0.01	7439-89-6
Surface Water	LACDPW_S29	1/20/2017	wet	Iron	65	mg/l	1	EPA 200.7	1	7439-89-6
Surface Water	LACDPW_S29	7/18/2017	dry	Iron	0.19	mg/l	1	EPA 200.8	0.00091	7439-89-6
Surface Water	LACDPW_S29	1/9/2018	wet	Iron	41	mg/l	1	EPA 200.8	0.00091	7439-89-6
Surface Water	LACDPW_S29	1/16/2018	dry	Iron	0.35	mg/l	1	EPA 200.8	0.00091	7439-89-6
Surface Water	LACDPW_S29	3/10/2018	dry	Iron	38	mg/l	1	EPA 200.8	0.0091	7439-89-6
Surface Water	LACDPW_S29	3/21/2018	wet	Iron	69	mg/l	1	EPA 200.8	0.0018	7439-89-6
Surface Water	LACDPW_S29	7/10/2018	dry	Iron	0.84	mg/l	1	EPA 200.8	0.00091	7439-89-6
Surface Water	LACDPW_S29	11/29/2018	wet	Iron	72	mg/l	1	EPA 200.8	0.0018	7439-89-6
Surface Water	LACDPW_S29	1/12/2019	wet	Iron	54	mg/l	1	EPA 200.8	0.0091	7439-89-6
Surface Water	LACDPW_S29	1/22/2019	dry	Iron	0.1	mg/l	1	EPA 200.8	0.00091	7439-89-6
Surface Water	LACDPW_S29	1/31/2019	dry	Iron	110	mg/l	1	EPA 200.8	0.0036	7439-89-6
Surface Water	LACDPW_S29	1/12/2017	wet	Iron (dissolved)	100	µg/l	0	EPA 200.8	50	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/18/2017	dry	Iron (dissolved)	20	µg/l	0	EPA 200.7	10	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/20/2017	wet	Iron (dissolved)	176	µg/l	1	EPA 200.7	10	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	7/18/2017	dry	Iron (dissolved)	19	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/9/2018	wet	Iron (dissolved)	120	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/16/2018	dry	Iron (dissolved)	9.5	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	3/10/2018	dry	Iron (dissolved)	47	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	3/21/2018	wet	Iron (dissolved)	36	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	7/10/2018	dry	Iron (dissolved)	23	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	11/29/2018	wet	Iron (dissolved)	96	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/12/2019	wet	Iron (dissolved)	48	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/22/2019	dry	Iron (dissolved)	16	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/31/2019	dry	Iron (dissolved)	77	µg/l	1	EPA 200.8	0.91	7439-89-6 (dissolved)
Surface Water	LACDPW_S29	1/12/2017	wet	Mercury	0.171	µg/l	1	EPA 1631E	0.0005	7439-97-6
Surface Water	LACDPW_S29	1/18/2017	dry	Mercury	0.00138	µg/l	1	EPA 1631E	0.0005	7439-97-6
Surface Water	LACDPW_S29	1/20/2017	wet	Mercury	0.141	µg/l	1	EPA 1631E	0.0005	7439-97-6
Surface Water	LACDPW_S29	7/18/2017	dry	Mercury	0.0011	µg/l	1	EPA 1631E	0.00031	7439-97-6
Surface Water	LACDPW_S29	1/9/2018	wet	Mercury	0.078	µg/l	1	EPA 1631E	0.0015	7439-97-6
Surface Water	LACDPW_S29	1/16/2018	dry	Mercury	0.0009	µg/l	1	EPA 1631E	0.00031	7439-97-6
Surface Water	LACDPW_S29	3/11/2018	wet	Mercury	0.035	µg/l	1	EPA 1631E	0.0015	7439-97-6
Surface Water	LACDPW_S29	3/21/2018	wet	Mercury	0.092	µg/l	1	EPA 1631E	0.0031	7439-97-6
Surface Water	LACDPW_S29	7/10/2018	dry	Mercury	0.0012	µg/l	1	EPA 1631E	0.00031	7439-97-6
Surface Water	LACDPW_S29	11/29/2018	wet	Mercury	0.28	µg/l	1	EPA 1631E	0.061	7439-97-6
Surface Water	LACDPW_S29	1/12/2019	wet	Mercury	0.049	µg/l	1	EPA 1631E	0.0031	7439-97-6

Surface Water	LACDPW_S29	1/22/2019	dry	Mercury	0.00202	µg/l	1	EPA 1631E	0.0002	7439-97-6
Surface Water	LACDPW_S29	1/31/2019	dry	Mercury	0.0433	µg/l	1	EPA 1631E	0.002	7439-97-6
Surface Water	LACDPW_S29	1/12/2017	wet	Mercury (dissolved)	0.00235	µg/l	1	EPA 1631E	0.0005	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/18/2017	dry	Mercury (dissolved)	0.000665	µg/l	1	EPA 1631E	0.0005	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/20/2017	wet	Mercury (dissolved)	0.00186	µg/l	1	EPA 1631E	0.0005	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	7/18/2017	dry	Mercury (dissolved)	0.00078	µg/l	1	EPA 1631E	0.00031	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/9/2018	wet	Mercury (dissolved)	0.0051	µg/l	1	EPA 1631E	0.00031	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/16/2018	dry	Mercury (dissolved)	0.00079	µg/l	1	EPA 1631E	0.00031	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	3/11/2018	wet	Mercury (dissolved)	0.0023	µg/l	1	EPA 1631E	0.00031	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	3/21/2018	wet	Mercury (dissolved)	0.0048	µg/l	1	EPA 1631E	0.00031	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	7/10/2018	dry	Mercury (dissolved)	0.0008	µg/l	1	EPA 1631E	0.00031	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	11/29/2018	wet	Mercury (dissolved)	0.004	µg/l	1	EPA 1631E	0.002	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/12/2019	wet	Mercury (dissolved)	0.0024	µg/l	1	EPA 1631E	0.00031	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/22/2019	dry	Mercury (dissolved)	0.00189	µg/l	1	EPA 1631E	0.0002	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/31/2019	dry	Mercury (dissolved)	0.00605	µg/l	1	EPA 1631E	0.0002	7439-97-6 (dissolved)
Surface Water	LACDPW_S29	1/12/2017	wet	Nitrate (as N)	1.78	mg/l	1	EPA 300.0	0.05	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/18/2017	dry	Nitrate (as N)	1.6	mg/l	1	EPA 300.0	0.05	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/20/2017	wet	Nitrate (as N)	0.644	mg/l	1	EPA 300.0	0.05	14797-55-8 (as N)
Surface Water	LACDPW_S29	7/18/2017	dry	Nitrate (as N)	1.1	mg/l	1	EPA 300.0	0.04	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/9/2018	wet	Nitrate (as N)	0.94	mg/l	1	EPA 353.2	0.083	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/16/2018	dry	Nitrate (as N)	0.77	mg/l	1	EPA 353.2	0.083	14797-55-8 (as N)
Surface Water	LACDPW_S29	3/10/2018	dry	Nitrate (as N)	0.45	mg/l	1	EPA 300.0	0.02	14797-55-8 (as N)
Surface Water	LACDPW_S29	3/21/2018	wet	Nitrate (as N)	0.42	mg/l	1	EPA 300.0	0.02	14797-55-8 (as N)
Surface Water	LACDPW_S29	7/10/2018	dry	Nitrate (as N)	1.5	mg/l	1	EPA 353.2	0.083	14797-55-8 (as N)
Surface Water	LACDPW_S29	11/29/2018	wet	Nitrate (as N)	0.81	mg/l	1	EPA 353.2	0.083	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/12/2019	wet	Nitrate (as N)	0.696	mg/l	1	EPA 353.2	0.083	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/22/2019	dry	Nitrate (as N)	1.3	mg/l	1	EPA 353.2	0.083	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/31/2019	dry	Nitrate (as N)	0.69	mg/l	1	EPA 353.2	0.083	14797-55-8 (as N)
Surface Water	LACDPW_S29	1/12/2017	wet	Nitrate (as NO3)	7.87	mg/l	1	EPA 300.0	0.2	14797-55-8 (as NO3)
Surface Water	LACDPW_S29	1/18/2017	dry	Nitrate (as NO3)	7.08	mg/l	1	EPA 300.0	0.2	14797-55-8 (as NO3)
Surface Water	LACDPW_S29	1/20/2017	wet	Nitrate (as NO3)	2.86	mg/l	1	EPA 300.0	0.2	14797-55-8 (as NO3)
Surface Water	LACDPW_S29	1/12/2017	wet	Nitrite (as N)	118	µg/l	1	EPA 300.0	70	14797-65-0 (as N)
Surface Water	LACDPW_S29	1/18/2017	dry	Nitrite (as N)	100	µg/l	0	EPA 300.0	70	14797-65-0 (as N)
Surface Water	LACDPW_S29	1/20/2017	wet	Nitrite (as N)	78	µg/l	1	EPA 300.0	70	14797-65-0 (as N)
Surface Water	LACDPW_S29	7/18/2017	dry	Nitrite (as N)	300	µg/l	0	EPA 300.0	40	14797-65-0 (as N)
Surface Water	LACDPW_S29	1/9/2018	wet	Nitrite (as N)	14	µg/l	1	EPA 353.2	10	14797-65-0 (as N)
Surface Water	LACDPW_S29	1/16/2018	dry	Nitrite (as N)	50	µg/l	1	EPA 353.2	10	14797-65-0 (as N)
Surface Water	LACDPW_S29	3/10/2018	dry	Nitrite (as N)	130	µg/l	1	EPA 300.0	20	14797-65-0 (as N)
Surface Water	LACDPW_S29	3/21/2018	wet	Nitrite (as N)	61	µg/l	1	EPA 300.0	20	14797-65-0 (as N)
Surface Water	LACDPW_S29	7/10/2018	dry	Nitrite (as N)	100	µg/l	0	EPA 353.2	10	14797-65-0 (as N)
Surface Water	LACDPW_S29	11/29/2018	wet	Nitrite (as N)	62	µg/l	1	EPA 353.2	10	14797-65-0 (as N)
Surface Water	LACDPW_S29	1/12/2019	wet	Nitrite (as N)	53.1	µg/l	1	EPA 353.2	10	14797-65-0 (as N)
Surface Water	LACDPW_S29	1/22/2019	dry	Nitrite (as N)	100	µg/l	0	EPA 353.2	10	14797-65-0 (as N)
Surface Water	LACDPW_S29	1/31/2019	dry	Nitrite (as N)	54	µg/l	1	EPA 353.2	10	14797-65-0 (as N)
Surface Water	LACDPW_S29	7/18/2017	dry	pH	7.29	pH units	1	Field - EPA 150.1	-9999	pH
Surface Water	LACDPW_S29	1/9/2018	wet	pH	7.92	pH units	1	Field - EPA 150.1	-9999	pH
Surface Water	LACDPW_S29	1/16/2018	dry	pH	7.75	pH units	1	Field - EPA 150.1	-9999	pH
Surface Water	LACDPW_S29	3/11/2018	wet	pH	7.54	pH units	1	Field - EPA 150.1	-9999	pH
Surface Water	LACDPW_S29	3/21/2018	wet	pH	7.61	pH units	1	Field - EPA 150.1	-9999	pH
Surface Water	LACDPW_S29	7/10/2018	dry	pH	7.5	pH units	1	Unknown Field Anal	-9999	pH
Surface Water	LACDPW_S29	11/29/2018	wet	pH	7.58	pH units	1	Unknown Field Anal	-9999	pH
Surface Water	LACDPW_S29	1/12/2019	wet	pH	7.55	pH units	1	Unknown Field Anal	-9999	pH
Surface Water	LACDPW_S29	1/22/2019	dry	pH	7.33	pH units	1	Unknown Field Anal	-9999	pH
Surface Water	LACDPW_S29	1/31/2019	dry	pH	7.67	pH units	1	Unknown Field Anal	-9999	pH
Surface Water	LACDPW_S29	1/12/2017	wet	Selenium	0.809	µg/l	1	EPA 200.8	0.5	7782-49-2
Surface Water	LACDPW_S29	1/18/2017	dry	Selenium	0.5	µg/l	0	EPA 200.8	0.5	7782-49-2
Surface Water	LACDPW_S29	1/20/2017	wet	Selenium	0.5	µg/l	0	EPA 200.8	0.5	7782-49-2
Surface Water	LACDPW_S29	7/18/2017	dry	Selenium	9.9	µg/l	1	EPA 200.8	0.14	7782-49-2
Surface Water	LACDPW_S29	1/9/2018	wet	Selenium	2.6	µg/l	1	EPA 200.8	0.14	7782-49-2
Surface Water	LACDPW_S29	1/16/2018	dry	Selenium	2.8	µg/l	1	EPA 200.8	0.14	7782-49-2
Surface Water	LACDPW_S29	3/10/2018	dry	Selenium	0.72	µg/l	1	EPA 200.8	0.14	7782-49-2
Surface Water	LACDPW_S29	3/21/2018	wet	Selenium	0.95	µg/l	1	EPA 200.8	0.28	7782-49-2
Surface Water	LACDPW_S29	7/10/2018	dry	Selenium	6.4	µg/l	1	EPA 200.8	0.14	7782-49-2
Surface Water	LACDPW_S29	11/29/2018	wet	Selenium	1.4	µg/l	1	EPA 200.8	0.28	7782-49-2
Surface Water	LACDPW_S29	1/12/2019	wet	Selenium	0.66	µg/l	1	EPA 200.8	0.28	7782-49-2
Surface Water	LACDPW_S29	1/22/2019	dry	Selenium	3.4	µg/l	1	EPA 200.8	0.14	7782-49-2
Surface Water	LACDPW_S29	1/31/2019	dry	Selenium	0.91	µg/l	1	EPA 200.8	0.56	7782-49-2
Surface Water	LACDPW_S29	1/12/2017	wet	Selenium (dissolved)	0.806	µg/l	1	EPA 200.8	0.5	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/18/2017	dry	Selenium (dissolved)	0.5	µg/l	0	EPA 200.8	0.5	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/20/2017	wet	Selenium (dissolved)	0.5	µg/l	0	EPA 200.8	0.5	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	7/18/2017	dry	Selenium (dissolved)	9.7	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/9/2018	wet	Selenium (dissolved)	0.4	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/16/2018	dry	Selenium (dissolved)	2.7	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	3/10/2018	dry	Selenium (dissolved)	0.4	µg/l	0	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	3/21/2018	wet	Selenium (dissolved)	0.4	µg/l	0	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	7/10/2018	dry	Selenium (dissolved)	6.9	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	11/29/2018	wet	Selenium (dissolved)	0.26	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/12/2019	wet	Selenium (dissolved)	0.16	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/22/2019	dry	Selenium (dissolved)	3.5	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/31/2019	dry	Selenium (dissolved)	0.3	µg/l	1	EPA 200.8	0.14	7782-49-2 (dissolved)
Surface Water	LACDPW_S29	1/12/2017	wet	Total Suspended Solids	8000	mg/l	1	SM 2540D	1	TSusS
Surface Water	LACDPW_S29	1/18/2017	dry	Total Suspended Solids	2.3	mg/l	1	SM 2540D	1	TSusS

Surface Water	LACDPW_S29	1/20/2017	wet	Total Suspended Solids	3470	mg/l	1	SM 2540D	1	TSusS
Surface Water	LACDPW_S29	7/18/2017	dry	Total Suspended Solids	5	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	1/9/2018	wet	Total Suspended Solids	900	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	1/16/2018	dry	Total Suspended Solids	2	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	3/10/2018	dry	Total Suspended Solids	1900	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	3/21/2018	wet	Total Suspended Solids	1500	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	7/10/2018	dry	Total Suspended Solids	22	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	11/29/2018	wet	Total Suspended Solids	1300	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	1/12/2019	wet	Total Suspended Solids	1280	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	1/22/2019	dry	Total Suspended Solids	420	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	1/31/2019	dry	Total Suspended Solids	2100	mg/l	1	SM 2540D	-9999	TSusS
Surface Water	LACDPW_S29	1/12/2017	wet	Zinc	86.4	µg/l	1	EPA 200.8	1	7440-66-6
Surface Water	LACDPW_S29	1/18/2017	dry	Zinc	5.91	µg/l	1	EPA 200.8	1	7440-66-6
Surface Water	LACDPW_S29	1/20/2017	wet	Zinc	870	µg/l	1	EPA 200.8	1	7440-66-6
Surface Water	LACDPW_S29	7/18/2017	dry	Zinc	2.1	µg/l	1	EPA 200.8	0.94	7440-66-6
Surface Water	LACDPW_S29	1/9/2018	wet	Zinc	170	µg/l	1	EPA 200.8	0.94	7440-66-6
Surface Water	LACDPW_S29	1/16/2018	dry	Zinc	3.1	µg/l	1	EPA 200.8	0.94	7440-66-6
Surface Water	LACDPW_S29	3/10/2018	dry	Zinc	170	µg/l	1	EPA 200.8	0.94	7440-66-6
Surface Water	LACDPW_S29	3/21/2018	wet	Zinc	260	µg/l	1	EPA 200.8	1.9	7440-66-6
Surface Water	LACDPW_S29	7/10/2018	dry	Zinc	5.8	µg/l	1	EPA 200.8	0.94	7440-66-6
Surface Water	LACDPW_S29	11/29/2018	wet	Zinc	340	µg/l	1	EPA 200.8	1.9	7440-66-6
Surface Water	LACDPW_S29	1/12/2019	wet	Zinc	210	µg/l	1	EPA 200.8	1.9	7440-66-6
Surface Water	LACDPW_S29	1/22/2019	dry	Zinc	2.6	µg/l	1	EPA 200.8	0.94	7440-66-6
Surface Water	LACDPW_S29	1/31/2019	dry	Zinc	330	µg/l	1	EPA 200.8	3.8	7440-66-6
Surface Water	LACDPW_S29	1/12/2017	wet	Zinc (dissolved)	2.87	µg/l	1	EPA 200.8	1	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	1/18/2017	dry	Zinc (dissolved)	3.5	µg/l	1	EPA 200.8	1	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	1/20/2017	wet	Zinc (dissolved)	1	µg/l	0	EPA 200.8	1	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	7/18/2017	dry	Zinc (dissolved)	1.5	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	1/9/2018	wet	Zinc (dissolved)	5.5	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	1/16/2018	dry	Zinc (dissolved)	3.1	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	3/10/2018	dry	Zinc (dissolved)	3.8	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	3/21/2018	wet	Zinc (dissolved)	1.9	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	7/10/2018	dry	Zinc (dissolved)	2.7	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	11/29/2018	wet	Zinc (dissolved)	4.3	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	1/12/2019	wet	Zinc (dissolved)	2.8	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	1/22/2019	dry	Zinc (dissolved)	2.9	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)
Surface Water	LACDPW_S29	1/31/2019	dry	Zinc (dissolved)	2.1	µg/l	1	EPA 200.8	0.94	7440-66-6 (dissolved)

APPENDIX D
Modeling Parameters and Methodology

D. WATER QUALITY MODEL METHODOLOGY

Appendix D List of Tables

Appendix D List of Figures

D.1. **Model Overview**

The model used to assess stormwater quality impacts associated with the proposed Newhall Entrada South and Valencia Commerce Center (VCC) 18108 (Project) is an empirical, volume-based pollutant loads model. This type of loadings model is generally applicable in the planning and evaluation stages of a project. The model was developed to assess the potential impact of development on water quality and to evaluate the effectiveness of the structural Best Management Practices (BMPs) that will treat storm water runoff as part of the project storm water treatment system. Two project conditions were evaluated with the water quality model:

- Pre-development
- Post-development
- Post-development with project design features (PDFs)

Measured runoff volumes and water quality characteristics of storm water are highly variable. To account for this variability, a statistical modeling approach was used to estimate the volume of stormwater, the concentration of pollutants in stormwater, and the overall pollutant load (total mass of pollutants) in stormwater runoff. A statistical description of stormwater provides an indication of the average characteristics and variability of the water quality parameters of stormwater. It does not forecast runoff characteristics for specific storms or monitoring periods.

The statistical model is based on relatively simple rainfall/runoff relationships and estimated concentrations in stormwater runoff. The volume of stormwater runoff is estimated using a modification to the Rational Formula, an empirical expression that relates runoff volume to the rainfall depth and the basin characteristics such as imperviousness, and soils infiltration characteristics. The pollutant concentration in storm water runoff is represented by an expected average pollutant concentration, called the event mean concentrations (EMC).

The model does not incorporate the hydraulics or detailed hydrology of the site, which would be more appropriate for subsequent design stages and requires additional data and more sophisticated modeling. The model includes water quality benefits achieved by structural BMPs, but not source control BMPs, because data is generally not available or conclusive for the latter.

Model results are presented for average annual runoff volumes, pollutant loads, and pollutant concentrations. The flow chart in Figure D-1 provides an overview of the modeling methodology.

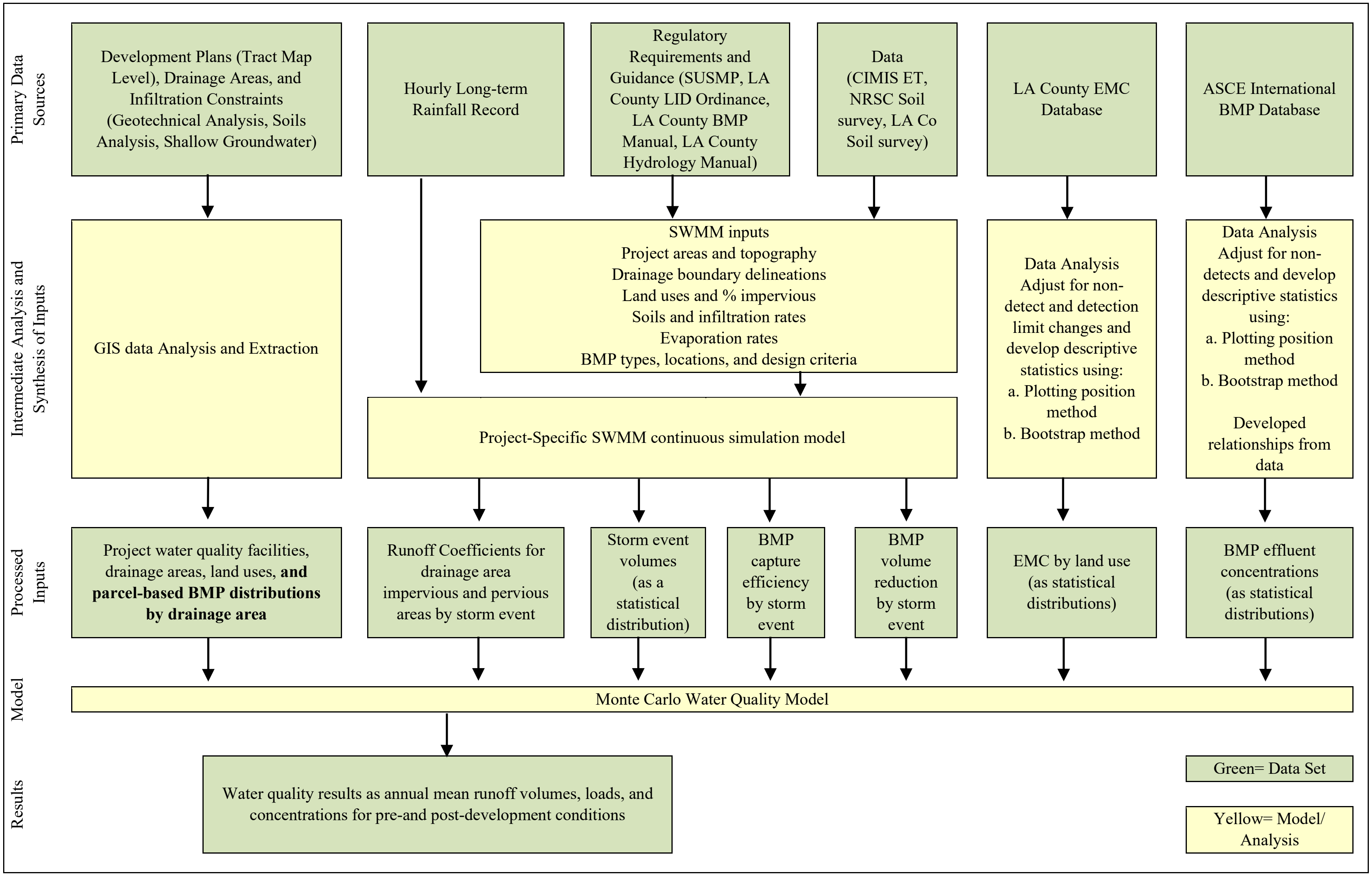

Figure D-1: Overview of Water Quality Analysis Methodology

D.1.1. Technical Basis for Modeling Methodology

A variety of modeling approaches are capable of meeting the technical requirements of this analysis. In general, models can be grouped into three categories:

- Stochastic (or probabilistic): this type of model utilizes observed statistical patterns to produce model estimates. Stochastistic models generally rely on empirical observations, but do not necessarily ignore causal relationships.
- Deterministic (or mechanistic, physically-based): this type of model attempts to perfectly represent physical processes and mechanisms using closed-form equations derived from physical phenomena. It is noted that because deterministic models attempt to describe systems that are inherently complex and poorly defined, most deterministic models must rely in part on empirical observations to represent causal relationships.
- Hybrid: this type of model combines elements of stochastic and deterministic models to provide more reliable model estimates.

The modeling methodology used for the Project incorporates stochastic and empirical elements, and is therefore most accurately described as a hybrid approach. The approach uses an empirical, stochastic water quality estimation approach (Monte Carlo) to produce water quality and pollutant loading estimates. Inputs to this model are derived from empirical sources (the Los Angeles County Land Use Monitoring Program and the ASCE International BMP Database) and deterministic modeling of hydrology and hydraulics using USEPA's Storm Water Management Model version 5.1.013 (SWMM 5). This approach makes use of robust land use and BMP monitoring datasets applicable to the Project and incorporates important causal relationships in hydrologic and hydraulic response that can be reliably represented with deterministic methods. This approach is believed to be most appropriate to meet the technical requirements of the impact analysis for the Project-level analysis at the tract map scale.

The literature studies summarized below generally support the use of an empirically-based hybrid approach for the type of analysis required for the Project:

- Obropta et al. (2007) evaluated six deterministic models, three stochastic models, and three hybrid approaches. They concluded that *hybrid approaches show strong potential for reducing stormwater quality model prediction error and uncertainty* [improving the ability to assess] *best management practice design, land use change impact assessment* [and other applications].
- Charbeneau and Barrett (1998) evaluated different approaches for estimating stormwater pollutant loads based on a comparison of model results to observed land use monitoring data. They found that (1) the development of accurate physically-based models *remains a difficult and elusive goal*, and current understanding of processes *is not sufficient to accurately predict event loads*, (2) a simple empirical stochastic approach is generally as reliable or more reliable than more complicated mechanistic approaches, (3) the use of land use event mean concentrations (EMCs) is appropriate for planning purposes, (4) the

land use EMC approach is most reliable when land use EMCs are used as a stochastic input parameter generated from a probabilistic distribution, and (5) stormwater volume is the single most important variable in predicting pollutant loads.

- The National Research Council's (NRC) 2008 report on *Urban Stormwater Management in the United States* generally supports these findings regarding the appropriate use of stormwater quality and quantity models.

As with all environmental modeling, the precision of results is heavily dependent on how well the hydrologic, water quality, and BMP effectiveness data describe the actual site characteristics. Local and regional data are used to the fullest extent possible to help minimize errors in predictions, but such data are limited, and traditional calibration and verification of the model is not feasible. It is important to note that the predictions of relative differences should be more accurate than absolute values.

D.1.2. Model Assumptions

The water quality modeling methodology requires that some assumptions are made for both the model input parameters and the way the modeling calculations are carried out. Section D.2.6 discusses the assumptions that were made in specifying the model parameters and Section D.3.4 discusses the assumptions regarding the modeling approach. Section D.4 discusses model accuracy.

D.2. Model Input Parameters

Many parameters that can affect pollutant loads and concentrations vary spatially and may not be adequately represented by stormwater monitoring data collected at discrete locations. Examples include source concentrations, topography, soil type, and rainfall characteristics, all of which can influence the buildup and mobilization of pollutants. The following model parameters represent the best data currently available for representation of existing and developed site conditions in the water quality model.

D.2.1. Rainfall & Storm Characteristics

Rainfall analysis was conducted with hourly precipitation data from a 40-year period of record (water year (WY) 1969-2008) recorded at the National Climatic Data Center (NCDC) Newhall rain gauge (station number 046162), located in the town of Newhall, California.

Additional records for water years (WY) 2009, 2010, 2011 and 2012 are available for the gauge; however, all of the data from WY 2011 and 2012 are flagged as missing or deleted and data from WY 2010 has approximately 4.5 months of missing or deleted data, most of which are during the wet season (June through December). WY 2009 is a more complete record with 8.5 percent flagged data; however, the addition of this one year of data into the 40-year record would not yield significantly different results. An additional check of data from WY 2013 through 2019, including a search of 12 nearby rain gauges, concluded that there are no high-quality data available at or in the vicinity of the Newhall rain gauge for WY 2009 through 2019

Figure D-2 shows the location of the Newhall gauge in relation to the Project area. This gauge is located approximately 4 miles from the Project. The gauge elevation of 1,243 ft above mean sea level (AMSL) is comparable to the Project area elevation of approximately 1,000-1,200 ft AMSL.

While the period of record rainfall data collected at the Newhall rain gauge is quite long (40 years), there are some gaps in the record. In order to improve the characterization of rainfall at the project site, estimates of the missing rainfall data were made through correlation of the Newhall rain gauge with the San Fernando rain gauge (NCDC station number 047762), which is located approximately 6 miles away from the Newhall gauge, and 10 miles away from the Project (south and slightly east).

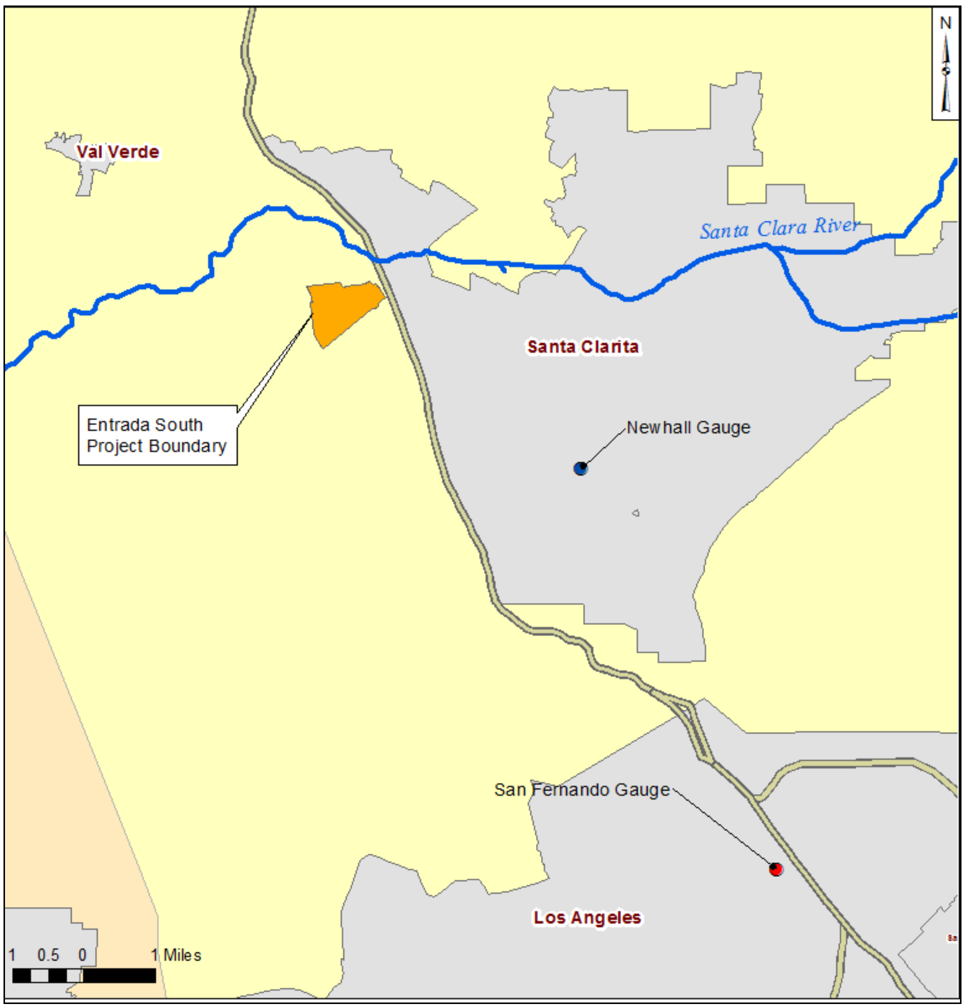

Figure D-2: Location of Newhall Rain Gauge in the Vicinity of the Project Area

The Castaic Junction gauge monitored by Los Angeles County Department of Public Works (LACDPW) is located closer to the Project; however, the usable period of record at this gauge is limited to approximately 12 years, which is considered too short to produce significant results in long-term simulation. Other gauges in the area report daily rainfall totals only. Hourly data are required to support water quality modeling efforts.

San Fernando rainfall data was adjusted based on comparison between the two gauges over periods for which they both contained data. A comparison of hourly or daily rainfall totals is not expected to yield a strong correlation as spatial variability is exaggerated on short time scales (i.e., a single storm could result in appreciable rainfall at one gauge and little rainfall at the other). However, monthly correlations are expected to yield meaningful comparison between the gauges when taken over a long period of record. Data from the gauges from WY 1969 to 2008 were screened to keep only the months without missing data and with measured rainfall at both stations. Correlation of the monthly rainfall totals is shown in Figure D-3.

This monthly correlation indicated slightly higher rainfall amounts at the Newhall gauge compared to the San Fernando gauge.

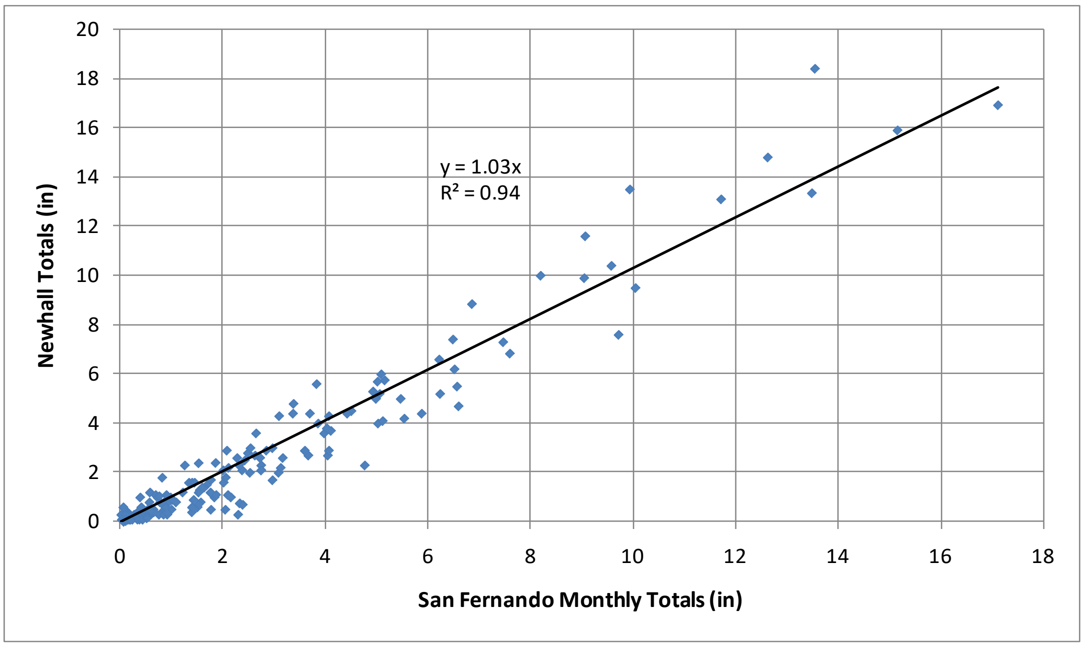

Figure D-3: Correlation of 24-hour Totals between Newhall & San Fernando Gauges

Based on the relationship developed through the monthly comparison, a multiplier of 1.03 was applied to the hourly rainfall data from the San Fernando gauge to fill in the missing periods of rainfall data at the Newhall gauge. Values were rounded to the nearest 1/100 inch after the adjustment.

Rainfall analysis was conducted for two data groups: all storm events; and only storm events with sufficient depth to be expected to contribute to stormwater runoff (i.e., storms >0.1 inches). The rainfall data were analyzed using a code similar in performance to USEPA's Synoptic Rainfall Analysis Program (SYNOP). The customized code (GeoSYNOP) facilitates resolving missing periods of data and is more robust when handling storm date and time. GeoSYNOP subdivides the rainfall record into discrete events separated by an inter-event dry period, which was set to a minimum of 6 hours for the Project. Small rainfall events, which resulted in rainfall of less than or equal to 0.10 inches, were deleted from the record used for water quality impact analysis, as such events tend to produce little if any runoff (USEPA, 1989; Schueler, 1987). For the Newhall gauge, a total of 609 storm events (>0.1 inches) were separated from the continuous data from October 1, 1968 to September 30, 2008. Storm statistics for the full data set (all storms) and the trimmed data set (only storms > 0.1 inch) are shown in Table D-1.

Table D-1: Analysis Results for the Actual and Filled Newhall Rainfall Data

Storms	Newhall Gauge WY 1969 – 2008	Patched Record
All Storms	Average annual rainfall (in):	18.4
	Total number of storms:	1011
	Average number of storms per year:	25.3
	Average storm volume (in):	0.73
	Average storm duration (hrs):	7.3
	Average storm intensity (in/hr):	0.097
Storms >0.1 inch	Average annual rainfall (in):	17.4
	Total number of storms:	609
	Average number of storms per year:	15.2
	Average storm volume (in):	1.14
	Average storm duration (hrs):	11.4
	Average storm intensity (in/hr):	0.102

[1] Augmented record includes adjusted data from San Fernando gauge to fill gaps in Newhall gauge record.

D.2.2. Runoff Coefficients

The long-term runoff coefficient (i.e., the fraction of precipitation that runs off as stormwater) is dependent on a number of factors. The long-term runoff coefficient is most strongly dependent on catchment imperviousness. However, soil characteristics, watershed slope and roughness, rainfall patterns, evapotranspiration (ET) rates and a variety of other factors also influence runoff coefficient. Runoff coefficients are expected to vary from storm event to storm event as a function of antecedent conditions, storm intensity distribution, storm duration, and storm depth. The following describes how the runoff coefficients were estimated for use in the Water Quality model.

D.2.2.1. SWMM Runoff Coefficient Modeling Parameters

The water quality model uses an equation consistent with the Los Angeles County Hydrology Manual to estimate a runoff coefficient for sub-basins as a function of the percent impervious for a given storm event. The format of this equation is described as:

$$C = C_i * i + C_p * (1-i)$$

Where:

C = composite runoff coefficient
C_i = runoff coefficient from impervious areas
C_p = runoff coefficient from pervious areas
i = imperviousness fraction (ranges from 0 to 1)

Per the Los Angeles County Hydrology Manual, C_i = 0.90, and C_p is a function of Los Angeles County soil type and rainfall intensity. Los Angeles County soil types observed on the site include 020, 097 and 098. While the C_p value characteristic of these soils is also dependent on rainfall intensity, which varies during each storm event, a C_p value of 0.1 is typically assumed for small to moderate storms. Because small to moderate storms make up the majority of average annual rainfall volume, this value is appropriate for use as a long-term average runoff coefficient consistent with the Hydrology Manual method.

It is recognized, however, that when examining individual storms, C_p for smaller storms may be zero, while for larger storms C_p may greatly exceed the long-term average. The water quality model should ideally estimate Project-specific pervious area runoff coefficients on a storm-by-storm basis, using a robust method that accounts for more detailed hydrologic processes and antecedent conditions. Such a method should consider the range of conditions that could occur and select appropriately conservative values to account for uncertainty.

Continuous simulation modeling, using SWMM 5, was conducted for Project drainage areas to generate appropriate storm-by-storm pervious and impervious runoff coefficients to use in the runoff coefficient equation for each storm event. A standalone C# executable program was used that: reads in a SWMM 5 binary output file; segregates rainfall into storm events (using algorithms identical in performance to GeoSYNOP, described above, with a defined dry interevent period of 6 hours); tracks the fate of rainfall to losses (i.e., infiltration, ET) and runoff for each storm; and tabulates runoff coefficients for every subcatchment, and percent capture and percent volume reduction for every BMP storage node, by storm event. The majority of the SWMM modeling parameters used for this analysis are shown in Table D-2.

Table D-2: SWMM Runoff Module Parameters

SWMM Runoff Parameters	Units	Values
Wet time step	seconds	900
Wet/dry time step	seconds	900
Dry time step	seconds	14,400
Impervious Manning's n		0.012
Pervious Manning's n		0.25
Drainage area modeled for C determination	acres	Actual drainage areas used, sub-divided by soil-group areas; see and accompanying description.

SWMM Runoff Parameters	Units	Values
Shape		Rectangular, 500 ft flow path length for pervious areas, 250 ft flow path length for impervious/developed area (represents typical overland flow path lengths, not a very sensitive parameter)
Slopes	ft/ft	0.05 (represents average of relatively flat landscaping, streets, and roofs)
Evaporation	in / month	60% of reference evapotranspiration values contained in Table D-6
Soil properties / infiltration		Green-Ampt soil parameters as shown in Table D-4 and Table D-5
Depression storage, impervious	inches	0.02, based on Table 5-14 in SWMM manual (James and James, 2000)
Depression storage, pervious	inches	0.06, based on Table 5-14 in SWMM manual (James and James, 2000)

To develop Project-specific runoff coefficients, Project areas were subdivided based on the drainage areas provided for each BMP treatment facility. Drainage areas were divided into model sub-catchments using underlying hydrologic soil group (HSG). The HSGs were identified based on catchment-specific soils distributions obtained from the Natural Resources Conservation Service (NRCS) Soil Survey of the Antelope Valley Area (Survey CA675) and were divided as follows for modeling purposes: HSG A/B, and HSG C. Group A soils were grouped with B soils because of the extreme scarcity of HSG A on the Project site and the similarity in infiltration parameters between A and B soils. There are no soils classified as HSG D in the Entrada South or VCC 18108 project areas. Runoff results corresponding to HSG groupings were then weighted by area and combined to obtain a composite pervious area runoff coefficient for each drainage area for each storm event. The soils distributions assumed for this modeling effort are shown in Table D-3.

Table D-3: SWMM Runoff Block Modeled Soils Distribution by Drainage Basin

<table>
<tr><th colspan="3">Soil Group</th><th>HSG A/B</th><th>HSG C</th><th>Total Area</th></tr>
<tr><td rowspan="10">Entrada South</td><td rowspan="2">B</td><td>Acres</td><td>20.5</td><td>50.3</td><td rowspan="2">70.8</td></tr>
<tr><td>% Total</td><td>29%</td><td>71%</td></tr>
<tr><td rowspan="2">C</td><td>Acres</td><td>11.8</td><td>-</td><td rowspan="2">11.8</td></tr>
<tr><td>% Total</td><td>100%</td><td>-</td></tr>
<tr><td rowspan="2">D</td><td>Acres[1]</td><td>6.8</td><td>112.1</td><td rowspan="2">118.9</td></tr>
<tr><td>% Total</td><td>6%</td><td>94%</td></tr>
<tr><td rowspan="2">Parcel-Based[2]</td><td>Acres</td><td>17.2</td><td>34.4</td><td rowspan="2">51.6</td></tr>
<tr><td>% Total</td><td>33%</td><td>67%</td></tr>
<tr><td rowspan="2">No Treatment</td><td>Acres</td><td>69.9</td><td>47.3</td><td rowspan="2">117.2</td></tr>
<tr><td>% Total</td><td>60%</td><td>40%</td></tr>
<tr><td rowspan="12">VCC[3]</td><td rowspan="2">A</td><td>Acres</td><td>93.8</td><td>0.0</td><td rowspan="2">93.8</td></tr>
<tr><td>% Total</td><td>100.0%</td><td>0.0%</td></tr>
<tr><td rowspan="2">B</td><td>Acres</td><td>15.9</td><td>16.8</td><td rowspan="2">32.7</td></tr>
<tr><td>% Total</td><td>48.6%</td><td>51.4%</td></tr>
<tr><td rowspan="2">C</td><td>Acres</td><td>0.0</td><td>5.8</td><td rowspan="2">5.8</td></tr>
<tr><td>% Total</td><td>0.0%</td><td>100.0%</td></tr>
<tr><td rowspan="2">OS</td><td>Acres</td><td>25.3</td><td>9.3</td><td rowspan="2">34.6</td></tr>
<tr><td>% Total</td><td>73.1%</td><td>26.9%</td></tr>
<tr><td rowspan="2">OS Access Road</td><td>Acres</td><td>8.4</td><td>0.9</td><td rowspan="2">9.3</td></tr>
<tr><td>% Total</td><td>90.3%</td><td>9.7%</td></tr>
<tr><td rowspan="2">No Treatment</td><td>Acres</td><td>145.4</td><td>7.4</td><td rowspan="2">152.8</td></tr>
<tr><td>% Total</td><td>95.2%</td><td>4.8%</td></tr>
</table>

[1] Area within Entrada South draining to Regional Basin D in Mission Village.

[2] Two street segments in Entrada South to be treated by Right-of-Way LID "Green Streets" BMPs ("ROW LID 1" and "ROW LID 2") were included in the total area modeled with parcel-based BMP treatment.

[3] VCC is planned to be treated by parcel based LID. The basins were designated based on the existing soil groups and proposed land use types.

Soils in the Project area will exhibit a range of infiltrative capacity, depending on soil type (a subset of HSG) and condition. Soil type, combined with HSG, can be used to estimate a typical range of values for modeled soil parameters, such as the Green-Ampt parameters, while soil condition (pre- or post-development) may be used to select the most appropriate input value within the range. HSG and soil texture classes provided in the NRCS Soil Survey were used to classify soils on the Project site into the two soil groups shown in Table D-3 above (A/B and C) and assign typical ranges of soil parameter input values to these soil groups. Green-Ampt suction head and initial moisture deficit values for each HSG were based on the soil texture class reported by the NRCS soil survey for the dominant texture class within the respective HSGs (Table D-4; these input values do not differ between Entrada South and VCC 18108).

Table D-4: Green-Ampt Soil Parameters

Hydrologic Soil Group	Prevalent Soil Texture Class	Suction Head[1] (in)	IMD[1] (in/in)
A/B	Loam	8	0.32
C	Silty Clay Loam	8	0.29

[1]Estimated based on texture class from Rawls, et al., (1983)

Green-Ampt saturated hydraulic conductivity (K_{sat}) for each soil group was determined on an area-weighted basis as the average of: 1) the low range of K_{sat} reported in the NRCS soil survey; 2) infiltration rates by identified HSG, as recommended by Musgrave (1955); and 3) characteristic infiltration rates for LACDPW-identified soil classes interpreted from Appendix C of the LA County Hydrology Manual. Spatial analyses were used to composite these values by drainage area (Table D-5). It has been assumed that compaction during construction will reduce the K_{sat} by 25% in the post-development condition in areas where construction is planned. While localized effects of incidental compaction may be greater, this assumption is believed to represent a reasonable estimate of drainage basin-wide reduction in long-term infiltration rate, considering that not all pervious areas will be subjected to incidental compaction and vegetation and other natural process tend to restore infiltration rates with time.

Table D-5: Infiltration Rates by Basin Tributary Area

Project	Basin	Hydrologic Soil Group	Pre-Development Ks (in/hr)	Post-Development Ks (in/hr)
Entrada South	**B**	A/B	0.37	0.28
		C	0.19	0.15
	C	A/B	0.37	0.28
	D[1]	A/B	0.38	0.28
		C	0.19	0.15
	Parcel-Based[1]	A/B	0.38	0.28
		C	0.19	0.15
	No Treatment	A/B	0.37	0.28
		C	0.19	0.15
VCC	**A**	A/B	0.38	0.29
	B	A/B	0.38	0.29
		C	0.21	0.16
	C	C	0.21	0.16
	OS	A/B	0.38	0.29
		C	0.21	0.16
	OS Access Road	A/B	0.38	0.29
		C	0.21	0.16

Project	Basin	Hydrologic Soil Group	Pre-Development Ks (in/hr)	Post-Development Ks (in/hr)
	No Treatment	A/B	0.38	0.29
		C	0.21	0.16

[1] Represents area within Entrada South draining to Regional Basin D in Mission Village.

[2] Two street segments in Entrada South to be treated by Right-of-Way LID "Green Streets" BMPs ("ROW LID 1" and "ROW LID 2") were included in the total area modeled with parcel-based BMP treatment.

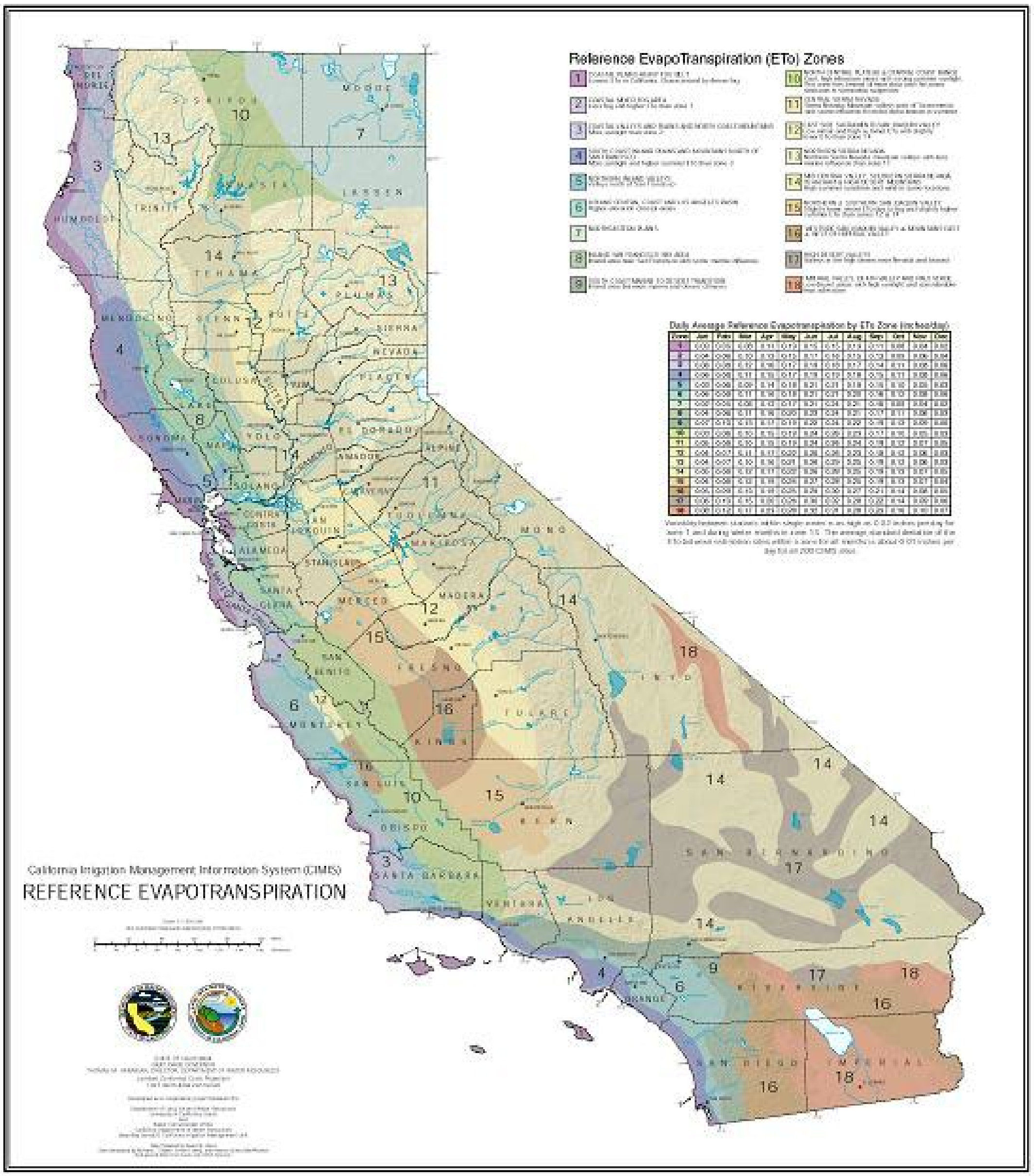

Figure D-4: Reference ET for CA Zones

Reference evapotranspiration (ET) values for estimating actual ET rates were taken from Figure D-4, produced by the California Department of Water Resources. The Project site is located in zone 14. Reference ET values for zone 14 are reproduced in Table D-6.

Existing site conditions consist of natural grasses, shrubs, and small trees; agricultural row crops, roads, both irrigated and dry farming; and mineral extraction areas including gravel/dirt roads, and unvegetated clearings. To represent average existing site conditions, 60% of the reference ET values were used to reflect partially shaded conditions, semi-arid vegetation, dry crops and bare soil. Sixty percent of the reference ET values were also used to simulate the landscaped areas in the post-development condition which will generally be planted with predominantly drought-tolerant vegetation.

Table D-6: Evaporation Parameters for Hydrology Model (from CA ET map)

Month	ET Rates			60%
	inch / day	days / month	inch / month	inch / month
January	0.05	31	1.55	0.93
February	0.08	28	2.24	1.34
March	0.12	31	3.72	2.23
April	0.17	30	5.1	3.06
May	0.22	31	6.82	4.09
June	0.26	30	7.8	4.68
July	0.28	31	8.68	5.21
August	0.25	31	7.75	4.65
September	0.19	30	5.7	3.42
October	0.13	31	4.03	2.42
November	0.07	30	2.1	1.26
December	0.05	31	1.55	0.93
Total (year)		365	57.04	34.22

D.2.2.2. SWMM Runoff Coefficient Results

Using the SWMM Stormwater Modeling Methodology explained in Section D.2.1, the pervious and impervious storm-weighted (weighted by storm over the entire period of record) runoff coefficients were calculated and are displayed in Table D-7. These coefficients are compared to the runoff coefficients as calculated using the LA Hydrology manual method, assuming 100% imperviousness for the impervious runoff coefficient and 0% imperviousness for the undeveloped runoff coefficient.

Table D-7: SWMM Runoff Coefficients and Hydrology Manual Coefficients

Project	Drainage Area	Impervious Runoff Coefficient (unitless)		Undeveloped Pervious Runoff Coefficient (unitless)		Developed Pervious Runoff Coefficient (unitless)	
		Model Methodology	LA County Hydrology Manual	Model Methodology	LA County Hydrology Manual	Model Methodology	LA County Hydrology Manual
Entrada South	B	96.5	90	5.6	10	10	10
	C	96.5	90	1.9	10	4.3	10
	D[1]	96.5	90	6.8	10	10.9	10
	Parcel-Based[2]	96.5	90	5.3	10	9.6	10
	No Treatment	96.5	90	4.0	10	7.5	10
VCC	A	96.5	90	1.7	10	3.9	10
	B	96.5	90	4.2	10	7.4	10
	C	96.5	90	6.6	10	10.9	10
	OS[3]	96.5	90	3.0	10	5.8	10
	OS Access Road	96.5	90	2.2	10	4.6	10
	No Treatment	96.5	90	1.9	10	4.3	10

[1] Represents area within Entrada South draining to Regional Basin D in Mission Village.
[2] Two street segments in Entrada South to be treated by Right-of-Way LID "Green Streets" BMPs ("ROW LID 1" and "ROW LID 2") were included in the total area modeled with parcel-based BMP treatment.
[3] No treatment is provided for drainage area OS. The drainage area is separated out for SWMM due to expected compaction and runoff volume change.

In Table D-7 above, runoff coefficients used in modeling methodology are summarized alongside those calculated using the LA County Hydrology Manual method, for comparison. As is evident, the runoff coefficient for impervious areas calculated using the model method is generally higher (i.e., yielding higher runoff rates), and thus more conservative, than the runoff coefficient calculated using the LA County Hydrology Manual method. The pervious runoff calculations estimated using the model methodology yielded lower runoff coefficients than the LA County method, which is also more conservative as it estimates lower runoff volumes from the Project site in the existing condition.

D.2.3. Land Use & Treatment BMPs

The delineation of land uses and areas within Entrada South and VCC 18108 were determined from land use maps provided by Hunsaker & Associates, LA, Inc. for Vesting Tentative Tract Maps Vesting Tentative Tract Map (VTTM) #53295 and #18108, respectively, and subsequent (Geographic Information System) GIS analysis for the developed Project conditions. The existing condition land uses were determined from GIS analysis of the LACDPW existing land use coverage. Based on an inspection of recent aerial photography, project areas designated with the existing land use "Mineral Extraction- Oil and Gas" were divided into open space land use (85%) and light industrial land use (15%) to better define the origin of stormwater runoff and stormwater constituents. Existing and developed conditions of the Project and associated off-site areas are summarized in Table D-8 and Table D-9, respectively.

Table D-8: Modeled Existing Conditions for Project & External Map Improvement Impact Areas

Project	Land Use	Development Area (acres)
Entrada South	Mineral Extraction - Oil and Gas	106.6
	Vacant Undifferentiated	263.8
	Total	**370.4**
VCC 18108	Agriculture	30.4
	Major Road	5.2
	Mineral Extraction - Other than Oil and Gas	8.1
	Vacant Undifferentiated	285.1
	Total	**328.8**

Table D-9: Modeled Developed Conditions Project & External Map Improvement Areas

Project	Land Use	Development Area (acres)[1]
Entrada South[2]	Road	10.0
	Multi-Family Residential	153.3
	Open Space	130.4
	Commercial	49.1
	Public Facility (Water Quality)	2.2
	Park	5.4
	Recreation[3]	20.0
	Total	**370.4**
VCC 18108[2]	Open Space	187.2
	Road	12.3
	Commercial	129.3
	Total	**328.8**

[1] Land use acreages may not exactly match the final programmatic land use description. All differences, unless noted, are minor and are not significant in water quality analysis results.
[2] For the purpose of analysis, minor roads were considered to be an integral part of adjacent land uses and assume all properties of those land uses.
[3] 'Recreation' area includes both 'Recreation' and 'Recreation Trails' land uses described in Table D-10.

Table D-10 provides the modeled land uses and percent impervious values used to represent the existing and developed project and External Map Improvement conditions. The modeled land uses were based on the most representative land use within the available data sets (see Section D.2.6.3).

Table D-10: Modeled Land Uses and Percent Imperviousness

Land Use	Modeled Percent Impervious	Modeled Land Use
Existing Land Uses		
Agriculture	2%	Agriculture
Mineral Extraction - Oil and Gas[1]	10%[1]	Light Industrial/Vacant[1]
Mineral Extraction - Other than Oil and Gas[1]		
Vacant	1%	Open Space
Major Road	91%	Transportation
Proposed Land Uses		
Multi-Family Residential	74%	Multi-family Residential
Commercial	91%	Commercial
Park	1%	Educational[3]
Recreation	80%	Educational
Recreation Trails	10%	Open Space
Road	91%	Transportation
Open Space	1%	Open Space
Water Quality Facility	100%	Water[2]

[1] Areas zoned Oil and Gas Extraction were assumed to be 85% vacant land use area with 1% imperviousness and 15% light industrial land use area with 60% imperviousness, equivalent to 10% composite imperviousness.
[2] The 'Water' land use has no EMC values associated with it as this is not a pollutant-generating source.
[3] Educational/Institutional land use is assumed to represent similar pollutant contributions as landscaped parks and public areas.

D.2.4. Stormwater Runoff Pollutant Concentrations

Stormwater monitoring data collected by the LACDPW was used to derive estimates of pollutant concentrations in runoff from urban land uses. The existing conditions of the Project site contain some agricultural uses. Stormwater monitoring data collected by Ventura County was used to estimate stormwater pollutant concentrations for agricultural land use.

D.2.4.1. Los Angeles County Monitoring Data

Recent and regional land-use based stormwater quality monitoring data was collected through the LA County Stormwater Monitoring Program. This program was initiated with the goal of providing technical data and information to support effective watershed stormwater quality management programs in Los Angeles County. Specific objectives of this project included monitoring and assessing pollutant concentrations from specific land uses and watershed areas. In order to achieve this objective, the County undertook an extensive stormwater sampling project that included 8 land use stations and 5 mass emission stations (located at the mouths of major streams and rivers), which were tested for 82 water quality constituents. These data are presented in *Los Angeles County 1994-2000 Integrated Receiving Water Impacts Report, 2000* and *Los Angeles County 2000-2001 Stormwater Monitoring Report, 2001*.

Stormwater quality for the Project was estimated based on the recent EMC data collected by LA County (LA County, 2000). These data were used because of the relatively close location to the project site and because the monitored land uses were representative of the proposed land uses for the Project. The monitored land uses stations are listed in Table D-11 with a brief description of the site and when the monitoring data were collected.

Table D-11: LA County Land Use Monitoring Stations Available for Water Quality Modeling

Station Name	#	Modeled Land Use	Site Description[1]	Years Monitoring Conducted
Santa Monica Pier	S08	Commercial	The monitoring site is located near intersection of Appian Way and Moss Avenue in Santa Monica. The storm drain discharges below the Santa Monica Pier. Drainage area is approximately 81 acres. The Santa Monica Mall and Third St. Promenade dominate the watershed with remaining land uses consisting of office buildings, small shops, restaurants, hotels and high-density apartments.	1995-1999
Sawpit Creek	S11	Open Space (& Parks)	Located in Los Angeles River watershed in City of Monrovia. The monitoring station is Sawpit Creek, downstream of Monrovia Creek. Sawpit Creek is a natural watercourse at this location. Drainage area is approximately 3300 acres.	1995-2001
Project 620	S18	Single Family Residential	Located in the Los Angeles River watershed in the City of Glendale. The monitoring station is at the intersection of Glenwood Road and Cleveland Avenue. Land use is predominantly high-density, single-family residential. Drainage area is approximately 120 acres.	1995-2001
Project 1202	S24	Light Industrial	Located in the Dominguez Channel/Los Angeles Harbor Watershed in the City of Carson. The monitoring station is near the intersection of Wilmington Avenue and 220th Street. The overall watershed land use is predominantly industrial.	1995-2001
Dominguez Channel	S23	Freeway (Roadways)	Located within the Dominguez Channel/Los Angeles Harbor watershed in Lennox, near LAX. The monitoring station is near the intersection of 116th Street and Isis Avenue. Land use is predominantly transportation and includes areas of LAX and Interstate 105.	1995-2001
Project 474	S25	Education (Schools)	Located in Los Angeles River watershed in the Northridge section of the City of Los Angeles. The monitoring station is located along Lindley Avenue, one block south of Nordoff Street. The station monitors runoff from the California State University of Northridge. Drainage area is approximately 262 acres.	1997-2001

Station Name	#	Modeled Land Use	Site Description[1]	Years Monitoring Conducted
Project 404	S26	Multi-Family Residential	Located in Los Angeles River watershed in City of Arcadia. The monitoring station is located along Duarte Road, between Holly Ave and La Cadena Ave. Drainage area is approximately 214 acres.	1997-2001

[1] Los Angeles County 1999-2000 Draft Stormwater Monitoring Report (Los Angeles County, 2000)

D.2.4.2. Ventura County Monitoring Data

As part of its (National Pollutant Discharge Elimination System) NPDES permit, the Ventura County Flood Control District conducts monitoring to determine the water quality of stormwater runoff from areas with specific land uses. One monitoring station, Wood Road at Revolon Slough (site A-1), drains the approximately 350-acre Oxnard Agricultural Plain, which is comprised almost entirely of agricultural land (primarily row crops), including a small number of farm residences and ancillary farm facilities for equipment maintenance and storage. Data from the Wood Road station was used to estimate pollutant concentrations in stormwater runoff for agricultural land use.

Land use runoff sampling for the Ventura County stormwater monitoring program originally began during the 1992/93 monitoring season, with up to several samples collected at each site during each storm season. For the A-1 site, the period of record begins during the 1996/97 storm season and continues through the present. Data through 2008 were available at the time of preparation of this report. All land use monitoring sites are equipped with automated monitoring equipment, including flowmeters (with area-velocity probes and level sensors) and refrigerated auto-samplers which enable the collection of flow-weighted composite samples. Stormwater quality monitoring data for the agricultural land use site was provided by the Ventura County Watershed Protection District.

D.2.4.3. Data Analysis for Derivation of Land Use EMCs

The LACDPW monitored stormwater runoff quality from various land uses throughout the County on an annual basis beginning in 1995 through 2001. For each year of monitoring several storm EMCs are reported and included in the County's annual water quality report to the Los Angeles Regional Water Quality Control Board. The convention for dealing with the censored data (e.g., data only known to be below the analytical detection limit) is to substitute half of the detection limit for all non-detects. L.A. County has followed this convention when providing summary arithmetic statistics of the stormwater monitoring data. This method tends to introduce bias into the estimate of the mean and standard deviation and the summary statistics are not believed to be robust or adequately account for non-detects. To further complicate matters, the detection limit for dissolved copper and total lead has changed during the period stormwater monitoring was conducted by LACDPW.

In an effort to provide more reliable and accurate estimates of land use EMCs for the Project water quality modeling, a robust method of estimating descriptive statistics for censored data with multiple detection limits was employed. The plotting position method described in Helsel and Cohn (1988) was used to estimate censored values using the distribution of uncensored values. Descriptive statistics were then estimated using the parametric bootstrap method suggested by Singh, Singh, and Engelhardt (1997).

The final land use EMC input parameters developed for the Monte Carlo water quality model include the log-normal mean and log-normal standard deviation. Analyses demonstrate that nearly all of the Los Angeles County land use data sets can be more closely represented by the log-normal distribution than the normal distribution[1], which is consistent with findings by Pitt et al. (2004) based on analyses of the National Stormwater Quality Database (NSQD). Table D-13 summarizes the number of data points and the percent non-detects for the pollutants and land uses of interest that have sufficient data available for modeling based on the Los Angeles County data set. While data may be available to develop descriptive statistics for other pollutants (e.g., organics, other metal constituents, trash), reliable land use EMCs statistics could not be computed due to statistically insufficient number of detected results or due to the use sampling techniques not amenable to estimating representative EMCs (e.g., catch basin clean-outs in the case of trash). Also, the availability of BMP effluent quality data similarly limits the number of pollutants that can be effectively modeled; i.e., other pollutants (e.g., organics, other metal constituents) may have land use EMC data available but not BMP effluent data.

D.2.4.4. Example Data Set

To illustrate the statistical methods used to obtain land use EMCs, the LACDPW stormwater monitoring data collected for total lead from the transportation land use station is used. The data were collected from 01/1996 to 04/2001. At the beginning of March, 1997, the detection limit for total lead changed from 10 to 5 μg/L.

Table D-12 describes the data according to the number of censored and uncensored values in the example data set.

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[1] Statistical distribution test results reported by Los Angeles County also confirm this assessment, as summarized by Table 4-14 found at http://LACDPW.org/wmd/npdes/Int_report/Tables/Table_4-14.pdf.

Table D-12: Number of Censored and Uncensored Data Points in the Total Lead Transportation Land Use Data Set

Total Lead EMC Data for Transportation Land Use	
Uncensored	37
Censored < 10 µg/L	2
Censored < 5 µg/L	38
Total Data Count	77

Prior to applying the plotting position method, it is necessary to check the normality of the data. Figure D-5 shows histograms and probability plots of the transportation land use total lead data above detection limits in normal and lognormal space. As indicated in the figure, the data tends to follow a lognormal distribution, a finding that is common with many pollutants in stormwater.

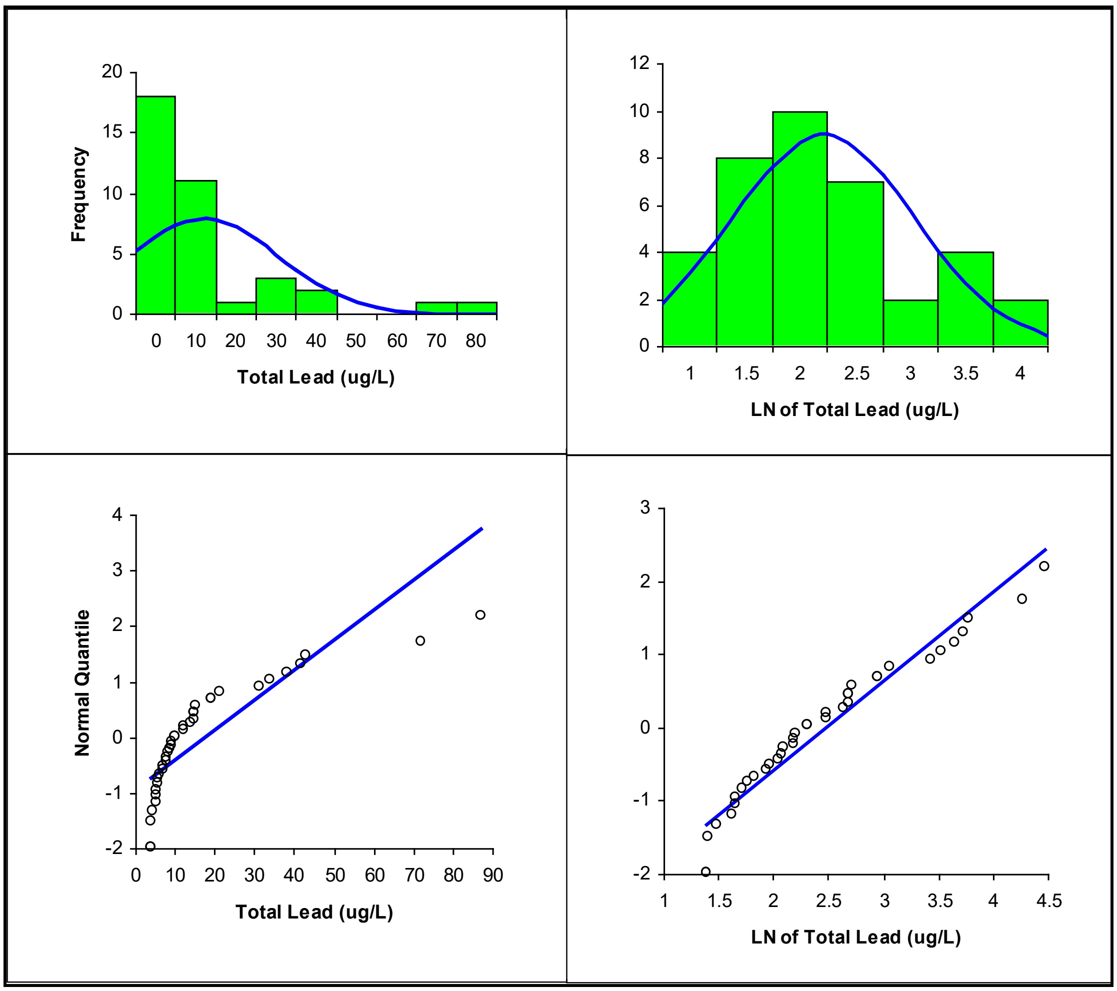

Figure D-5: Histograms and Probability Plots of Transportation Total Lead Data in Arithmetic and Lognormal Space

To verify the visual check that the data are lognormally distributed, the Shapiro-Wilk goodness-of-fit test was used (Royston, 1992). In this test, if $p > 0.1$, the null hypothesis that the log data follow a normal distribution cannot be rejected. For this example data set, the p-value of the log-transformed uncensored data is 0.293, which indicates that lognormal distribution is a good approximation of the distribution of the data set.

D.2.4.4.1. Method for Dealing with Multiple Detection Limits

To account for the multiple detection limits in the censored data sets, a regression on order statistics (ROS) method was employed. ROS is a category of robust methods for estimating descriptive statistics of censored data sets that utilize the normal scores for the order statistics (Shumway et al. 2002). The plotting position method by Hirsch and Stendinger (1987) (summarized by Helsel and Cohn, 1988) was the ROS method used. In this method, plotting positions are based on conditional probabilities and ranks, where the ranks of the censored (below detection) and uncensored data (above detection) related to each detection limit are ranked independently. The method is summarized in the equations below.

After plotting positions for the censored and uncensored values have been calculated, the uncensored values are plotted against the z-statistic corresponding to the plotting position and the best-fit line of the known data points is derived. Using this line and the plotting positions for the uncensored data, the values for the uncensored data are extrapolated. Figure D-6 illustrates the results of the application of the plotting position method on the total lead data for transportation land use.

$$pe_j = pe_{j+1} + \frac{A_j}{\left(A_j + B_j\right)} \times \left(1 - pe_{j+1}\right) \qquad (1)$$

Where:

A_j = the number of uncensored observations above the j detection limit and below the j +1 detection limit.

B_j = the number of censored and uncensored observations less than or equal to the j detection limit.

pe_j = the probability of exceeding the j threshold for j = m, m -1, … 2, 1 where m is the number of thresholds; by convention $pe_{m+1} = 0$.

Equation 2 was used for plotting the uncensored data and equation 3 was used for plotting the censored data; the plotting positions of the data were calculated using the Weibull plotting position formula.

$$p(i) = \left(1 - pe_j\right) + \frac{\left(pe_j - pe_{j+1}\right) \times r}{\left(A_j + 1\right)} \qquad (2)$$

Where:

p(i) = the plotting position of the uncensored i data point.
r = the rank of the ith observation of the Aj observations above the j detection limit.

$$pc(i) = \frac{(1 - pe_j) \times r}{(n_j + 1)} \quad (3)$$

Where:

pc(i) = the plotting position of the censored i data point.
R = the rank of the ith observation of the nj censored values below the j detection limit.

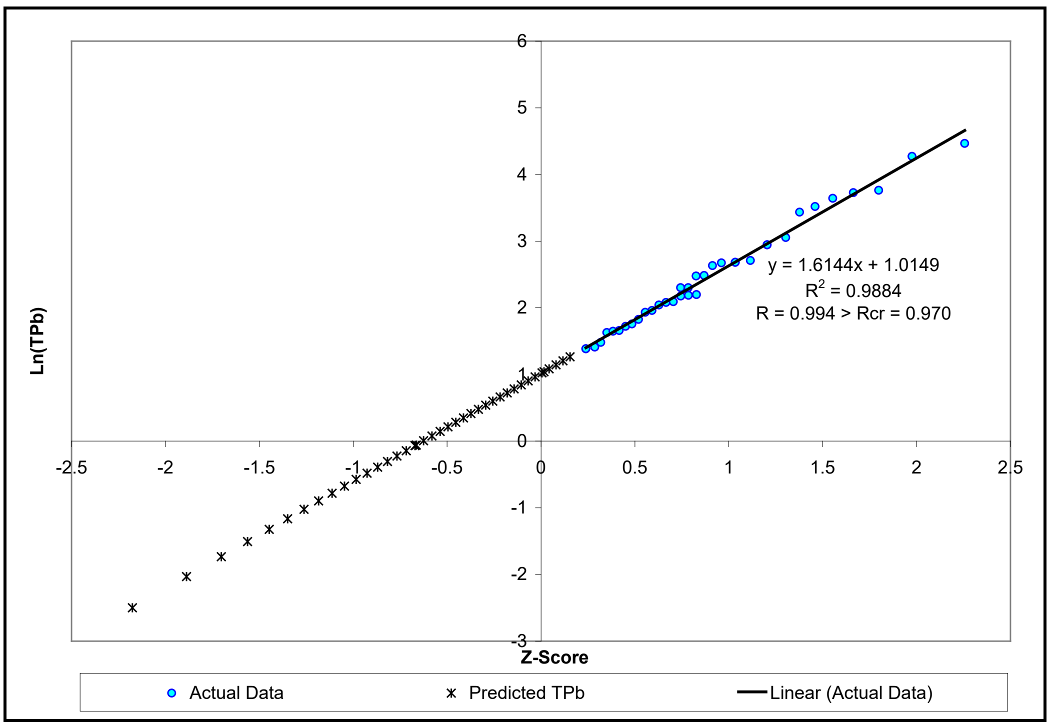

Figure D-6: Probability Plot of the Uncensored and Predicted (Censored) Total Lead Transportation EMCs

D.2.4.4.2. Method for Calculating Descriptive Statistics

After the censored data are estimated (or for datasets without non-detects), descriptive statistics were computed using the bootstrap method (Singh et al. 1997). The bootstrap method samples from the data set with replacement several thousand times and calculates the desired descriptive statistics from the sampled data. The steps of the bootstrap estimation method are described below.

1. Take a sample of size *n* with replacement (the sampled data point remains in the data set for subsequent sampling) from the existing data set (Singh et al. recommends n be the same size as the original data set, this recommendation was followed for the analysis) and compute the descriptive statistic, θ_i, from the sampled data.
2. Repeat Step 1 independently N times (20,000 for this analysis) each time calculating a new estimate for θ_i.
3. Calculate the bootstrap estimate θ_B by averaging the θ_i's for i=1 to N.

Fundamentally, the bootstrap procedure is based on the Central Limit Theorem (CLT), which suggests that even when the underlying population distribution is non-normal, averaging produces a distribution more closely approximated with normal distribution than the sampled distribution (Devore 1995). Figure D-7 compares the total lead data after estimating censored values using the ROS method described prior to applying the bootstrap method with bootstrapped means of the ROS data. Note the bootstrap means are more normally distributed than the original data and the central tendency of the data is centered near 8 ug/L.

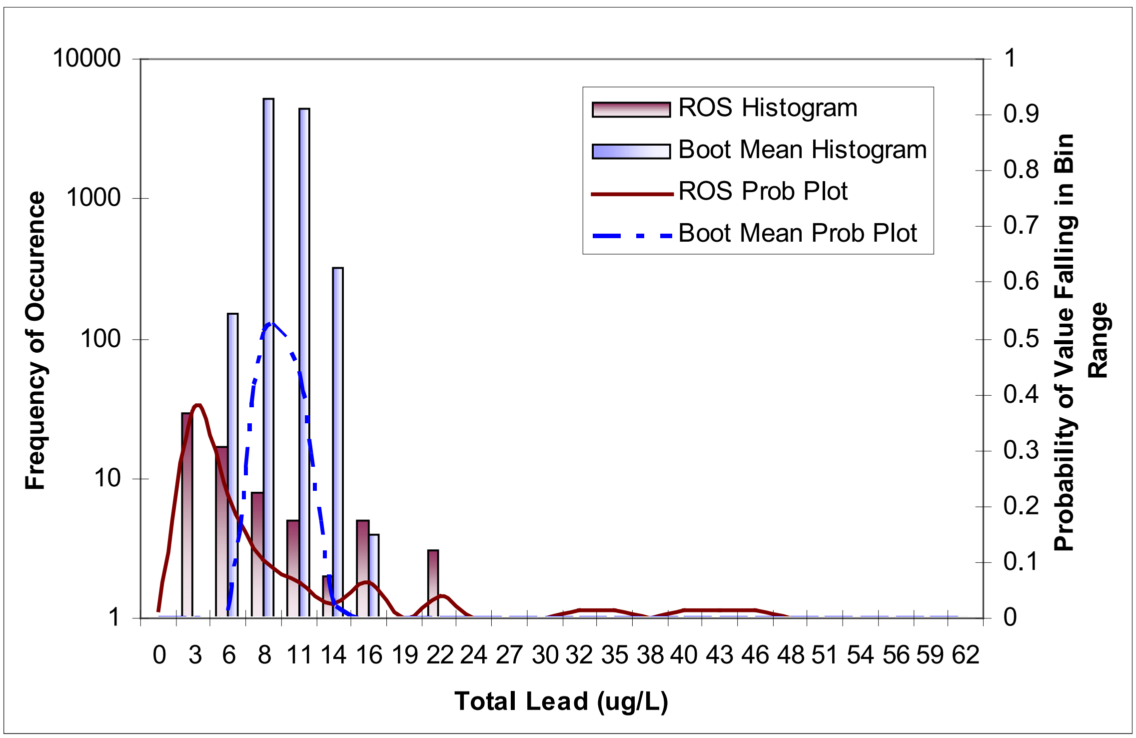

Figure D-7: Comparison of the Distribution of ROS Method Total Lead Data and the Bootstrap Means of the ROS Data.

The majority of the LACDPW stormwater monitoring for the pollutant land use combinations analyzed fit a lognormal distribution. The data that did not statistically fit the lognormal distribution were more closely approximated with a lognormal distribution than a normal distribution. The bootstrap method was applied differently depending on the distributional fit of the data.

If the pollutant EMC data for a particular land use fit a lognormal distribution according to the Shapiro-Wilk goodness-of-fit test, the log-transformed data were bootstrapped and an estimate of the mean and standard deviation were obtained in log space and then converted to arithmetic space. The assumption of lognormality was more stringently applied than normal by using an alpha significance value of 0.1. This was done to improve the estimate of the standard deviation when the hypothesis of lognormality is rejected. When analyzing data in log space there is a tendency to overestimate the standard deviation for relatively symmetric data and underestimate the standard deviation for severely skewed data. For datasets that did not fit the lognormal distribution, the raw data were bootstrapped to obtain the mean and standard deviation statistics. Bootstrapping the data in arithmetic space assumes no distribution in those instances when a distribution could not be confirmed through goodness-of-fit testing.

D.2.4.4.3. Conclusions

The plotting position method for multiple detection limits has been used in conjunction with the bootstrap procedure for calculating the descriptive statistics used to represent pollutant EMC distributions in the water quality model. Table D-14 summarizes the lognormal descriptive statistics, and Table D-15 summarizes the resulting arithmetic means. The latter data represent the land use specific pollutant EMCs in the Monte Carlo water quality model.

Table D-13: Summary of Number of Data Points and Percent Non-Detects for Los Angeles County Land Use EMC Data

Land Use		TSS	TP	NH3-N	NO3-N	NO2-N	TKN	Dissolved Copper	Total Lead	Dissolved Zinc	Total Iron	Chloride
Commercial	Count	31	32	33	33	7	36	40	40	40	40	33
	% ND	0%	3%	21%	21%	0%	3%	15%	45%	10%	5%	0%
Industrial	Count	53	55	57	56	9	57	61	61	61	61	57
	% ND	0%	5%	19%	5%	16%	0%	15%	43%	7%	25%	0%
Transportation	Count	75	71	74	75	10	75	77	77	77	77	76
	% ND	0%	1%	27%	20%	0%	0%	1%	52%	6%	18%	4%
Multi-Family Residential	Count	45	38	46	46	11	50	54	54	54	54	46
	% ND	2%	3%	24%	26%	0%	0%	37%	72%	41%	33%	8%
Single Family Residential	Count	41	42	44	43	15	46	48	48	48	48	43
	% ND	0%	0%	16%	30%	0%	0%	40%	52%	81%	35%	2%
Vacant / Open Space	Count	48	46	48	50	35	50	52	57	52	52	50
	% ND	2%	41%	67%	2%	70%	0%	90%	88%	96%	40%	0%
Agriculture (Ventura County)	Count	24	6	25	23	7	21	25	25	25	N/A[1]	16
	% ND	13%	0%	48%	9%	0%	10%	0%	0%	0%	N/A[1]	19%

Note:

1. There are insufficient data for total iron in the Ventura County agriculture monitoring database, so this analysis uses the Los Angeles Vacant/Open Space concentrations to represent agricultural land use areas.

Table D-14: Lognormal Statistics for Modeling Pollutant Concentrations from Land Uses

Land Use		TSS	TP	NH3-N	NO3-N	NO2-N	TKN	Dissolved Copper	Total Lead	Dissolved Zinc	Total Iron	Chloride
Units[1]		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L
Commercial	Mean	4.00	-1.19	-1.08	-0.947	-2.63	0.698	2.25	1.45	4.87	6.47	3.44
	St. Dev	0.634	0.733	1.60	0.832	1.17	1.04	0.723	1.47	0.575	1.45	0.969
Industrial	Mean	5.07	-1.30	-1.14	-0.532	-2.67	0.803	2.39	1.68	5.57	6.78	2.27
	St. Dev	0.798	0.860	1.12	0.891	0.788	0.711	0.818	1.49	0.978	1.77	0.620
Transportation	Mean	3.97	-0.909	-1.71	-0.863	-2.69	0.373	3.24	1.60	5.10	6.39	1.58
	St. Dev	0.878	1.03	1.20	1.06	0.755	0.690	0.693	1.12	0.776	1.14	0.718
Multi-Family Residential	Mean	3.20	-1.75	-1.26	-0.401	-2.94	0.391	1.76	0.827	3.96	5.97	1.71
	St. Dev	0.988	0.777	1.07	1.28	1.20	0.624	0.687	1.17	0.882	1.26	1.69
Single Family Residential	Mean	4.24	-1.13	-1.20	-1.17	-3.14	0.776	1.91	1.85	2.49	6.67	1.49
	St. Dev	1.08	0.672	0.996	1.35	1.24	0.787	0.811	1.07	1.28	1.17	0.640
Vacant / Open Space	Mean	3.44	-3.20	-3.18	-0.031	-3.95	-0.354	-1.83	-0.375	3.24	4.76	1.87
	St. Dev	1.97	1.44	1.37	0.615	0.494	0.792	1.59	1.72	0.438	2.02	0.249
Agriculture (Ventura County)	Mean	6.56	0.930	-0.080	2.59	-1.17	1.58	2.64	2.65	3.06	4.76[1]	3.93
	St. Dev	0.654	1.38	0.976	0.654	0.725	0.639	0.863	1.23	1.03	2.02[1]	0.926

Notes:

1. Units presented are before lognormal transformation.
2. There are insufficient data for total iron in the Ventura County agriculture monitoring database, so this analysis uses the Los Angeles Vacant/Open Space concentrations to represent agricultural land use areas.

Table D-15: Resulting Arithmetic Means from Lognormal Statistics used for Modeling Pollutant Concentrations[1]

Land Use	TSS	TP	NH3-N	NO3-N	NO2-N	TKN	Dissolved Copper	Total Lead	Dissolved Zinc	Total Iron	Chloride
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L
Commercial	67	0.40	1.2	0.55	0.14	3.4	12	12	153	4,942	50
Industrial	219	0.39	0.60	0.87	0.09	2.9	15	16	422	7,461	12
Transportation	78	0.68	0.37	0.74	0.09	1.8	32	9.2	222	1212	6.3
Multi-Family Residential	40	0.23	0.50	1.5	0.11	1.8	7.4	4.5	78	965	23
Single Family Residential	124	0.40	0.49	0.78	0.09	3.0	9.4	11	27	1429	5.4
Vacant / Open Space	217	0.12	0.11	1.2	0.02	1.0	0.6	3.0	28	2725	6.7
Agriculture (Ventura County)	877	6.59	1.5	17	0.40	6.0	20	30	36	2725	78

[1]Calculated from values provided in Table D-14

D.2.5. Estimate of BMP Performance Parameters

BMP performance is a function of three factors: (1) the fraction of stormwater runoff receiving treatment (often referred to as percent of runoff captured, or simply percent capture); (2) the pollutant removal achieved in the unit by virtue of infiltration and/or ET (generically referred to as volume reduction); and (3) the pollutant removal achieved in the treatment unit by virtue of improved water quality.

Capture efficiency calculations used to estimate results for the individual storms and volume reduction estimates are discussed in Section D.2.5.1. Pollutant removal estimates are described in Section D.2.5.2.

D.2.5.1. BMP Capture Efficiency and Volume Reduction

The Project is proposed to be treated by biofiltration, bioinfiltration, and infiltration facilities. The Monte Carlo model utilizes event-by-event estimates of BMP capture efficiencies and volume reduction to describe the hydrologic and hydraulic performance of Project BMPs. The event-based inputs were developed using SWMM simulations, using inputs described above in Table D-2. Results from the SWMM simulations are post-processed in a standalone program to yield capture efficiency and volume reduction for each storm in the record.

The SWMM engine in conjunction with the standalone program tracks rainfall, runoff, and treatment system routing in the context of individual storm events. Storm events are delineated from within the continuous rainfall record using algorithms identical in performance to GeoSYNOP, described herein; depth and start and stop times of each event are recorded. The rainfall volume associated with each event is tracked between the volume lost and that which runs off; start and stop times of runoff for each storm are recorded for later use. Finally, the runoff volume associated with each storm event is tracked between treated volume, bypassed volume, infiltrated volume and evaporated volume. This constitutes a volume-tracking approach of calculating capture efficiency and volume reduction by storm event.

The result of these algorithms is a capture efficiency and volume reduction for each storm in the period of record. The volume reduction achieved by a BMP is a function of the capture efficiency and the fraction of captured stormwater runoff that is infiltrated, evaporated, or transpired by vegetation.

D.2.5.1.1. LID BMPs

Low Impact Design (LID) BMPs would be implemented on the Project to treat the required water quality design volume. Estimates of capture efficiency and volume reductions achieved by the BMPs were developed based on hydraulic representations of the BMPs in EPA SWMM 5 using the tributary catchments included in Table D-16 and Table D-17.

The hydraulic representations of the BMP types modeled in SWMM were based on standard BMP profiles, consistent with Attachment H of the 2012 MS4 Permit. A summary of the BMP profiles by type are provided in Table F-16.

Table D-16: Entrada South SWMM Hydraulic Representation of Parcel-based BMPs

Parameter	Units	Bioinfiltration	Infiltration	Biofiltration	Flow-based Biofiltration BMP
Minimum Surface Ponding Depth below Overflow	ft	3	5	5	N/A
Media Depth	ft	2	0	2	N/A
Thickness of Gravel Layer	ft	3	0	2.75	N/A
Height of Underdrain Invert Elevation above Bottom of BMP	ft	3	N/A	0	N/A
Effective Storage Depth Above Underdrain	ft	1.5	N/A	1.5	N/A
Effective Storage Depth Below Underdrain	ft	0.6	N/A	0	N/A
Total Effective Storage Depth[1]	ft	2.1	N/A	1.5	N/A
Treatment flow rate	cfs	N/A	N/A	N/A	0.577

[1] Effective storage accounts for media and gravel layer porosities, representing target volume storage volumes to achieve 80% average annual capture efficiency given BMP footprint areas.

The surface area was sized using the LA County LID Volume Calculation in compliance with Attachment H, by scaling down initially proposed surface areas until each facility achieved between 80.0% and 80.9% annual average capture of tributary runoff. The design infiltration rates were selected based on an assessment of likely infiltration rates. The filtration rate through the media is computed as the peak flow rate through the treatment orifice divided by the surface area of the media layer.

The tributary areas, BMP types, SWMM hydraulic inputs, and average annual performance results for each BMP are summarized in Table F-17 for Entrada South and Table F-18 for VCC.

Table D-17: Entrada South SWMM Tributary Area and BMP Hydraulic Inputs and Performance Results

Basin	BMP Type	Tributary Drainage Area		Design K_{sat} of Underlying Soil[1]	Computed K_{sat} of Amended Media	Modeled Depth of Retention Storage[2]	Average Annual Capture Efficiency	Average Annual Volume Reduction of Captured Water[3]	Average Annual Reduction in Runoff Volume
		Area (acres)	**Imperviousness (%)**	in/hr	in/hr	ft	Percent	Percent	Percent
B	Infiltration	70.8	62.2%	3	N/A	6.1	80%	100%	80%
C	Bioinfiltration	11.8	60.1%	0.15	4.2	2.3	80%	23%	18%
D[4]	Biofiltration	118.9	64.0%	0	6.4	0	80%	1%	0%
Parcel-Based[5]	Biofiltration	51.6	90.1%	0	5.0	0	80%	3%	0%

[1] Basin B design K_{sat} based on infiltration values measured near the proposed BMP areas (Frankian 2013); Basin C design K_{sat} based on infiltration values measured in compacted fill near the project area (Leighton 2019); Basin D and biofiltration parcel based BMPs are lined.

[2] Retention storage depth represents the depth below which a volume stored can infiltrate (i.e., volume below the underdrain, if present).

[3] Biofiltration basins are vegetated and provide incidental volume reduction of captured water via evapotranspiration.

[4] Greater than 80% average annual capture efficiency at Regional Basin D was demonstrated in the Memorandum: *Mission Village Phase 1, 2, 5, & 6 Water Quality Plan (Regional Facilities B, C, and D) – Evaluation of Conformance with Newhall LID Performance Standard* (Geosyntec, 2019). A smaller basin was modeled in the current analysis to achieve at least 80% average annual capture efficiency of runoff from only the area within Entrada South draining to Mission Village Basin D.

[5] Two street segments in Entrada South to be treated by Right-of-Way LID “Green Streets” BMPs (“ROW LID 1” and “ROW LID 2”) were included in the total area modeled with parcel-based BMP treatment.

Table D-18: VCC SWMM Tributary Area and BMP Hydraulic Inputs and Performance Results

Basin	**BMP Type**	**Modeled Unit Tributary Drainage Area**[1]		Design K_{sat} of Underlying Soil	Computed K_{sat} of Amended Media	Modeled Depth of Retention Storage[2]	Average Annual Capture Efficiency (Percent Capture)	Average Annual Volume Reduction of Captured Water (Percent Volume Reduction)[3]	Average Annual Reduction in Runoff Volume
		Area (acres)	**Imperviousness (%)**	in/hr	in/hr	ft	-	-	-
A	Biofiltration	2	91.0	0	5.0	0	80%	3.1%	0%
B	Biofiltration	2	91.0	0	5.0	0	80%	3.1%	0%
C	Biofiltration	2	91.0	0	5.0	0	80%	3.1%	0%
OS Access Road	Biofiltration	2	91.0	0	5.0	0	90%	3.1%	0%

[1] Parcel-based BMPs in VCC are modeled with unit tributary drainage area to better represent the hydraulics. A 2-acre area is used as the typical parcel size.
[2] Retention storage depth is determined based on the equivalent depths of volume retained in ponding and gravel (i.e., for Category 2, volume below underdrain).
[3] Biofiltration basins are vegetated and provide incidental volume reduction of captured water via evapotranspiration.

The storm-by-storm capture efficiency and volume reduction estimated from the BMP simulations, summarized in Table F-17 and F-18 above, were extracted from SWMM model output and used to represent the hydraulic performance of these BMPs in the Monte Carlo model.

D.2.5.2. BMP Pollutant Removal

BMP effluent quality, like land use EMCs, is highly variable. To account for this variability, effluent quality data were analyzed, and descriptive statistics were generated by means of a technique similar to that used to generate land use EMCs. The descriptive statistics generated were used as BMP effectiveness inputs to the Monte Carlo model.

The International Stormwater BMP Database (www.bmpdatabase.org) is a comprehensive source of BMP performance information. The BMP Database is comprised of carefully examined data from a peer-reviewed collection of studies that have monitored the effectiveness of a variety of BMPs in treating water quality pollutants for a variety of land use types. Research on characterizing BMP performance suggests that effluent quality rather than percent removal is more reliable in modeling stormwater treatment (Strecker et al. 2001). Schueler (1996) also found in his evaluation of detention basins and stormwater wetlands that BMP performance is often limited by an achievable effluent quality, or "irreducible pollutant concentration;" acknowledging that a practical lower limit exists to which stormwater pollutants can be removed by a given technology. While there is likely a relationship between influent and effluent for some BMPs and some constituent concentrations, the analyses that have been conducted to date do not support flat percent removal values relative to influent quality. As such, the distribution of effluent concentrations of stormwater BMPs reported in the BMP Database are used to estimate BMP performance for water quality modeling of the proposed conditions.

Future studies may support a refinement to the approach of effluent concentration-based BMP performance modeling, such as the development of more complex influent-effluent relationships. However, it should be noted that the stochastic modeling approach accounts for, at least in part, the uncertainty of the relationship between influent and effluent concentrations since the BMP effluent distributions are based on a variety of BMP studies with a wide range of influent concentrations, representing a variety of tributary drainage area land use characteristics. Furthermore, the Monte Carlo model employed only accounts for pollutant reductions if the predicted influent is greater than the achievable effluent quality estimated for the modeled BMP (i.e. effluent equals influent [or land use-based] concentrations up until the influent concentration exceeds the effluent concentration). Therefore, influent (or land use EMC-based) concentrations are considered by the model since they are directly used to determine whether or not treatment occurs.

The Monte Carlo model characterizes BMP pollutant removal as a function of BMP effluent quality (statistical distributions and irreducible concentration) derived from analysis of the

International BMP Database (BMP Database, www.bmpdatabase.org). To support the updated BMP plan, the BMP Database was queried and analyzed to produce effluent quality distributions characteristic of the types of BMPs included in the updated BMP plan. In terms of effluent quality, all project BMP types were modeled as biofiltration BMPs, except for Entrada South BMPs B1 and B2, which are modeled as infiltration BMPs. Biofiltration BMPs use the better-performing data of Media Filters or Bioretention, as identified in the BMP Database. Infiltration BMPs were modeled with no water quality treatment, only volume reduction through infiltration.

Similar to the estimation of land use EMCs, final BMP effluent values used were determined using a combination of regression-on-order statistics and the "bootstrap" method. Lognormality was assumed for BMP effluent concentrations. This assumption was confirmed through goodness-of-fit tests on the BMP effluent concentration data, where it was found that 41% of the BMP data sets fit the lognormal distribution and the remaining data sets fit this distribution better than the normal distribution. Table D-19 summarizes the number of data points (individual storm events) and percent non-detects for the pollutants and BMP types of interest for which sufficient data were available. Table F-20 summarizes the log-normal statistics that will be used in the water quality model, and Table F-21 summarizes arithmetic descriptive statistics for those data sets.

BMP effluent concentrations are assumed to be limited by an "irreducible effluent concentration," or a minimum achievable concentration. Lower limits are currently set at the 10th percentile effluent concentration of BMP data in the International BMP Database for each modeled BMP type for which the BMP data show statistically significant differences in influent and effluent means. If the differences are not statistically significant, the 90th percentile is used as the minimum achievable effluent concentration, which essentially assumes no treatment. Table D-22 summarizes the irreducible effluent concentration estimates used by for water quality modeling of the proposed condition.

Infiltration BMPs are assumed to provide no treatment for water that either overflows the BMP or bypasses the BMP. Pollutant removal is only simulated for those pollutants with available data from the International BMP Database. In instances where data are not available for a parameter (e.g., nitrite-nitrogen and chloride), no concentration reduction was assumed for that parameter. However, load reductions may still be estimated as a result of volume reductions.

No treatment was assumed for nitrite (NO_2) and chloride, so these constituents are not included on the following summary tables even though they were included in the model.

Table D-19: Summary of Number of Data Points and Percent Non-Detects for BMP Effluent Concentration Data from the International BMP Database

BMP		TSS	TP	NH3	NO3	TKN	DCu	TPb	DZn	TFe
Biofiltration	Count	654	650	249	81	517	246	188	195	74
	% ND	6%	3%	34%	16%	2%	8%	56%	12%	0%

Table D-20: International BMP Database Lognormal Statistics of BMP Effluent Concentrations

BMP		TSS	TP	NH3	NO3	TKN	DCu	TPb	DZn	TFe
Biofiltration	Mean	2.169	-1.447	-2.799	-0.834	0.093	2.137	-0.087	2.269	6.410
	St. Dev	1.278	1.257	1.662	0.983	0.944	1.180	1.519	1.159	1.350

Table D-21: International BMP Database Arithmetic Estimates of BMP Effluent Concentrations

BMP		TSS	TP	NH3	NO3	TKN	DCu	TPb	DZn	TFe
Biofiltration	units	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L
	Mean	19.17	0.55	0.30	0.68	1.74	18.04	2.71	20.69	1588.06

Table D-22: International BMP Database Arithmetic Irreducible Effluent Concentration Estimates

BMP		TSS	TP	NH3	NO3	TKN	DCu	TPb	DZn	TFe
	units	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L
Biofiltration	Irreducible Effluent Concentration	1.599	0.049	0.008	0.100	0.310	2.090	0.111	1.988	108.6

D.2.6. Model Parameter Reliability & Assumptions

The input parameters for the water quality model fall into the following five main categories:

1. Rainfall data;
2. Runoff Coefficients;
3. Land Use data;
4. Stormwater pollutant EMCs; and
5. BMP performance estimates.

Each of the categories of input data is evaluated for accuracy in reflecting the project site conditions. This section discusses the reliability of new or revised model parameters and assumptions necessary to support the LID BMP Plan.

D.2.6.1. Rainfall Data

A comparison of yearly average precipitation at the LACDPW daily-recording Castaic Junction gauge to yearly average precipitation at the Newhall gauge indicates approximately 4 inches per year greater precipitation at Newhall (Elev. 1,243 ft) than at Castaic Junction (Elev. 1,005 ft). The Project has elevations that range from approximately 1,000 to 1,200 feet, therefore would likely be expected to experience rainfall depths somewhat less on average than experienced at the Newhall gauge and potentially greater than experienced at Castaic Junction. The use of Newhall gauge rainfall data is results in a conservative estimate of stormwater runoff volumes and changes in average annual volumes resulting from development. The San Fernando gauge, which was used to fill in missing periods in the Newhall gauge measures only slightly lower average rainfall depths than the Newhall gauge and the data used from this gauge were corrected to account for this small difference. The use of San Fernando gauge data to fill gaps in the Newhall record therefore results in a more accurate representation of actual rainfall and does not significantly bias estimates of runoff volume or concentration.

D.2.6.2. Runoff Coefficients

The estimation of runoff coefficients, described in Section D.2.2, is highly dependent on soil properties (i.e., infiltration potential) and less dependent on parameters such as ET rates, slopes, and surface roughness. Soil properties are estimated as accurately as possible from available soils data, incorporating the latest soil survey conducted by the United States Department of Agriculture (USDA) NRCS as well as locally developed soil infiltration relationships provided in the Los Angeles County Hydrology Manual (LACDPW, 2006). The resultant estimates of runoff coefficients that may somewhat overestimate or underestimate stormwater runoff.

D.2.6.3. Land Use Data

Land use data is generally considered a relatively accurately quantified input parameter. The geospatial land use data for the developed conditions can be used to classify land use type and compute area. The percent impervious values used in the water quality model for the urban land uses in the developed project condition are based upon the values listed in the LA County Hydrology Manual (2006). The percent impervious values assigned to types of urban land uses may slightly overestimate imperviousness for some land uses because the Manual is intended for drainage and flood control analysis of large storm events. However, on the whole the Hydrology Manual values are generally considered to be a fairly accurate quantification of impervious where detailed site designs are not available. The emphasis of modeling efforts described herein is to quantify imperviousness as accurately as possible without intentionally incorporating conservatism.

D.2.6.4. Stormwater Pollutant EMCs

Stormwater pollutant EMCs are estimated from monitoring data collected by the LACDPW from land use characterization stations and generally do not have site design and source control BMPs that will be implemented for the Project. Therefore, the stormwater pollutant EMCs estimated from the LACDPW data are probably slightly conservative compared to the pollutant concentrations in stormwater runoff that will occur from the developed conditions of the project site.

D.2.6.5. BMP Performance

BMP performance parameter reliability and assumptions are discussed in the sections following.

D.2.6.5.1. BMP Model Representations

For the purpose of estimating the characteristic hydraulic performance (capture efficiencies and volume reductions) of BMPs, detailed hydraulic representations were simulated to manage runoff from catchments delineated by Hunsaker, which were identified by combination of underlying HSG and assigned an imperviousness value based on the land use combination within each catchment.

In order to size BMPs for the purpose of analysis, BMP geometries were assumed based on the assumed underlying infiltration rate and the Project design goals for BMPs. While the geometry assumed for this analysis is specific to a certain BMP design, the resulting performance parameters derived from this representation are reasonably representative of the hydraulic performance of the Project design goals for BMPs.

D.2.6.5.2. Facility Capture and Volume Reduction Estimates

Stormwater capture efficiency estimates were calculated in SWMM to provide results on a storm-by-storm basis for input into the water quality model, to accurately reflect the anticipated performance of the Project BMPs. Infiltration, ET, and flows out of BMPs are tracked on an event-basis by SWMM and used to determine capture efficiency and volume reduction of BMPs. Capture efficiency and volume reduction are believed to be estimated accurately by using the described SWMM 5-based methodology.

D.2.6.5.3. BMP Effluent Statistics

BMP effluent concentrations are based on studies contained in the International BMP Database. These studies are screened to remove data for undersized (i.e., inadequate design criteria) BMPs that are likely to have pollutant removal performance substantially less than the BMPs to be constructed for the Project. This screening is believed to improve the accuracy of BMP performance estimates; however, it is only intended to remove BMPs that are clearly unrepresentative in terms of sizing. The screening process is intended to include BMPs with adequate performance that may not be as well designed or maintained as the structural BMPs for the Project. It is anticipated that the BMPs for the Project will perform as well, if not better than, the projected performance based on the American Society of Civil Engineers (ASCE) International BMP Database.

D.2.6.6. Assumption of No Correlation between Model Parameters

The water quality model randomly selects stormwater pollutant concentrations independent of the storm depth or antecedent dry period for each storm event modeled. The validity of the assumption of independence between variables is described in section D.3. In general, no consistent level of correlation has been demonstrated between stormwater EMCs and rainfall depth or the antecedent dry period.

The assumption of independence of model parameters is believed to result in representative or somewhat conservative estimates post-developed runoff quality and loading, as well as somewhat conservative estimates of Project impacts. First, the empirical distribution of runoff EMCs implicitly includes events with a wide range of antecedent dry periods and event sizes. Therefore, the effects of antecedent dry period and storm depth are implicitly reflected in model estimates. Second, where weak correlations have been observed, concentrations tend to decrease with increasing storm depth. Because bypass from BMPs tends to occur more frequently in larger events and at the end of events, the assumption of no dependence would generally result in higher bypass concentrations, on average, than would be expected if these negative correlations were included. On these bases, random selection of stormwater pollutant concentrations, independent of storm depth and antecedent dry period, is believed to be the most reliable option for the modeling methodology at this level of analysis.

D.2.6.7. Conclusions

The runoff coefficient, land use type and area, land use percent imperviousness and BMP performance model input parameters are thought to be reasonably accurate representations of the site conditions and do not increase the conservativeness of the water quality model. The rainfall data and stormwater pollutant EMC estimates are believed to result in conservative estimates of stormwater runoff volumes, pollutant concentrations and therefore pollutant loads. Overall, the predevelopment model input parameters likely result in a slight underestimation of estimated loads and concentrations in the existing condition. The water quality estimates for the developed project condition are also believed to be conservative (i.e., tend to overestimate loads and concentrations) due to pollutant concentration estimates, and BMP performance estimates that in general do not include the benefits of site design or source control BMPs that are planned to be implemented in the Project.

D.3. **Model Methodology**

A Monte Carlo simulation method was used to develop the statistical description for storm water quality. In this approach, the storm water characteristics for a single rainfall event are estimated. The rainfall depth is determined by randomly sampling from the historical rainfall depth frequency distribution. Similarly, an EMC is determined by randomly sampling from the frequency distribution of EMCs. The rainfall volume and EMC are used to determine runoff volume, pollutant concentration, and pollutant load of the single storm event. BMP volume reduction and performance (effluent quality), determined by randomly sampling from the developed frequency distributions, are used to calculate the pollutant removal resulting from treatment in the BMP system. This procedure is then repeated thousands of times (20,000), recording the volume, EMC and load from each randomly selected storm event, including treatment for the developed project condition. The statistics of these recorded results provide a description of the average characteristics and variability of the volume and water quality of storm water runoff.

This method was applied to the Project using Project-specific inputs as described above. The modeled pollutants for the Project were:

- Total Suspended Solids (sediment)
- Total Phosphorus
- Ammonia
- Nitrate and Nitrite
- Total Nitrogen[2]
- Dissolved Copper
- Total Iron
- Chloride

The steps in the Monte Carlo Water Quality Model are as follows:

1. Develop a statistical description of the number of storm events per year, and randomly select a number N_{storms}.

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[2] TKN is modeled, but the results are not reported. Total Nitrogen results are reported from the sum of nitrate, nitrite, and TKN.

2. Estimate the volume of storm runoff for each land use area from a randomly selected storm event.
3. Randomly select a pollutant concentration in storm runoff for each land-use area and each pollutant.
4. Calculate the total runoff volume, pollutant load, and concentration in runoff from the modeled portion of the project, for both existing and developed conditions.
5. Calculate a total annual pollutant load by repeating steps 2-4 N_{storms} times, where N_{storms} is the number of storms per year, randomly selected in step 1.
6. Repeat steps 1 - 6 a total of 20,000 times for each pollutant modeled, recording the estimated pollutant concentration and annual load for each iteration.
7. Develop a statistical representation (mean annual value) of the recorded storm water pollutant loads and concentrations.

Each of the seven steps is described below.

D.3.1. Storms & Stormwater Runoff (steps 1 & 2)

Step 1 – Statistical Representation of Number of Storm Events per Year

Number of Storms per Year

The number of storm events per year was calculated for the 40 complete years in the available period of record from WY 1969 – 2008. The modeled average number of storm events per year (> 0.1 inches) was 15.2, with a standard deviation of 6.0. Figure D-8 illustrates a frequency histogram of the number of storm events per year at the Newhall gauge. The number of storm events per year was modeled with a normal distribution. In the simulation, the number of storms per year was determined by randomly sampling from the normal distribution and rounding to the nearest whole number, using the equation:

$$N_{storms} = 15.2 + 6.0\ R_N$$

Where:

R_N = a standard normal variant with a mean of 0 and a standard deviation of 1.

If the arbitrary number of storms per year was zero or negative, then the normal distribution was re-sampled until a positive number was obtained.

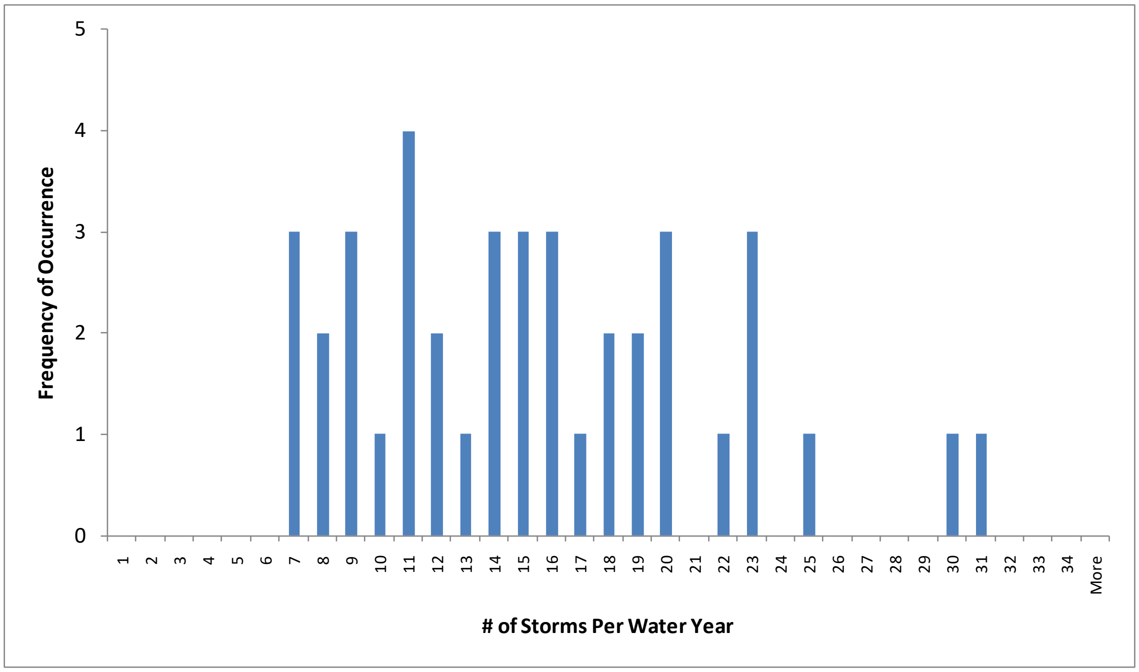

Figure D-8: Distribution of Storms per Year at the Newhall Gauge

Step 2 – Estimate the Volume of Storm Runoff from a Storm Event.

The runoff volume from each storm was estimated using the following equation:

$$V = R_v P A \quad (5)$$

where:

V = the stormwater runoff volume (ft3)
P = the rainfall depth of the storm (ft)
A = the drainage area (ft2)
Rv = the volumetric runoff coefficient for each storm event, a unit-less value that is a function of the imperviousness of the drainage.

For sub-basins that contain multiple land-use types, the total stormwater runoff volume is determined as the sum of runoff from each land-use type:

$$V_{wshed} = \Sigma_{lu} V_{lu} = \Sigma_{lu} (R_{v\,lu} PA_{lu}) \quad (6)$$

where *lu* designates the land-use type. It is assumed that rain falls uniformly over all land-uses in the sub-basin.

The steps used to calculate the volume of runoff from a randomly selected storm event were:

Step 2a : Obtain a rainfall depth by randomly sampling from the 609 storm events.

Step 2b : For each land-use area, calculate a runoff volume using equation (5). The same rainfall depth is applied to each land-use area.

Step 2c: Sum the runoff volumes from each land-use area to obtain the total runoff from the watershed for a particular storm event with equation (6).

D.3.2. Pollutant Loads & Concentrations (step 3 & 4)

Step 3 – Estimate a Pollutant Concentration in Storm Runoff from Each Land Use Area

Runoff Concentration

The distribution of land use-based pollutant concentration in storm runoff was developed based on the process described in Section F.2.4.3. For each storm event, stormwater EMCs were sampled randomly for each modeled land use and water quality parameter. The runoff concentration from each land-use area was evaluated with the expression:

$$C_{land-use} = \exp(\mu_{\ln x} + \sigma_{\ln x} R_N) \qquad (7)$$

where:

$\mu_{\ln x}$ = the log-normal mean

$\sigma_{\ln x}$ = the log-normal standard deviation

R_N = a standard normal random variable

Step 4 – Calculate the Total Runoff Volume, Pollutant Load, and Pollutant Concentration in a Storm Event

Step 4A: The total runoff volume in the watershed was calculated with equation (6) as discussed in Step 2:

$$V_{wshed} = V_{land-use1} + V_{land-use2} + \ldots + V_{land-usei} \quad (8)$$

where the same randomly selected rainfall event was used to calculate runoff volume in each of the land-use areas.

Step 4B: The total pollutant load from the watershed was calculated by:

$$L_{wshed} = V_{land-use1} C_{land-use1} + \ldots + V_{land-usei} C_{land-usei} \qquad (9)$$

where the concentration in each individual land-use area was calculated with equation (7) discussed in step 3.

Step 4C: The average pollutant concentration in runoff from the entire watershed from a single storm event was calculated by dividing the total watershed load (Step 4B) by the total watershed runoff volume (Step 4A):

$$C_{wshed} = L_{wshed} / V_{wshed} \qquad (10)$$

Additional calculations were made to determine the reduction in pollutant load and concentration achieved with treatment BMPs. The fraction of stormwater runoff receiving treatment was calculated for each storm event, using the capture efficiency associated with that event, as described in Section F.2.5. BMP performance was modeled using a randomly selected effluent concentration achieved within the BMP for each water quality pollutant.

Step 4D: The total pollutant load from watersheds with treatment BMPs was calculated by:

$$L_{wshed\_BMPs} = \left[Cap_{\%} \times V_{wshed} \times C_{eff} \times (1 - VR\%)\right] + \left[(1 - Cap_{\%}) \times V_{wshed} \times C_{wshed}\right] \qquad (11)$$

where:

$Cap_{\%}$ = the volumetric percent capture of the BMP.
Ceff = the randomly determined effluent concentration from the BMP.
VR% = the percent reduction in effluent volume achieved by the BMP (see Section F.2.5.1.3).

C_{eff} was determined from sampling from the lognormal distribution described by the parameters contained in Table D-16 and Table D-17. V_{wshed} and C_{wshed} were calculated per Steps 4A and 4C, respectively

Step 4E: The average pollutant concentration in runoff from the entire watershed with treatment from a single storm event was calculated by dividing the total watershed load with treatment by the total watershed runoff volume less the volume lost in BMPs:

$$C_{wshed\_BMPs} = L_{wshed\_BMPs} / V_{wshed\_BMPs} \qquad (12)$$

where:

$$V_{wshed\_BMPs} = V_{wshed} \times \left[1 - (Cap_{\%} \times VR\%)\right] \qquad (13)$$

The results of step 4D (Eq 11) and step 4E (Eq. 12) were used to compute model results for developed conditions with treatment.

Figure D-9 provides a diagrammatic representation of these water quality calculations.

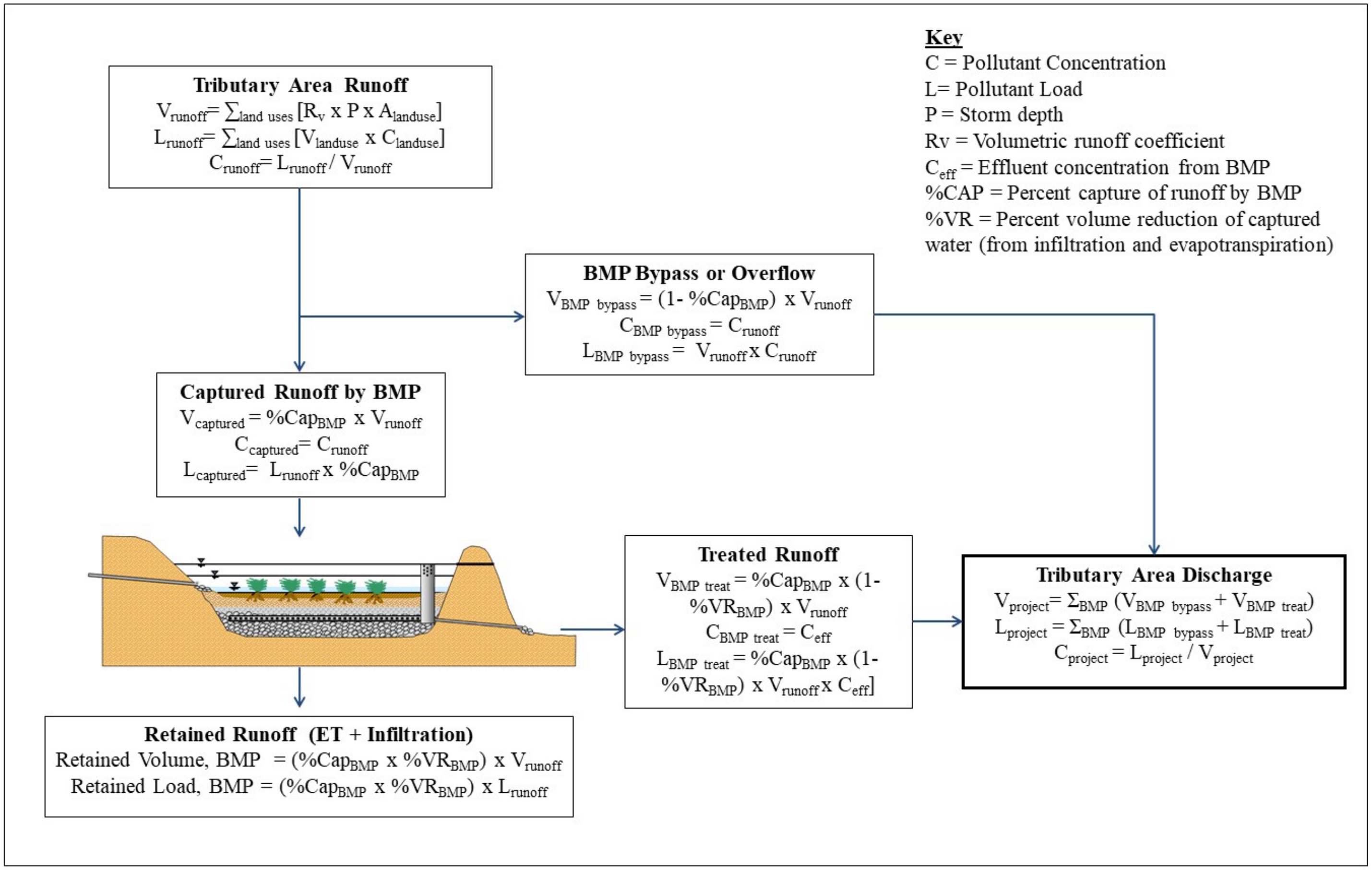

Figure D-9: Monte Carlo Model Schematic

D.3.3. Annual Pollutant Loads, Concentrations, and Distributions (steps 5, 6, & 7)

Step 5 – Calculate a Total Annual Pollutant Load

The annual pollutant load is simply the sum of pollutant loads generated from all storms in a given year, based on the random selection described in Step 1. Therefore, steps 2-4 were repeated N_{storms} times (where N_{storms} was randomly selected per step 1), recording the total pollutant load from each randomly selected storm event. The individual storm loads were summed to obtain the total annual pollutant load.

Step 6 & 7 – Determine Distribution of Storm Concentration and Annual Loads

Steps 1-5 were repeated a total of 20,000 times, recording the pollutant concentration and annual load from each iteration. The resultant distributions can be used to present a frequency distribution for pollutant concentrations or loads using statistics calculated from the 20,000 Monte-Carlo iterations.

D.3.4. Model Methodology Assumptions

The following five key assumptions are made for the Monte Carlo water quality modeling methodology:

1. The assumed probability distributions of model parameters;
2. The assumption of independence between model parameters (i.e., no correlation between randomly determined variables);
3. Assigning a Lower Limit to BMP Effluent Concentrations;
4. Limiting pollutant removals to pollutants with data; and
5. Modeling structural BMPs to only remove pollutants and not acting as a source.

The implications of each of these assumptions to the water quality projections are discussed below.

1) Distribution Assumptions: Probability distributions are assumed to represent the number of storms per year, stormwater pollutant concentrations, and BMP effluent concentrations. Observed rainfall data (i.e., storm frequency) and stormwater monitoring data are fit with either a normal or lognormal distribution using standard statistical procedures. The values of storms per year, rainfall depth, runoff pollutant concentration, and BMP effluent concentrations used in given iteration in the Monte Carlo analysis are governed by the selected distributions. Large samples of these estimated variables will approximate the assumed distributions and will have the same mean and variance that was observed in the rainfall and monitoring data. The following describes the distributions for various input parameters.

Storms per Year: Figure D-8 shows the number of storms per year occurring at the Newhall rain gauge (augmented with data from the San Fernando gauge). The number of storms occurring per year at the Newhall gauge appears to lie between the normal and lognormal distributions. The normal distribution was used to determine the number of storms per year simulated in the water quality model, as use of the lognormal distribution would overestimate the average annual rainfall, as well as its variability, when the distribution of the data is not heavily skewed. As discussed in Section D.2.6, use of rainfall data collected at the Newhall gauge already tends to overestimate the average annual rainfall for the Project site. When using the normal distribution to randomly determine the number of storms per year, the resulting average annual rainfall output from the water quality model is typically in the range of 17.4 to 17.6 inches per year. This is in close agreement with the average annual rainfall from runoff producing storms of 17.4 inches determined directly from the rainfall data (see Table D-1).

As described, rain data is based upon hourly precipitation data from a 40-year period of record (water years (WY) 1969-2008) given a lack of data from later years. The 40-year period of record is assumed to be representative of precipitation conditions at the site.

Stormwater Pollutant Concentrations: The Shapiro-Wilk Test was used to determine the statistical distribution that best represents the raw stormwater runoff monitoring data collected in Los Angeles and Ventura Counties. In most instances the data were found to be log-normally distributed at a confidence level of 0.10. In some instances, the data were not well fit by either the normal or lognormal distributions but were found to be more closely approximated by the log-normal distribution. For data sets with greater than 50 percent non-detects or that were not log-normally distributed according to the Shapiro-Wilk test, data were analyzed (ROS and bootstrap) in arithmetic space as to not unreasonably overestimate the standard deviation of the data set. Since stormwater pollutant concentrations, in general, tend to be well approximated by the lognormal distribution (Helsel and Hirsh, 2002), the data sets that did not meet the lognormal criterion are still believed to belong to a log-normally distributed population, but the number of data points is too few to statistically confirm that this is the case. Therefore, simulations of stormwater concentrations in the water quality model were still conducted in lognormal space. This assumption is believed to result in a more accurate prediction than would the application of the normal distribution.

BMP Effluent Concentrations: Goodness-of-fit tests conducted on the raw BMP effluent monitoring data from the International BMP Database with the Shapiro-Wilk Test either resulted in (1) confirmation of the appropriateness of the lognormal distribution for the data; or (2) in the instances when the data did not meet the significance criteria of a p value > 0.1, that the data were more closely approximated with the lognormal distribution than the normal. The use of the lognormal distribution to represent BMP effluent concentrations results in higher average estimates of BMP effluent concentration. This is believed to be a more accurate estimation of BMP performance than use of the normal distribution and is considered a more conservative assumption (leading if anything to higher than anticipated effluent concentrations).

2) <u>Assumption of No Correlation between Model Parameters</u>: The water quality model randomly selects stormwater pollutant concentrations independent of the storm depth or

antecedent dry period for each storm event modeled. The validity of the assumption of independence between variables is supported by analyses conducted by Environmental Defense Sciences (2002), who did not find a strong correlation between rainfall volume and event mean concentrations (EMCs) in the LA County data for the education land-use site. Data analyses for the single-family residential land use were found to be weakly correlated (R^2 of 0.6 ± 0.1) for some pollutants with storm depth; however some pollutant showed little correlation between these variables. Where weak correlations were present, stormwater pollutant concentrations tended to decrease with storm size. Correlations between pollutant concentration and antecedent dry period were similarly variable. For the single-family land use, correlations between pollutant concentration and antecedent dry period were moderately significant for a few pollutants (R^2 of 0.8 ± 0.03), and weak for other pollutants. Correlations between pollutant concentration and antecedent dry period varied widely for the educational and multi-family land uses.

The results of these analyses indicated that no consistent level of correlation has been demonstrated between the stormwater EMCs and the rainfall depth or the antecedent dry period, with weak or no correlation observed for most pollutants and land-uses. On this basis, random selection of stormwater pollutant concentrations, independent of storm depth and antecedent dry period, is warranted for the water quality model.

Effluent concentrations are considered a more reliable estimator of treatment performance than percent removal (Strecker et al. 2001). BMP effluent concentrations were sampled independently of stormwater concentrations (i.e., influent concentration to the BMP) in the water quality model. As with the pollutant EMCs, independent sampling of effluent concentrations preserves the mean and standard deviation in the monitoring data.

3) <u>BMP Performance – Irreducible Pollutant Effluent Concentrations</u>: When sampling from the lognormal distribution to estimate BMP performance with an effluent concentration it is possible to select values approaching or equal to zero. While well-functioning BMPs are capable of achieving high rates of pollutant removal, it is generally accepted that BMPs cannot completely remove pollutants from the water column. In effect BMPs, at best, can achieve what is called an "irreducible pollutant concentration" (Schueler, 1996). In an effort to prevent overestimating BMP performance in the model, lower limits were set for the effluent concentrations of each modeled pollutant and BMP as described in Section D.2.4.3.

4) <u>BMP Performance – Limiting Pollutant Removal Estimates to Available Data</u>: Table F-21 and Table D-22 present model parameters used for estimating BMP pollutant effluent concentrations. Pollutant removal is only simulated for those pollutants that have available data in the BMP Database. In instances where data is not available for a parameter, no treatment is assumed for that parameter. This does not prevent the model from calculating load reductions of the pollutant as a result of hydrologic source control.

5) <u>BMP Performance – BMPs are not a Source of Pollutants</u>: In instances when the randomly determined BMP effluent concentration exceeds the modeled influent concentration, no pollutant

removal occurs, and the effluent concentration is modified to equal the influent concentration. This prevents BMPs from acting as a source of pollutants in the water quality modeling. The commitment to regular and effective maintenance of the stormwater BMPs provides support for this assumption.

Conclusions: The above assumptions are expected to improve the accuracy of the water quality model estimates. The net result for the model outputs are somewhat conservative estimates of pollutant loads and concentrations due to estimation of model input parameters that are not compromised by the model methodology.

D.4. **Model Reliability**

Factors that affect model reliability include variability in environmental conditions and model error. To account for environmental variability, a statistical modeling approach was used that takes into account the observed variability in precipitation from storm to storm and from year to year. The model also takes into account the observed variability in water quality from storm to storm, and for different types of land uses. One way to express this variability is the coefficient of variation (COV) which is the ratio of the standard deviation of the variable to the mean value. Based on the statistical model, the range of COVs for pollutant loads was from 0.2 to 2.1 (Entrada South) and from 0.2 to 3.2 (VCC 18108) on an average annual basis, depending on the pollutant. This variability, or greater, is expected in typical storm water runoff.

Model error relates to the ability of the model to properly simulate the processes that affect storm water runoff, concentrations, and loads. Ideally model error is measured through calibration, but calibration is not feasible when considering a future condition. We are confident that the model is a reasonable reflection of storm water processes because the model relies largely on measured regional data. For example, the runoff water quality data are obtained from a comprehensive monitoring program conducted by LA County that has measured runoff concentrations from a variety of land use catchments and for a statistically reliable number of storm events. In addition, parameter estimation is fairly conservative resulting in moderately conservative estimates of changes in pollutant concentrations and loads.

D.5. **References**

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APPENDIX E

Toxic Olfactory Impacts to Southern Steelhead

Geosyntec consultants

engineers | scientists | innovators

TOXIC OLFACTORY IMPACTS TO SOUTHERN STEELHEAD

Entrada South and Valencia Commerce Center Project

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July 21, 2023

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ACRONYMS AND ABBREVIATIONS

BLM	Biotic Ligand Model
CDFW	California Department of Fish and Wildlife
DOC	Dissolved Organic Carbon
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
TOC	Total Organic Carbon
VCC	Valencia Commerce Center

1. EXECUTIVE SUMMARY

In October 2007, the National Oceanic and Atmospheric Administration (NOAA) and the National Marine Fisheries Service (NMFS) produced a technical memorandum entitled "*An Overview of Sensory Effects on Juvenile Salmonids Exposed to Dissolved Copper: Applying a Benchmark Concentration Approach to Evaluate Sublethal Neurobehavioral Toxicity*" (the "NOAA Memo").[1] The NOAA Memo summarized various laboratory studies and from them drew conclusions about the potential for sublethal effects of copper on juvenile salmonids, which include steelhead. According to the NOAA Memo, the laboratory studies showed that, under certain conditions, dissolved copper at concentrations equal to or slightly above ambient background concentrations can disrupt salmonid behavior.

Geosyntec Consultants was asked to review the scientific literature to determine whether more recent research has confirmed, modified, rebutted, or superseded the findings set forth in the NOAA Memo. As discussed below, several studies published since 2007 have more clearly defined the factors that influence dissolved copper toxicity, particularly with respect to the olfactory endpoint, which largely governs behavior responses in fish. These newer studies show that the olfactory effect threshold used in the NOAA Memo did not take into account the extent to which dissolved organic carbon (DOC) affects copper binding and reduces the amount of copper bioavailable to fish. As a result, the NOAA Memo overstated the actual threat posed by dissolved copper on salmonids.

Laboratory studies show that when DOC concentrations are increased, dissolved copper becomes less bioavailable, which means that copper concentrations must be increased to elicit the same negative olfactory response in fish. These new data have been incorporated into an Olfactory Biotic Ligand Model (BLM) that predicts "effects levels" of olfactory toxicity based on common water quality. Using the Olfactory BLM, scientists found that for most California streams, the combination of DOC and water hardness protected salmon from adverse olfactory effects at dissolved copper concentrations significantly higher than those identified in the NOAA Memo as behaviorally disruptive. Given that hardness in the Santa Clara River is relatively high, the olfactory BLM would predict that conditions in the River are highly protective of the olfactory toxicity endpoint.

This is particularly critical for an evaluation of the Santa Clara River, as the dissolved and total organic carbon (DOC and TOC respectively) levels are highly elevated relative to other streams. Specifically, DOC concentrations in the Santa Clara River sometimes exceed 85 mg/L, which is significantly higher than those evaluated in other Western US streams. When these high DOC concentrations are coupled with the naturally high levels of observed hardness in the Santa Clara River, the level of dissolved copper necessary to affect salmon olfaction would likely be ten to one hundred times greater than the 7.0 µg/L predicted to be discharged to the Santa Clara River from the Entrada South Planning area and the 9.0 µg/L predicted to be discharged to the Santa

[1] The 2007 NOAA Memo is often referred to in the scientific literature as "Hecht et al. (2007)".

Clara River from the Valencia Commerce Center (VCC) Planning area under post-development conditions.

Recent studies also establish that most forms or "species" of dissolved copper are not bioavailable to fish. In fact, more than 99 percent of dissolved copper found in road runoff and urban stormwater is "complexed" or bound to other material, making it unavailable for biological uptake. Only uncomplexed or "free" copper is bioavailable, but very little free copper exists in the dissolved copper found in urban stormwater. The NOAA Memo, however, relied on studies where the dosing method effectively exposed fish to dissolved copper consisting of almost 100 percent free copper – a condition that simply does not exist under natural conditions. As a result, these studies and the NOAA Memo substantially overstated the actual toxicity of dissolved copper in rivers and streams.

These subsequent studies and developments establish that the olfactory effect threshold in the NOAA Memo considerably overstates the toxic effects of stormwater, as it fails to account for water quality factors that reduce copper bioavailability. This threshold should not be used to establish a benchmark for toxicity impacts to juvenile salmonids in the Santa Clara River. The average annual dissolved copper concentration in combined discharges from the Modified Project (directly and cumulatively) is predicted to be well below the benchmark CTR water quality criteria for aquatic life protection, which is a more appropriate benchmark for evaluating the potential for effects to aquatic life. Further, the Modified Project's[2] dissolved copper discharges are not expected to increase the concentration of dissolved copper in the Santa Clara River. Finally, although steelhead are not expected to occur in the Santa Clara River in the vicinity of the Modified Project, based on an analysis using the olfactory BLM model and sampling data from the Santa Clara River, the River likely has DOC and hardness levels sufficient to completely protect the olfactory response of juvenile steelhead from dissolved copper discharges at concentrations expected to be discharged from the Modified Project.

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[2] The California Department of Fish and Wildlife (CDFW) prepared and took final action on an Environmental Impact Report and Additional Environmental Assessment in 2017 (herein referred to as the "State Certified EIR;" SCH No. 200001125) for the Newhall Ranch Resource Management and Development Plan (RMDP) and Spineflower Conservation Plan (SCP) (herein referred to as the "2017 Approved Project"). The State Certified EIR addressed the impacts associated with the resource management and development facilitated by the RMDP/SCP, which included development within the Newhall Ranch Specific Plan (NRSP), Entrada South, and Valencia Commerce Center (VCC) planning areas. The "2017 Approved Project" refers to the resource management activities and development facilitated by the RMDP/SCP as approved by CDFW in 2017 for the Entrada and VCC Planning Areas.

Because development in the Entrada South and VCC planning areas was previously analyzed in the State Certified EIR, this report assesses potential impacts due to the proposed changes in the land use plan for the Modified Entrada South and VCC Project (herein referred to as the "Modified Project"), as compared to the impacts associated with the 2017 Approved Project. More specifically, the purpose of this report is to analyze whether the Modified Project gives rise to any new significant impacts or results in a substantial increase in the severity of previously identified impacts on water quality.

2. BACKGROUND

Steelhead salmon (Oncorhynchus mykiss) is one of six Pacific salmon in the genus Oncorhynchus that are native to the North American coast. Steelhead, along with other species of Pacific salmon, exhibit an anadromous life history, where juveniles of the species undergo a change (smoltification) that allows them to migrate to and mature in salt water before returning to their freshwater natal rivers or streams (i.e., streams where they were spawned) to reproduce. Steelhead in southern California comprise a “distinct population segment” of the species (NMFS, 2012). Southern California steelhead were listed as an endangered species under the U.S. Endangered Species Act in 1977 and were accepted as a candidate for listing as endangered under the California Endangered Species Act in May 2022.

Southern steelhead are not expected to occur in the Modified Project area as (1) the Modified Project Site does not support suitable spawning substrate and cool water temperatures required for spawning, and (2) the Modified Project is upstream from the "Dry Gap," an area in which the Santa Clara River does not have surface flows except in very high flow periods, eliminating the possibility of fish migration. For these reasons, there is no historical record of steelhead use of the Santa Clara River or tributaries upstream of Piru Creek and the Dry Gap; however, southern steelhead are known to occur in the lower Santa Clara River and a subset of Ventura County tributaries (CDFW, 2017).

Within the Santa Clara River drainage, southern steelhead historically inhabited Piru Creek, Sespe Creek, Santa Paula Creek, Hopper Creek, and possibly Pole Creek (Titus et al., 2011). Presently, southern steelhead occur in the Santa Clara River Watershed in Piru Creek between the confluence with the Santa Clara River and the Santa Felicia Dam, in Sespe Creek, in Santa Paula Creek, and possibly in Hopper and Pole Creeks (Stoeker and Kelly, 2005).

Migration and life history patterns of southern steelhead depend on rainfall and stream flow (CDFW, 2017). In the Santa Clara River, a sandbar is present at the mouth of the Estuary during periods of low river flow that blocks migration to and from the ocean. Adult steelhead congregate in the Pacific Ocean off the mouth of the River and migrate upstream after the sandbar is breached (Shapovalov and Taft, 1954) from seasonal tidal influences and/or when triggered by rising stream flows from storm events (Moyle, 2002). Steelhead in the Santa Clara River are presumed to be adapted to utilize winter freshets (a rise or overflowing of a stream resulting from heavy rain or snow melt) as a means to move from the sea to the upper areas of the watershed (CDFW, 2017). These winter freshets typically have provided enough surface flow to break through the sandbar that builds up at the River-Estuary interface during the low flow summer months.

Adult steelhead have been observed in the lower Santa Clara River and a subset of Ventura County tributaries (see above) in February, March, and early April (CDFW, 2017). Downstream migration of juveniles usually occurs between March and June (Shapovalov and Taft, 1954). In southern California, steelhead typically migrate to the ocean as a one- or two-year old (CDFW, 2017). Outmigrating steelhead in the Santa Clara River have been observed from January through early June, but the majority of steelhead smolt emigrate during the period from March through early May, and the timing of migration is strongly dependent on stream flows (ENTRIX, 2000).

3. EFFECTS OF DISSOLVED COPPER ON STEELHEAD SMOLTS

An increase in the in-stream dissolved copper concentration in the Santa Clara River where and when steelhead smolts are present may have a deleterious effect on the smolts (Baldwin et al., 2003; Sandahl et al., 2004). The effects of dissolved copper in freshwater environments are discussed in the NOAA Memo "An Overview of Sensory Effects on Juvenile Salmonids Exposed to Dissolved Copper: Applying a Benchmark Concentration Approach to Evaluate Sublethal Neurobehavioral Toxicity" (Hecht et al., 2007).

The NOAA Memo states that salmonid behavior, specifically predator avoidance, can be disrupted at concentrations of dissolved copper that are at or slightly above ambient background concentrations (i.e., levels unaffected by development), particularly after short exposure periods (e.g., fifteen minutes to three hours). In the NOAA Memo, the background concentration was operationally defined as surface waters with less than 3 µg/L of dissolved copper, as the control water used in the experiments to establish the benchmark concentration (BMC) had background dissolved copper concentrations as high as 3 µg/L (Hecht et al., 2007). The NOAA Memo reviewed the sublethal effects of dissolved copper on juvenile salmonids, specifically on juvenile Coho salmon (less than 10 months old), and then extrapolated the results to be generally applicable to other juvenile anadromous species (including southern steelhead).

The effects on juvenile salmonid olfactory function (i.e., sense of smell) and predator avoidance were examined in the NOAA Memo using a BMC. BMCs are calculated using an USEPA methodology (USEPA, 1995) to estimate the olfactory effects thresholds for dissolved copper in surface waters. The NOAA Memo stated that the BMC approach took into account the full range of a dose-response dataset by fitting the dataset with an appropriate regression equation to identify the no observable adverse effect level. In the NOAA Memo, a BMC approach was used to estimate the thresholds for dissolved copper's sublethal effects on the chemosensory physiology and predator avoidance behaviors of juvenile Coho salmon, using the dataset from Sandahl, et al. (2004). The NOAA Memo reports that 2.1 µg/L corresponds to reductions in predator avoidance behavior (alarm reaction) of approximately 8 percent to 57 percent (BMC50), and thus the BMC goal was set to 5.1 µg/L, which represents the established BMC50 when combined with the study's background concentration of 3 µg/L. Other datasets mentioned in the NOAA Memo report BMC50 range between 3.6 µg/L and 10.7 µg/L, but the NOAA Memo concluded that the more conservative dataset was more relevant.

Since the release of the NOAA Memo in 2007, several studies have been published which more clearly define factors that influence dissolved copper toxicity, particularly with regards to the olfactory endpoint. Based on these newer studies, the level of bioavailability reflected in the BMCs should be recognized as a special condition exaggerated for several reasons, most specifically for not incorporating the competitive effect of DOC on copper binding and the subsequent reduction in bioavailability. Laboratory studies have established that increasing dissolved organic carbon concentrations reduce the bioavailability of dissolved copper and increase the required concentration to elicit the same decreased olfactory response (McIntyre et al., 2006; McIntyre et al., 2008; Linbo et al., 2009). NOAA investigations of a single concentration of copper (20 µg/L dissolved copper) found that 6 mg/L of DOC reduced the olfactory toxicity of this exposure level. Similarly, Linbo (et al. 2009) found that "increasing organic carbon across a range of environmentally relevant concentrations (0.1 mg/L – 4.3 mg/L) increased the EC50 for copper toxicity (the effective concentration resulting in a 50 percent loss of hair cells) from approximately 12 µg/L to approximately 50 µg/L."

Meyer and Adams (2010a, 2010b) have taken these data and incorporated them with the Biotic Ligand Model developed for calculating copper bioavailability (Hydroqual, 2013; USEPA, 2007a) to develop an Olfactory BLM that can be used to predict effect levels for olfactory toxicity based on common water quality parameters, particularly the levels of DOC present in the receiving environment. DeForest et al. (2011a, 2011b, 2011c) applied this olfactory BLM to data available for numerous western United States streams and found that the olfactory BLM was highly protective relative to water quality acute and chronic criteria under almost all natural conditions (levels typically by a factor of two to three times greater than hardness adjusted water quality criteria), except when water hardness was extremely low. As hardness in the Santa Clara River is relatively high, the olfactory BLM would predict that conditions in the River are protective of the olfactory toxicity endpoint. Finally, Nason et al. (2011) measured dissolved copper availability in Oregon highway runoff and found that 99 percent of the copper present was in a non-bioavailable form.

Based on a review of NOAA's study design and results in light of this new information, it is highly likely that the BMC goal of 5.1 µg/L for dissolved copper defined in the NOAA Memo is far more conservative and thus overprotective than would be necessary to protect against adverse effects to salmonids in real world environments. Any effort to evaluate impacts from the Modified Project on steelhead smolt present in the Santa Clara River must take into account the receiving water conditions (basic water quality parameters such as hardness, pH, alkalinity, cations, anions, and DOC) and the specific concentrations of dissolved copper discharged from the Modified Project before reaching a determination of potential adverse effects. The basis for this determination is discussed in detail below.

3.1 Bioavailability of Dissolved Copper

The BMCs in the NOAA Memo were derived from experiments using a single freshwater source (dechlorinated, soft municipal water) unlikely to contain any alternative ligands to complex with the added copper, resulting in effectively 100 percent bioavailability of the copper species present. The NOAA Memo acknowledged, however, that hardness, alkalinity, and dissolved organic carbon (DOC) are known to alter the bioavailability of dissolved copper in surface waters. According to the NOAA Memo, hardness and alkalinity provided little amelioration of olfactory effects in juvenile salmonids but increases in DOC showed greater protection to dissolved copper (Hecht et al., 2007). This finding was confirmed by Green et al. (2010), which reported that waterborne calcium reduced binding of copper to the olfactory epithelium but did not protect against olfactory impairment. A more recent study conducted with juvenile Chinook salmon (Kennedy et al., 2012) showed that increasing DOC linearly decreased copper-induced olfactory inhibition. In this study, at DOC concentrations of 5 mg/L, median concentrations of total copper found to inhibit olfactory function by half (the IC50) were determined to be 30 µg/L for acute (4-day) exposures and 21.5 μg/L for sub-chronic (14-day) exposures.[3] The presence of other metals, specifically iron, was shown to slightly decrease this protective effect; however, the decrease was not found to be significant. The study by Kennedy is particularly important as this study measured actual behavioral responses to copper in free swimming fish, in contrast to the studies examined in the NOAA Memo, which only measured electrochemical responses in anesthetized fish.

A study conducted by McIntyre et al. (2008), which is referenced in the NOAA Memo, similarly found that olfactory capacity with exposure to dissolved copper concentrations of 20 μg/L was completely protected at DOC levels equal to or greater than 6.0 mg/L. According to McIntyre et al., twenty-nine percent of United States Geological Survey (USGS) surface water samples from West Coast basins had a DOC concentration sufficient to limit olfactory impairment to 50 percent or less and six percent of all samples had a DOC concentration sufficient to completely protect the olfactory responses of juvenile Coho salmon from the olfactory effect of 20 μg/L dissolved copper (McIntyre et al., 2008). As stated in the NOAA Memo, this information points to "the importance of evaluating site-specific DOC data to address the potential influence of this water quality parameter on olfactory toxicity." Kennedy et al. (2012) similarly stated that "…DOC concentrations should be considered when evaluating the potential impact of copper on fish olfaction."

Sampling data for DOC in the Santa Clara River are limited; however, two samples collected in Santa Clara River Reach 5 in February 2014 had DOC concentrations of 29 mg/L and 24 mg/L respectively. Sampling data for Total Organic Carbon (TOC) in Santa Clara River Reach 5 are summarized in Table 1 below. Although no data are available to establish a direct correlation between DOC and TOC concentration in this data, USEPA (2007b) presents an estimated DOC:TOC ratio of 89.87:100 for streams in California. Using this estimate, DOC levels in Santa Clara River Reach 5 ranged from 1.7 to 47.6 mg/L (average 9.4 mg/L) in the observed data.

Table 1: Wet Weather Water Quality Data for Total Organic Carbon in Santa Clara River Reach 5

Constituent	Santa Clara Reach 5 Summary Statistics[1]				
	Maximum[2]	Minimum[3]	Average[4]	No. of Samples	No. of Non-Detects
Total Organic Carbon (mg/L)	53	1.87	10.4	65	0

Notes:
1 Summary statistics for Santa Clara River Reach 5 wet weather include the LACDPW Santa Clara River Mass Emission Station S29 (2002 – 2019), Newhall WRP NPDES Stations, NRSP Conditions of Approval monitoring, and USCR Coordinated Integrated Monitoring Program.
2 Maximum value reported within Santa Clara Reach 5. The maximum values for a constituent at a site are listed as "< Maximum MDL" when all the samples were non-detects.
3 Minimum value reported within Santa Clara Reach 5. The minimum value for a constituent at a site is listed as "< Minimum MDL" when at least one of the samples was non-detect.

[3] Data directly comparing Chinook to steelhead salmon sensitivity to copper are limited, though at least one study showed comparable LC50 values for these species during the smolt stage (Chapman, 1978).

4 Average value reported within Santa Clara Reach 5. The average value for a constituent at a site are listed as "< Maximum MDL" when all the samples were non-detects. The average values are calculated using a substituted value of one-half the MDL for samples that were non-detect.

mg/L - milligrams per liter, µg/L - micrograms per liter, MPN/100 ml - most probable number per 100 milliliter

The predicted average annual dissolved copper concentration in stormwater runoff from the Modified Project after treatment in the LID BMPs, 7 µg/L (Entrada South) to 9 µg/L (VCC), is much less than that used in the McIntyre study, while the DOC concentrations observed in the Santa Clara River are much greater than the level cited as being completely protective of olfactory responses in juvenile Coho salmon. Additionally, an earlier study of the carbon isotope geochemistry of the Santa Clara River (Masiello and Druffel, 2001) found that this river system was a consistent exporter of old soil organic matter, further supporting the premise that the Santa Clara River has a regular supply of terrestrial-derived organic matter that would be present to bind to any dissolved copper discharged to the River.

3.2 Copper Speciation and Olfactory Toxicity

Three species of copper – free copper ion (Cu^{2+}), copper hydroxide ($CuOH^{+}$), and copper carbonate ($CuCO_3$) – have been reported to bind to biotic ligands, such as fish gills and nasal olfactory cells (Niyogi and Wood, 2004) and could contribute to the inhibition of salmon olfaction (i.e., ability to smell) in freshwater systems such as the Santa Clara River (McIntyre et al., 2008). Under the water quality conditions found in the Santa Clara River (e.g., acidity or pH) (Kamer and Fairey, 2005), the types of copper species (i.e., the forms of copper) present would include Cu^{2+}, $CuOH^{+}$, and $CuCO_3$ in different ratios depending on water column pH (Bodek et al., 1988). Niyogi and Wood (2004) reported that these three species of copper have differential affinities for biotic ligands (e.g., Daphnia or water flea gills), with free copper ion (Cu^{2+}) having a binding affinity four times greater than copper hydroxide (CuOH+) for these ligands and ten times greater than copper carbonate ($CuCO_3$). Accounting for these differential binding affinities (and assuming that fish gills show the same differential binding affinities as water flea gills), the proportion of copper bound to the biotic ligands as free copper ion (Cu^{2+}) would vary between 99 percent Cu^{2+} at pH 6.0 to 86 percent Cu^{2+} at pH 8.5. As such, between 86 percent and 99 percent of the copper not bound to the dissolved organic matter in the Santa Clara River that is bound to fish gills would be in the form of free copper ion (Cu^{2+}). The biotic ligand model in its various formulations (Niyogi and Wood, 2004), discussed below, can appropriately account for the differential affinity of these three copper species in predicting the influence of dissolved organic matter on the bioavailability and toxicity of copper and the resulting levels of olfactory inhibition in salmonid species in the Santa Clara River.

As stated in the previous section, bioavailability of dissolved copper is an important factor in evaluating the potential for copper toxicity. Specifically, correlations have been found between toxicity and ‘free' or weakly complexed copper species (Brooks, et al., 2007; Luider, et al., 2004; Sigg and Behra, 2005; USEPA, 2007b). Based on these data, there are significant concerns and issues with the across-the-board application of the 5.1 µg/L dissolved copper BMC, due to the copper dosing method employed in the salmonid toxicity and behavior studies cited in the NOAA Memo, which support the consideration of receiving water chemistry in any evaluation of dissolved copper discharges and invalidate the broad scale application of a single, laboratory-based BMC in all receiving water conditions.

The standard laboratory procedure for measurement of dissolved copper is to filter a sample through a 0.45 micron filter. The resulting remaining copper in solution that is considered "dissolved" is actually comprised of both "free" (ionic) copper and copper that is complexed with inorganic or organic molecules, very small particles, or colloidal material (not truly dissolved). Toxicity is believed to be most directly linked to concentrations of the free form of copper since many complexed forms, particularly organic forms, are generally not biologically available (DiToro et al., 2001; Nason et al., 2011; Buck et al., 2007; USEPA, 2000). In the main study used as the basis for the BMC in the NOAA Memo, Sandahl et al. (2004), copper solutions were created by adding copper chloride ($CuCl_2$) to distilled water, which likely would have resulted in nearly all of the dissolved copper occurring in the free ionic form. This is unlikely to be representative of actual stormwater discharges or the water quality conditions present in the Santa Clara River.

After the release of the NOAA Memo, Nason, et al. (2011) published a study for the Oregon Department of Transportation and the Federal Highway Administration that looked at the speciation of copper in highway stormwater runoff in Oregon and its implications for bioavailability and toxicity to endangered salmon. The study used these findings to interpret previously conducted salmonid toxicity and behavior studies. The Nason study evaluated particulate-bound and dissolved copper concentrations as well as two sub-categories of dissolved copper: "free copper" (Cu^{2+}_{Free}) and complexed copper. The study found that the dissolved copper that was complexed with organic matter typically comprised more than 99.9 percent of the reported dissolved copper, and therefore less than 0.1 percent of the total dissolved copper existed in the bioavailable free ionic form. As noted above, the toxicity of copper is directly dependent on its bioavailability to organisms; in general, bioavailability is limited to Cu^{2+} and weakly complexed copper (Brooks, et al., 2007; Luider, et al., 2004; Sigg and Behra, 2005; USEPA, 2007b). Therefore, very little of the copper in the highway stormwater runoff measured in the Nason study was found to be bioavailable; the concentrations of Cu^{2+} were generally several orders of magnitude below the levels found by Sandahl et al. (2007) to inhibit juvenile salmonid olfactory function and predator avoidance.

A more recent study by Nason et al. (2012) on stormwater runoff in Oregon similarly found free ionic copper concentrations no greater than 6.3 nanograms per liter (ng/L), again, several orders of magnitude below the inhibitory levels found by Sandahl et al. (2004) and cited in the NOAA Memo. Similarly, the McIntyre et al. (2008) study notes that at levels of DOC greater than 6 mg/L, concentrations of free copper were less than one percent of the total dissolved copper concentration.

Nason, et al. (2011) recommends that a replication of the Sandahl, et al. (2004) and McIntyre, et al. (2008) studies be completed. Nason suggests that the addition of copper speciation techniques and characterization of natural organic matter would more robustly quantify potential toxicity and/or behavior effects of dissolved copper concentrations for Coho salmon under different water quality conditions. Given that the Nason studies found that more than 99 percent of the dissolved copper in stormwater was complexed, it is likely that Cu^{2+} was significantly higher in these previous studies due to the dosing method than would be expected in highway or urban runoff, and thus the findings of these previous studies likely significantly over predict the potential toxicity or behavior effects on Coho Salmon from dissolved copper levels in actual receiving waters.

3.3 Olfactory Biotic Ligand Model Application

In putting forth the BMC of 5.1 µg/L dissolved copper, Hecht et al. (2007) concluded that "… the BMC thresholds presented in this document to be broadly applicable to most Pacific salmonid freshwater environments as typical hardness, alkalinity, and DOC concentrations are unlikely to confer substantial protection against dCu [dissolved copper] olfactory toxicity." However, DeForest et al. (2011) found this not to be the case when they applied a salmon olfactory-based Biotic Ligand Model developed by Meyer and Adams (2010a,b) to the ranges of DOC, hardness, and cations/anions in 133 streams in the western United States, including California. Dissolved organic carbon concentrations ranged between 0.6 and 12.2 mg/L for the 31 streams they examined in California, with a hardness range for these same streams of 20 mg/L to 523 mg/L as $CaCO_3$ (DeForest et al., 2011). For the California streams evaluated, the combination of DOC with hardness was found to protect salmon from adverse olfactory effects at dissolved copper concentrations ranging from 7 µg/L to 211 µg/L.

With the estimated and observed DOC concentrations in the Santa Clara River ranging significantly higher than those evaluated in the DeForest et al. (2011) study (up to 53 mg/L) coupled with the naturally high levels of observed hardness in Santa Clara River Reach 5 (the average hardness observed in Santa Clara Reach 5 during wet weather is 264 mg/L as $CaCO_3$), the level of dissolved copper necessary to adversely affect salmon olfaction would likely be ten to hundred times greater than the 7.0 µg/L – 9.0 µg/L predicted to be discharged in stormwater to the Santa Clara River from the Modified Project. As such, Modified Project stormwater discharges of dissolved copper are very unlikely to adversely affect juvenile steelhead in the Santa Clara River. The Modified Project will not result in any new significant impacts on water quality compared to the 2017 Approved Project analyzed in the State-certified EIR.

3.4 Effect of LID Treatment BMPs

A study conducted by NOAA's Northwest Fisheries Science Center (Stromberg *et al.,* 2016) investigated the effects of untreated conventional urban stormwater runoff (prepared in the laboratory), untreated highway runoff, and highway runoff that was treated using bioinfiltration facilities (i.e., stormwater BMPs such as those implemented by the Modified Project). The study found that laboratory-prepared mixtures of metals and petroleum hydrocarbons typically found in untreated urban stormwater runoff were not sufficient to cause acute mortality in adult coho salmon that return from the ocean to spawn (e.g., "coho spawner mortality syndrome"). In contrast, the untreated highway runoff was universally lethal to adult coho relative to unexposed controls. The study found that although the focal (measured) contaminants were not completely removed by the stormwater bioinfiltration, the overall improvement in water quality was sufficient to completely prevent the lethal effects and sublethal symptomology caused by untreated stormwater.

4. APPLICABILITY OF THE NOAA MEMORANDUM AS A MODIFIED PROJECT BENCHMARK

The CTR establishes the applicable criterion for analyzing impacts of dissolved copper on the Modified Project's receiving water, not the NOAA Memo. USEPA adopted the CTR in 2000 to create legally applicable water quality criteria in the State of California for inland surface waters, enclosed bays, and estuaries for all purposes and programs under the CWA (USEPA, 2000). When adopting the CTR, USEPA consulted with NOAA. With the exception of aquatic life criterion for mercury and acute freshwater criterion for selenium, NOAA issued a final Biological Opinion finding that the CTR criteria would not likely jeopardize the continued existence of any federally listed species or result in the destruction or adverse modification of designated critical habitat (USEPA, 2000).

Unlike the CTR and Basin Plan standards, the BMC set forth in the NOAA Memo has not been adopted by any state, federal, or local agency for the purposes of analyzing pollutant discharges or enforcing water quality regulations. Moreover, the BMC in the NOAA Memo has not been peer reviewed or vetted through any rule-making process, as is typically required of water quality standards established under the CWA (33 U.S.C. §1313(a)-(f); 33 U.S.C. §1314(a)). In addition, the NOAA Memo does not account for the most recent best available science concerning the influence of receiving water chemistry on copper bioavailability. Thus, it does not provide an appropriate criterion for analyzing potential effects of the Modified Project on aquatic life.

5. CONCLUSION

In summary, the NOAA Technical Memorandum appears to have relied on studies that did not utilize real stormwater with a realistic speciation of dissolved copper that would represent treated urban runoff mixed with receiving waters to develop a 5.1 µg/L dissolved copper BMC. Instead, the NOAA Memo relied on studies that utilized a copper dosing approach that likely resulted in levels of Cu2+ that are not representative of, nor typically observed in, urban runoff or receiving waters. Because Cu2+ is considered the most bioavailable form of Cu, the NOAA Memo considerably overstated the toxic effects of stormwater. The NOAA Memo therefore should not be relied upon to establish a benchmark for toxicity impacts to juvenile salmonids in the Santa Clara River.

The average annual concentration in stormwater runoff from the Modified Project (directly and cumulatively) is predicted to be well below the benchmark CTR water quality criteria for aquatic life protection and is not expected to increase the concentration of dissolved copper in the Santa Clara River. Finally, the Santa Clara River has a DOC concentration and hardness levels that are likely sufficient to completely protect the olfactory response of juvenile steelhead from the effect of dissolved copper at the concentration predicted in the Modified Project's discharges. This conclusion is supported by the results of the NOAA study (Stromberg *et al.,* 2016) that found that bioinfiltration treatment was protective of lethal effects and sublethal symptomology caused by untreated stormwater. On this basis, the Modified Project is not expected to result in adverse toxicity effects on juvenile salmonids due to dissolved copper in stormwater runoff.

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APPENDIX F

Hydromodification Susceptibility Analysis for Castaic Creek, Valencia Commerce Center Vesting Tentative Parcel Map 18108

Catalyst
ENVIRONMENTAL SOLUTIONS

Technical Memorandum

Date: January 26, 2023

From: Daniel Tormey, Ph.D., P.G.

RE: **Hydromodification Susceptibility Analysis for Castaic Creek, Valencia Commerce Center Vesting Tentative Parcel Map 18108**

1.0 Introduction

The Valencia Commerce Center Vesting Tentative Parcel Map (VTPM) 18108 (Project) includes low impact development (LID) best management practices (BMPs). Requirements for the BMPs are provided by the Project LID Performance Standard as defined by the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles and Ventura Counties Permit (Order No. R4-2021-0105) and the Los Angeles County Department of Public Works (LACDPW) 2013 LID Ordinance (Chapter 12-84). In addition, the Newhall Waste Discharge Requirements (WDRs) (Order No. R4-2012-0139) and the Newhall Ranch Sub-Regional Stormwater Mitigation Plan (NRSSMP)[1] also serve as benchmarks for evaluating conformance.

This Technical Memorandum evaluates whether the reach of Castaic Creek in the Project area between the Interstate 5 and Old Road bridges and the Santa Clara River (Figure 1) is susceptible to hydromodification, as part of the determination of BMP conformance with these requirements. Hydromodification is the alteration of stream flows or the beds or banks of rivers, streams, or creeks, including ephemeral washes, which results in hydrogeomorphic changes. Activities that alter natural stream flows include increasing the amount of impervious land within the watershed, altering patterns of surface runoff and infiltration, and channelizing natural water courses. Activities that alter the natural stream channel include, but are not limited to, straightening, narrowing or widening, deepening, lining, piping/under-grounding, filling or relocating, bank stabilization, instream activities (e.g., construction, mining, dredging), dams, levees, spillways, drop structures, weirs, and impoundments.

The LACDPW LID Ordinance and Los Angeles County NPDES MS4 Permit exempts projects from hydromodification control requirements that discharge directly or via a storm drain into the Santa Clara River because the Los Angeles Regional Water Quality Board (LARWQB) has determined that rivers subject to geomorphic reset events, including the Santa Clara River, are not susceptible to hydromodification impacts[2].

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[1] Geosyntec Consultants, 2010. Newhall Ranch Specific Plan Sub-Regional Stormwater Mitigation Plan. Prepared for Newhall Land by Geosyntec Consultants. April 2009, amended March 2010.

2 Los Angeles County LID Ordinance, Chapter 12.84.445(A)(4): *Exemptions:…Projects that have any increased discharge directly or through a storm drain to a sump, lake, area under tidal influence, into a waterway that has an estimated hundred (100)-year peak flow of 25,000 cubic feet per second (cfs) or more, or other receiving water that is not susceptible to hydromodification impacts.*

The conclusion of this analysis is that the reach of Castaic Creek downstream from the Interstate 5 and Old Road bridges to the Santa Clara River is not susceptible to hydromodification impacts because:

1) This reach of Castaic Creek functions together and concurrently with the reset events of the Santa Clara River, and together the system is not susceptible to hydromodification.
2) The reach is subject to the fluvial geomorphology controlled by releases from Castaic Dam and the local subwatershed. This subwatershed is in highly erodible sediments and even in the controlled state has sediment production rates second only to Sespe Creek in the lower Santa Clara River watershed. As such the reset events caused by approximately decadal spills from Castaic Dam overprint any morphological effects during lower flows, resulting in a reach that is sediment transport limited and not susceptible to hydromodification.
3) The proposed VTPM development has been analyzed to determine the potential effects to existing sedimentation rates and geomorphic stability. The Project effects were determined to be less than significant. As such, even though the reach is not susceptible to hydromodification, the Project changes are relatively minor.

The remainder of this Technical Memorandum provides the basis for these findings.

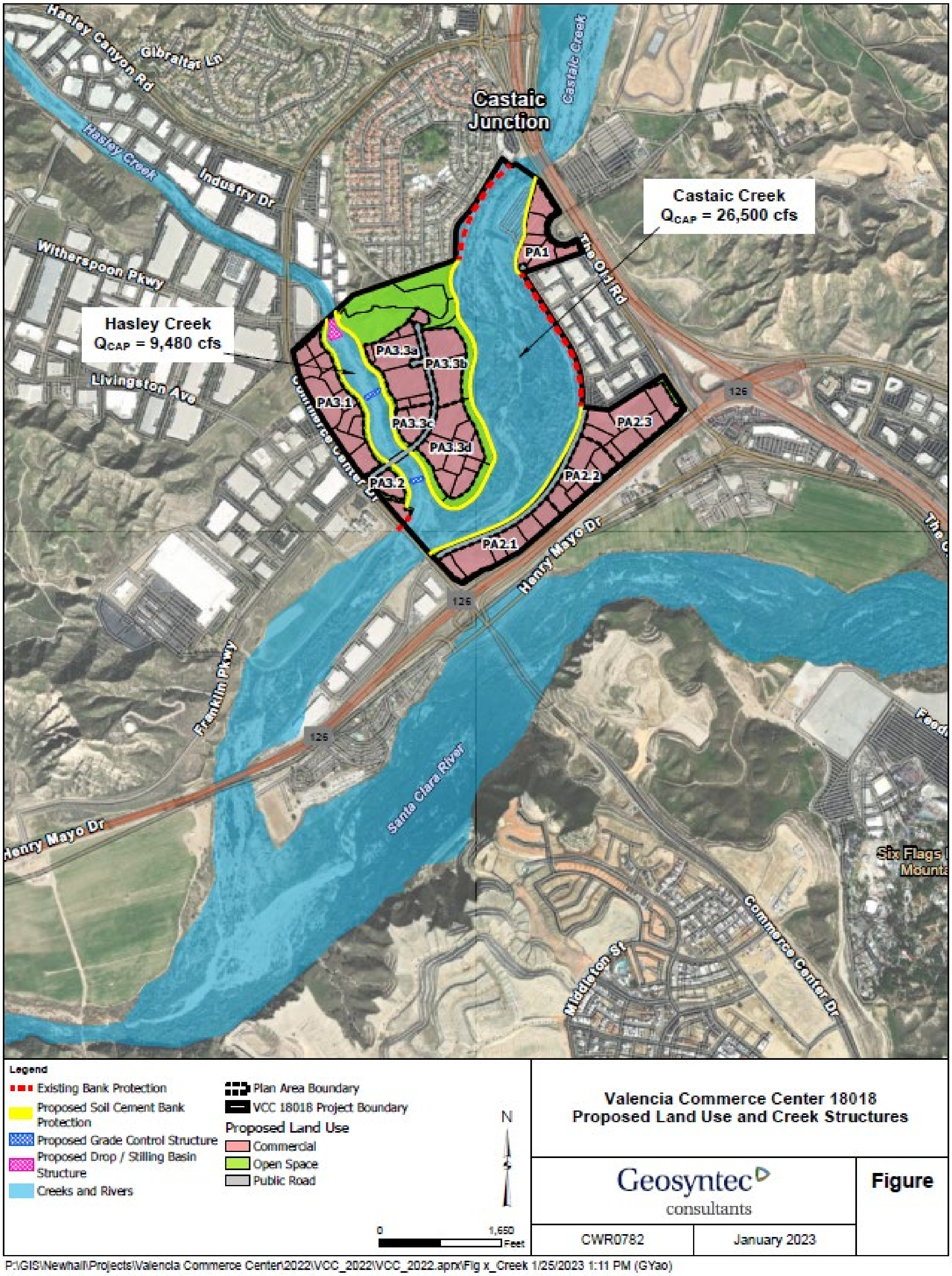

Figure 1: Project Area Map

2.0 Is This Reach of Castaic Creek Susceptible to Hydromodification Impacts?

As part of their consideration of the Newhall Ranch WDR (Order No. R4-2012-0139) and the NRSSMP3, the LARWQCB determined that the Santa Clara River in the Project area is not susceptible to hydromodification. This finding was based on a weight of evidence analysis of the Santa Clara River system and its geomorphic controls4,5. The findings have been validated through long-term fluvial geomorphic monitoring conducted in compliance with the Newhall Ranch WDR (Order No. R4-2012-0139) on the Santa Clara River and this reach of Castaic Creek beginning in 20156.

With respect to the Santa Clara River, it is a dynamic, episodic system. Understanding the magnitude of past response is a key factor in assessing the potential response to future urbanization within the watershed. The construction of Castaic Dam in 1974, regulating approximately 25 percent of the watershed at the Los Angeles/Ventura County line, cut off a significant supply of sediment to the Santa Clara River. This change, however, does not appear to have had an effect on the channel dimensions of the Santa Clara River mainstem. The width of the active corridor, as well as the general form of the channel, are generally consistent both before and after construction of the dam. It appears that the Santa Clara River adjusted without morphological expression to absorb this change. One factor contributing to the lack of change is the large volume of sediment stored in the tectonic basin above the county line—a result of bedrock control associated with movement along the San Gabriel fault, which supports the large extent of semi-consolidated and alluvial deposits adjoining the drainage net[7]. The presence of this bedrock control near the County line, and the large volume of sediment stored upstream, leads to the Santa Clara River upstream of the County line lacking the power to transport the volume of sediment delivered to the channel. As such, the Santa Clara River in this area is a sediment transport-limited stream, with morphology reset by flows of approximately 10-year recurrence interval8.

With respect to the reach of Castaic Creek between the confluence with Hasley Creek and the Santa Clara River, Stillwater[9] and the annual monitoring conducted in compliance with the Newhall Ranch WDR (Order No. R4-2012-0139) on the Santa Clara River beginning in 2015[10] have evaluated this reach. The annual monitoring specifically includes a measurement site at the confluence and upstream in Lower Castaic Creek. These studies have determined that the reach of Lower Castaic Creek has direct connectivity with the mainstem Santa Clara River. They also determined that the direct connectivity and

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[3] Geosyntec Consultants. 2010. Newhall Ranch Specific Plan Sub-Regional Stormwater Mitigation Plan. Prepared for Newhall Land by Geosyntec Consultants. April 2009, amended March 2010.

[4] Balance Hydrologics. 2005. Rationale for hydromodification exemption for the Santa Clara River, Newhall Ranch, LA County, California. Updated 2012.

[5] Stillwater Sciences. 2011. Geomorphic Assessment of the Santa Clara River Watershed, Synthesis of the Lower and Upper Watershed Studies. April 2011. Ventura County Watershed Protection District Planning and Regulatory Division.

[6] Tormey, and Ramboll Environ. 2015. Geomorphological Monitoring and Management Program, Santa Clara River Baseline Report.

[7] Balance Hydrologics. 2005. Rationale for hydromodification exemption for the Santa Clara River, Newhall Ranch, LA County, California. Updated 2012.

8 Balance Hydrologics. 2005. Rationale for hydromodification exemption for the Santa Clara River, Newhall Ranch, LA County, California. Updated 2012.

[9] Stillwater Sciences. 2011. Geomorphic Assessment of the Santa Clara River Watershed, Synthesis of the Lower and Upper Watershed Studies. April 2011. Ventura County Watershed Protection District Planning and Regulatory Division.

[10] Tormey, and Ramboll Environ. 2015. Geomorphological Monitoring and Management Program, Santa Clara River Baseline Report.

close proximity to the Santa Clara River makes this reach of lower Castaic Creek subject to the same reset events owing to this direct connection.

The area of the annual monitoring conducted in compliance with the Newhall Ranch WDR (Order No. R4-2012-0139) included 2019 LiDAR data acquisition and development of a digital elevation model (DEM) from these data[11]. The DEM provides a river-wide view of topography and assists with characterizing channel dimensions through the dense riparian areas along the Santa Clara River. Figure 2 depicts the Digital Elevation Model (DEM) derived from the 2019 LiDAR survey, merged with an aerial photograph of the study area. The DEM can be presented in many ways; this figure shows color-coding to represent channel elevation. Figure 3 shows the same 2019 DEM, without color coding.

Both figures illustrate the direct connection between the Santa Clara River and Lower Castaic Creek, with their behavior coordinated and similar during the approximately 10-year recurrence interval events that control the morphology of both streams in this area. Also evident in Figure 3 is that inflow from Hasley Creek does not have a significant change to the morphology of Lower Castaic Creek (note that the downstream Castaic Creek morphology does not appear to adjust at the confluence with Hasley Creek). As with the Santa Clara River, this reach of lower Castaic Creek is therefore not susceptible to hydromodification.

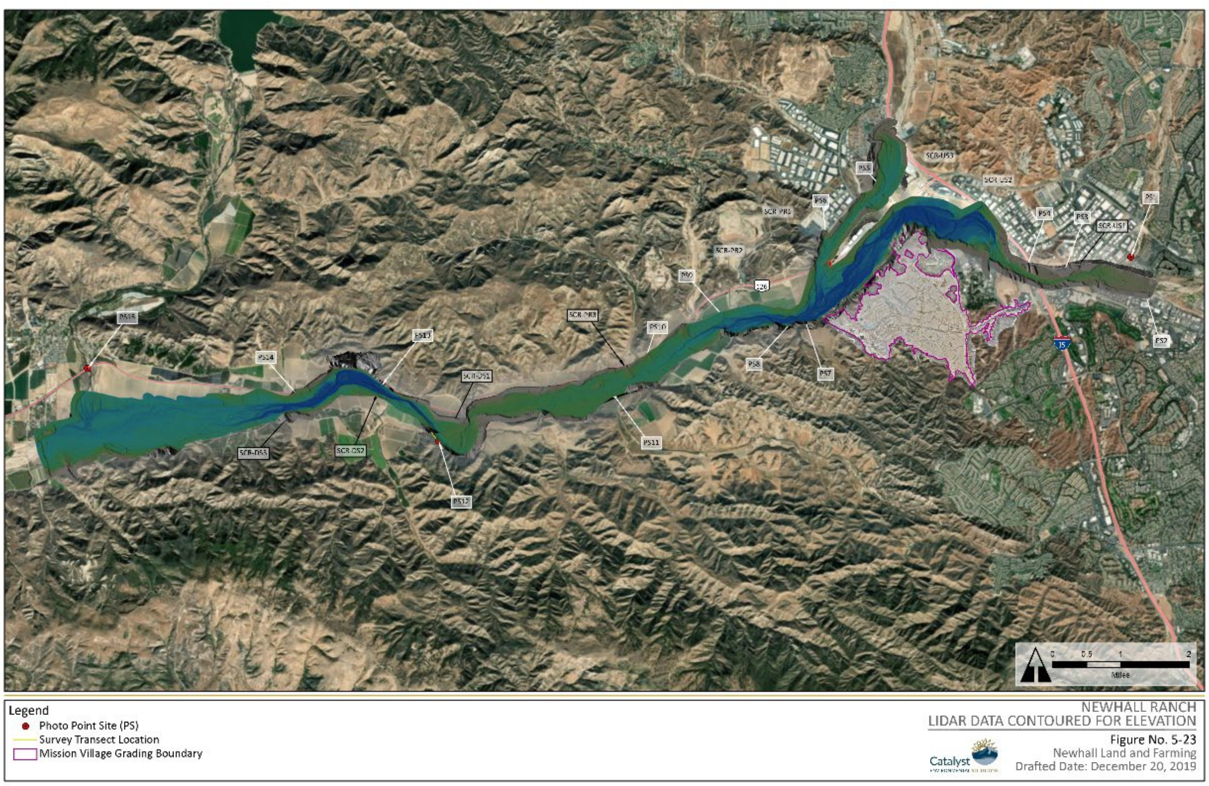

Figure 2: 2019 LiDAR DEM Color Contoured to Depict Elevation

11 Tormey, and Catalyst Environmental Solutions. 2020. Geomorphological Monitoring and Management Program: Santa Clara River 2019 Survey and Monitoring Report, Annual Monitoring and Measured Transects.

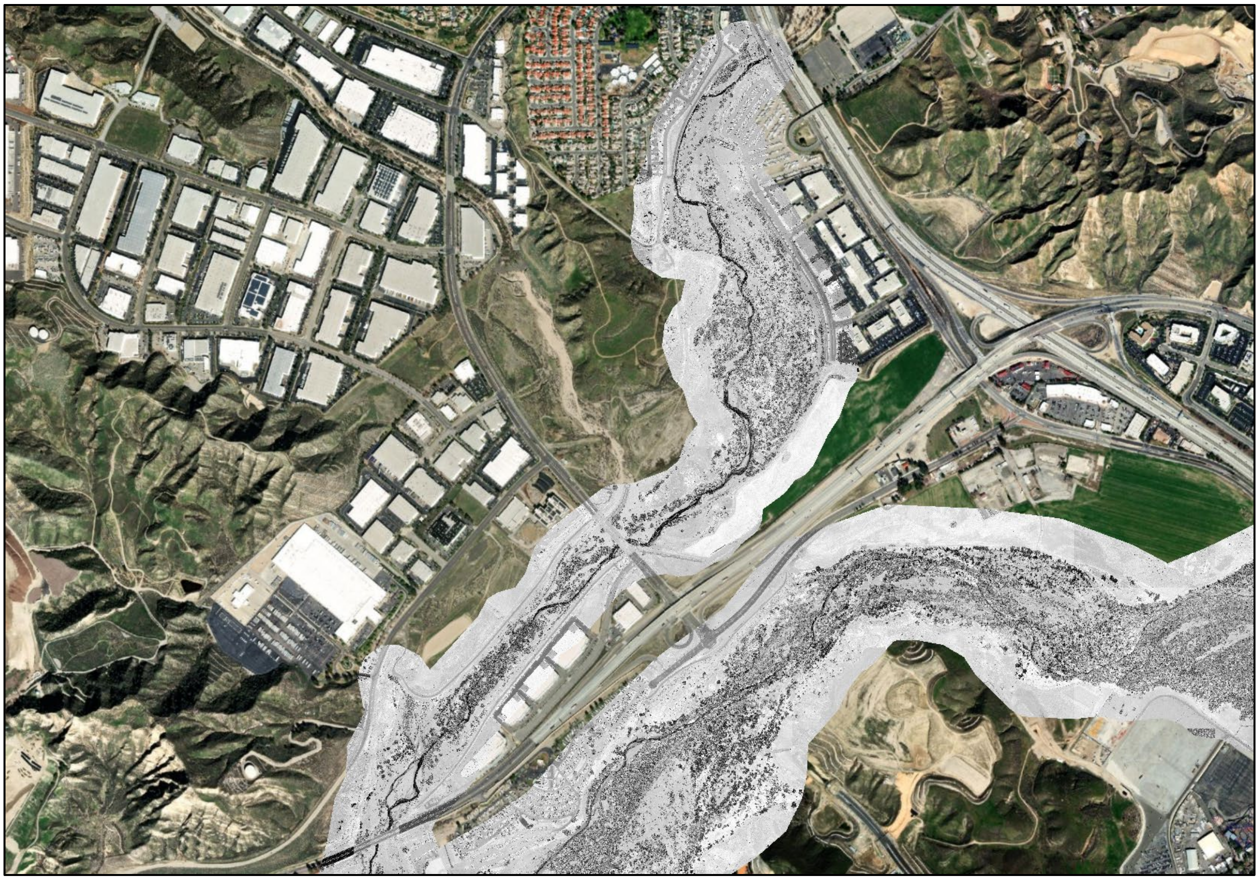

Figure 3: 2019 LiDAR DEM in Project Area

In addition, the segment of Castaic Creek below Castaic Dam (that is, lower Castaic Creek) also behaves similarly to the Santa Clara River in terms of sediment load and hydrologic control by releases and spills from Castaic Dam. As noted above, the watershed area above the dam is approximately one-quarter of the watershed area of the Santa Clara River at the Los Angeles/Ventura County line, and therefore the dam effectively reduced the sediment contributing area by about 25 percent. Previous study of this change[12] indicated that the construction of the dam and corresponding cut off of sediment did not appear to have had an effect on the channel dimensions of the Santa Clara River mainstem. In part this was attributed to a large sediment supply, and a generally transport-limited reach of Castaic Creek. Although the dam changed the sediment budget, the hydrology still consists of channel-forming flows, analogous to reset events, during spills from Castaic Lake, which set the geomorphology until the next reset event. Therefore the hydrology of Lower Castaic Creek is similar to that of the Santa Clara River, with 10-year recurrence interval flows capable of a reset of geomorphic conditions.

Stillwater[13] evaluated the relative differences in sediment production from subwatersheds in the lower Santa Clara River. They determined that subwatersheds with the greatest sediment-production rates per unit area (>3,000 tons per square kilometer per year) are located in landscapes characterized by sparse vegetation cover, weak lithologies, and moderate to steep slopes, with lower Castaic Creek as the

[12] Balance Hydrologics. 2005. Rationale for hydromodification exemption for the Santa Clara River, Newhall Ranch, LA County, California. Updated 2012.

[13] Stillwater Sciences. 2011. Geomorphic Assessment of the Santa Clara River Watershed, Synthesis of the Lower and Upper Watershed Studies. April 2011. Ventura County Watershed Protection District Planning and Regulatory Division.

highest sediment production, after Sespe Creek. The study also notes that Castaic Creek has excess sediment deposition over erosion, with notable sediment aggradation near the confluence with the Santa Clara River. The annual geomorphology monitoring performed in compliance with the Newhall Ranch WDR (Order No. R4-2012-0139) includes a measurement point in the Project area where Route 126 passes over Castaic Creek, approximately 1 mile upstream from the confluence with the Santa Clara River. At this location, Castaic Creek is broad, flat, and braided with a substrate consisting of sand with subdominant gravels. The Project reach is sediment transport limited, which produces the braided morphology, similar to that seen in the Santa Clara River. In addition, the Project reach is subject to reset flows, and is not only in direct communication with the Santa Clara River, but is itself analogous to the behavior of the Santa Clara River. The Project reach of Castaic Creek is therefore not susceptible to hydromodification.

3.0 Could the Project Cause Hydromodification Impacts?

The data summarized in this Technical Memorandum indicates that the reach of Castaic Creek from Interstate 5 and Old Road bridges to the confluence with the Santa Clara River is not susceptible to hydromodification impacts. This section presents a summary of the evaluation of whether the Project-related changes to this reach of lower Castaic Creek are minor and have low risk to hydromodification, regardless of susceptibility. The primary hydromodification impacts addressed herein are related to erosion, sedimentation, and geomorphic function (i.e., channel stability). The Project's site design and LID BMPs would minimize increases in runoff volume from the developed areas, which is the preferred method for controlling hydromodification impacts from new development.[14] Concentrated flows would be alleviated by energy dissipaters at the discharge points to streams. Accordingly, energy dissipation at storm drain outfalls would provide erosion protection in areas where discharges have the potential to cause localized stream erosion. In addition, the Project's buried bank stabilization would serve to protect against erosion of the river bank. The following summarizes the basis for a finding that, regardless of this reach of Castaic Creek's susceptibility to hydromodification, the potential for such geomorphic change as a result of the Project is small.

The evaluation of changes to water quality and hydrology presented in Section 5.5 of the Draft Supplemental Environmental Impact Report prepared for the Modified Project estimates the potential for erosion by analyzing the modelled changes to hydraulic shear stress and flow velocities, in conjunction with potentially erodible materials that occur as a result of streambed modifications proposed by the Project improvements and associated facilities. The results of the velocity analysis are used to analyze erosion and/or deposition impacts associated with the Project.

Compared to the 2017 Approved Project, the Modified Project would include installation of cement bank stabilization, where necessary to protect against flooding and erosion pursuant to Federal Emergency Management Agency (FEMA) and LADPW requirements. The 2017 Approved Project included installation of approximately 8,500 feet of soil cement bank protection on the east and west sides of Castaic Creek. The soil cement bank protection on the east bank extended downstream from the Interstate 5 bridge to the existing rip rap bank protection and extended downstream from the existing rip rap to the Commerce Center Drive bridge. The soil cement bank protection on the west bank

[14] Coleman, Derrick, Craig MacRae, and Eric D. Stein. 2005. Southern California Coast Water Research Project, Effect of Increases in Peak Flows and Imperviousness on the Morphology of Southern California Streams, Technical Report 450, April 2005. https://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/450_peak_flow.pdf. Accessed January 12, 2023.

extended downstream from the existing concrete slope lining to the confluence with Hasley Creek where it turned upstream along the east bank of Hasley Creek.

Under the Modified Project, the length of the soil cement bank protection on Castaic Creek would be the same as in the 2017 Approved Project, with the same upstream and downstream limits. However, under the Modified Project, more of the Castaic Creek floodplain would be retained because the planned bank protection alignments on the east and west side of Castaic Creek would be pulled back from the creek bed. The revised alignments in the Modified Project conditions would reduce impacts to existing jurisdictional streambed areas in Castaic Creek compared to the 2017 Approved Project, which represents an environmentally beneficial improvement. Figure 4 shows the alignments for the bank protection within the VCC Planning Area under the 2017 Approved Project as compared with the Modified Project.

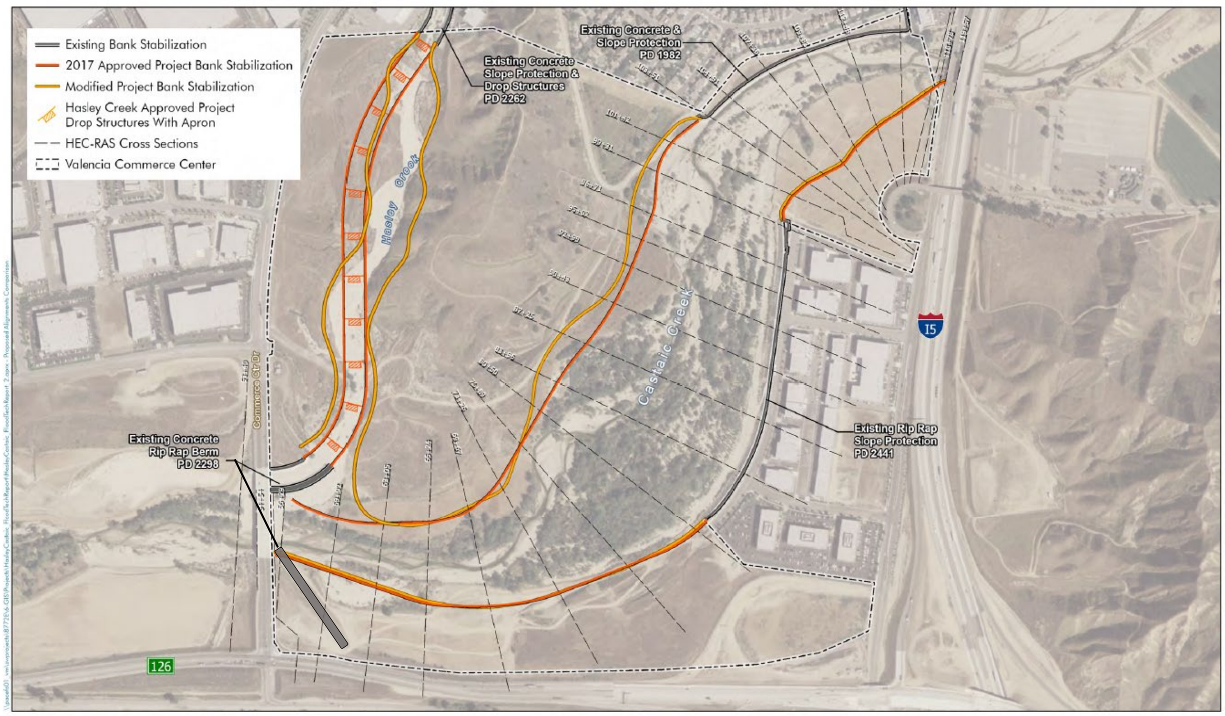

Figure 4. Existing, 2017 Approved Project and Modified Project Bank Protection Alignments for Castaic and Hasley Creeks.

In summary of the analysis, the changes to the hydraulic conditions on Castaic Creek associated with the Modified Project are anticipated to reduce erosion and reduce disruption of established vegetation during all storm events as compared with the 2017 Approved Project. As such, the Modified Project would not result in any new or more severe significant impacts compared to those identified in the State-certified EIR with respect to this topic. From an impact perspective, the Modified Project's changes to the floodplain extents within Castaic Creek and Hasley Creek are environmentally beneficial, as the changes serve to preserve substantially more existing streambed, preserve more jurisdictional area, and provide stable systems for conveyance and flood protection through the subject reaches of both Castaic Creek and Hasley Creek. Further, the Project's site design and LID BMPs would minimize increases in runoff volume from the developed areas, which is the preferred method for controlling hydromodification impacts from new development.