Coyote Watershed

Preliminary Watershed Management Plan

Anderson Reservoir; Source: Santa Clara County Parks

Bren School of Environmental Science & Management

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Thuy-Tien Bui
Izzy Coiro
Priscilla Ta

Coyote Watershed and Key Issues

The Coyote Watershed is located in the South Bay Area of California, spanning the entirety of Santa Clara County and portions of San Mateo and Alameda Counties. It is the largest watershed in the Santa Clara Basin and serves as a critical water source for local ecosystems, industries, and communities. Coyote Watershed includes densely populated urban areas anticipated to grow larger which will strain water supply. The influence of local industries and commercial properties put additional pressures on water demands and contribute to the pollution of the watershed's numerous water bodies. Many of the streams in this watershed are listed as impaired, with identified issues that threaten water quality comprising high biochemical oxygen demand, excess nutrients and sediments, and toxic chemicals. Floods also threaten this watershed, with the valley floor characterized as a major flood zone due to the surrounding geology. Considering the diverse threats to water supply and quality, effective monitoring will be necessary to consistently assess conditions across the watershed. Ultimately, Coyote Watershed's diverse uses and threats highlights the need for a holistic approach to ensuring sustainable water resource management.

Objectives

Considering the key issues of Coyote Watershed, this preliminary watershed management plan aims to assess:

- Trends in water use and identify opportunities to meet water demands while balancing sustainable water supply.
- Sources of and trends in water quality impairment and identify best management practices (BMPs) to reduce pollution of impaired streams.
- Flood threat and identify BMPs to reduce flood risk.
- The distribution of current monitoring efforts and identify opportunities to address data gaps through increased monitoring or additional monitoring stations.

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1. COYOTE WATERSHED OVERVIEW

This preliminary watershed management plan (WMP) aims to assess the current conditions of Coyote Watershed and provide a framework for conserving water resources and protecting water quality. WMPs are developed to identify threats and recommend pathways to protect pristine or remediate impaired water resources. Coyote Watershed, located in the southern portion of the San Francisco Bay Area, provides water and habitat for local cities, industries, agriculture, and biodiversity. However, development, pollution, and droughts threaten the quality and quantity of water in the region. Considering the diverse uses and threats associated with Coyote Watershed, it is imperative to develop a plan that can balance the region's diverse water uses to ensure sustainable water resource management.

1.1 Location

The majority of the Coyote Watershed is in Santa Clara County, California in the San Francisco Bay Hydrologic Region (Figure 1.1). The northern boundary of the watershed extends into the eastern region of San Mateo County and the southern region of Alameda County. It is the largest watershed in the Santa Clara basin, covering approximately 852 square miles extending longitudinally from the city of San Felipe to south San Francisco Bay and latitudinally from the Diablo Range to the flanks of the Santa Cruz Mountains. The watershed is approximately 58 miles long and 22 miles wide. The Coyote Watershed encompasses highly populated cities such as San Jose, Santa Clara, and Sunnyvale.

Figure 1.1. Map of the Coyote Watershed Boundary and Location. The Coyote Watershed is an 852 square mile watershed located in the San Francisco Bay Hydrologic Region in North Central California. The map shows the watershed boundary and its location within the state of California.

1.2 Topography

The Coyote Watershed's diverse topography slopes downward in elevation into the Santa Clara Valley from the east and west mountain ranges (Figure 1.2). The northern and central portions of the watershed comprise the valley floor with the lowest elevations at 10 meters below sea level. The valley is the flattest and most heavily developed portion of the watershed draining northward into the tidal estuary of South San Francisco Bay (Lowe et al. 2021). Towards the flanks of the Diablo and Santa Cruz Mountain Ranges, elevation peaks at 1156 meters above sea level. These eastern, western, and southernmost regions are primarily steep, rural, or undeveloped (Lowe et al. 2021).

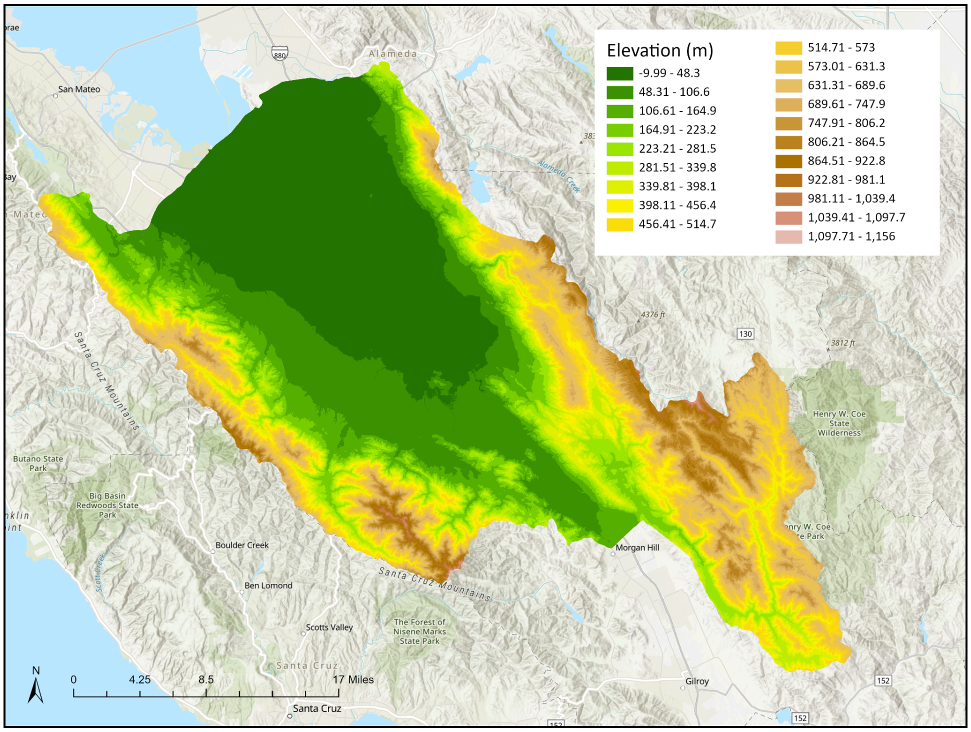

Figure 1.2. ⅓ Arc Digital Elevation Model for the Coyote Watershed. *DEM Source: USGS 3D Elevation Program.* The Digital Elevation Model (DEM) shows peak elevations near the eastern and western mountain ranges and lowest elevations in the Santa Clara Valley Floor.

1.3 Climate

The Coyote Watershed is located in a Mediterranean type climate characterized by sharply contrasting wet and dry seasons. Santa Clara County, which comprises the majority of the Coyote Watershed, has an average maximum monthly temperature of 20.2°C, an average minimum monthly temperature of 9.2°C, and an average mean monthly temperature of 14.7°C for the period of 1940-2023 (Figure 1.3; PRISM Climate Group, 2023). The region receives an average of 508.38 mm of precipitation annually, with 82% of total annual precipitation falling during the wet season from November to March (Figure 1.4; Miller & Null 2015). Average annual precipitation varies between approximately 381 mm in the valley to 635 mm in the watershed's headwaters (Lowe et al. 2021). Rainfall outside of the wet season months is sparse and minimal during summer months (Miller & Null 2015).

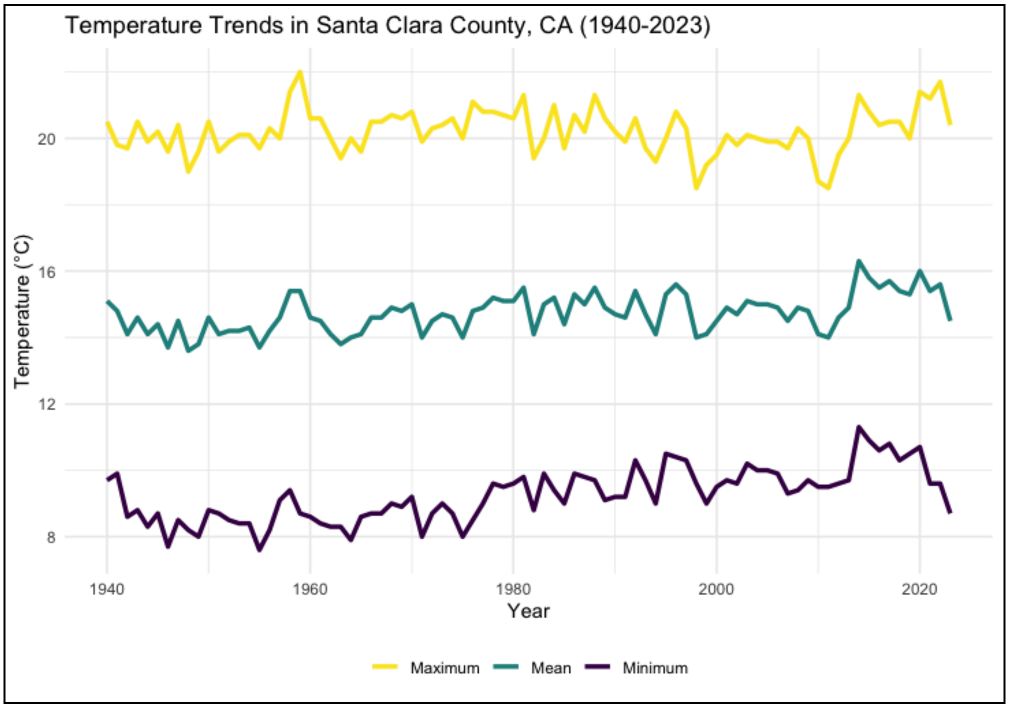

Figure 1.3. Temperature Trends in Santa Clara County from 1940-2023. *Data Source: PRISM Climate Group.* Fluctuations in annual minimum, maximum, and mean annual temperatures (°C) over an 83 year period in Santa Clara County, California show a general increase in annual temperatures between 1975 and 2014 and a general decrease in recent years (2014-2023).

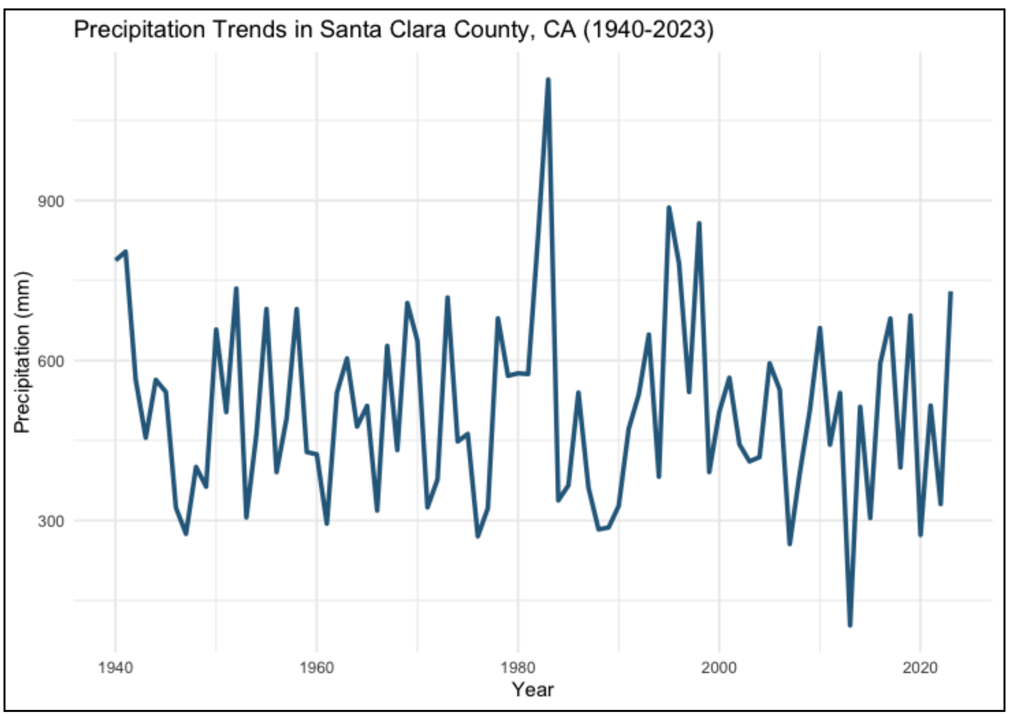

Figure 1.4. Annual Precipitation Trends in Santa Clara County from 1940-2023. *Data Source: PRISM Climate Group.* Annual average precipitation (mm) over an 83 year period in Santa Clara County, California shows precipitation peaked in 1983 and was lowest in 2013.

1.4 Geology

The Coyote Watershed is in the Coast Range geomorphic province of California, which is characterized by thick Mesozoic and Cenozoic sedimentary strata (Wagner, 2002). Franciscan Complex surrounds the valley of the watershed, where Quaternary alluvium dominates (Figure 1.5; Langenheim et al., 2015). As shown in Figure 1.6, Coyote Watershed is predominantly characterized by soils with high clay content, and slow to very slow infiltration rates that yield large amounts of runoff during winter storms. These slowly infiltrating soils are distributed across nearly the entire extent of the watershed, with the only exception occurring along the ridgeline of the Santa Cruz Mountains (Figure 1.6). Here, the sandy loam soils facilitate higher infiltration rates which reduces the potential for runoff (Figure 1.6).

The Coyote Watershed is also located in a geologically active area, as it is positioned within the San Andreas Fault system. The San Andreas Fault system consists of multiple right-lateral strike-slip faults facilitating transverse movement along the North American and Pacific plates. The San Andreas fault borders the western edge of the watershed, while the Calaveras and Hayward faults occupy the northeastern edge (Figure 1.5). The Silver Creek fault bisects the watershed, as it runs along the center from the San Francisco Bay to Anderson Reservoir in Morgan Hill.

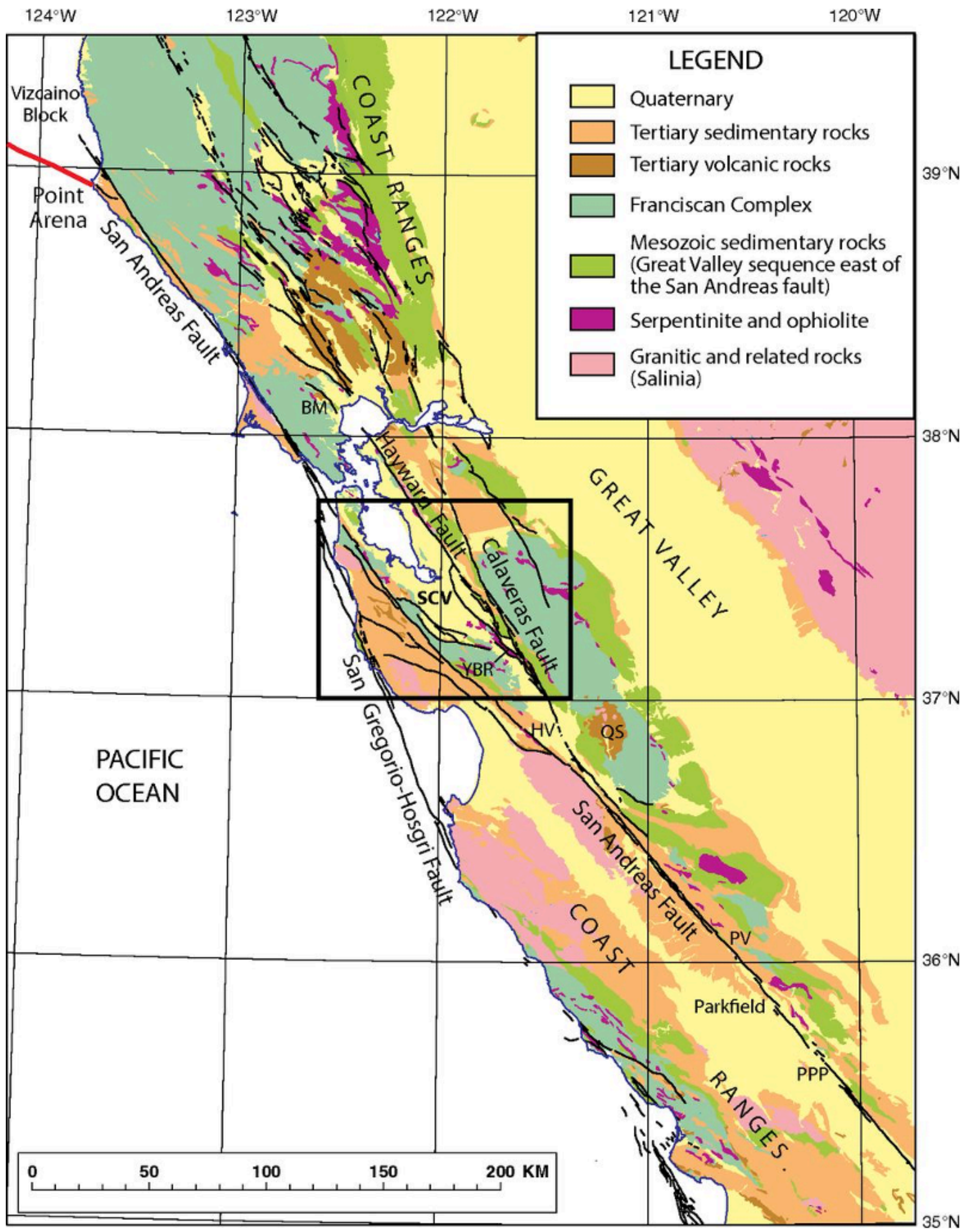

Figure 1.5. Major Geological Features of Santa Clara Valley. *Source: Langenheim et al., 2015.* The Coyote Watershed is located within the Santa Clara Valley (SCV), which is highlighted by the black box. Major geological features are noted in different colors, with black lines representing Quaternary faults.

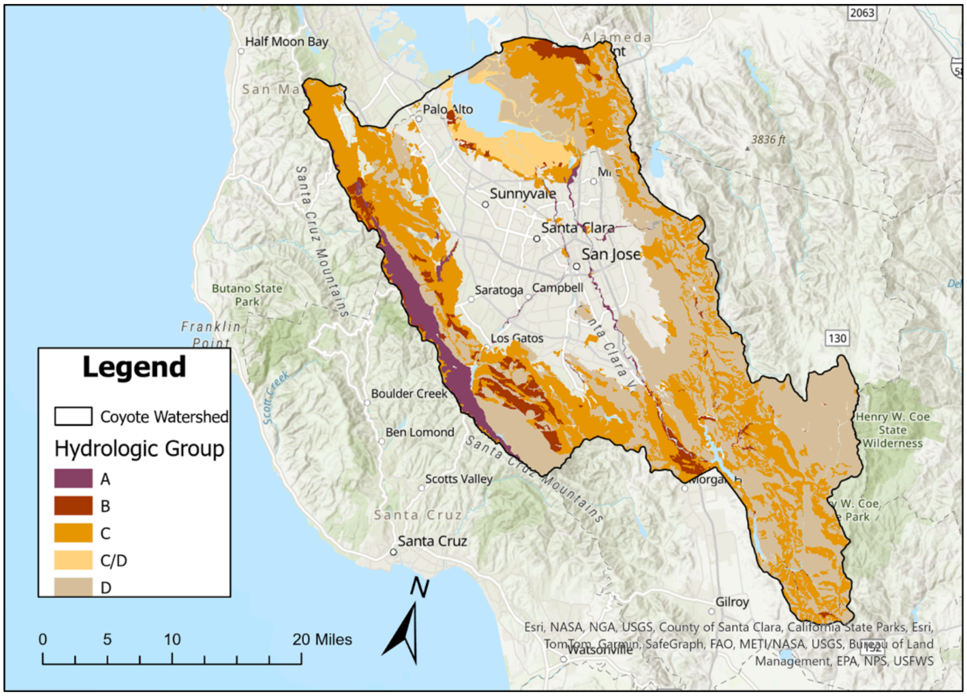

Figure 1.6. Distribution of Soil Hydrologic Groups in Coyote Watershed. Colored polygons represent distinct soil hydrologic groups found within the Coyote Watershed in Santa Clara County, California. Groups differ by infiltration rate, with A having high, B moderate, C slow, and D very slow infiltration. Group C/D have combined soils with slow and very slow infiltration.

1.5 Soil

The areas east of Coyote Creek and adjacent to the San Francisco Bay (baylands) are predominantly clay and silty clay soils (Figure 1.7). Although clay soils are porous, permeability is low due to the small pore size and tightly packed structure restricting water movement through the soil. This increases runoff risk. This is apparent in the baylands and eastern portion of the watershed where soils have very low to moderately low (0.001 - 1 um/s) permeability (Figure 1.8). Although clay particles aggregate when wet, clay and silt particles are easily erodible once disaggregated because they are lighter and easier to transport (O'Geen et al., 2006). For this reason, areas with clay and silty clay soils also have higher potential for erosion (Figure 1.9).

The areas west of Coyote Creek have loam soil, with sandy clay loam in the valley transitioning to silt loam and sandy loam as elevation increases (Figure 1.7). Loam soils are a blend of sand, silt, and clay, which allows for diversity in pore size and higher permeability compared to clay soils. The valley floor contains sandy clay loam and silt loam which has moderately high permeability (1.001 - 10 um/s) (Figure 1.7, 1.8). Moving westward, soil texture transitions to sandy loam which has a larger pore size and loosely packed structure facilitating higher permeability. This is illustrated in Figure 1.8 where the areas adjacent to the Santa Cruz Mountains have high to very high permeability (10.001 - 373 um/s). These soils are also less erodible - likely due to the higher sand content which is heavier to transport and facilitates greater water movement through the soil.

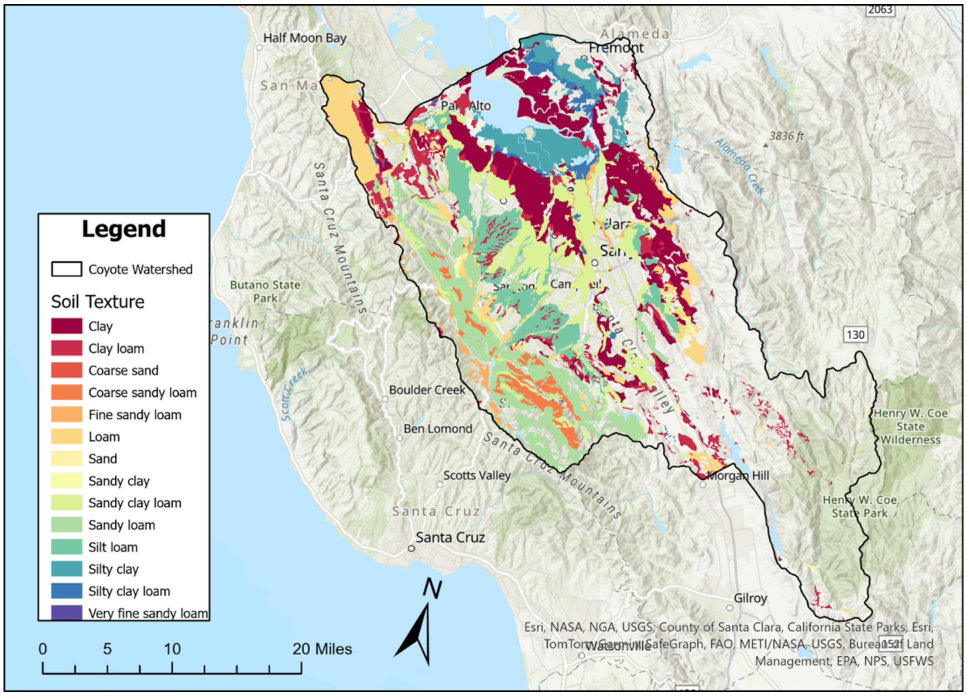

Figure 1.7. Soil Textures of Coyote Watershed. Colored polygons represent unique soil textures present in Coyote Watershed in Santa Clara County, California.

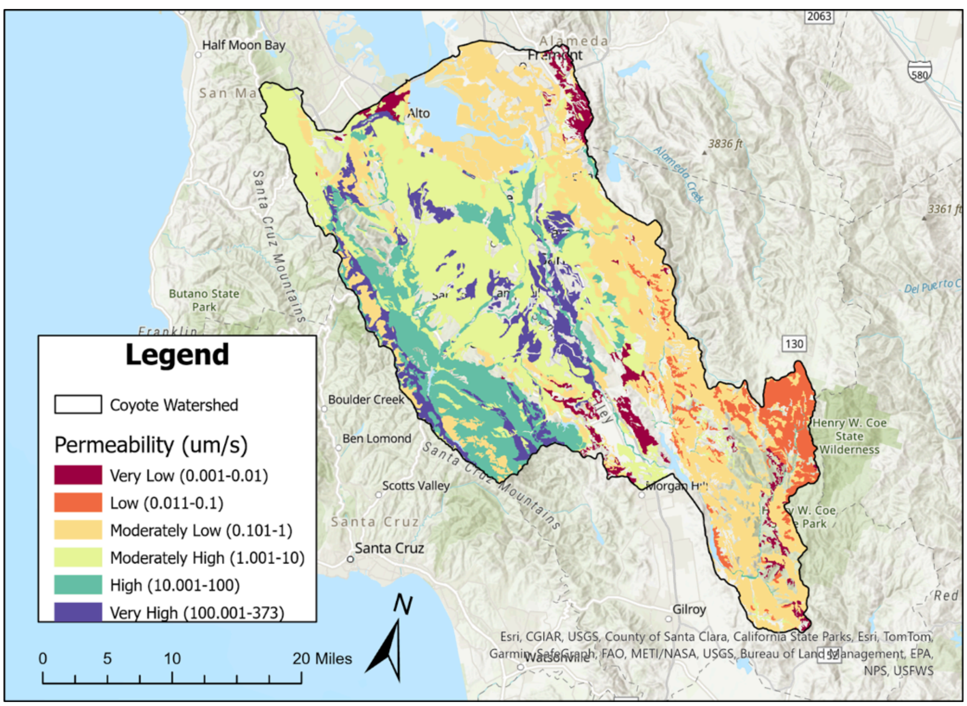

Figure 1.8. Soil Permeability of Coyote Watershed. Different classes of soil permeability are shown in different colors for Coyote Watershed. Soil permeability can be classified as very low (≤ 0.01 um/s), low (≤ 0.1 um/s), moderately low (≤ 1 um/s), moderately high (≤ 10 um/s), high (≤ 100 um/s), and very high (> 100 um/s). The range of soil permeability observed in Coyote Watershed is between 0.001 - 373 um/s.

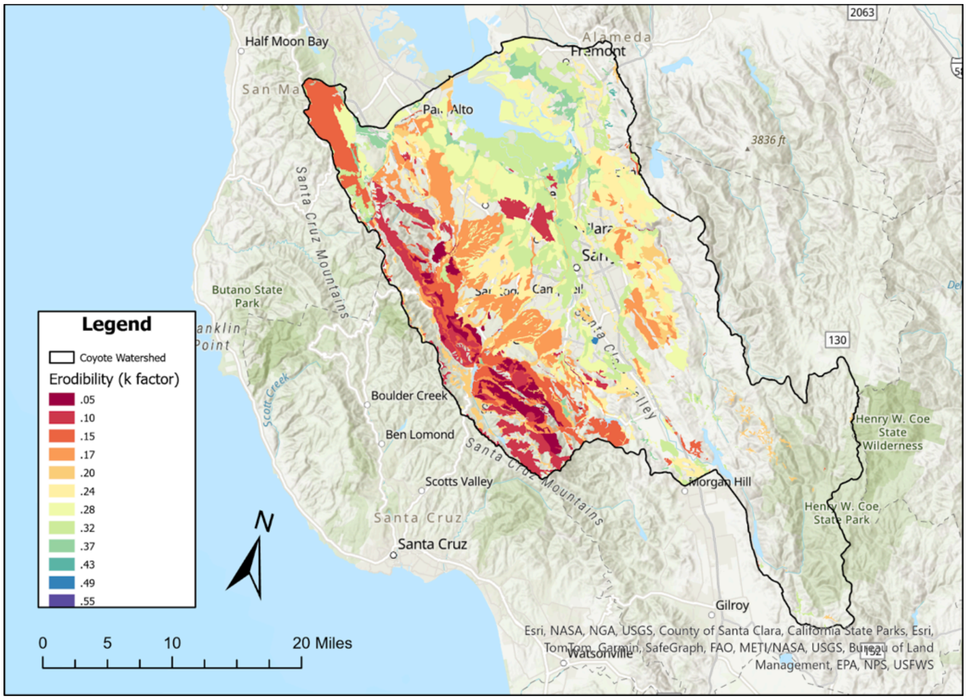

Figure 1.9. Soil Erodibility of Coyote Watershed. The erodibility of soils in Coyote Watershed are depicted by different colors. Soil erodibility is reported in k-factor units, with a lower k-factor associated with lower erosion potential. The range of soil erodibility observed in Coyote Watershed ranges from a k-factor of 0.05 to 0.55.

1.6 Hydrology

In Figure 1.10, the various rivers, streams, and other bodies of water are outlined in the Coyote Watershed. The watershed spans three counties: Santa Clara, Alameda, and San Mateo; and its hydrology stems from canals within the San Francisco Bay. As the water flows out from the bay, the bodies of water turn from tributaries to rivers, to streams, continually branching out to cover the whole of the area. There are also five lakes within the watershed, with both inputs and outputs of rivers and streams. Anderson Lake and Coyote Lake are two large reservoirs impounded by dams.

Coyote Creek is the longest creek in the county and the main waterway of the Coyote Watershed, running 63.6 miles. The watershed serves as a source of drinking water for 270,000 residential and commercial users, through the Penitencia Water Treatment Plant (Valley Water).

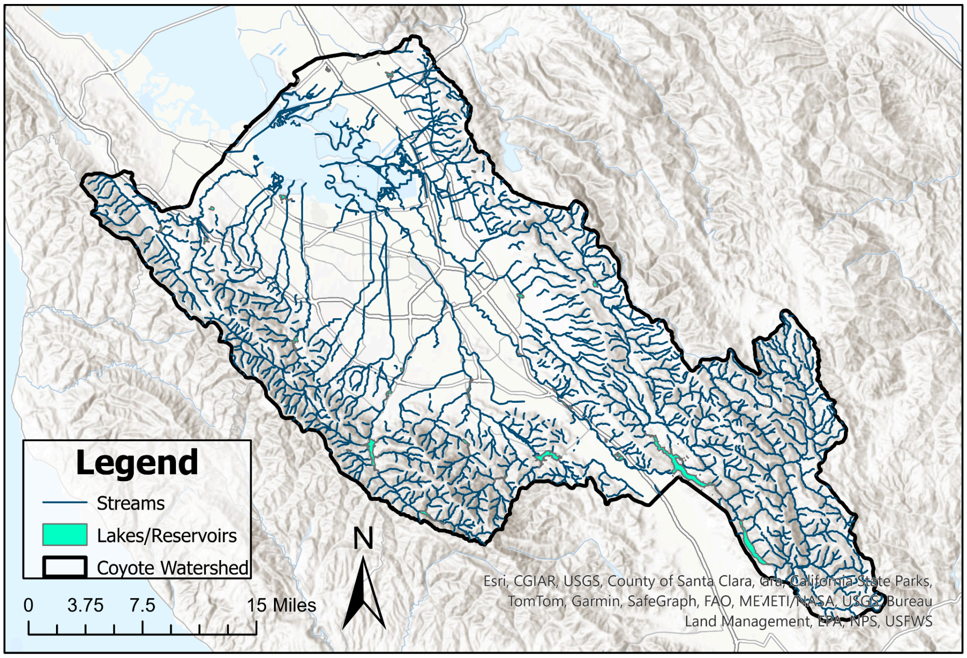

Figure 1.10. Hydrology of Coyote Watershed. Various water bodies in Coyote Watershed are shown with streams noted in dark blue, and lakes and reservoirs in turquoise.

1.7 Land-Use

The Coyote Watershed spans 852 square miles of area within three counties, with the majority of land cover classified as "forest" or "developed", as is depicted in Figure 1.11. Large portions of the Coyote Creek Hills region are publicly owned and protected park land. This includes a number of protected areas and open-space preserves and privately held large ranches that are used for grazing and resource management (Lowe et al. 2021). Most forest lands are either mixed forest (evergreen and deciduous together) or solely evergreen forest. The Coyote Creek Watershed Plan aims to focus on ecosystem health rather than political jurisdictions when it comes to land and water management, with much of the forest cover being parks for recreational use (Coyote Watershed). In contrast, the Santa Clara Valley Floor has been largely altered by development, with dense urban areas in the cities of San Jose, Milpitas, Sunnyvale, and Fremont. The southern portion of the valley consists of agricultural lands and rural residential land uses (Lowe et al. 2021).

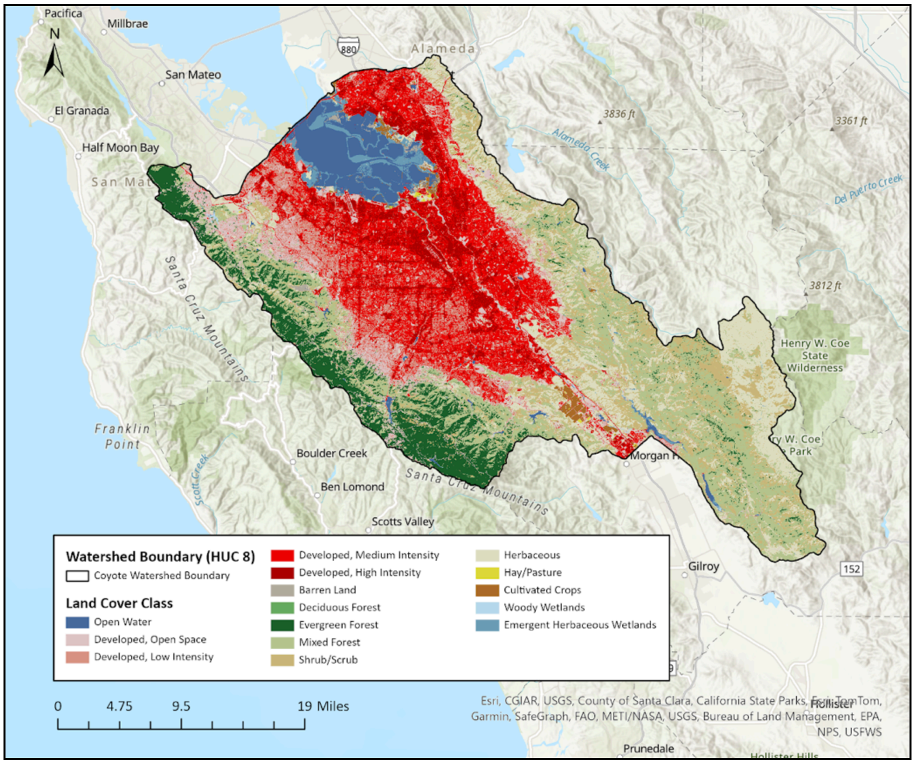

Figure 1.11. Land Use Classification in Coyote Creek Watershed. The various land cover classes that occur in the Coyote Watershed are depicted with different colors, with the largest being Developed Land, in red. There are also large areas of Evergreen and Mixed Forests in green, and some Open Water due to the inclusion of the San Francisco Bay.

1.8 Biological Assets

Coyote Watershed is home to over 100 special status species that rely on the region's diverse ecosystems for food and shelter (Valley Water, 2022). Major ecosystems include chaparral, coastal sage scrub, conifer woodlands, grasslands, oak woodlands, riparian forests, and wetlands. The region's serpentine grasslands and scrublands support endemic plants such as the federally endangered Tiburon Paintbrush, Metcalf Canyon Jewelflower, and Coyote Ceanothus. The nectar plants found in these grasslands and scrublands are a vital food source for the threatened Bay Checkerspot Butterfly (Valley Water, 2022). California Red-Legged Frogs and Tiger Salamanders rely on all of these ecosystems for movement habitat, but critical breeding and foraging habitat for these species are found in riparian forests and wetlands (ICF International, 2012). Riparian forests and other woodlands also provide important habitat for migratory birds and provide shade for aquatic life, such as the threatened Central Valley distinct population of Steelhead Trout (Valley Water, 2002).

The region's diverse ecosystems also provide critical services for local human communities such as: erosion control, nutrient cycling, pollination, water storage and transport, and water quality regulation. Despite the ecological significance of these ecosystems, urban expansion, flood control projects, agriculture, invasive plants, aggregate mining, and the legacy of quicksilver mining continue to pose significant threats to habitat quality and ecosystem services (ICF International, 2012).

1.9 Summary

The Coyote Watershed, located primarily in Santa Clara County and extending into Alameda and San Mateo counties, is the largest watershed in the region, covering 852 square miles. It features diverse landscapes, from urban areas like San Jose to rural, undeveloped mountain regions. It is located in a Mediterranean climate marked by wet winters and dry summers. The watershed's geology is shaped by its location in the San Andreas Fault system, resulting in complex soil dynamics, where clay-heavy soils cause slow infiltration and increased runoff, while sandy loam in higher elevations promotes better drainage. That drainage leads to Coyote Creek, the longest waterway in the county, which serves as a vital water source for 270,000 residents. The watershed’s ecosystems are home to over 100 special status species, including endangered plants and animals like the Tiburon Paintbrush and Bay Checkerspot Butterfly, which thrive in specialized habitats such as serpentine grasslands and riparian forests. Despite its ecological significance and the essential services it provides, including water regulation and erosion control, the watershed faces ongoing threats from urban expansion, agriculture, invasive species, and past mining activities. Due to the high value of the Coyote watershed and the benefits that can be derived from its land, water, and biodiversity, efforts to manage the watershed focus on balancing human development with the preservation of its natural ecosystems and resources.

2. DEMOGRAPHICS, WATER SUPPLY, AND WATER DEMAND

Watersheds in California face increasing pressures on their water supply due to climate-change-induced drought impacts and rising population demands. The challenge of balancing water needs across human sectors and ecosystems underscores the importance of sustainable water management. Understanding trends in population demographics, water supply, water usage, and water demand can inform future management of water resources and allocation. The Coyote Watershed serves as a critical water source for local ecosystems, wildlife, and densely populated human communities. Managing this balance requires careful planning and sustainable water resource management to ensure that the supply can meet the future demands of a growing population without depleting the watershed's natural resources.

2.1 Current Population and Projected Population Growth

The Coyote Watershed primarily spans Santa Clara County in the San Francisco Bay Area, California, with the northeastern and northwestern portions covering parts of San Mateo and Alameda County. Combined, the current population sizes of these three counties are 4,383,054 (U.S. Census Bureau, 2020). Each county has demonstrated an average 10-year population growth rate of greater than 5%, which was used to project the population sizes for the year 2030 (Table 2.1). Santa Clara County has been the largest contributor to the Coyote Watershed's population size since 1990, followed by Alameda County and San Mateo County (Figures 2.1 and 2.2).

Table 2.1. Coyote Watershed Counties Population Data. *Data Source: U.S. Census Bureau.*

County	Population Size					Average 10 Year Growth Rate
	1990	2000	2010	2020	2030	
Santa Clara	1,497,577	1,682,585	1,781,642	1,936,259	2,110,002	8.97%
San Mateo	649,623	707,161	718,451	764,442	807,391	5.62%
Alameda	1,279,182	1,443,741	1,510,271	1,682,353	1,844,233	9.62%
Total Population Size (2020 Census)				4,383,054		

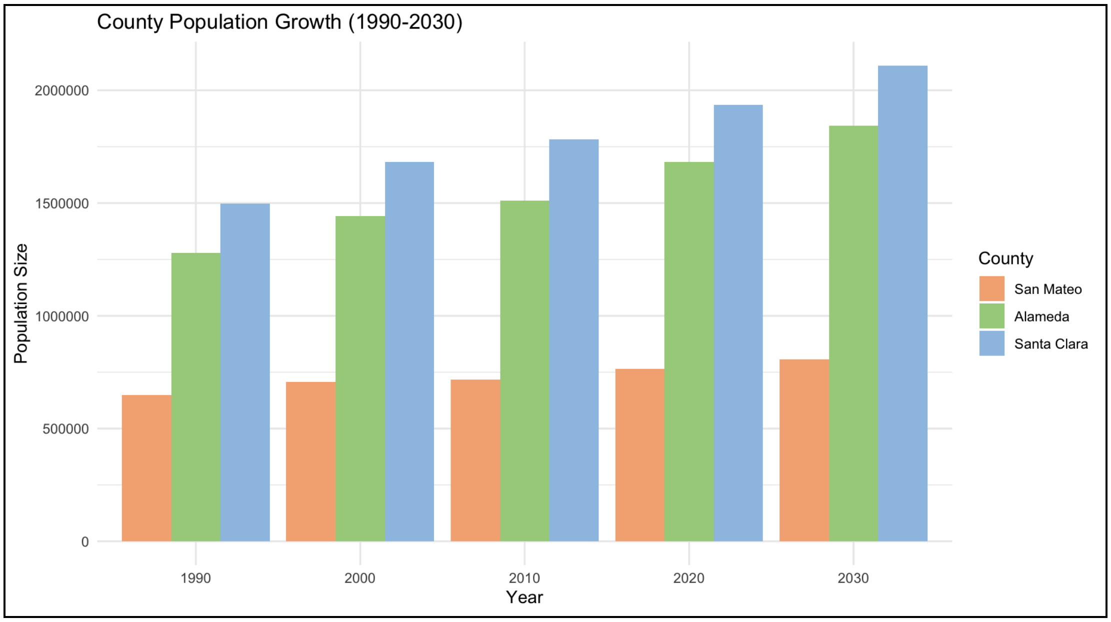

Figure 2.1. Coyote Watershed Decennial Population Size by County (1990-2030). Population size for three counties within the Coyote Watershed demonstrates trending growth since 1990 and is projected to increase further by 2030.

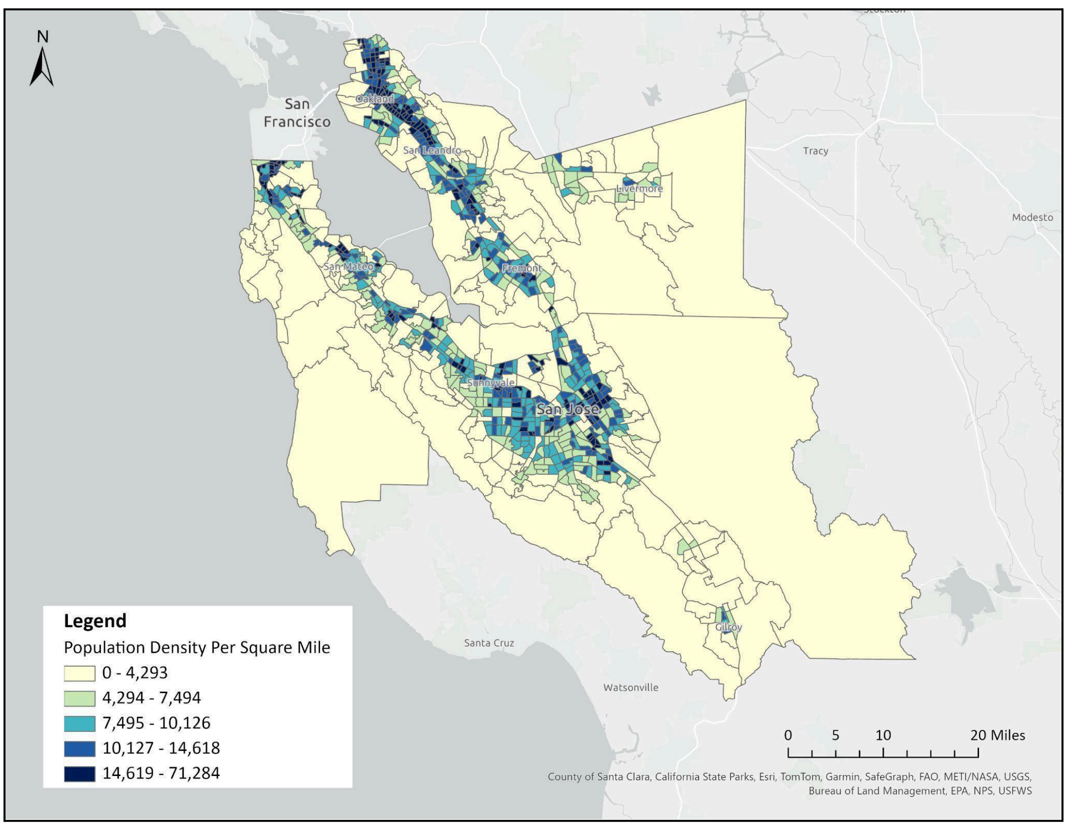

Figure 2.2. Population Density within Alameda, Santa Clara, and San Mateo County Census Tracts. *Data Source: U.S. Census Bureau.* The map shows population density per square mile broken down into 5 quantile classes. Population density is highest in developed, urban cities such as San Jose, Fremont, and Milpitas.

Coyote Watershed is in a region with high economic activity. Here, the high-tech, manufacturing, and health science industries dominate. For the counties that make up Coyote Watershed, the median household income is $104,888, $128,091, and $130,890 for Alameda, San Mateo, and Santa Clara counties respectively (Table 2.2). When evaluating the average per capita income, however, values are lower at $49,883, $64,450, and $52,297 for Alameda, San Mateo, and Santa Clara counties respectively (Table 2.2).

Coyote Watershed encompasses the entirety of Silicon Valley, a world-renowned hub for technological innovation that attracts national and international talent. However, the tech and manufacturing industries are major water consumers as they require large volumes of water to cool data centers and manufacture semiconductors and other advanced technology. These impacts, combined with the influx of people employed in tech, contributes to the growing population which threatens water quantity and quality in the region. Coyote Watershed also encompasses densely populated urban areas projected to house at least 2.1 million people by 2030 (Table 2.1). As such, high human activity and urban development also threaten to reduce water resources and pollute water quality. Agriculture occurring at the outskirts of urban areas also threaten to contaminate water resources and negatively impact watershed health.

Table 2.2. 2016-2020 Financial Characteristics of Counties in Coyote Watershed. Median household income (US dollars) and per capita income (US dollars) were reported for Alameda, San Mateo, and Santa Clara counties. Incomes reflect inflation adjusted values. Information was sourced from the US Census Bureau American Community Survey's 5-year estimates for the period 2016 to 2020.

County	Median Household Income ($)	Per Capita Income ($)
Alameda	104,888	49,883
San Mateo	128,091	64,450
Santa Clara	130,890	52,297

2.2 Water Supply

All of Coyote Watershed's water supply originates from groundwater or surface water, whether it is local or imported. In Figure 2.3, the total water supply is compared in each county, with delineations between groundwater and surface water. Through time, more surface water is being supplied than groundwater, and the overall supply appears to be increasing with some variability over the years. Rainwater and runoff is typically combined with imported water and then put back into creeks and reservoirs, to maintain groundwater levels and natural percolation (Santa Clara Valley Water, 2024). Much of the surface water is filtered through wastewater treatment plants (WWTPs), and some of that water is recycled, or reclaimed, as seen in Figure 2.4. Due to the higher populations and water supply in Santa Clara and Alameda, those counties have greater amounts of reclaimed water than San Mateo County. However, Alameda County recycles their water more efficiently than Santa Clara County, having a higher amount of reclaimed water, but a lower level of water supply and a lower population.

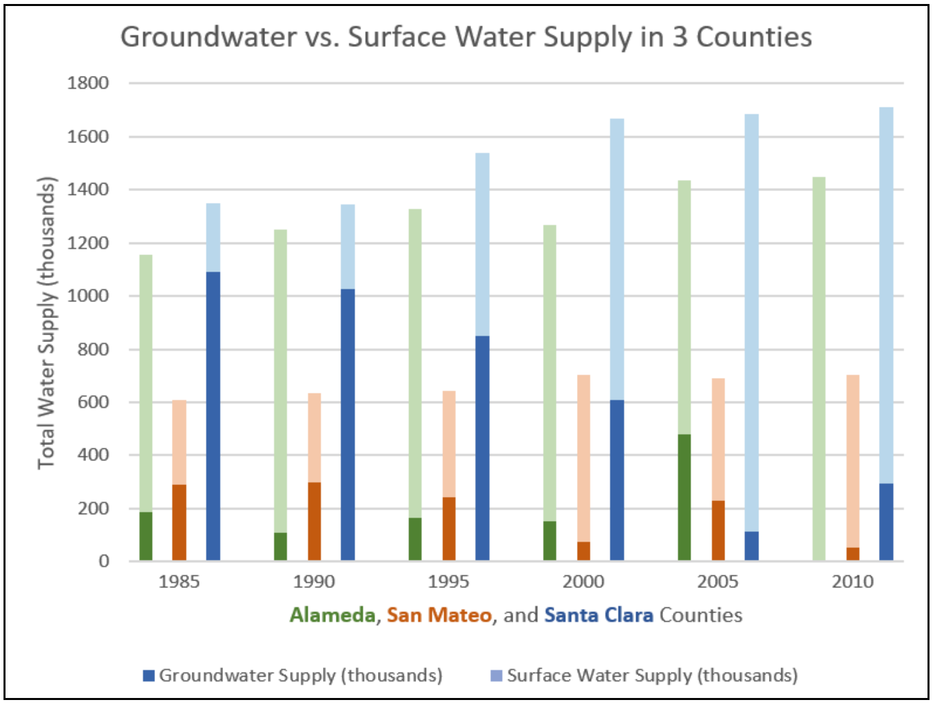

Figure 2.3: Groundwater vs. Supply Water Supply in Alameda, San Mateo, and Santa Clara Counties from 1985-2015. According to USGS data from 1985-2015, Santa Clara (blue) has a greater water supply than Alameda (green), and both have a much higher water supply than San Mateo (orange). It seems to be a trend that in all three counties surface water (lighter color) makes up the majority of water supply compared to groundwater (darker color), and that both the overall supply and the surface water supply is increasing as time goes on.

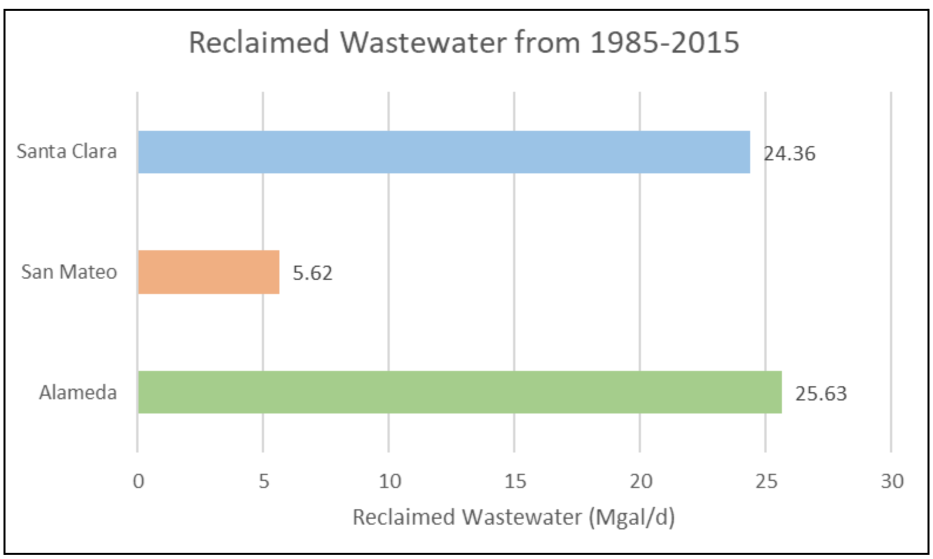

Figure 2.4: Reclaimed Wastewater in Mgal/d for Santa Clara, San Mateo, and Alameda Counties from 1985-2015. According to USGS data, from 1985-2015, Alameda County reclaimed (or recycled) 25.63 Mgal/d of their wastewater, Santa Clara reclaimed 24.36 Mgal/d of their wastewater, and San Mateo reclaimed 5.62 Mgal/d of their wastewater. San Mateo shows a trend throughout this analysis of having a lower supply of water than the other two counties, which explains why their reclaimed water would be at such a low amount.

Over half of Coyote Watershed's municipal water supply comes from imported sources. In Santa Clara County, 55% of the county's water supply comes from the federal Central Valley Project (CVP), California State Water Project (SWP), and San Francisco Public Utilities Commission's Regional Waterway System (SFPUC RWS) (Figure 2.5; Hemeter et al., 2019). In Alameda and San Mateo counties, 83% of municipal water supply comes from SFPUC RWS, SWP, and the Santa Clara Valley Water District (Figure 2.6; BAWSCA, (n.d.)). Reclaimed water comprises only 5% of water supply in Santa Clara County, and 4% in Alameda and San Mateo counties (Figures 2.5 and 2.6; Hemeter et al., 2019; BAWSCA, (n.d.)).

Considering the strain of a growing population, industry, drought, and variability of imported water availability on local water supply, efforts to diversify water sources and decrease reliance on imported water sources is critical for Coyote Watershed. As shown in Figure 2.7, water supply is predicted to fall short of meeting water demand as early as 2025 in Santa Clara County. This highlights the importance of seeking opportunities to recharge groundwater, increase water reuse, or find additional imported water sources beyond the CVP, SWP, and SFPUC RWS supply could aid in more reliable water supply.

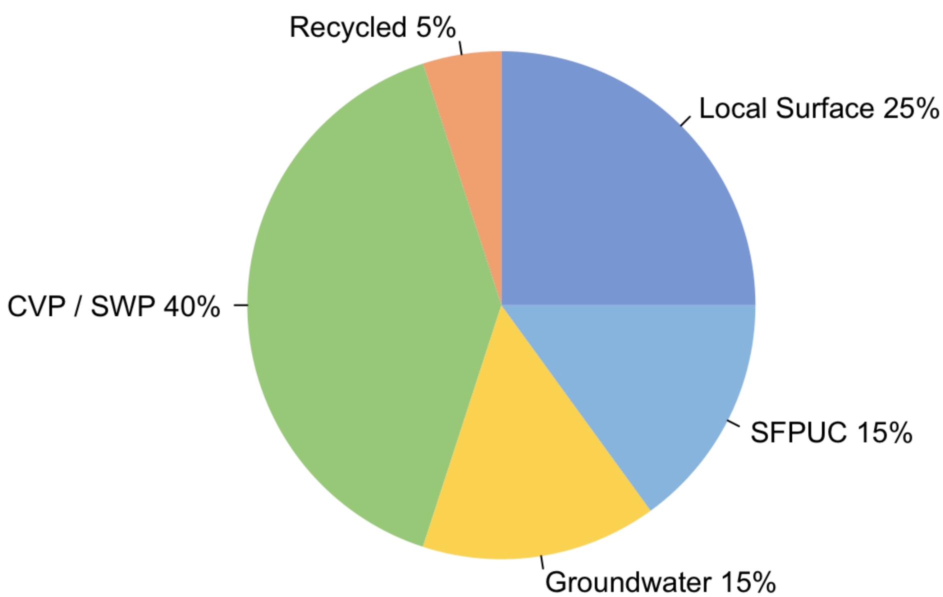

Figure 2.5. Santa Clara County Historic Water Sources. *Source:* Hemeter et al., 2019. The pie chart illustrates the percent contribution of different water sources to Santa Clara County's total water supply. Imported water sources include the Federal Central Valley Project (CVP), California State Water Project (SWP), and San Francisco Public Utilities Commission's (SFPUC) Regional Waterway System. Local sources include local surface water, groundwater, and recycled water.

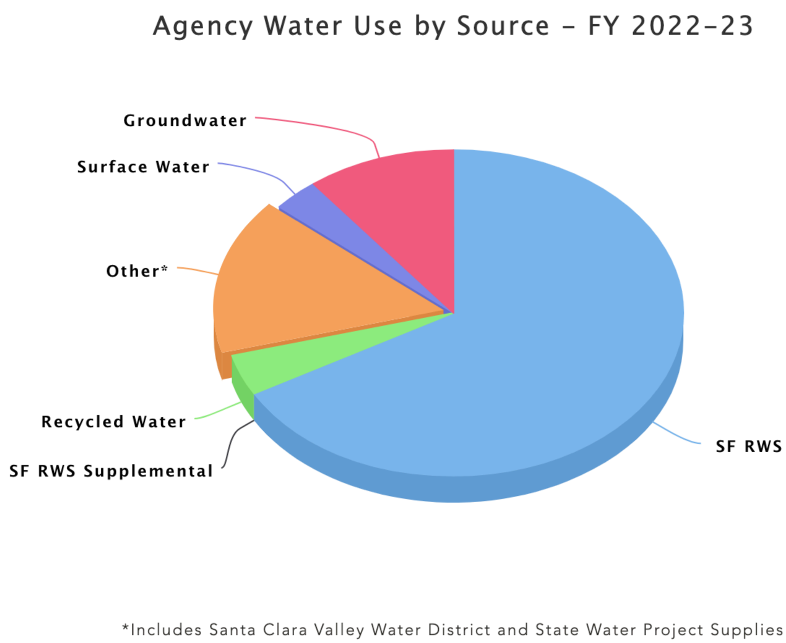

Figure 2.6. 2022-2023 Water Sources for Bay Area Water Supply & Conservation Agency Member Organizations. *Source: BAWSCA, n.d.* The pie chart depicts the percent contribution of different water sources to Bay Area Water Supply & Conservation Agency (BAWSCA) member organizations. Member organizations include the Alameda County Water District and multiple municipalities part of San Mateo County. Imported water sources include the San Francisco Public Utilities Commission Regional Water System (SF RWS), Santa Clara Valley Water District, and California State Water Project. Local sources include local surface water, groundwater and recycled water.

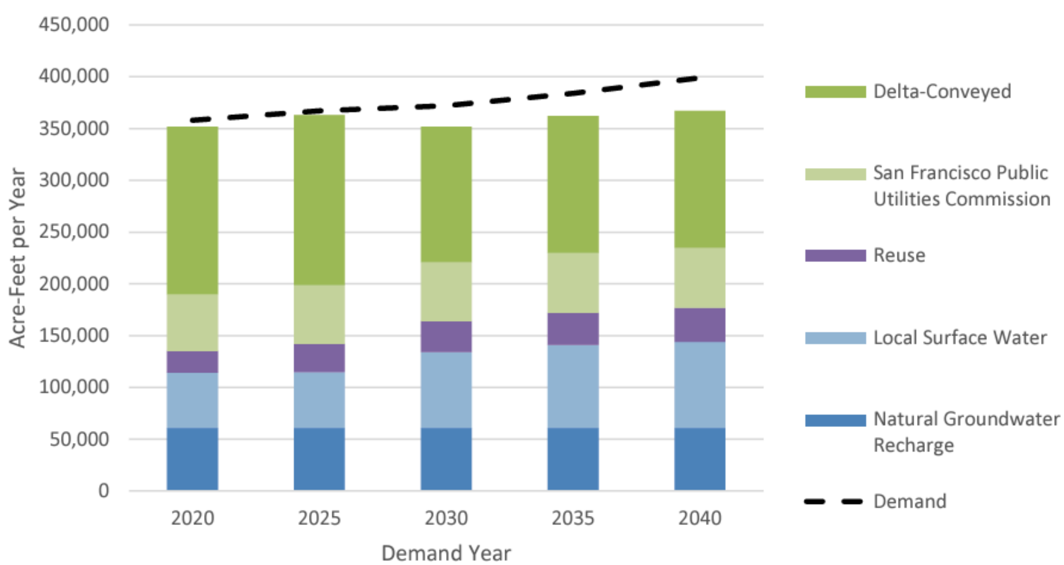

Figure 2.7. Average Water Supply Through 2040. *Source: Hemeter et al., 2019.* The average amount of water, calculated in acre-feet per year, supplied to Santa Clara County by different sources was modeled for 2020 to 2040 in five year intervals. Water sources include Delta-Conveyed (dark green), San Francisco Public Utilities Commission Regional Water System (light green), recycled water (purple), local surface water (light blue), and natural groundwater recharge (dark blue). Water demand was also modeled for this time period and is represented by the black dotted line.

2.3 Water Demand

Due to a higher population in both Santa Clara and Alameda counties compared to San Mateo County, the overall water demand in these two counties is higher. From 1985-2015, Santa Clara had a total use of about 327.52 Mgal/d, Alameda's total use was about 209.08 Mgal/d, and San Mateo's total water use was about 121.06 Mgal/d (USGS). Alameda is more efficient with their water use and recycling than Santa Clara, but Santa Clara also has a slightly higher population. In Figures 2.8, 2.9, and 2.10, the water demand is outlined for each county (Alameda, San Mateo, and Santa Clara respectively) with percentages of the type of use. The leading cause of demand in each county is for household uses, such as drinking water, food preparation, or cleaning purposes. This results in the average residential water use per capita throughout the three counties being 26.8 gallons per day per person. The use per capita was slightly higher in Alameda county in 1985 than in San Mateo or Santa Clara, but by 1995 Alameda's use had decreased and San Mateo and Santa Clara's use per capita had increased (Figure 2.11). The second leading cause of water use across the watershed was irrigation for agricultural fields or golf courses (Figure 2.8, 2.9, 2.10). Of the total acres irrigated in each county comprising Coyote Watershed, at least 75% of the irrigated acres were crop fields while the remaining were golf courses (Figure 2.12). There is significant use of water for industrial and commercial purposes, but not much used for livestock or mining. There is no significant trend in the data of water demand increasing or decreasing, rather it has remained steady around the same point from 1985-2015 (USGS).

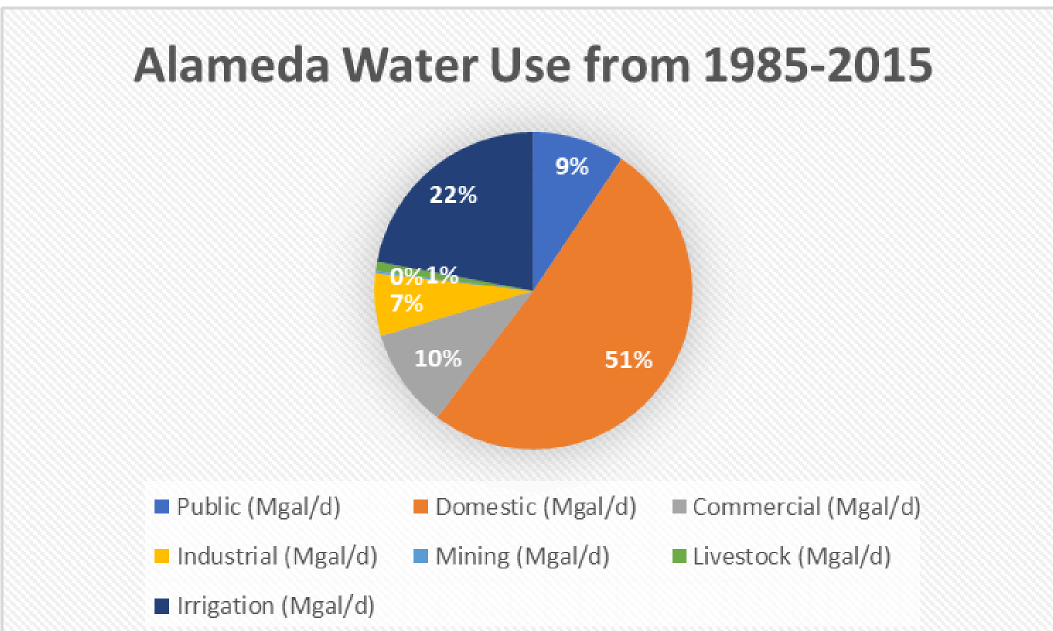

Figure 2.8: Alameda Water Use Makeup from 1985-2015. *Data Source: USGS.* The domestic use of water (household uses) makes up the majority (51%) of water consumption in Alameda County. There is quite a bit of demand for irrigation (22%); some commercial (10%), public (9%), and industrial (7%) use; and very little demand in regard to livestock (1%) and mining (<1%).

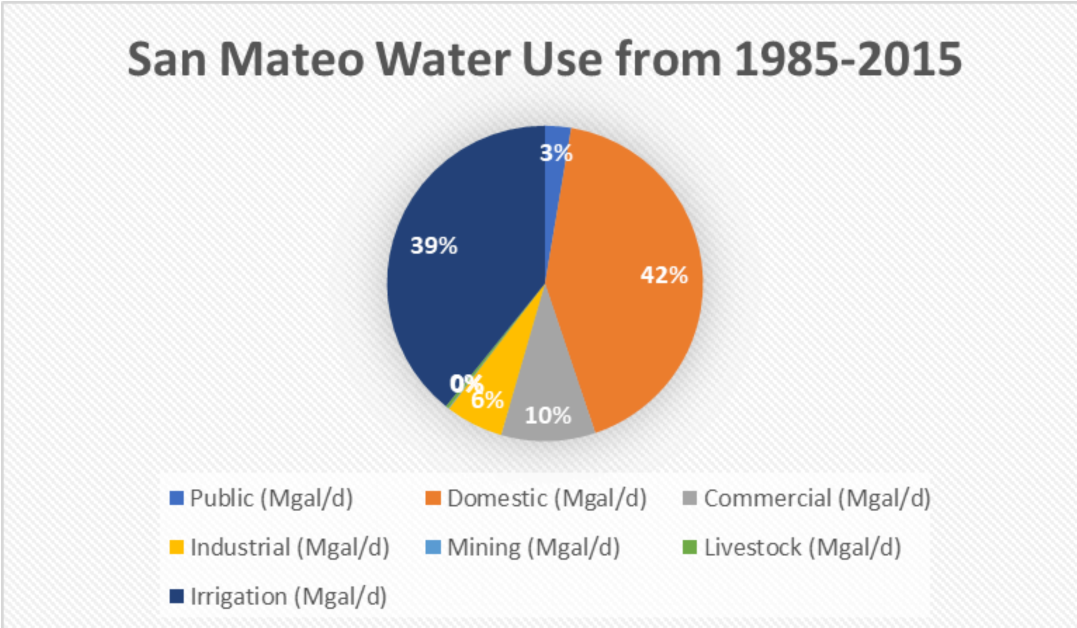

Figure 2.9: San Mateo Water Use Makeup from 1985-2015. *Data Source: USGS.* The domestic (42%) and irrigation (39%) uses of water make up the overwhelming majority of water consumption in San Mateo County. Other water demand comes from commercial (10%), industrial (6%), and public (3%) uses. Very little demand is related to livestock (<1%) and mining (<1%).

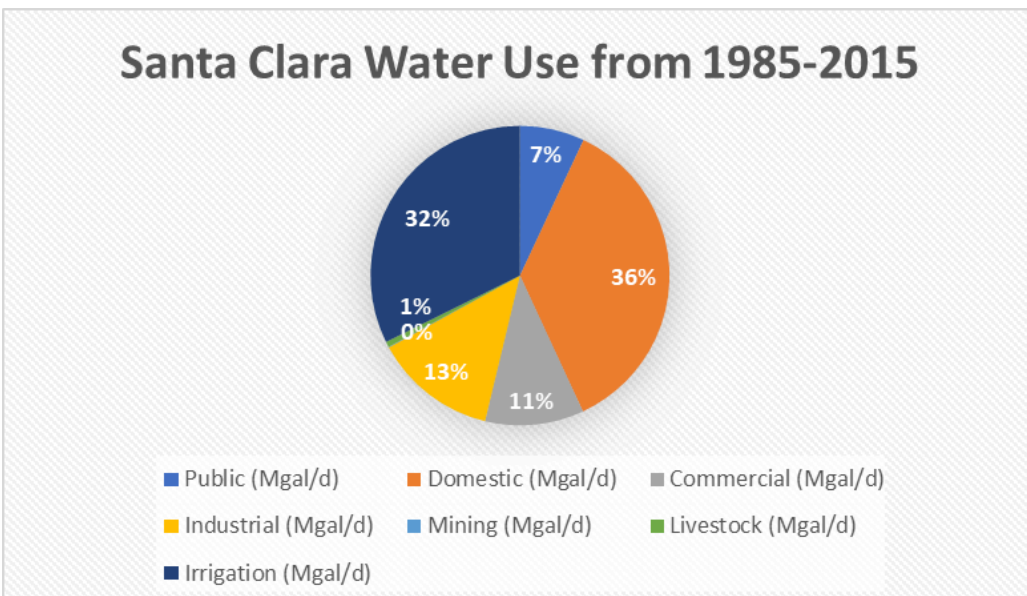

Figure 2.10: Santa Clara Water Use Makeup from 1985-2015. *Data Source: USGS.* The domestic (36%) and irrigation (32%) uses of water make up the majority of water consumption in Santa Clara County. Other significant water demand comes from industrial (13%), commercial (11%), and public (7%) uses. Very little demand is related to livestock (1%) and mining (<1%).

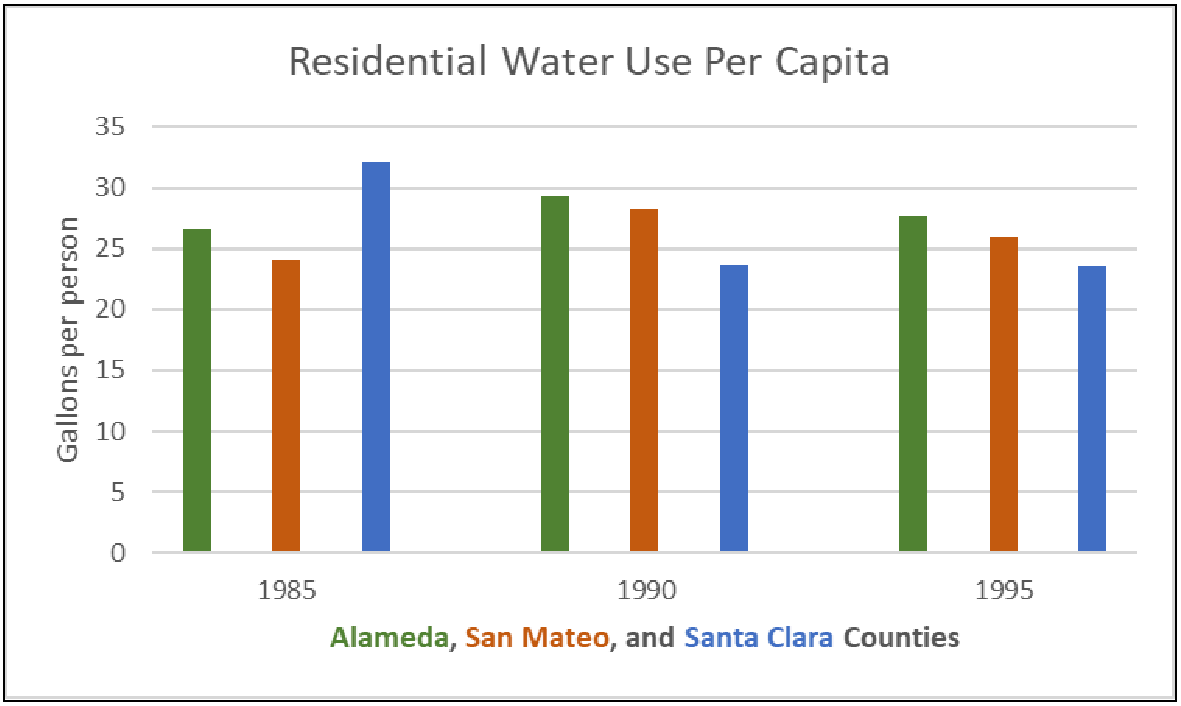

Figure 2.11: Residential Water Use Per Capita from 1985-1995 in Alameda, San Mateo, and Santa Clara Counties. *Data Source: USGS*. The daily water use in gallons is pretty consistent throughout the three counties, averaging to be between 26 and 27 gallons per person per day. The water use in Santa Clara county decreased from 1985-1995, but increased in Alameda and San Mateo counties.

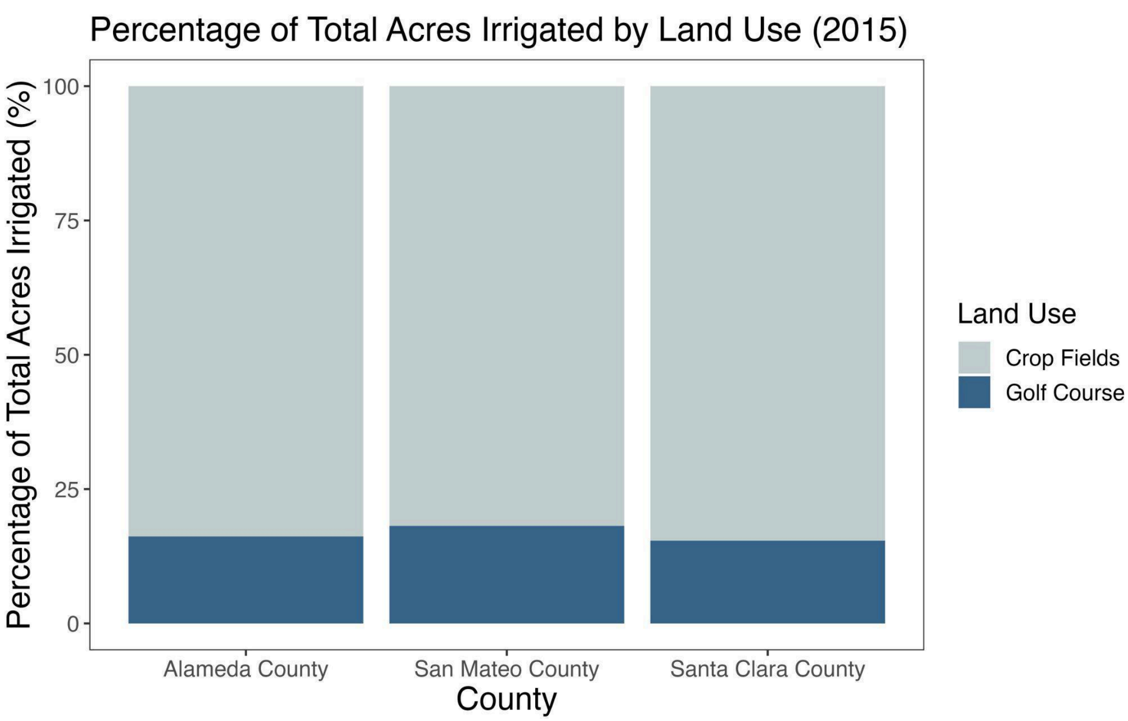

Figure 2.12: Percentage of Total Acres Irrigated by Land Use Type. The proportion of total acres irrigated in Coyote Watershed was calculated for each land use type in 2015. Land uses requiring irrigation were crop fields (light gray) and golf courses (dark blue).

2.4 Summary

The Coyote Watershed is the largest watershed in the Santa Clara Basin, spanning three counties (Alameda, Santa Clara, and San Mateo) with growing population sizes. The watershed primarily covers Santa Clara County which has the largest population size concentrated in urban areas. Water supply and demand within the watershed is reflective of the current population size. In recent years, more surface water than groundwater is being supplied to meet water demands, which raises sustainability concerns in the long run. Over half of municipal water supply is imported, and water supply is predicted to fall short of meeting water demand as early as 2025 in Santa Clara County. In all three counties, the majority of water is used for households and irrigation. The projected increase in population size is expected to be followed by increases in water demand in urban areas within the watershed. Further research is needed to determine whether a reduction in agricultural water demand will decrease as a result of growing population size. This will inform the sustainable management of water resources and allocation in coming years.

3. LAND USES AND WATER QUALITY CRITERIA

A thorough understanding of the planned land uses, water uses, and water quality criteria for Coyote Watershed is critical to the design of the watershed management plan. Knowledge of existing land-use plans within the watershed will help us understand water demands and how the water supply for industrial, domestic, or agricultural uses. Knowledge of water quality criteria is important to be able to maintain the water at safe levels of contaminants, such as nitrate, fecal coliform, and other pollutants. Synthesizing this information will allow us to properly develop a watershed management plan that maintains clean water and efficient use.

3.1 Existing Land-Use Planning

Major urban areas are in two of the three counties within the Coyote Watershed: Santa Clara County and Alameda County. Each county has developed robust urban planning frameworks to accommodate population growth while addressing environmental sustainability and infrastructure demands. Typically, these plans look 10 to 20 years into the future, anticipating population growth and changes in industry and technology, though they undergo periodic updates, usually every 4 to 10 years, to evaluate goals, address emerging needs, and incorporate feedback from community stakeholders. Existing urban development plans differ between counties and major urban areas of this watershed, including the cities of San Jose and Fremont.

<u>San Jose, Santa Clara County</u>
In 2011, the San Jose City Council adopted the Envision San Jose 2040 General Plan, which centers on 12 major strategies that aim to balance the city's community, transportation, economic, and environmental priorities (City of San Jose). The General Plan outlines living and working environments, continued development of the Downtown area, preservation and improvement of residential neighborhoods, and the creation of new urban villages. Land use planning is central to the economic, environmental, and community focuses of the plan. The Envision San José 2040 General Plan outlines 29 land use designations, which are illustrated in Figure 3.1. With residential neighborhoods and open hillside as the top current land uses, the city is directing future growth into designated areas designed to target growth intensification while meeting environmental, fiscal, economic, and transportation goals.

The San Jose Zoning Ordinance outlines a set of regulations that aim to regulate future growth and development, protect the economic and social stability, and provide open space. The San Jose Planning Division has proposed recent updates to ordinances which include the implementation of a state bill to increase the availability of entry-level homes for sale and home ownership opportunity. The proposed changes will also update single-family residential development standards to clarify pedestrian access improvements and rear yard coverage calculations.

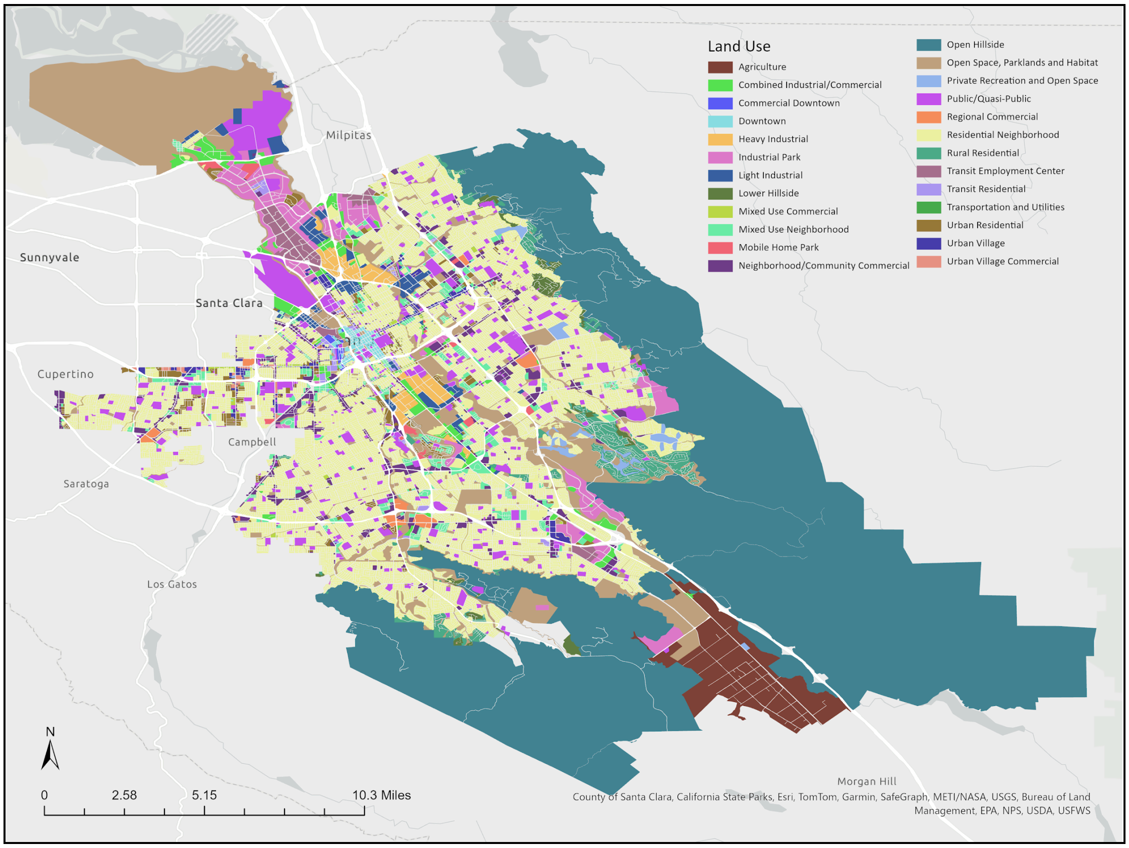

Figure 3.1. Current Land Use in San Jose, California. *Data Source: City of San Jose*. The map shows land use designations across 25 of 29 categories identified in the city's general plan. The majority of the land use by area is designated as residential neighborhood, followed by open hillside.

<u>Fremont, Alameda County</u>

Fremont's General Plan 2030 highlights new key goals focused on sustainability, transit-oriented development, and enhancing the design of the built environment (City of Fremont). The city recognizes water quality and conservation as core components of a sustainable community and prioritizes steps to improve water quality. Specific actions include reducing stormwater runoff pollution through Bay-friendly landscaping guidelines, requiring water efficient landscaping in new development and encouraging the use of reclaimed water. Fremont is also planning higher-intensity development near transit in response to projected population growth by 2030. They have designated priority development areas as part of their goal of becoming strategically more urban. At the core of these sustainable urban development plans is current and future land use planning. The city has developed land use diagrams to illustrate intended land uses over a 20-year time horizon. Residential land use types continue to dominate by area, followed by a variety of different open space designations (Figure 3.2).

The land use map is largely implemented through the city's zoning regulations. Fremont's Zoning Ordinance implements the policies outlined in the General Plan by regulating land uses. The Zoning Ordinance sets designated zones for the different types of land uses including single-family and multifamily residential, commercial, and industrial areas, setting regulations on building heights, lot sizes, density, and mixed-use development to guide growth and maintain community character.

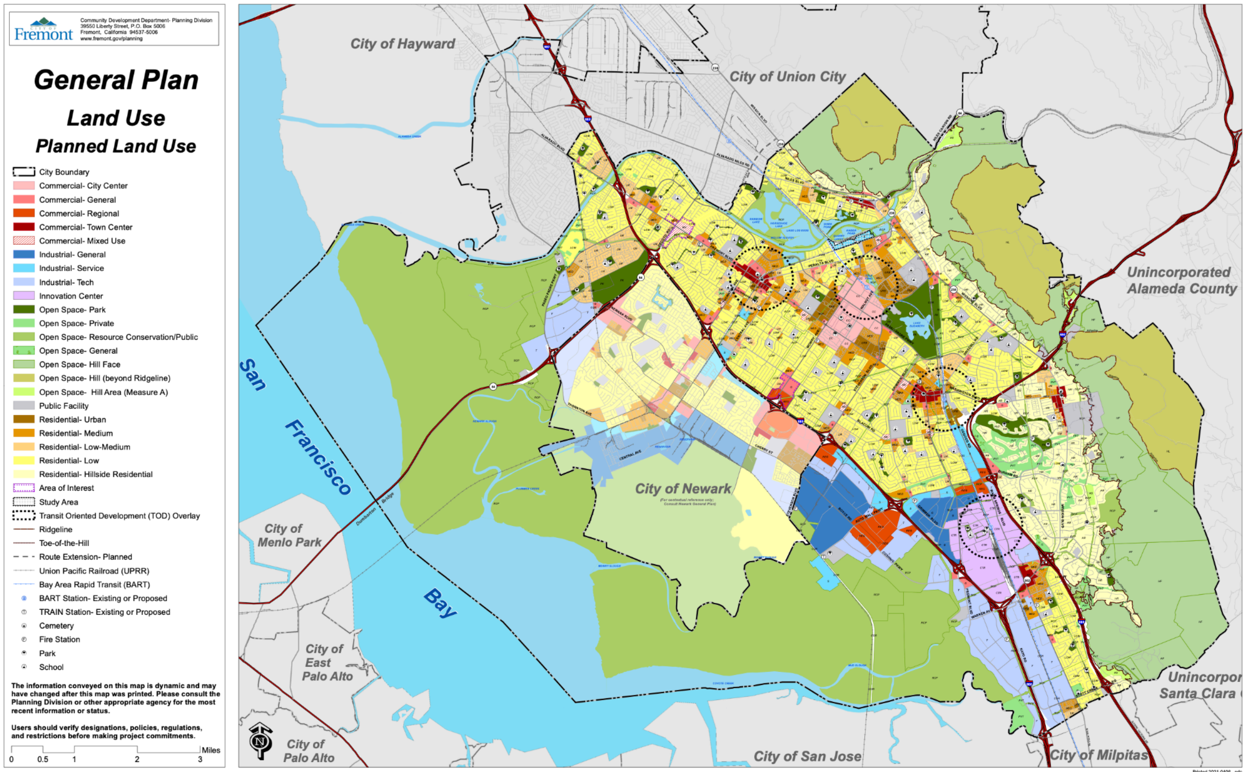

Figure 3.2. Planned Land Use in Fremont, California. *Data Source: City of Fremont*. The map illustrates 22 intended land use types in Fremont over a 20-year time horizon. Residential and Open Space are the top land use types by area.

3.2 Hydrology

Santa Clara County has identified areas at risk of flooding based on FEMA floodplain mapping (Valley Water). These areas are designated as flood zones and guide decisions on how and where to develop land (Figure 3.3). Floodplain development regulations are based on the flood that has a 1% probability of being equaled or exceeded in any year (100-year flood). All development within areas designated as the 100-year floodplain is subject to regulation and requires a Building or Grading Permit. The Santa Clara County Floodplain Ordinance sets standards for buildings and development to protect from flood risk and minimize potential losses.

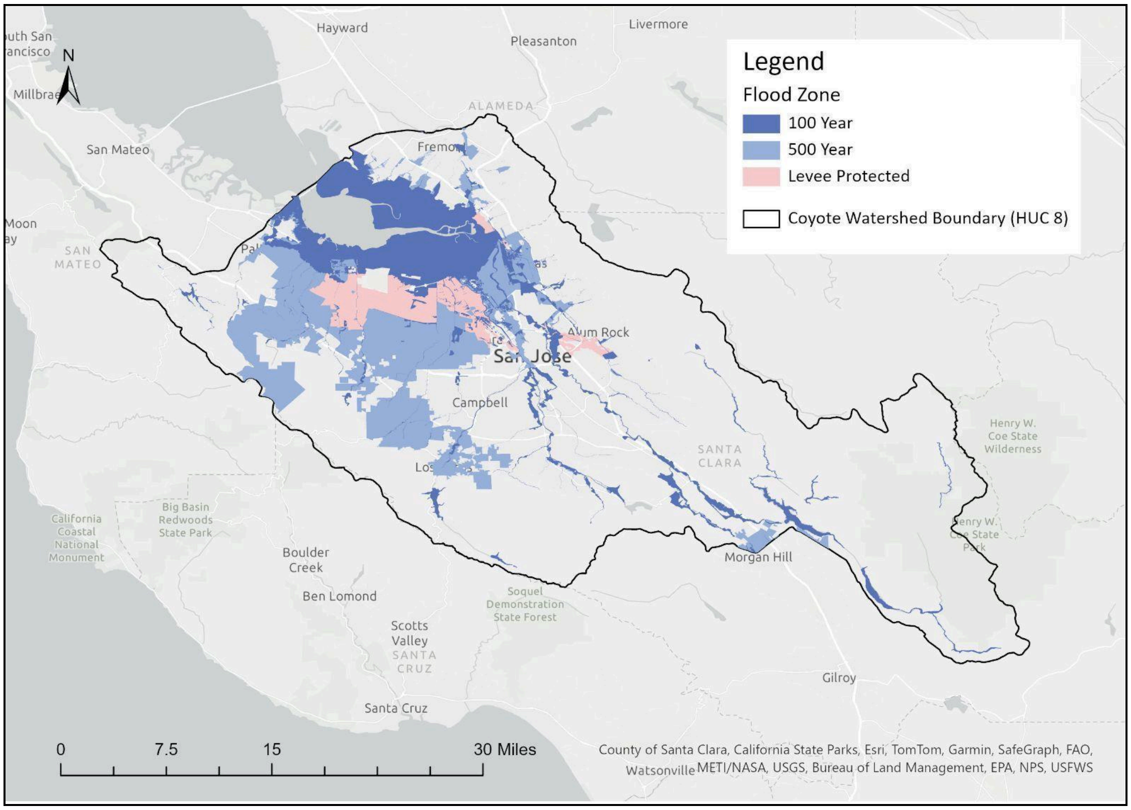

Figure 3.3. FEMA Flood Zones within the Coyote Watershed. *Data Source: FEMA Flood Maps 2021*. Flood zones designated as 100-year, 500-year, and Levee Protected indicate higher flood risk near South San Francisco Bay, with 500-year flood zones extending into major urban areas.

As the manager of groundwater resources in Santa Clara County, Valley Water has created a Groundwater Sustainability Plan (GSP) to achieve sustainability and satisfy the objectives of the Sustainable Groundwater Management Act (SGMA). Primary goals of the 2021 GSP are to:

1. Manage groundwater in conjunction with surface water to prevent land subsidence and avoid overdraft.
2. Implement programs to protect and promote groundwater quality.
3. Maintain and develop adequate groundwater models and monitoring networks.
4. Work with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

Valley Water has also developed outcome measures for four sustainability indicators in order to gauge performance in meeting groundwater sustainability goals at two thresholds (Table 3.1). Figure 3.4 provides a helpful visualization of how groundwater elevation has fluctuated over time in correspondence with land surface elevation and population size.

Table 3.1. Sustainability Indicators – Outcome Measures and Thresholds. *Source: Gurdak & Cook 2021*

Sustainability Indicator	Outcome Measure	Lower Threshold Measure
Groundwater Storage	Projected end of year groundwater storage is greater than 278,000 acre-feet (AF) in the Santa Clara Plain, 5,000 AF in the Coyote Valley, and 17,000 AF in the Llagas Subbasin.	Projected end of year countywide groundwater storage is greater than Stage 5 (150,000 AF) of the Water Shortage Contingency Plan.
Subsidence	Groundwater levels are above subsidence thresholds at the Santa Clara Sub-basin subsidence index wells.	Groundwater levels are above the historical low water levels at the majority of the Santa Clara Sub-basin subsidence index wells.
Groundwater Quality	At least 95% meet primary drinking water standards, and at least 90% have stable or decreasing trends for total dissolved solids (TDS).	At least 70% of water supply wells have stable or decreasing trends for nitrate and TDS.
Seawater Intrusion	In the Santa Clara Sub-basin shallow aquifer, the 100 mg/L chloride isocontour area is less than the historical maximum extent area (57 square miles).	In the Santa Clara Sub-basin shallow aquifer, the 100 mg/L chloride isocontour area is less than 81 square miles, which represents a one mile radial buffer of the historical maximum extent area.

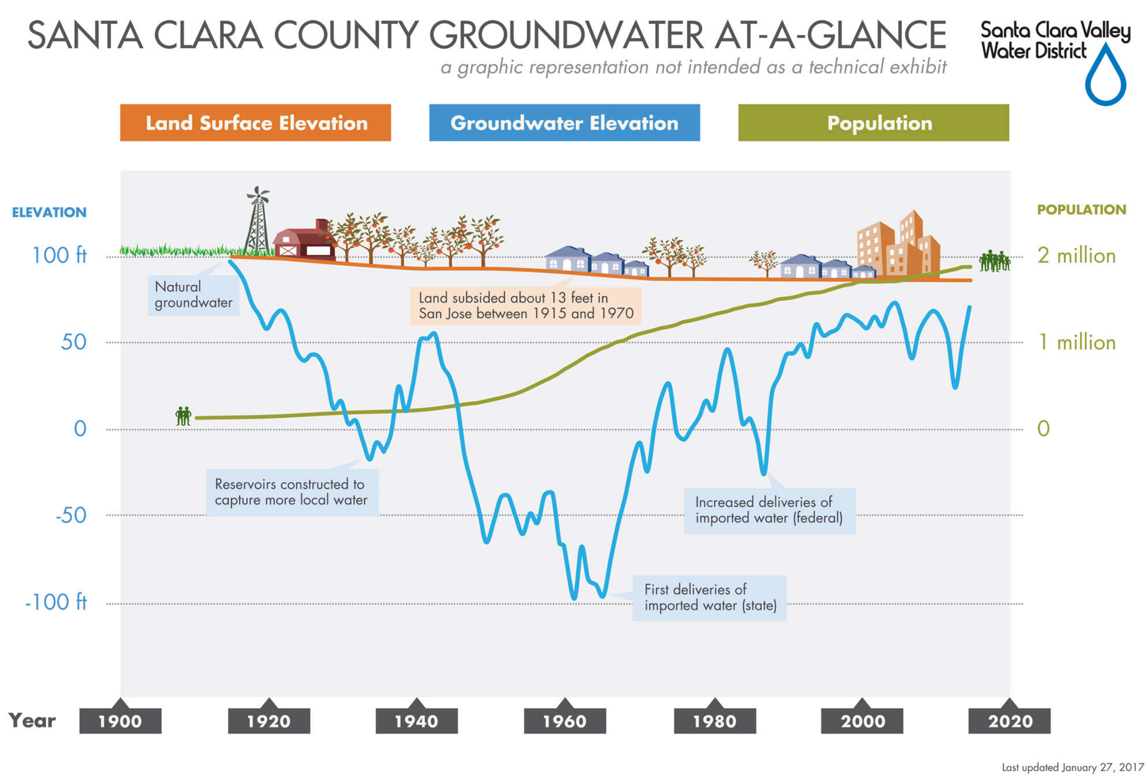

Figure 3.4. Santa Clara County groundwater at-a-glance. *Data Source: Santa Clara Valley Water District.* The diagram shows how groundwater elevation has fluctuated over time in correspondence with land surface elevation and population size.

3.3 Beneficial uses

Most of the streams, lakes, and reservoirs within Coyote Watershed are beneficial for aquatic, wildlife, and recreational use (Table 3.2). All water bodies support wildlife habitat and can be used for recreational activities such as swimming or boating, with some restrictions on water contact activities for large reservoirs such as Anderson or Coyote (Table 3.3). Most streams also serve as important warm or cold water habitats which may support listed species, such as the threatened Central California Coast Steelhead DPS and their spawning and migration habitat (Table 3.3). Examples of specific streams include Bear Gulch, Los Trancos, Permanente, Guadalupe, and Coyote Creeks (Table 3.3). Drinking water supply primarily comes from reservoirs such as Anderson, Coyote, or Stevens Creek, though Los Gatos and Bear Gulch Creeks also serve as sources (Table 3.3). Water bodies used for agriculture include Calabazas Creek, Coyote Reservoir, and Felt Lake (Table 3.3). As for water sources dedicated to industrial uses in Coyote Watershed, the San Francisco Bay is the sole source (Table 3.3).

Table 3.2. Different Beneficial Water Uses. *Source: San Francisco Bay Regional Water Quality Control Board, 2024.* Descriptions of different beneficial water uses are described.

Beneficial Water Use	Abbreviation	Description
Agricultural Supply	AGR	Used for farming, horticulture, or ranching.
Cold Freshwater Habitat	COLD	Used to support cold water ecosystems, including preservation or enhancement of aquatic habitats, vegetation, fish, wildlife, or invertebrates.
Commercial and Sport Fishing	COMM	Used for commercial or recreational collection of fish, shellfish, or other organisms intended for human consumption or bait.
Estuarine Habitat	EST	Used to support estuarine ecosystems, including preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife, and the propagation, sustenance, and migration of estuarine organisms.
Freshwater Replenishment	FRSH	Used for natural or artificial maintenance of surface water quantity or quality.
Groundwater Recharge	GWR	Used for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting saltwater intrusion into freshwater aquifers.
Industrial Service Supply	IND	Used for industrial activities that do not depend on water quality. Examples include mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.
Marine Habitat	MAR	Used to support marine ecosystems, including preservation or enhancement of marine habitats, vegetation, fish, shellfish, or wildlife.

Fish Migration	MIGR	Used to support habitats necessary for migration, acclimation between freshwater and saltwater, and protection of aquatic organisms that are temporary inhabitants of waters within the region.
Municipal and Domestic Supply	MUN	Used for community, military, or individual water supply systems.
Navigation	NAV	Used for shipping, travel, or other transportation by private, military, or commercial vessels.
Industrial Process Supply	PROC	Used for industrial activities that do depend on water quality.
Preservation of Rare and Endangered Species	RARE	Used to support habitats necessary for the survival and successful maintenance of federal- or state-listed plant or animal species.
Water Contact Recreation	REC-1	Used for recreational activities involving body contact with water. Examples include swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs.
Non Contact Water Recreation	REC-2	Used for recreational activities involving proximity to water, but not involving body contact with water. Examples include picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with above activities.
Shellfish Harvesting	SHELL	Used to support habitats suitable for collection of crustaceans and filter-feeding shellfish for human consumption, commercial, or sport purposes.
Fish Spawning	SPWN	Used to support high quality aquatic habitats suitable for reproduction and early development of fish.
Warm Freshwater Habitat	WARM	Used to support warm water ecosystems including preservation or enhancement of aquatic habitats, vegetation, fish, wildlife, or invertebrates.
Wildlife Habitat	WILD	Used to support wildlife habitats, including preservation and enhancement of vegetation and prey species used by wildlife.

Table 3.3. Beneficial Uses of Santa Clara Basin Water Bodies. *Source: San Francisco Bay Regional Water Quality Control Board, 2024.* Beneficial uses of water bodies in the Santa Clara Basin are listed by counties. Use types are grouped by benefits to human consumption, aquatic life, wildlife, and recreation. Human consumptive uses include: AGR, MUN, FRSH, GWR, IND, PROC, and COM. Aquatic life uses include: SHELL, COLD, EST, MAR, MIGR, RARE, SPWN, and WARM. Wildlife use is abbreviated as WILD. Recreational uses include: REC-1, REC-2, and NAV. Detailed descriptions of each use type is presented in Table 3.2.

SANTA CLARA BASIN

	Human Consumptive Uses							Aquatic Life Uses								Wildlife Use	Recreational Uses		
COUNTY Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
San Francisco Bay South					E		E	E		E		E	E	E		E	E	E	E
ALAMEDA & SANTA CLARA COUNTIES																			
Newark Slough										E			E			E	E	E	
Plummer Creek (Zone 5 Line F-1)										E			E			E	E	E	
Mowry Slough										E			E			E	E	E	
Coyote Slough										E			E			E	E	E	
Mud Slough										E			E			E	E	E	
Laguna Creek (Arroyo la Laguna, or Zone 6 Line E)															E	E	E	E	
Mission Creek (Zone 6 Line L)															E	E	E	E	
Lake Elizabeth									E					E	E	E	E*	E	
Sabrecat Creek (Zone 6 Line K)															E	E	E	E	
Canada del Aliso (Zone 6 Line J)															E	E	E	E	
Agua Caliente Creek (Alameda) (Zone 6 Line F)															E	E	E	E	
Agua Fria Creek (Zone 6 Line D)															E	E	E	E	
Stivers Lagoon (Fremont Lagoon)			E												E	E	E	E	
Mallard (Artesian) Slough										E			E			E	E	E	
Scott Creek (Zone 6 Line A)															E	E	E	E	
Toroges Creek (Zone 6 Line C)													E		E	E	E	E	
SAN MATEO AND SANTA CLARA COUNTIES																			
San Francisquito Creek									E			E	E	E	E	E	E	E	
Lake Lagunita													E		E	E	E	E	
Los Trancos Creek									E			E	E	E	E	E	E	E	
Felt Lake	E													E	E	E	E	E	
Bear Creek (San Mateo)									E			E	E	E	E	E	E	E	
Bear Gulch Creek (San Mateo)		E							E			E	E	E	E	E	E	E	
West Union Creek									E			E	E	E	E	E	E	E	
Searsville Lake	E								E					E	E	E	E	E	

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

SANTA CLARA BASIN

COUNTY Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
SAN MATEO AND SANTA CLARA COUNTIES, continued																			
Alambique Creek									E						E	E	E	E	
Sausal Creek (San Mateo)									E						E	E	E	E	
SANTA CLARA COUNTY ONLY																			
Palo Alto Harbor & Baylands										E		E	E			E	E	E	
Mayfield Slough										E		E	E			E	E	E	
Matadero Creek									E			E	E	E	E	E	E	E	
Deer Creek (Santa Clara)									E				E		E	E	E	E	
Arastradero Creek									E				E		E	E	E	E	
Charleston Slough										E		E	E			E	E	E	
Barron Creek															E	E	E	E	
Adobe Creek (Santa Clara)									E						E	E	E	E	
Mountain View Slough										E			E			E	E	E	
Permanente Creek				E					E				E	E	E	E	E	E	
Hale Creek									E						E	E	E	E	
Stevens Creek			E	E					E			E	E	E	E	E	E	E	
Stevens Creek Reservoir		E		E			E		E			E		E	E	E	E	E	
Swiss Creek			E						E						E	E	E	E	
Guadalupe Slough										E			E			E	E	E	
Moffett Channel										E						E	E	E	
Calabazas Creek	E			E					E						E	E	E	E	
San Tomas Aquino Creek									E				E		E	E	E	E	
Saratoga Creek	E		E	E					E						E	E	E	E	
Bonjetti Creek									E						E	E	E	E	
McElroy Creek									E						E	E	E	E	
Alviso Slough										E		E	E			E	E	E	
Guadalupe River				E					E			E	E	E	E	E	E	E	
Los Gatos Creek		E	E	E					E			P	E	P	E	E	E	P	
Campbell Percolation Pond				E			E		E					E	E	E	E	E	
Vasona Reservoir		E		E			E		E					E	E	E	E	E	
Lexington Reservoir		E		E			E		E					E	E	E	E	E	
Soda Springs Creek			E						E						E	E	E	E	

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

SANTA CLARA BASIN

COUNTY Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
SANTA CLARA COUNTY ONLY, continued																			
Lake Elsman		E							E						E	E	E*	E	
Austrian Gulch Creek			E						E					E	E	E	E	E	
Ross Creek				E											E	E	E	E	
Canoas Creek															E	E	E	E	
Guadalupe Creek			E	E					E			E	E	E	E	E	E	E	
Los Capitancillos Percolation Ponds				E											E	E	E	E	
Guadalupe Percolation Ponds				E											E	E	E	E	
Pheasant Creek			E						E					E	E	E	E	E	
Guadalupe Reservoir		E		E					E					E	E	E	E	E	
Los Capitancillos Creek			E	E					E						E	E	E	E	
Rincon Creek			E	E					E			E	E		E	E	E	E	
Alamitos Creek			E	E					E			E	E	E	E	E	E	E	
Arroyo Calero			E						E			E	E	E	E	E	E	E	
Calero Reservoir		E		E										E	E	E	E*	E	
Almaden Reservoir		E		E					E				E	E	E	E	E*	E	
Herbert Creek			E						E						E	E	E	E	
Barrett Canyon Creek			E						E						E	E	E	E	
Coyote Creek (nontidal)				E			E		E			E	E	E	E	E	E	E	
Upper Penitencia Creek			E	E					E			E	E	E	E	E	E	E	
Arroyo Aguague Creek									E			E	E	E	E	E	E	E	
Halls Valley Lake (Grant Lake)							E							E	E	E	E	E	
Cherry Flat Reservoir	E	E												E	E	E	E*	E	
Lower Silver Creek															E	E	E	E	
Babb Creek															E	E	E	E	
South Babb Creek															E	E	E	E	
Flint Creek															E	E	E	E	
Thompson Creek															E	E	E	E	
Quimby Creek															E	E	E	E	
Yerba Buena Creek															E	E	E	E	
Upper Silver Creek													E		E	E	E	E	

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

SANTA CLARA BASIN

COUNTY Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
SANTA CLARA COUNTY ONLY, continued																			
Cottonwood Lake							E		E					E	E	E	E	E	
Fisher Creek															E	E	E	E	
Anderson Reservoir		E		E			E		E					E	E	E	E*	E	
San Felipe Creek			E						E					E	E	E	E	E	
Las Animas Creek			E						E						E	E	E	E	
Packwood Creek			E						E					E	E	E	E	E	
Hoover Creek			E						E					E	E	E	E	E	
Otis Canyon Creek			E						E						E	E	E	E	
Coyote Reservoir	E	E					E		E					E	E	E	E*	E	
Canada de los Osos Creek			E												E	E	E	E	
Soda Springs Canyon Creek									E						E	E	E	E	
Lower Penitencia Creek															E	E	E	E	
Berryessa Creek															E	E	E	E	
Calera Creek (Santa Clara)															E	E	E	E	
Tularcitos Creek															E	E	E	E	
Arroyo de los Coches													E		E	E	E	E	
Sandy Wool Lake							E		E					E	E	E	E*	E	

3.4 Water Quality Criteria

In any watershed management plan, there are specific criteria that must be met in order to maintain good water quality throughout the area. The Coyote Watershed is located within the San Francisco Bay Basin, and therefore is subject to water quality criteria set forth in the San Francisco Bay, in the state of California, and on the federal level. According to the San Francisco Bay Regional Water Quality Control Board, there are two types of criteria that are relevant to determining the overall quality of the watershed. The first, narrative criteria, "present general descriptions of water quality that must be attained through pollutant control measures and watershed management" (Table 3.4; SFWQCB, 2024). In general, these criteria can be tested without numerical calculations and can be observed naturally, such as the color of the water or the presence of debris. Narrative criteria form the basis for numerical criteria, however, which are typically for the purpose of measuring and calculating the pollutant concentrations in a body of water. Together, the narrative and numerical criteria determine the overall quality of the watershed.

The following criteria are outlined by the San Francisco Bay Regional Water Quality Control Board and are applicable to the Coyote Watershed. Each pollutant has a level that it must be maintained at or kept beneath, and all pollutants must be below the designated Total Maximum Daily Load (TMDL), if one is adopted into a management plan.

Bacteria

Table 3.4. Bacteria Level Criteria. *Source: San Francisco Bay Water Quality Control Board.* Levels of bacteria in the water bodies must be maintained at certain levels in order for the water to be safe for recreation, harvesting fish, and municipal supplies, and is determined by the combination of fecal and other coliform levels, enterococcus presence, and E.coli.

Beneficial Use	Fecal Coliform[a] (MPN/100mL)	Total Coliform[a] (MPN/100mL)	Enterococcus (CFU/100mL)[g]	E. coli (CFU/100mL)[g]
Water Contact Recreation			geometric mean < 30 STV < 110	geometric mean < 100 STV < 320
Shellfish Harvesting[b]	median < 14 90th percentile < 43	median < 70 90th percentile < 230[c]		
Non-contact Water Recreation[d]	mean < 2000 90th percentile < 4000			
Municipal Supply: Surface Water[e]	geometric mean < 20	geometric mean < 100		
Municipal Supply: Groundwater		< 1.1[f]		

Bioaccumulation

Pollutant and microplastic levels can bioaccumulate through the food chain, from the water and sediment to small organisms to fish to humans. These levels must be carefully monitored in order to determine if organisms are safe to harvest from these waters.

Dissolved Oxygen

The San Francisco Bay Water Quality Control Board has determined necessary dissolved oxygen levels based on several parameters, such as location, habitat, and length of measurement. In a cold water habitat, dissolved oxygen levels must be at or above 7.0 mg/l, and in a warm water habitat, the minimum dissolved oxygen level is stated to be 5.0 mg/l. In addition, “the median dissolved oxygen concentration for any three consecutive months shall not be less than 80 percent of the dissolved oxygen content at saturation” (SFWQCB, 2024). These levels are put in place to protect fish life, but even higher levels are ideal for more sensitive life forms.

Floating Material/Color

The appearance of contaminants that can be seen by the naked eye can be measured through the amount of floating material, such as foam, oil and grease, and debris, or the color of the water. Unnatural or unusual colors show an issue arising from possible pollutants, and would have to be researched more thoroughly. The more floating material there is, the more probable it is that the water is unsafe. These measures are put in place both for aesthetic and safety purposes.

pH

All water pH levels must be maintained between 6.5 and 8.5, and any factors of pH that are controllable by management should not change pH levels by greater than 0.5 units.

Sulfide

Sulfide levels must be maintained at the natural background concentration level. A change in levels even by a few hundredths of a milligram per liter can be observed through smell and sight.

Toxicity

Levels of toxicity are determined by survival levels. Acute toxicity is survival levels of less than 90%, or less than 70% ten percent of the time.

Chemical Constituents

The levels of many toxic metals are regulated on a 4-day average and a 1-hour average basis (Tables 3.5 and 3.6). In addition, the levels of copper allowed are different between different portions of the watershed. A slightly higher concentration is allowed on the southern side of the San Francisco Bay than on the northern side (Table 3.5). The levels of mercury found in fish is dependent on the size of the fish. Smaller fish (5-15 cm) require a lower concentration than larger fish are allowed (15-35 cm) (Table 3.7). The San Francisco Bay Water Quality Control Board has also outlined ideal limits of toxic pollutants, which are used for any future management purposes (Table 3.8).

Table 3.5. Acceptable Levels of Copper and Nickel. *Source: San Francisco Bay Water Quality Control Board, 2024.*

Compound	4-day Average (CCC)[2]	1-hr Average (CMC)[3]	Extent of Applicability
Copper	6.9	10.8	The portion of Lower San Francisco Bay south of the line representing the Hayward Shoals shown on Figure 7.2.1-1. and South San Francisco Bay
Copper	6.0	9.4	The portion of the delta located in the San Francisco Bay Region, Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, and the portion of Lower San Francisco Bay north of the line representing the Hayward Shoals on Figure 7.2.1-1.
Nickel	11.9	62.4*	South San Francisco Bay

Table 3.6. Water Quality Objectives for Toxic Pollutants. *Source: San Francisco Bay Water Quality Control Board, 2024.*

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

Table 3.7. Acceptable Mercury Levels. Source: San Francisco Bay Water Quality Control Board.

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

Table 3.8. List of Ideal Limits in Municipal Waters. *Source: San Francisco Bay Water Quality Control Board.* The following levels are the ideal limits that the San Francisco Bay Water Quality Control Board have set as objectives for the San Francisco Bay. These will govern any future changes to watershed management plans.

Parameter	Objective (in MG/L)
Physical:	
Color (units)[a]	15.0
Odor (number)[a]	3.0
Turbidity (NTU)[a]	5.0
pH[b]	6.5 - 8.0
TDS[c]	500.0
EC (mmhos/cm)[c]	900
Corrosivity	non-corrosive
Inorganic Parameters:	
Aluminum[d]	1.0[d] / 0.2[a]
Antimony[d]	0.006
Arsenic[d]	0.05
Asbestos[d]	7 MFL[e]
Barium[d]	1.0
Beryllium[d]	0.004
Chloride[c]	250.0
Cadmium[d]	0.005
Chromium[d]	0.05
Copper[a]	1.0
Cyanide[d]	0.15
Fluoride[f]	0.6 - 1.7[g]
Iron[a]	0.3
Lead[b]	0.05
Manganese[a]	0.05
Mercury[d]	0.002
Nickel[d]	0.1
Nitrate (as NO_3)[d]	45.0
Nitrate + Nitrite (as N)[d]	10.0
Nitrite (as N)[d]	1.0
Selenium[d]	0.05
Silver[b]	0.1
Sulfate[c]	250.0
Thallium[d]	0.002
Zinc[a]	5.0
Organic Parameters:	
MBAS (Foaming agents)[a]	0.5
Oil and grease[b]	none
Phenols[b]	0.001
Trihalomethanes[b]	0.1
Chlorinated Hydrocarbons:	
Endrin[h]	0.002
Lindane[h]	0.0002
Methoxychlor[h]	0.03
Toxaphene[h]	0.003
2,3,7,8-TCDD (Dioxin)[h]	3×10^{-8}
2,4-D[h]	0.07
2,4,4-TP Silvex[h]	0.05
Synthetic Organic Chemicals:	
Alachor[h]	0.002
Atrazine[h]	0.001
Bentazon[h]	0.018
Benzo(a)pyrene[h]	0.0002
Dalapon[h]	0.2
Dinoseb[h]	0.007
Diquat[h]	0.02
Endothall[h]	0.1
Ethylene dibromide[h]	0.00005
Glyphosate[h]	0.7
Heptachlor[h]	0.00001
Heptachlor epoxide[h]	0.00001
Hexachlorecyclopentadiene[h]	0.001
Molinate[h]	0.02
Oxarnyl[h]	0.05
Pentachlorophenol[h]	0.001
Picloram[h]	0.5
Polychlorinated Biphenyls[h]	0.0005
Simazine[h]	0.004
Thiobencarb[h]	0.07 / 0.001
Volatile Organic Chemicals:	
Benzene[h]	0.001
Carbon Tetrachloride[h]	0.005
1,2-Dibromo-3-chloropropane[h]	0.0002
1,2-Dichlorobenzene[h]	0.6
1,4-Dichlorobenzene[h]	0.005
1,1-Dichloroethane[h]	0.005
1,2-Dichloroethane[h]	0.0005
cis-1,2-Dichloroethlyene[h]	0.006
trans-1,2-Dichloroethylene[h]	0.01
1,1-Dichloroethylene[h]	0.006
Dichloromethane[h]	0.005
1,2-Dichloropropane[h]	0.005
1,3-Dichloropropene[h]	0.0005
Ethylbenzene[h]	0.7
Methyl-tert-butyl ether[h]	0.13 / 0.005
Monochlorobenzene[h]	0.07
Styrene[h]	0.1
1,1,2,2-Tetrachloroethane[h]	0.001
Tetrachloroethylene[h]	0.005
1,2,4-Trichlorobenzene[h]	0.005
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane[h]	0.005
Trichloroethylene[h]	0.005
Trichlorofluoromethane	0.15
Volatile Organic Chemicals (cont'd):	
1,1,2-Trichloro-1,2,2-trifluoromethane[h]	1.2
Toluene[h]	0.15
Vinyl Chloride[h]	0.0005
Xylenes (single or sum of isomers)[h]	1.750
Radioactivity:	
Combined Radium-226 and Radium-228[i]	5
Gross Alpha Particle Activity[i]	15i
Tritium[i]	20,000
Strontium-90[i]	8
Gross Beta Particle Activity[i]	50
Uranium[i]	20

NOTES:

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

b. Table III-2, 1986 Basin Plan

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

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

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

f. Flouride objectives depend on temperature.

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

3.5 Summary

Coyote Watershed includes major urban areas, such as the city of San Jose in Santa Clara County and Fremont in Alameda County. In San Jose, land-use plans focus on future development to meet the housing and infrastructure needs of a growing population. In Fremont, land-use plans focus on sustainability through transit-oriented development and enhanced design of the built environment. Water quality and conservation are also key considerations in Fremont's land-use plans. The Santa Clara Valley is a major flood zone, necessitating efforts to assess and reduce flood risks. The sustainability of groundwater resources in the Coyote Watershed must also be assessed to ensure reliable groundwater supply and quality and prevent regional land subsidence due to overdraft. Most water bodies in the watershed are beneficial for aquatic, wildlife, and recreational use. Reservoirs are primarily designated for drinking and agricultural water supply. Streams provide habitat to support aquatic and terrestrial wildlife, and bay waters are used for industry. Efforts to protect water quality include setting minimum permissible levels of dissolved oxygen, pH, bacteria, metals, and other water quality indicators allowed in Coyote Watershed water bodies. Overall, considerations of land-use planning, water use, and water quality requirements are necessary to build a comprehensive watershed management plan.

4. FLOW AND WATER QUALITY MONITORING

Flow and water quality monitoring are essential tools in watershed management, offering valuable insights into the health and functioning of watersheds and greater ecosystems. Data on flow and precipitation reveal the seasonal and long-term patterns of water movement within a watershed, while water quality measurements provide information on the concentration and distribution of pollutants. These monitoring datasets allow for a comprehensive assessment of pollutant fluxes, highlighting potential risks to human health, wildlife, and ecosystems downstream. Understanding these dynamics is vital for preserving habitat quality, supporting agricultural productivity, and protecting nearshore water bodies. However, consistent and accessible data from monitoring stations is variable and limited, posing challenges to effective watershed management. Hydrological data obtained from USGS and meteorological data obtained from NOAA allow water flow, precipitation, and temperature to be monitored over seasons and decades.

4.1 Meteorology

The meteorology of a watershed consists mainly of measurements of the levels of precipitation and temperature within the region. Within the Coyote Watershed, we gathered data from three different locations; one near the San Francisco Bay in Fremont, one in downtown San Jose, and one in the outskirts of San Jose; in order to get a better understanding of precipitation and temperature throughout the whole area (Table 4.1 and Figure 4.1). The site location in Fremont had consistent data collection for both precipitation and temperature from 2000 to 2024 (Figure 4.2). In San Jose, however, there were some missing measurements. The site located in downtown San Jose had consistent collection from 1996 to 2008 for both precipitation and temperature, but stopped temperature and precipitation collection after 2008 and resumed precipitation measurements in 2023 (Figure 4.4). In the outskirts of San Jose only precipitation was recorded, however it was consistent from 2008 to 2019 (Figure 4.3). These kinds of data, sourced from the National Oceanic and Atmospheric Administration (NOAA), can give us a better understanding of how water flows throughout the watershed from body to body, and how it might be affected by climate.

Table 4.1. Meteorology Stations. *Source: NOAA.*

Site Name	Site ID	Latitude	Longitude	Start Date	End Date
Fremont, CA US	GHCND:USC00043244	37.5422	-122.0158	1996-06-01	2021-10-19
San Jose, CA US (downtown)	GHCND:USC00047821	37.34972	-121.90333	1893-01-01	2024-10-20
San Jose, CA US (outskirts)	GHCND:US1CASC0007	37.35432639	-121.7954817	2008-11-25	2019-01-21

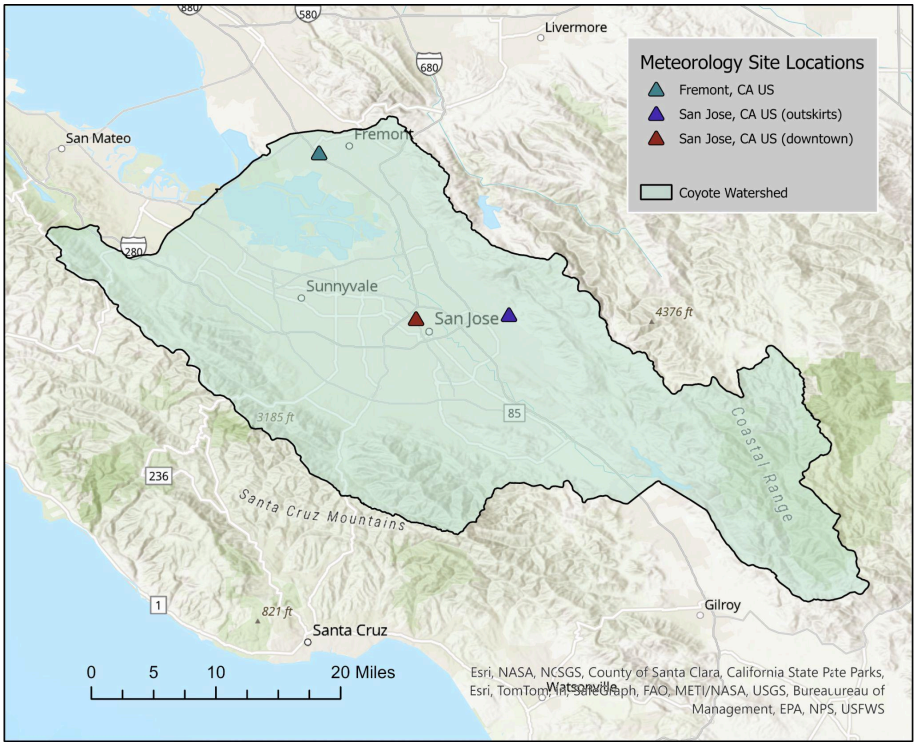

Figure 4.1. Meteorology Station Locations. *Source: NOAA.* We chose three stations within the Coyote Watershed to focus on. We chose one near the San Francisco Bay in Fremont, one in downtown San Jose, and one in the outskirts/suburbs of San Jose, in order to get a more accurate representation of the precipitation and air temperature throughout the whole watershed.

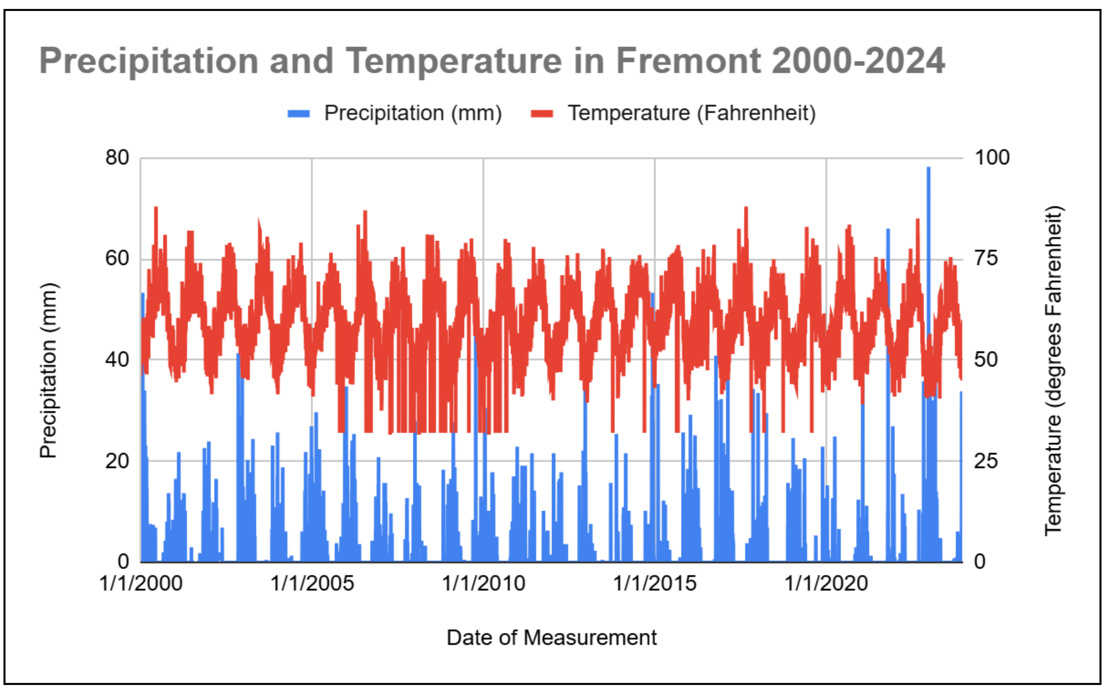

Figure 4.2. Precipitation and Temperature Measurements in Fremont from 2000 to 2024. *Source: NOAA.* From January 2000 to January 2024, there was consistent data collection at the Fremont site location, for both precipitation and temperature. Precipitation occurred at anywhere from 0 to 75 millimeters, but generally peaked around 25 millimeters. Temperature consistently fluctuated around 60 ℉.

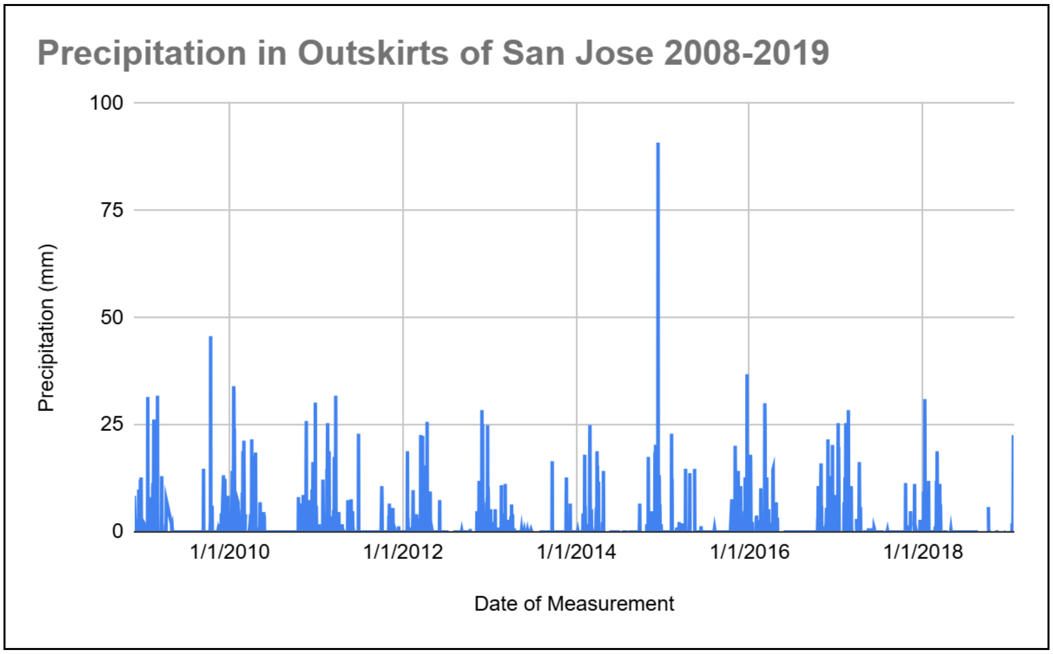

Figure 4.3. Precipitation and Temperature Measurements in the Outskirts of San Jose from 2008 to 2019. *Source: NOAA.* From January 2008 to January 2019, there was consistent data collection at the site location in the outskirts of San Jose, but only for precipitation. Precipitation occurred at anywhere from 0 to 90 millimeters, but generally peaked around 25 millimeters, reflecting wet and dry season patterns.

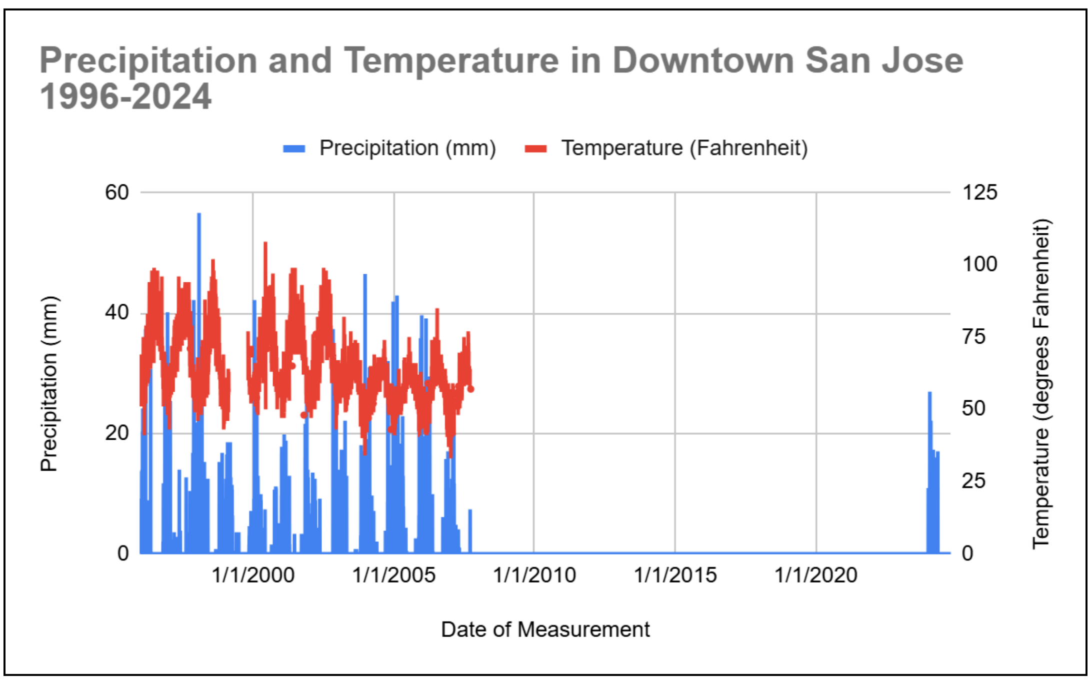

Figure 4.4. Precipitation and Temperature Measurements in Downtown San Jose from 1996 to 2024. *Source: NOAA.* From January 1996 to December 2008, there was consistent data collection at the downtown San Jose site location, for both precipitation and temperature. Precipitation occurred at anywhere from 0 to 45 millimeters, but generally peaked around 25 millimeters. Temperature consistently fluctuated around 65°F. However, there were no precipitation or temperature measurements recorded at this site after 2008, save for precipitation measurements restarting in 2023.

4.2 Flow Monitoring

Flow monitoring of a watershed consists of measurements of the volume of water that flows from the land surface into surrounding bodies of water. Within the Coyote Watershed, we gathered data from three different locations; one near the San Francisco Bay in Milpitas, one in downtown San Jose, and one in San Martin; in order to get a better understanding of water flow throughout the whole area (Table 4.2 and Figure 4.5). The site locations in Milpitas and San Jose seem to have consistent data collection from 2000 (Figure 4.8) and 2002 (Figure 4.7) to 2024. In San Martin, however, there were only measurements from 2017 to 2024, and they seem to be a bit more scarce (Figure 4.6). These kinds of data, sourced from the USGS National Water Information System (NWIS), can give us a better understanding of how water flows throughout the watershed from body to body.

Table 4.2. Hydrology Flow Stations. Source: USGS NWIS.

Site Name	Site ID	Datum	Latitude	Longitude	Period of Record
COYOTE C BL COYOTE RES NR SAN MARTIN CA	11169860	NAD27	37.123056	-121.551667	11/17-01/24
GUADALUPE R ABV HWY 101 A SAN JOSE CA	11169025	NAD27	37.373889	-121.931944	05/02-01/24
COYOTE C AB HWY 237 A MILPITAS CA	11172175	NAD27	37.42222222	-121.9263889	01/01-01/24

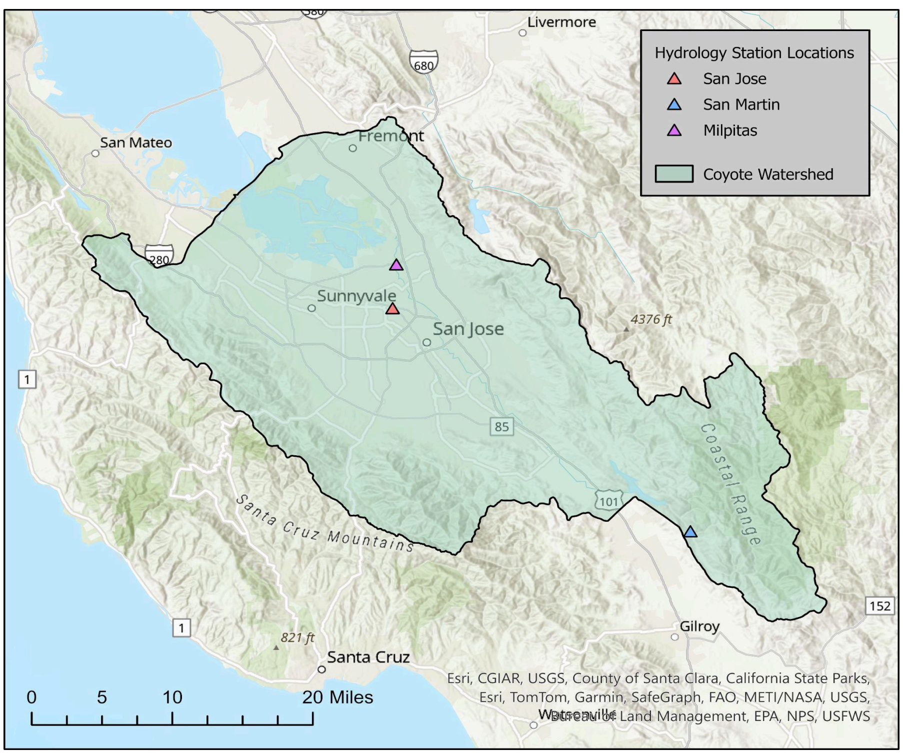

Figure 4.5. Hydrology Station Locations. *Source: USGS NWIS*. We chose three stations within the Coyote Watershed to focus on. We chose one closer to the San Francisco Bay, in Milpitas, one in downtown San Jose, and one in San Martin, in order to get a more accurate representation of the water flows throughout the whole watershed.

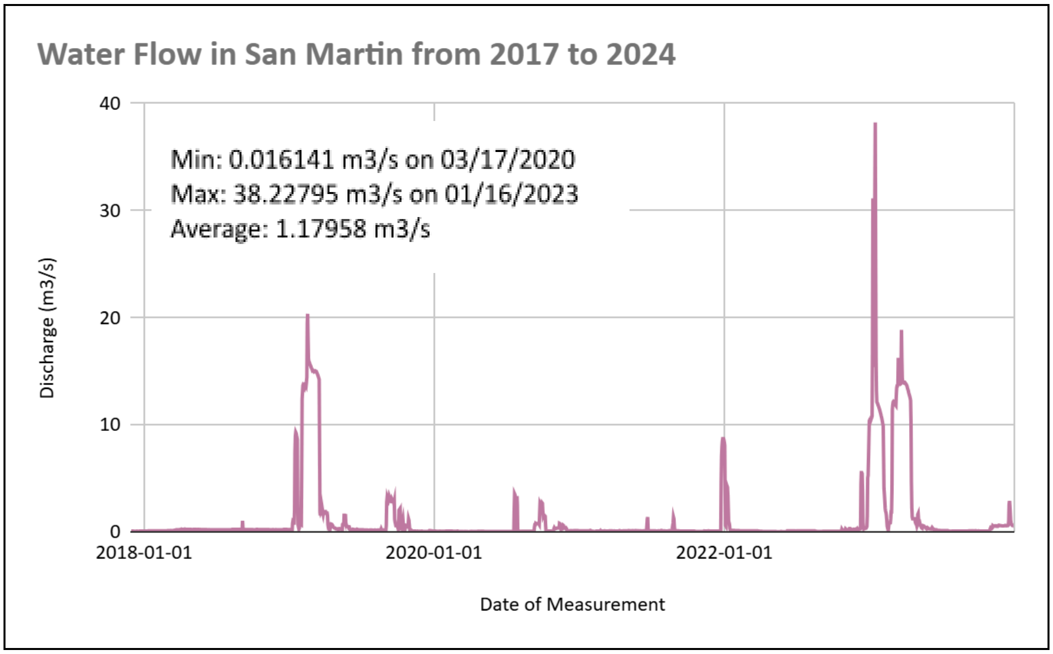

Figure 4.6. Water Flow Measurements in San Martin from 2017 to 2024. *Source: USGS NWIS.* From December 2017 to January 2024, there was inconsistent data collection at the San Martin site location. Measurements were spaced out in time, and resulted in lower values than the other sites show. Water discharge occurred anywhere from 0 to almost 40 m3/s, but generally peaked around 10 or 20 m3/s.

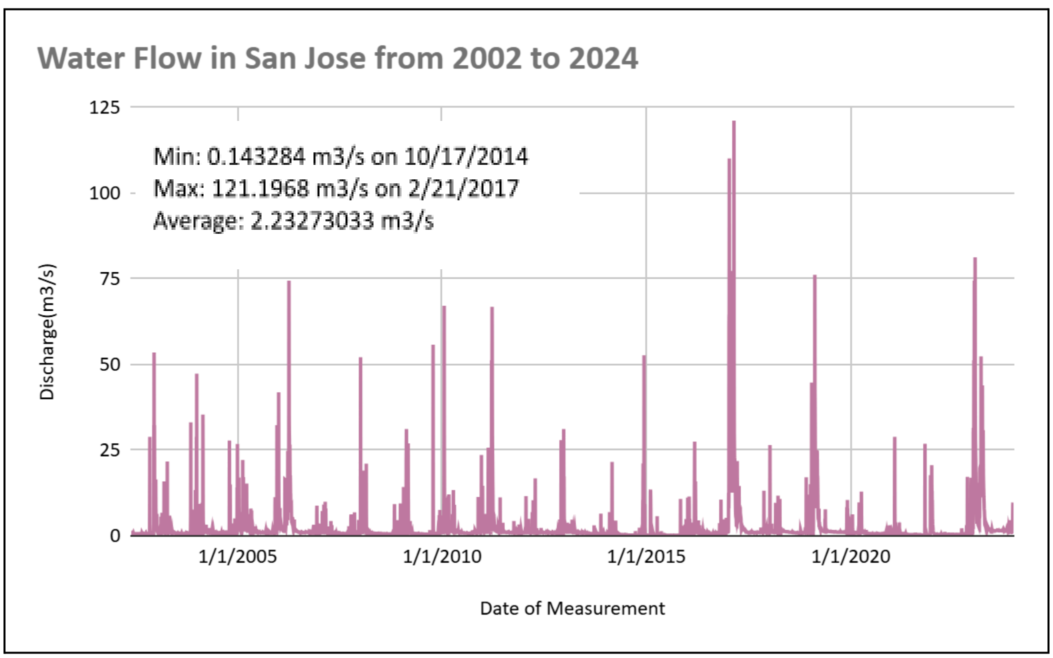

Figure 4.7. Water Flow Measurements in San Jose from 2002 to 2024. *Source: USGS NWIS.* From January 2002 to January 2024, there was consistent data collection for discharge levels at the San Jose site location. Water discharge occurred anywhere from 0 to over 100 m3/s, but generally peaked around 30 or 40 m3/s.

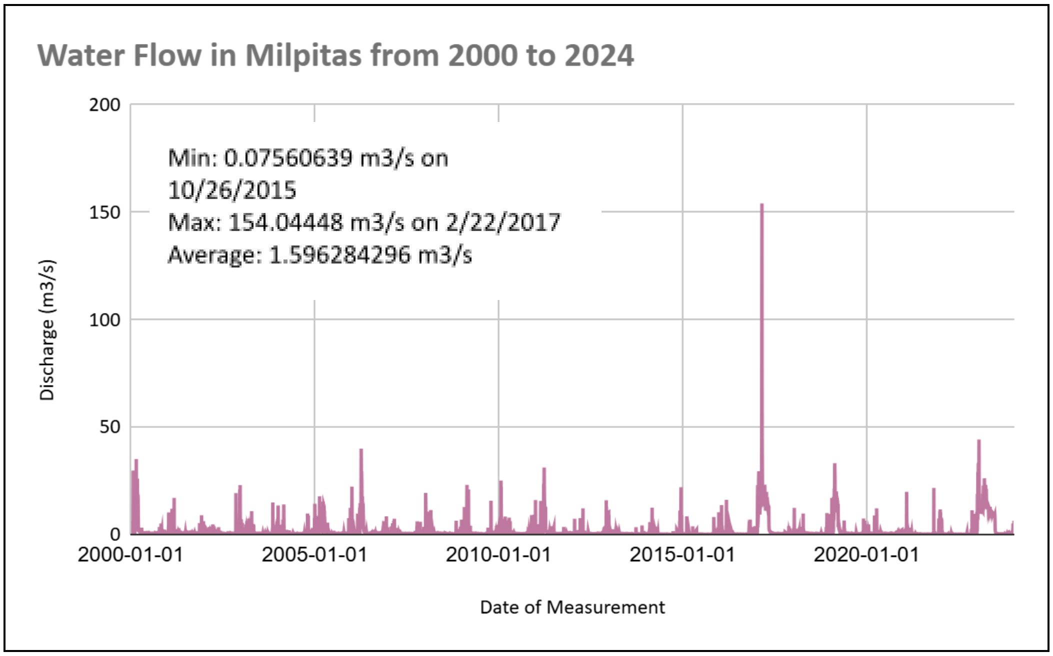

Figure 4.8. Water Flow Measurements in Milpitas from 2000 to 2024. *Source: USGS NWIS.* From January 2000 to January 2024, there was consistent data collection for discharge levels at the Milpitas site location. Water discharge occurred anywhere from 0 to 150 m3/s, but generally peaked around 30 m3/s.

4.3 Current Water Quality Monitoring

Identified issues that impair water quality in Coyote Watershed include ammonia, mercury, metals, pesticides, and total toxic chemicals (solvents, PCBs, etc.) contamination (US EPA, 2021). Low dissolved oxygen and high water temperatures also degrade water and habitat quality in the region (US EPA, 2021). With information sourced from 255 monitoring stations active from 2000-2020, the current status of specific water quality parameters of concern in Coyote Watershed is presented in Table 4.3.

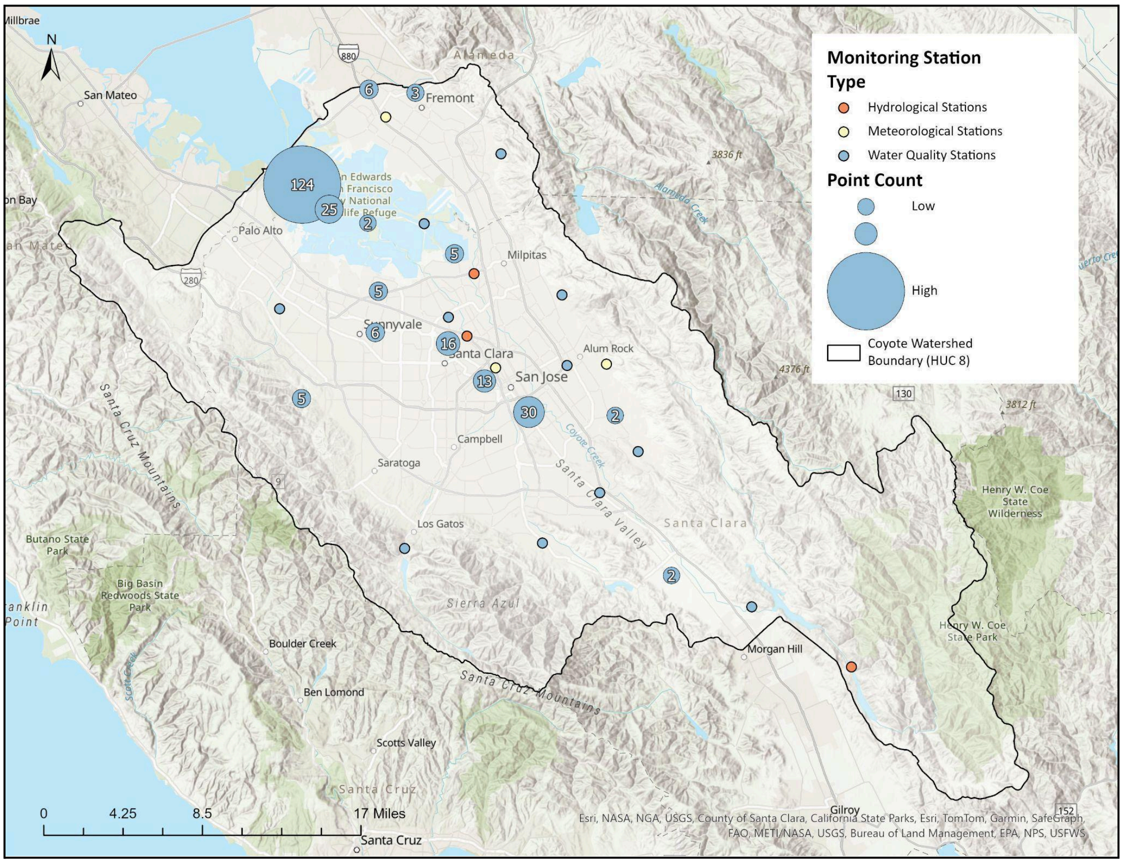

Figure 4.9. Map of environmental monitoring stations within the Coyote Watershed. Six selected hydrological and meteorological monitoring stations are shown in yellow and orange. All water quality stations are depicted in blue, with large clusters of stations located in South San Francisco Bay.

Table 4.3. Current Status of Major Water Quality Parameters of Concern in Coyote Watershed. *Data source: National Water Quality Monitoring Council, 2024.* The average and range concentration of major water quality parameters of concern in Coyote Watershed are presented below. Data on specific analytes were obtained from 255 monitoring sites distributed throughout the entire watershed during 2000-2020. *Note: Table only includes the most commonly known analytes for each parameter and parameters for which there was data. Due to this, certain analytes or parameters were excluded from analysis.*

Parameter	Analyte	Sample Size	Mean	Range	Unit
Ammonia	Ammonia	313	2382.45	0 - 35100	ug/L
Dissolved Oxygen	Dissolved oxygen	363	7900.44	4270 - 11840	ug/L
Mercury	Mercury	233	0.01	0 - 0.15	ug/L
Metals	Aluminum	68	15.04	0 - 386	ug/L
	Arsenic	272	33.51	0.91 - 2700	ug/L
	Copper	303	210.25	0.79 - 24000	ug/L
	Manganese	255	94.57	0 - 680.46	ug/L
	Nickel	271	126.25	0 - 14000	ug/L
	Selenium	273	0.52	0 - 7.96	ug/L
	Zinc	272	1172.79	0 - 110000	ug/L
PCBs	2,3',4,4'-Tetrachlorobiphenyl	218	0	0	ug/L
	2,3,5-Trichlorobiphenyl	1	0	0	ug/L
	2,3,6-Trichlorobiphenyl	8	0	0	ug/L
	2,3-Dichlorobiphenyl	5	0	0	ug/L
	2,4-Dichlorobiphenyl	7	0	0	ug/L
	2,5-Dichlorobiphenyl	9	0	0	ug/L
	2,6-Dichlorobiphenyl	6	0	0	ug/L
	2-Chlorobiphenyl	10	0	0	ug/L
	3,5-Dichlorobiphenyl	2	0	0	ug/L
	3-Chlorobiphenyl	10	0	0	ug/L
	4-Chlorobiphenyl	10	0	0	ug/L
Solvents	1,1,1-Trichloroethane	12	0	0	ug/L
	1,1,2,2-Tetrachloroethane	12	0	0	ug/L
	1,1-Dichloroethane	12	0	0	ug/L
	1,2-Dichlorobenzene-d4	12	0	0	ug/L
	1,2-Dichloroethane	12	0	0	ug/L
	1,4-Dichlorobenzene-d4	12	0	0	ug/L
	Carbon tetrachloride	12	0	0	ug/L
	Chlorobenzene	12	0	0	ug/L

	Chloromethane	12	0	0	ug/L
	Dichlorobenzene	12	0	0	ug/L
	Methylene chloride	14	0.16	0 - 1.6	ug/L
	Tetrachloroethylene	13	0.45	0 - 5.8	ug/L
	Trichloroethylene	12	0	0	ug/L
	Vinyl chloride	12	0	0	ug/L
Water Temperature	Temperature, water	232	17.43	-6.74 - 26.8	°C

In 2010, Coyote Watershed contained ten 303(d) listed impaired streams (Figure 10). Despite this, only four creeks (Coyote, Los Gatos, Permanente, and Silver) have long-term monitoring stations installed to track water quality parameters of concern to Coyote Watershed (Table 4.4). The spatial coverage of monitoring locations is best for Coyote Creek, with stations located in the headwaters near Anderson Reservoir, in the middle stream segments near San Jose, and at the outlet in the San Francisco Bay (Figure 10). In contrast, spatial coverage is poor for the remaining streams as monitoring sites are concentrated in segments closest to the headwaters (Figure 4.10). While Coyote Creek has the best spatial coverage for monitoring site locations, the parameters measured at each station are not consistent throughout the stream (Table 4.4). The current status of water quality parameters identified as an issue for the watershed are reported in Figures 4.11-4.21.

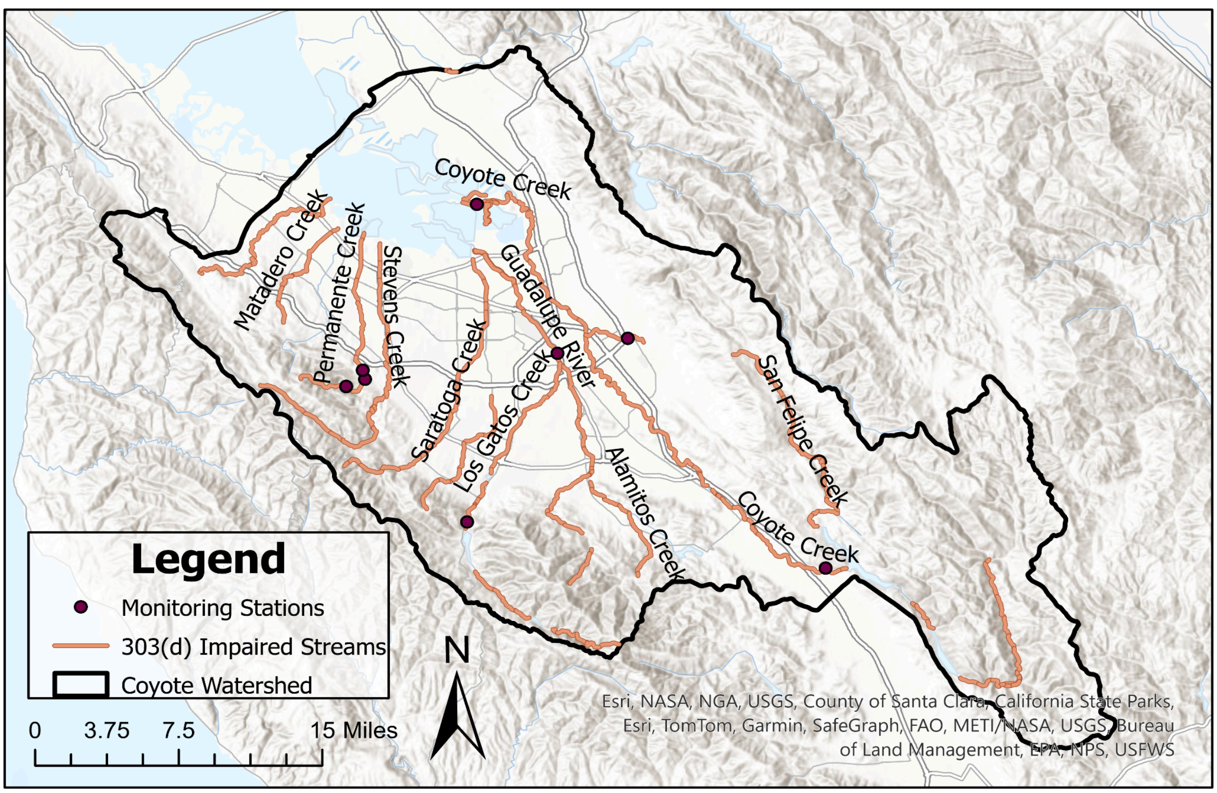

Figure 4.10. 303(d) Impaired Streams in Coyote Watershed. 303(d) impaired streams, as designated in 2010, are depicted with the orange lines while water quality monitoring stations are illustrated with dark purple circles. Mapped stations are located within 100m of the impaired stream.

Table 4.4. 303(d) Impaired Streams Monitoring Stations in Coyote Watershed. *Data Source: CA Water Boards, 2011; US EPA, 2021; National Water Quality Monitoring Council, 2024.* Stations within 100m of impaired streams are listed, along with the major water quality parameter(s) of concern being sampled.

Station	Impaired Stream	Identified Issues	Parameters Sampled
CA Water Board Water Quality Exchange Station E6425000	Coyote Creek	Low Oxygen, Mercury, Pesticides, Total Toxic Chemicals	Water temperature, dissolved oxygen
California Environmental Data Exchange Network Station C30			Mercury, metals, PCBs
CA Water Board Water Quality Exchange Station E6525000	Los Gatos Creek	Temperature	Water temperature, dissolved oxygen
California Environmental Data Exchange Network Station PER085	Permanente Creek	Metals, Pesticides, Total Toxic Chemicals, Trash	Ammonia, dissolved oxygen
California Environmental Data Exchange Network Station RSW001			Ammonia, dissolved oxygen
California Environmental Data Exchange Network Station RSW004			Ammonia, dissolved oxygen
California Environmental Data Exchange Network Station PER070			Ammonia, dissolved oxygen
California Environmental Data Exchange Network Station RSW005			Ammonia, dissolved oxygen
California Environmental Data Exchange Network Station 205COY185	Silver Creek	Trash	Ammonia, metals

Coyote Creek

Identified issues that impair Coyote Creek water quality include low dissolved oxygen, mercury, pesticides, and total toxic chemicals. The mean annual dissolved oxygen levels fluctuated over the years, but remained above the minimum requirements for warmwater (5000 ug/L) and coldwater (7000 ug/L) habitat (Figure 4.11; San Francisco Bay Regional Water Quality Control Board, 2024). From 2000 to 2002, mean annual metals, PCB, and mercury levels increased over time (Figure 4.12-4.14). Water temperatures were relatively stable until 2011 when temperatures started increasing (Figure 4.15). Although temperatures remain below the lethal limit for steelhead (22°C), current temperatures still pose a threat to this special status species due to elevated risk for disease and impaired smoltification (Valley Water, 2022).

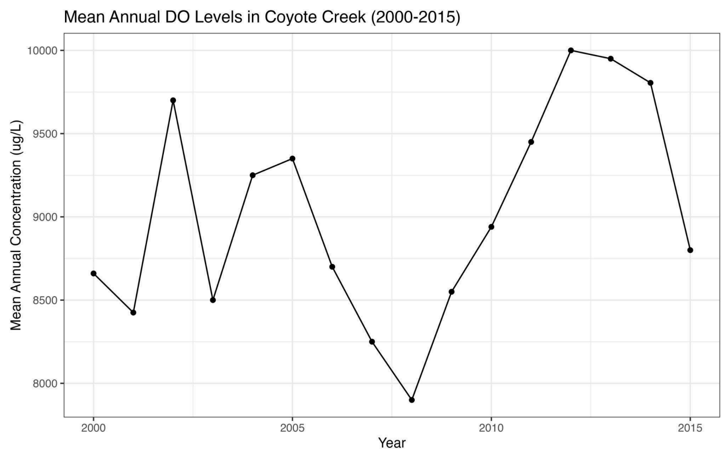

Figure 4.11. Mean Annual Dissolved Oxygen Levels in Coyote Creek (2000-2015). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual dissolved oxygen levels were reported using data obtained from Station E6425000 for 2000-2015.

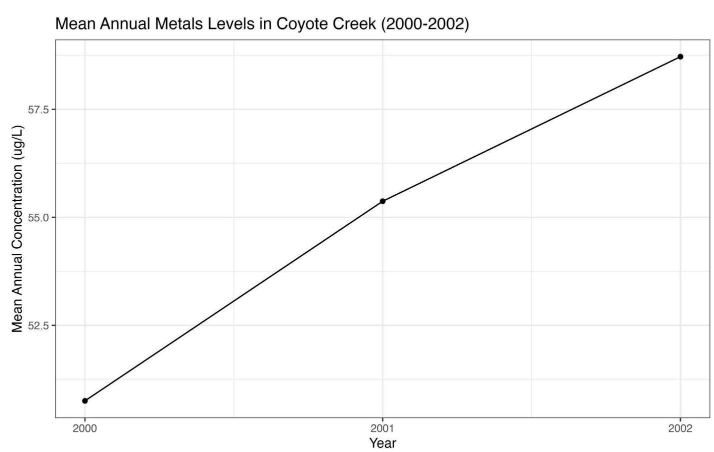

Figure 4.12. Mean Annual Metals Levels in Coyote Creek (2000-2002). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual metals levels were reported using data obtained from Station C30 for 2000-2002.

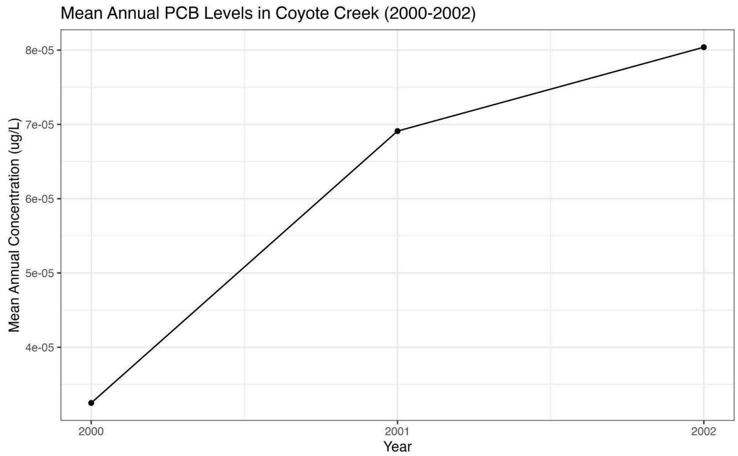

Figure 4.13. Mean Annual PCB Levels in Coyote Creek (2000-2002). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual PCB levels were reported using data obtained from Station C30 for 2000-2002.

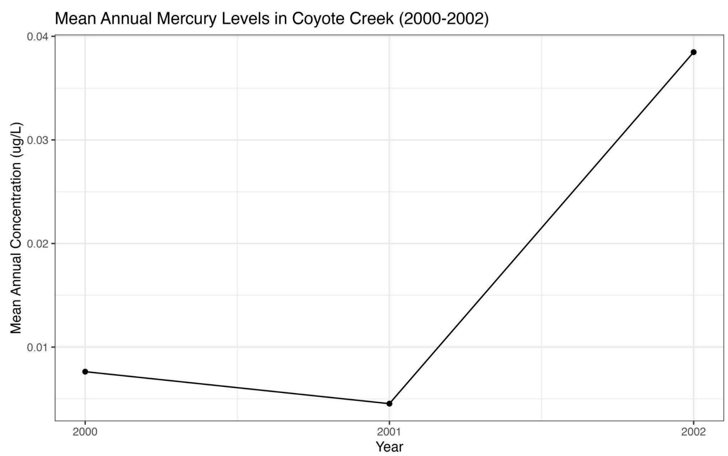

Figure 4.14. Mean Annual Mercury Levels in Coyote Creek (2000-2002). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual mercury levels were reported using data obtained from Station C30 for 2000-2002.

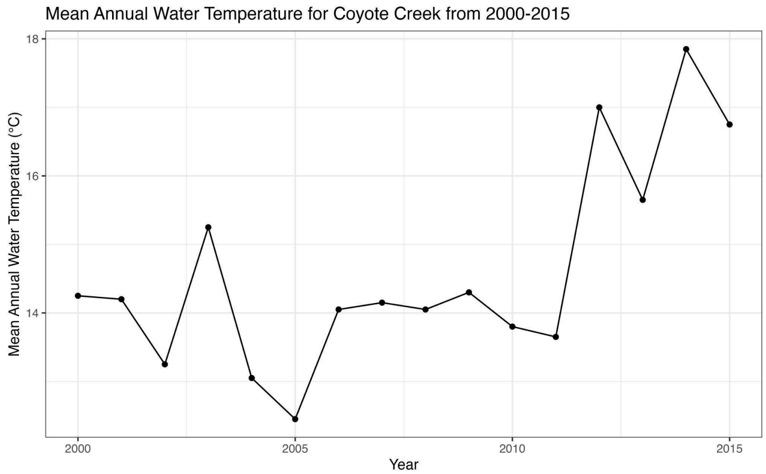

Figure 4.15. Mean Annual Water Temperature in Coyote Creek (2000-2015). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual water temperature was reported using data obtained from Station E6425000 for 2000-2015.

Los Gatos Creek

In Los Gatos Creek, mean annual dissolved oxygen levels experienced a sharp increase in 2002 before stabilizing between 9000-10,000 ug/L in the years afterwards (Figure 4.16). Water temperature was identified as an issue for this creek. Mean annual water temperature lowered to ~12°C between 2005 to 2010, but have since increased to ~17°C (Figure 4.17). Similar to Coyote Creek, temperatures remain below the lethal limit, but still may pose a threat to listed species fitness.

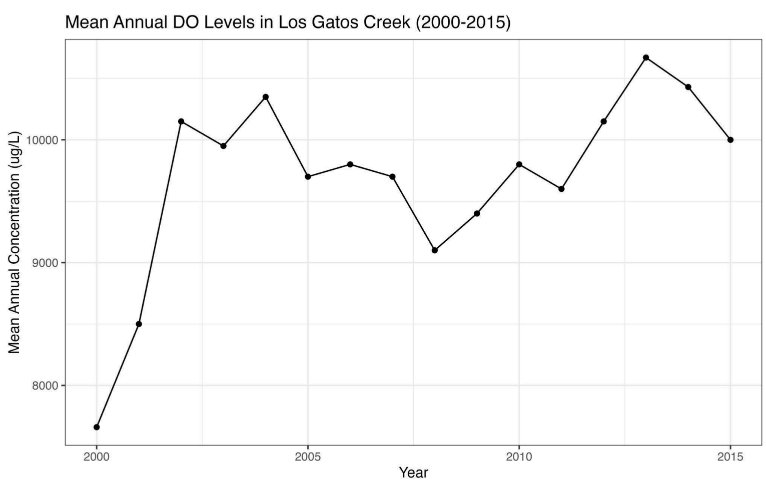

Figure 4.16. Mean Annual Dissolved Oxygen Levels in Los Gatos Creek (2000-2015). *Data source: National Water Quality Monitoring Council, 2024.* Mean annual dissolved oxygen levels were reported using data obtained from Station E6525000 for 2000-2015.

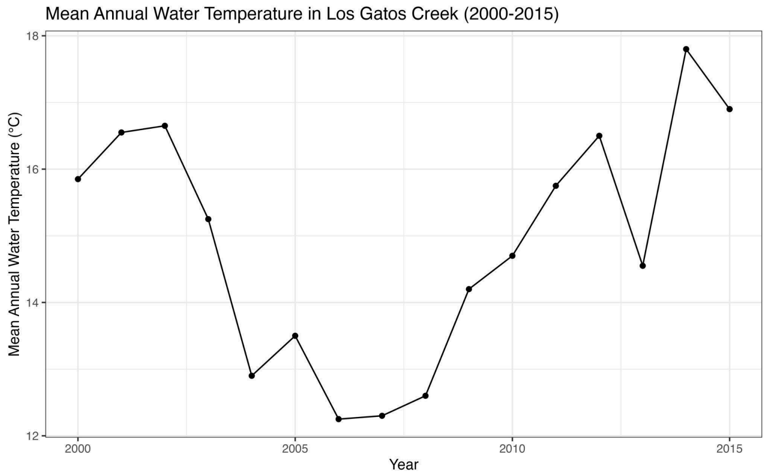

Figure 4.17. Mean Annual Water Temperature in Los Gatos (2000-2015). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual water temperature was reported using data obtained from Station E6525000 for 2000-2015.

Permanente Creek

Identified issues impairing Permanente Creek water quality were metals, pesticides, total toxic chemicals, and trash. However, no data was available to quantify the levels of these parameters in Permanente Creek. Instead, mean ammonia and dissolved oxygen levels were recorded. Mean annual ammonia peaked in 2019 and sharply declined the year afterwards (Figure 4.18). Mean annual dissolved oxygen declined over time, dipping below the minimum requirement for cold water habitat (7000 ug/L) in 2020 (Figure 4.19). Despite the declining trend, dissolved oxygen levels still satisfy the requirements for warmwater habitat (>5000 ug/L).

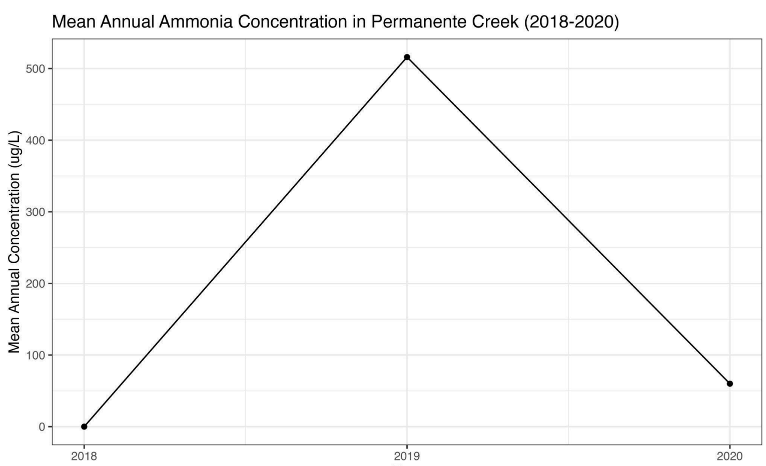

Figure 4.18. Mean Annual Ammonia Levels in Permanente Creek (2018-2020). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual ammonia levels were reported using data obtained from Stations PER085, RSW001, RSW004, PER070, and RSW005 for 2018-2020.

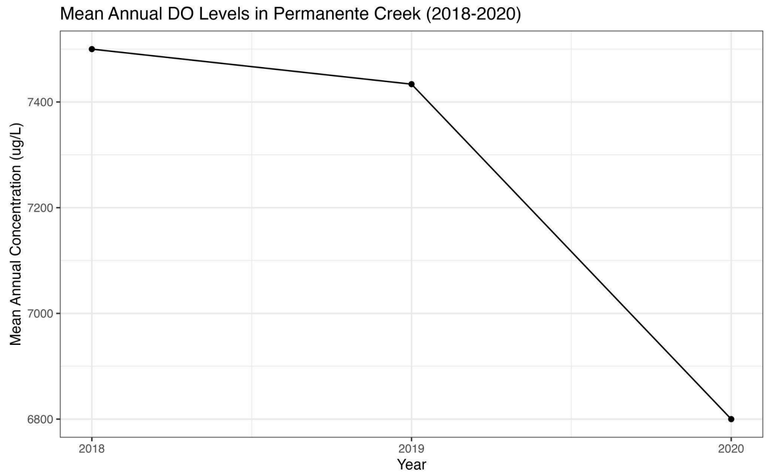

Figure 4.19. Mean Annual Dissolved Oxygen Levels in Permanente Creek (2018-2020). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual dissolved oxygen levels were reported using data obtained from Stations PER085, RSW001, RSW004, PER070, and RSW005 for 2018-2020.

Silver Creek

In Silver Creek, the mean annual ammonia concentration increased over time (Figure 4.20). In 2017, the mean annual concentration of metals was above 15 ug/L.

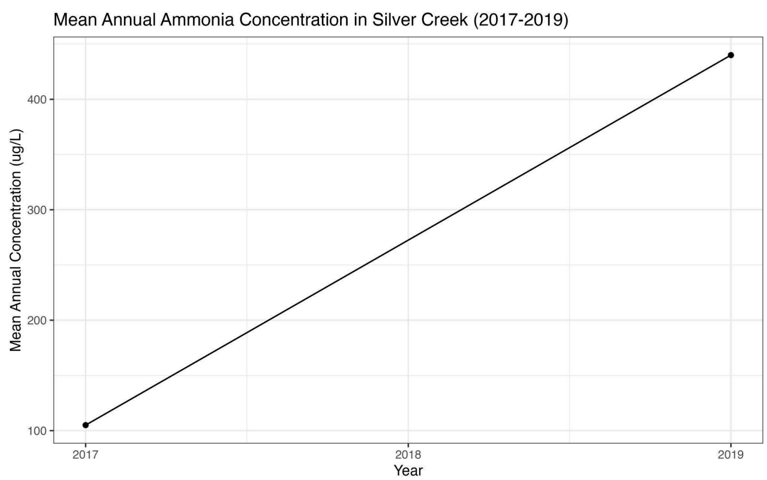

Figure 4.20. Mean Annual Ammonia Levels in Silver Creek (2017-2019). *Data Source: National Water Quality Monitoring Council, 2024.* Mean annual ammonia levels were reported using data obtained from Stations 205COY185 for 2017-2019.

4.3 Gaps in Monitoring

Hydrology, meteorology, and water quality monitoring sites showed spatial and temporal data gaps. USGS hydrology monitoring stations are more evenly distributed along the major waterways within the watershed but contain temporal gaps in data. Some monitoring periods of record are more recent (e.g. beginning in 2017) while others are no longer collecting data (e.g. ending in 2023 or before). However, there are monitoring stations that have several decades of recorded data. NOAA meteorological monitoring stations are more sparsely distributed and temporally variable. The majority are located in urban centers in the Santa Clara Valley and near San Francisco Bay. There is a lack of stations within the eastern, western, and southern portions of the watershed. Figure 4.22 suggests additional monitoring locations based on the current spatial distribution of stations. Many existing stations have short periods of record ranging a few years and some with long periods of record are missing data in between years. Additionally, temperature data is not available for all monitoring stations - very few stations recorded both temperature and precipitation data. Water quality monitoring stations are more abundant than hydrological and meteorological stations, but also lack important information. Pesticides are an identified issue impairing streams but are not monitored by water quality monitoring stations (Table 4.4).

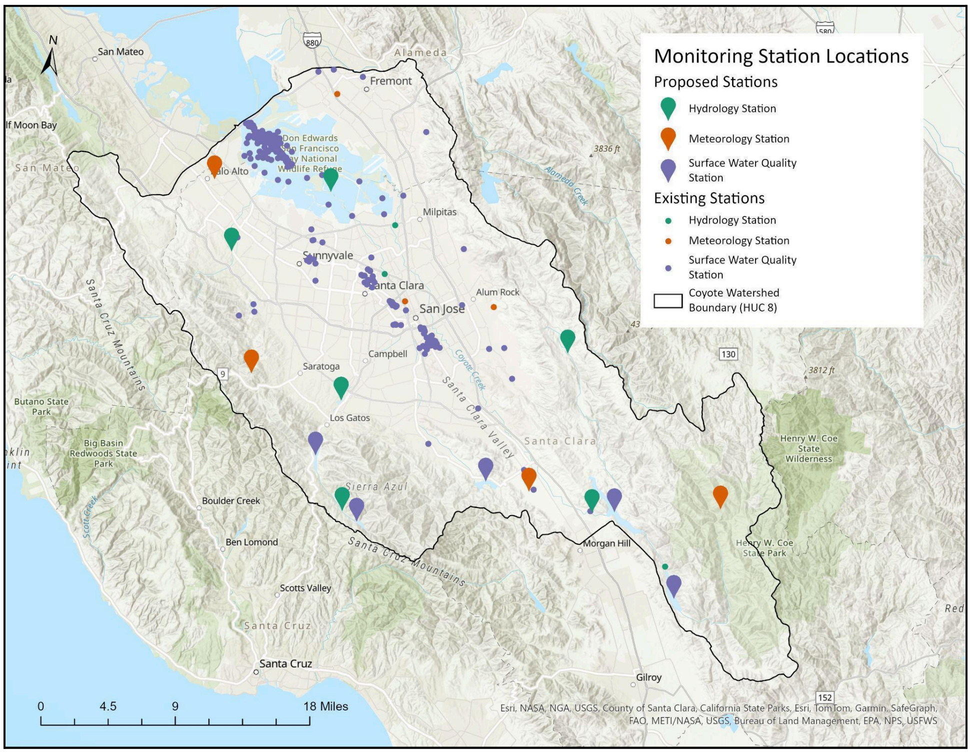

Figure 4.22. Existing and proposed monitoring stations in the Coyote Watershed. Proposed hydrology and water quality station locations, shown by the teardrop pins, are distributed across several water bodies not currently monitored. Proposed meteorology stations are located in more remote and high elevation regions that currently lack monitoring.

4.4 Summary

Across the three meteorology monitoring stations, precipitation was variable throughout years, with maximum precipitation aligning during the wet season. Temperature, collected at two of the three stations, showed seasonal fluctuations typical of a Mediterranean climate. Significant spatial and temporal data gaps existed for meteorological data. Some gauges did not record temperature and many had missing data in between years or short collection periods. Hydrological monitoring data shows annual peak flows following precipitation during the wet season, although different regions of the watershed had maximum and minimum flows during different years. Fall of 2014 and 2015 and spring of 2020 experienced notable drought conditions with regard to volumetric water discharge, while maximum flows occurred in early winter of 2017 and 2023. While flow data had fewer temporal data gaps, there are several water bodies within the watershed that remain unmonitored. Low dissolved oxygen, mercury, pesticides, and toxic chemicals are primary water quality issues of concern in the watershed. However, measurements of each of these issues in creeks across the watershed remain below the lethal limit and above minimum requirements. Monitoring gaps also existed for water quality, as pesticides were not accounted for in creeks with pesticides as an identified issue of concern. The proposed monitoring station locations aim to distribute monitoring more evenly across the watershed to accurately capture local aspects of water quality, meteorology, and hydrology. By filling in these data gaps, managers can be better informed in developing best management practices.

5. POINT SOURCE AND NONPOINT SOURCE POLLUTION

An understanding of pollution sources in Coyote Watershed is key to the development of a robust management plan. Pollution can originate from point or nonpoint sources. Point sources discharge pollutants directly into waterways through discernible, confined, and discrete conveyances, such as: pipes, man-made ditches, channels, tunnels, conduits, wells, discrete fissures, containers, rolling stock, concentrated animal feeding operations, vessels, or other floating craft (EPA, 2015; California Water Boards, 2024). Point sources are regulated and need a National Pollutant Discharge Elimination System (NPDES) permit to be able to discharge pollutants (California Water Boards, 2024). In contrast, non-point sources discharge pollutants indirectly into waterways through diffuse sources such as: land runoff, precipitation, atmospheric deposition, seepage, or hydrologic modification (EPA, 2015). Officially, non-point sources are defined as any source of water pollution that does not meet the definition of a point source (EPA, 2015). Given the diffuse nature of nonpoint source pollution, non-point sources are not as regulated as point sources.

This watershed is highly urbanized, with pollutant loads subject to the influence of human and industrial activities. Discharge from wastewater plants and industrial facilities comprise the main point sources contributing to nutrient, metal, and toxic chemical contamination of local waters (County of Santa Clara Watershed Protection Division, 2024). Urban runoff from roads, and residential and commercial properties also contribute to nutrient, pesticide, metal, and toxic chemical pollution (County of Santa Clara Watershed Protection Division, 2024). Knowledge of specific pollutants and sources is critical to developing strategies to mitigate or remediate water quality impairments and improve watershed health.

5.1 Point Sources

According to the EPA Enforcement and Compliance History Online (EPA ECHO) database, there are five major point sources that directly discharge pollutants into the water bodies of Coyote Watershed. These point sources include a water treatment plant, an amusement park, road infrastructure, and cement plants (Figure 5.1). While there are five major point sources in the watershed, only three sources (Sunnyvale Water Pollution Control Plant, Hanson Permanente Cement Plant, and Cupertino Quarry) have information on total pollutant loads. Across all point sources, dissolved solids have the highest or near-highest pollutant load and mercury has the lowest pollutant load (Table 5.1). Compared to the Hanson Permanente Cement Plant and Cupertino Quarry, the Sunnyvale Water Pollution Control Plant included a greater diversity of pollutants ranging from heavy metals to excess nutrients that would impair water quality. For the Sunnyvale Water Pollution Control Plant, inorganic nitrogen is the dominant pollutant with the highest load followed by dissolved solids (Table 5.1). For the other point sources, dissolved solids were the top pollutant (Table 5.1). Understanding the levels of pollution in the watershed allow for better planning for management practices, and locations of the point sources allow for the control of water use to maintain safety.

Table 5.1. Pollutant Loads from 3 Point Source Facilities in Coyote Watershed. Data Source: EPA.

Pollutant	Sunnyvale Water Pollution Control Plant (total lb/yr)	Hanson Permanente Cement Facility (total lb/yr)	Cupertino Quarry (total lb/yr)
Inorganic Nitrogen	582515.2463	NA	NA
Solids, total dissolved	NA	529051.9414	NA
Solids, total suspended	348163.8193	7583.292951	7981.708833
BOD, carbonaceous	101334.8028	NA	NA
Ammonia as N	77648.27015	NA	NA
Phosphorus	72016.26469	NA	NA
Oil and grease	NA	34.88262813	NA
Zinc	205.8768356	NA	NA
Selenium	63.02879282	3.389853184	0.180388823
Nickel	59.51628155	6.646198518	1.883675273
Copper	54.12591274	NA	0.92472849
Lead	NA	NA	0.05996547113
Cyanide	16.69769215	NA	0.01068547623
Arsenic	14.72393931	NA	NA
Chromium, Trivalent	6.974497566	NA	0.927065349
Chromium	6.974497566	NA	NA
Chromium, Hexavalent	6.974497566	2.021930443	1.136881904
Antimony	NA	0.3072134288	NA
Mercury	0.01296494798	0.0005850489252	NA

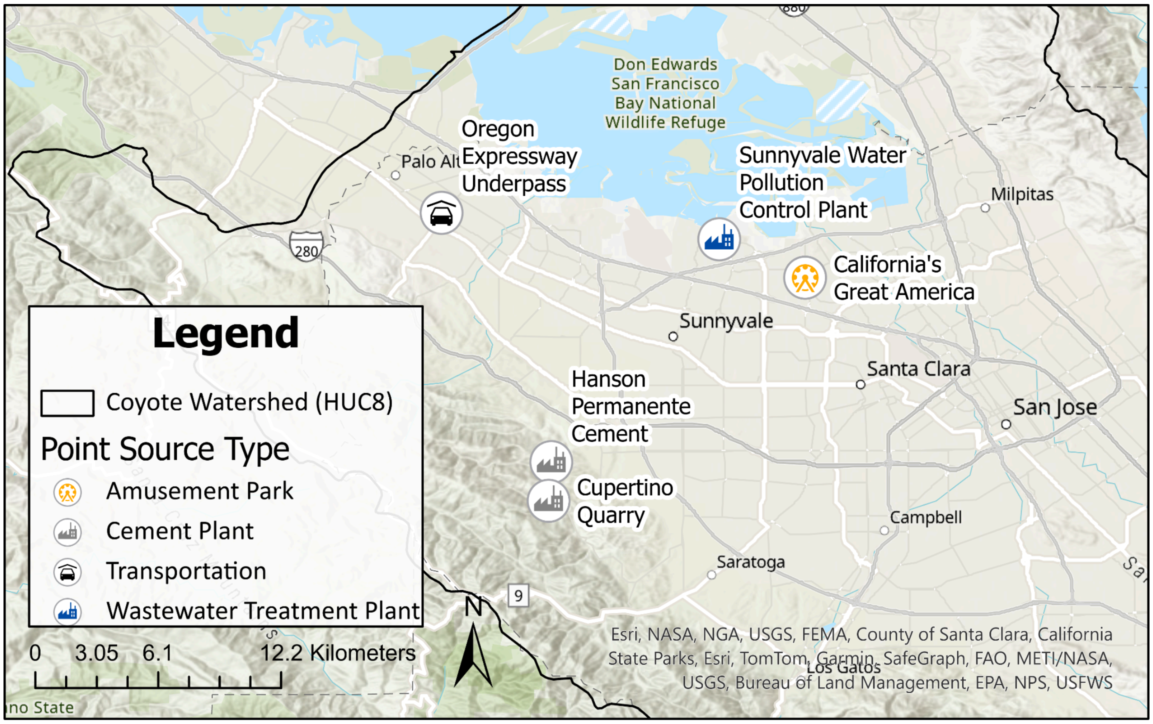

Figure 5.1. Coyote Watershed Point Sources. The location of five point source facilities in Coyote Watershed are depicted according to facility type. The different types of facilities include amusement parks (yellow), cement plant (grey), transportation infrastructure (black), and wastewater treatment plants (blue).

5.2 Non-Point Sources

Unlike point-source pollution, which originates from identifiable locations, non-point source pollution is harder to trace and manage, making it a critical water quality concern. Coyote Watershed encompasses a mix of urban, agricultural, and natural land uses. Agricultural runoff, urban runoff, and erosion from these land use activities contribute to nonpoint source pollution that introduces heavy metals, excess nutrients, pesticides, and sediments into waterways (Lowe et al. 2021). Historic and current grazing operations in the upper watershed negatively affect water quality by causing stream bank erosion and adding pathogens, excess nutrients, and sediment loads to the creeks. The diffuse nature of nonpoint source pollutants impairs stream health and riparian habitats throughout the watershed. In field assessments conducted by Santa Clara Valley Water District, nonpoint source discharges were observed in 83% of assessment areas and the percentage of assessment areas where nonpoint sources were thought to have a negative impact doubled between 2010 to 2020 (Lowe et al. 2021). Figure 5.2 shows five selected subwatersheds within the Coyote Watershed that encompass a significant portion of impaired streams: Anderson Lake-Coyote Creek (HUC 180500030105), Metcalfe Canyon-Coyote Creek (HUC 180500030202), Los Gatos Creek (HUC 180500030303), Permanente Creek-Frontal San Francisco Bay Estuaries (HUC 180500030406), and Pueblo Lands of San Jose-Frontal San Francisco Bay Estuaries (HUC 180500030305).

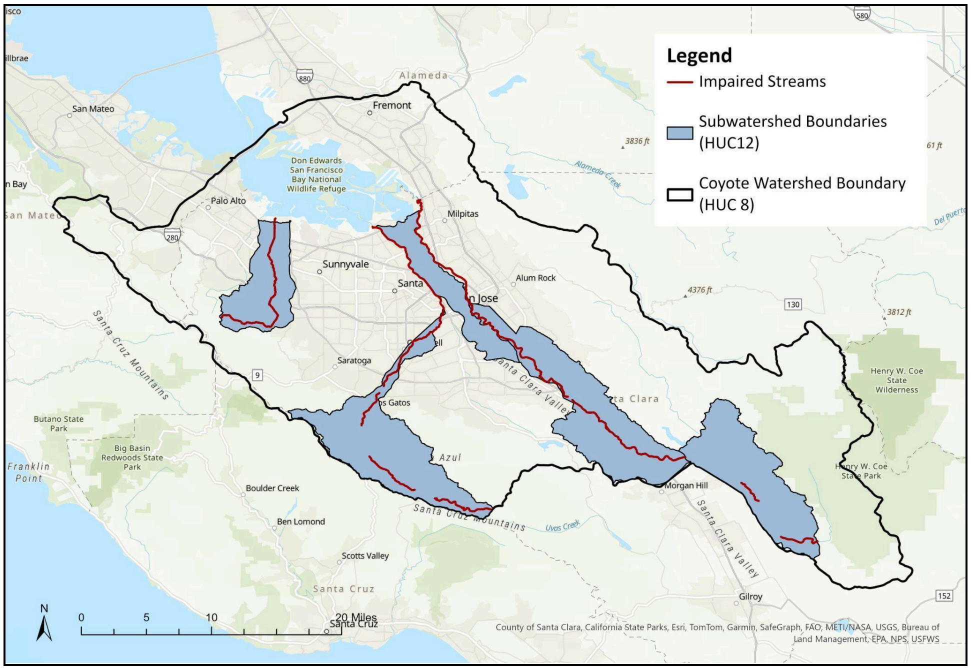

Figure 5.2. Map of impaired streams within selected HUC12 subwatersheds. Five subwatersheds shown were selected based on the presence of major impaired streams including Coyote Creek, which flows through two subwatersheds.

The focal subwatersheds each encompass different majority land use types. Los Gatos Creek and Anderson Lake-Coyote Creek are primarily forest (evergreen forest and mixed forest, respectively) with areas of developed land (NLCD 2021). Permanente Creek-Frontal San Francisco Bay Estuaries and Pueblo Lands of San Jose-Frontal San Francisco Bay Estuaries are primarily developed land, while Metcalfe Canyon-Coyote Creek contains a diverse mix of developed, cropland, forest, and shrub. The EPA's Pollutant Load Estimation Tool (PLET) estimates pollutant loads from non-point sources in each subwatershed and by different land uses. Table 5.2 outlines the total annual loads of major pollutants in each subwatershed, which is visualized in Figures 5.3 and 5.4. BOD is the largest total pollutant load within all five watersheds, with subwatershed W3 being the largest contributor of BOD and all other pollutants.

Table 5.2. Total loads by subwatershed for nitrogen (N), phosphorus (P) and biochemical oxygen demand (BOD) and sediment. *Source: EPA PLET 2024.*

Subwatershed (HUC 12)	N Load (lbs/year)	P Load (lbs/year)	BOD Load (lbs/year)	Sediment Load (tons/year)
W1 -180500030105	85,986.18	7,786.37	128,721.43	390.68
W2 -180500030202	54,337.22	4,637.3	83,763.36	762.93
W3 -180500030303	172,881.82	19,949.53	345,274.08	1,999.68
W4 -180500030406	80,272.98	8,845.71	135,784.81	807.62
W5 -180500030305	40,814.2	5,115.36	108,723.09	702.92
Total	434,292.41	46,334.27	802,266.77	4,663.83

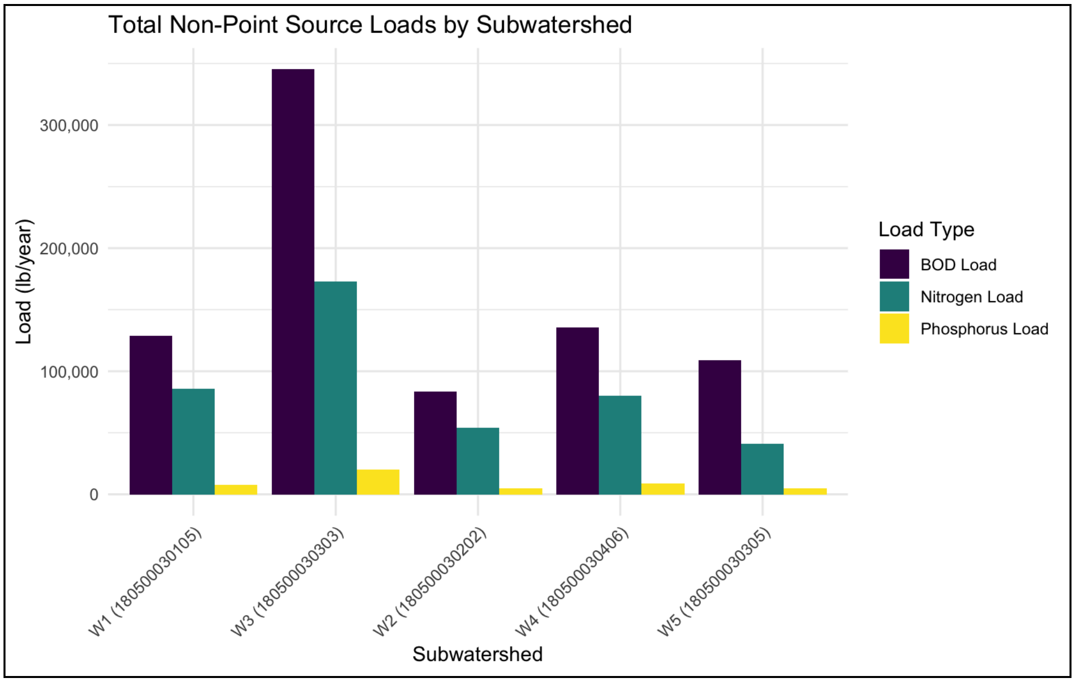

Figure 5.3. Total Non-Point Source Loads by Subwatershed. Nitrogen loads are highest among all subwatersheds, followed by phosphorous and BOD loads. Subwatershed W3 has the highest amount of nitrogen, phosphorus, and BOD loads.

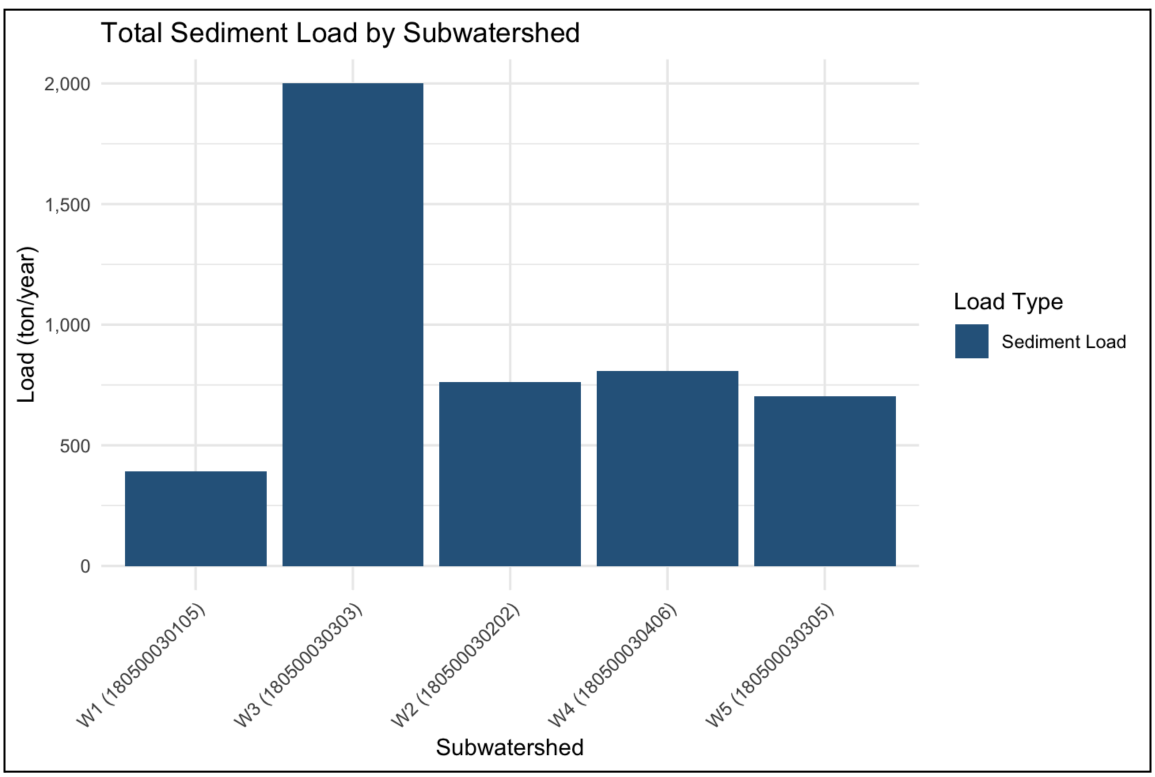

Figure 5.4. Total sediment load by subwatershed. Subwatershed W3 has the highest amount of sediment loads compared to the other selected subwatersheds. Sediment loads in subwatersheds W2, W4, and W5 are relatively evenly distributed.

Table 5.3 outlines total loads of nitrogen, phosphorus, BOD, and sediment contributed by different land types within the five selected subwatersheds. Urban land uses contribute the highest to BOD loads (72%), nitrogen loads (50%), phosphorus loads, and sediment loads (34%). Forests are the second highest contributor of nitrogen loads in the watershed and pastureland is the second highest contributor of BOD loads. These patterns are visualized in Figure 5.5, which breaks down nitrogen, phosphorus, and BOD loads by land use type.

Table 5.3. Contributed total loads by land use within 5 subwatersheds. *Source: EPA PLET 2024.*

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (tons/yr)
Septic	509.44	199.53	2,080.21	0
Feedlots	3,325.72	665.14	4,434.3	0
Cropland	6,326.13	1,479.25	13,090.68	669.45
Groundwater	75,879.82	3,755.58	0	0
Pastureland	53,740.09	4,376.9	173,258.55	349.19
Forest	143,841.08	12,656.76	30,769.71	183.05
Urban	150,670.13	23,201.1	578,633.33	3,462.14
TOTAL	434,292.41	46,334.27	802,266.77	4,663.83

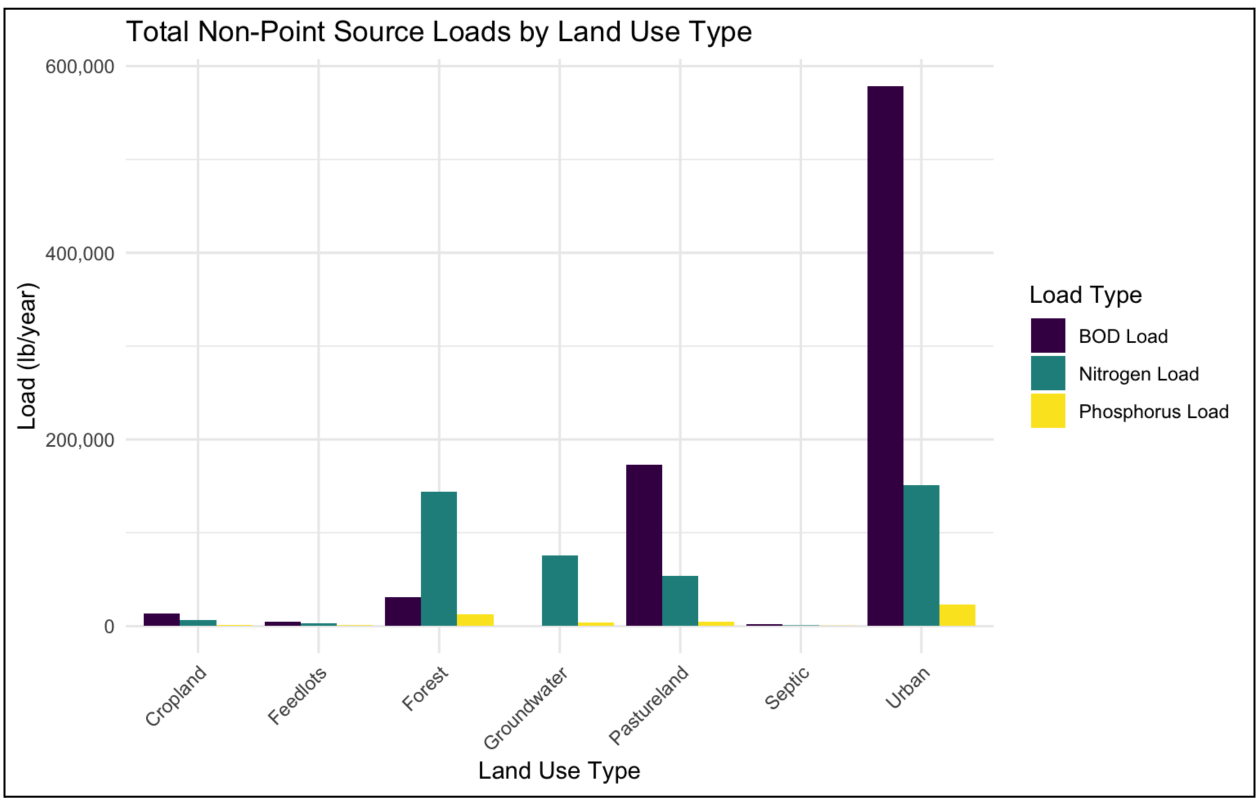

Figure 5.5. Total Non-Point Source Loads by Land Use Type. Nitrogen loads are the highest non-point source loads among the majority of land use types and are highest in urban land uses. Phosphorus makes up the highest amount of nonpoint source loads in forest and groundwater land uses.

5.3 Summary

A robust watershed management plan must consider the impacts of point and nonpoint source pollutants on overall watershed health. In Coyote Watershed, only three point sources reported their pollution loads. Across all point sources, total dissolved solids were identified as the primary pollutant with the highest loading into adjacent water bodies. Pollutant composition differed by point source facility, with water treatment plants discharging the greatest diversity of pollutants compared to cement plants. While our analysis revealed that pollutant loads differ by point source facility, it also highlighted the large data gap in point source reporting. Considering the region's high population density and industrial activity, we expected more than three point sources to exist within Coyote Watershed. The watershed's main non-point sources include erosion and runoff from urban areas, pastures, and forests.

Pollutant loads differed by land-use, with urban areas and pastures primarily introducing high BOD, and forests introducing high nitrogen loads. Non-point source pollution loads also differed by subwatershed, with Los Gatos Creek subwatershed (HUC 12 #180500030303) introducing the highest loads into nearby water bodies. This revealed the importance of prioritizing specific subwatersheds and land-uses to effectively manage non-point source pollution in Coyote Watershed. Overall, our evaluation of pollution sources in Coyote Watershed will inform the mitigation and remediation strategies to pursue, and the regions to implement these strategies to protect water quality and enhance watershed health.

6. BEST MANAGEMENT PRACTICES

The best Watershed Management Plans typically include suggestions and plans for how to manage different areas of the watershed and how to maintain healthy levels of pollutants in bodies of water. Best Management Practices (BMPs) are an example of this. They can be "devices, practices, or methods that are used to manage stormwater runoff by controlling peak runoff rate, improving water quality, and managing runoff volume" (Stormwater 2020). These can be in the form of rain gardens, infiltration trenches, pathways, permeable pavement, and more. To determine the appropriate size of BMPs, urban stormwater analysis plays a crucial role. This type of analysis examines how much rain an area typically receives, how land is being used (for example, whether it's covered by buildings, pavement, or natural vegetation), how much stormwater runs off these surfaces, and what kinds of pollutants might be present in the runoff. By studying these details, experts can figure out how large and effective the BMPs need to be to properly handle the stormwater in a specific area. Selecting BMPs usually starts with understanding the main issues that need to be addressed, such as reducing flooding, improving water quality, or controlling how much stormwater reaches a particular area. Based on these goals, the selection process involves choosing the most suitable options for solving those problems. For example, structural BMPs, like detention basins or rain gardens, might be used to collect and treat runoff, while non-structural BMPs, such as public education campaigns or improved landscaping practices, might focus on preventing pollutants from entering the water system in the first place. The key is to match the BMPs to the unique needs of the watershed while keeping in mind local environmental conditions and community goals.

6.1 Urban Stormwater Analysis

Over the past two decades, it has stormed 11-15% of the year in Coyote Watershed (Table 6.1). More storms occurred near urban San Jose (15.3% storm frequency) followed by the areas near Fremont (14.8%) and outer San Jose (11.9%). As shown in Figure 6.1, most storms occurring in the watershed were light storms (<12.7mm rainfall) followed by moderate storms (12.7-25.4mm rainfall) and strong storms (50.8-76.2mm rainfall). The spatial distribution of light and moderate storms was even throughout the watershed, with marginal differences in storm frequency between the three regions evaluated (Table 6.1). For strong storms (50.8-76.2mm), urban San Jose experienced the most (4.6%) followed by outer San Jose (3.4%) and Fremont (3.2%). Major and severe storm events were rare for Coyote Watershed, and primarily occurred near Fremont or the outskirts of San Jose (Table 6.1).

Understanding the frequency and spatial distribution of storms is necessary to implement BMPs for water moving through the watershed. While it does not rain much in this watershed, light storms producing 12.7mm rainfall are the most common. This implies that BMPs for this watershed must withstand, at minimum, the volume and level of water quality impairment associated with light storms. Stronger storms producing >12.7mm do occur in the watershed, but are nearly four times less frequent than that of light storms. When these stronger storms happen, the impact on water resources will be much higher than that of light storms. Therefore, BMPs addressing the impact of stronger storms should also be implemented if additional resources and budget allow.

Table 6.1. Summary of Storm Events in Coyote Watershed. *Data Source: NOAA.* The number of storms occurring after 2000 are reported for areas near Fremont, the outskirts of San Jose, and urban San Jose. The storm frequency (number of storm days each year over the total monitoring period) was also reported for each region. Due to monitoring limitations, the specific time period evaluated was 2000-2024 for Fremont, 2008-2019 for San Jose outskirts, and 2000-2008 & 2023 for urban San Jose.

	Fremont	San Jose (Outskirts)	San Jose (Urban)
Total Number of Storms	1354	523	503
Total Frequency of Storms (%)	14.8	11.9	15.3
Number of Light Storms <12.7mm	1131	435	417
Frequency of Light Storms (%)	83.5	83.2	82.9
Number of Moderate Storms 12.7-25.4mm	174	69	63
Frequency of Moderate Storms (%)	12.9	13.2	12.5
Number of Strong Storms 25.4-50.8mm	44	18	23
Frequency of Strong Storms (%)	3.2	3.4	4.6
Number of Major Storms 50.8-76.2mm	4	-	-
Frequency of Major Storms (%)	0.3	-	-
Number of Severe Storms >76.2	1	1	0
Frequency of Severe Storms (%)	0.07	0.2	-

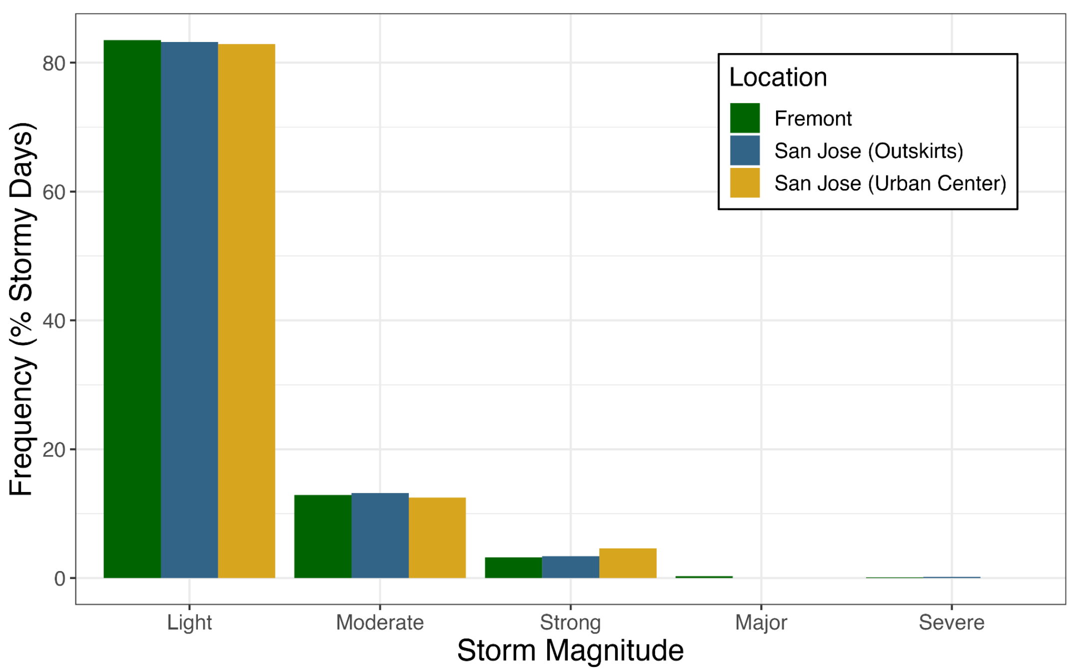

Figure 6.1. Storm Frequency by Magnitude. *Data Source: NOAA.* The frequency of storms, measured in percent of storm days, were reported for storms occurring at different magnitudes in the Fremont, San Jose outskirts and urban San Jose areas. Storms were classified as light (<12.7mm rain), moderate (12.7 - 25.4mm), strong (25.4 - 50.8mm), major (50.8 - 76.2mm), or severe (>76.2 mm). Due to monitoring limitations, the specific time period evaluated was 2000-2024 for Fremont, 2008-2019 for San Jose outskirts, and 2000-2008 and 2023 for urban San Jose.

6.2 Recommended Best Management Practices

Three sub watersheds that incorporated Coyote Creek were selected to cover diverse regions and land uses within the Coyote Watershed. Recommended Best Management Practices (BMPs) for Metcalfe Canyon, Los Gatos Creek, and Permanente Creek were determined using the Pollutant Load Estimation Tool (PLET) to address pollutant loads efficiently. BMPs targeting forested and cropland areas, the dominant land uses in these watersheds, were considered based on their effectiveness. Selection of BMPs in the analysis focused on practices with the highest efficiency levels based on the Best Management Practice Efficiency References. BMPs with the highest efficiency values for the given land use were input into PLET. Incorporating these BMPs into the tool quantified pollutant reductions in sediment and nutrient loads. The analysis highlights how tailored BMPs can mitigate significant pollutant contributions, optimizing management strategies for each subwatershed's unique land use characteristics to be implemented in other areas in the watershed.

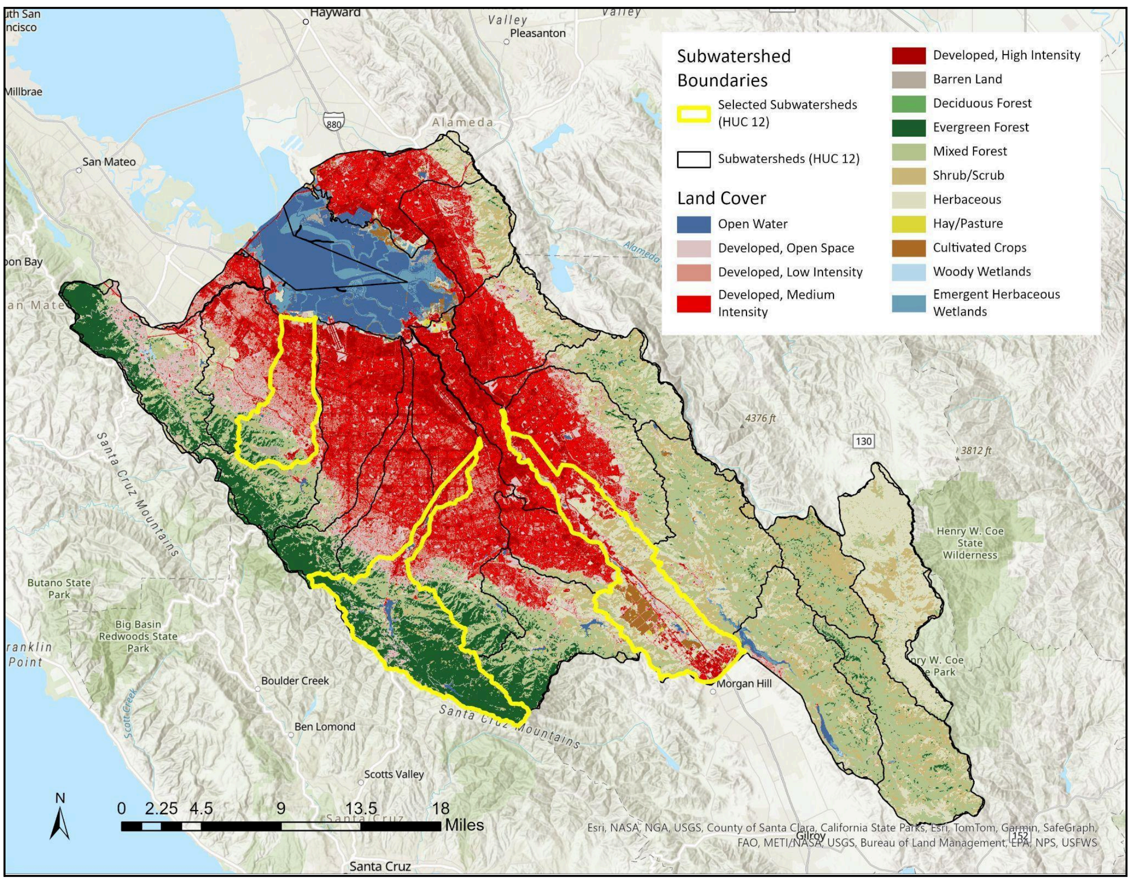

Figure 6.2. Land use in selected subwatersheds within the Coyote Watershed. Majority land uses across the three highlighted watersheds are urban, forest, herbaceous, and cultivated crops.

For the two selected land uses for the analysis (other than urban), the top three highest efficiency values were compared when applied to 50% of the subwatershed area. The acreage modeled for the BMPs was 29,995.91 acres across all subwatersheds. Of the BMPs listed in Table 6.2, land retirement was the most efficient practice for reducing nitrogen, phosphorus, and sediment loads in cropland while site preparation/straw/crimp seed/fertilizer/transplant was the most efficient for reducing sediment loads in forested areas.

Table 6.2. BMPs and efficiency value for reducing pollutant loads in each subwatershed. Efficiency values are calculated given BMP application in 50% of the subwatershed area.

Subwatershed	BMP	Nitrogen	Phosphorus	Sediment	Land Use
Metcalfe Canyon	Land Retirement	0.45	0.405	0.475	Crop
	Streambank stabilization and fencing	0.375	0.375	0.375	
	Conservation Tillage 2 (equal or more than 60% residue)	0.065	0.345	0.395	
Los Gatos Creek & Permanente Creek	Site preparation/ straw/crimp seed/fertilizer/ transplant	ND	ND	0.475	Forest
	Site preparation/ straw/crimp/ net	ND	ND	0.465	
	Site preparation/ straw/polymer/ seed /fertilizer/ transplant	ND	ND	0.43	

BMP Reduction Results

The implementation of the most efficient BMPs listed in Table 6.2 result in the following total reductions in pollutant loads across all three subwatersheds when implemented in 50% of the given land use area: 1.23% reduction in nitrogen, 1.96% in phosphorus, 0.23% BOD, and 5.26% sediment. This translates to the following reductions in pounds per year: 2,903.22 in nitrogen, 624.55 in phosphorus, and 1,745.53 in BOD. Overall sediment is reduced by 272.74 tons per year.

As the majority of non-point source pollution loads originated from urban land use, urban BMPs were modeled for commercial and single family urban land uses, which were the top urban land use types. Because Biochemical Oxygen Demand (BOD) was identified as the non-point source with the highest loads in urban areas, the most efficient BMP for reducing BOD loads, infiltration devices, was selected. When applied to 50% of urban areas across the three subwatersheds, infiltration devices offer the following load reductions: 0% in nitrogen, 8.44% in phosphorus, 13.86% in BOD and 11.87% in sediment. This translates to the following reductions in pounds per year: 3,054.23 reduction in phosphorus and 101,140.79 in BOD. Sediment is reduced by 513.97 tons per year. Table 6.3 outlines BMP load reduction for each subwatershed for both urban and selected land use when applied to 50% of the area and figure 3 shows possible areas where these BMPs can be implemented based on land use type.

Table 6.3. Pollutant load reductions under most efficient BMPs for focal subwatersheds. Metcalfe Canyon employed land retirement for croplands and Los Gatos Creek and Permanente Creek employed Site preparation/ straw/crimp seed/fertilizer/ transplant for forested lands. All watersheds implemented infiltration devices in urban areas.

Watershed	N Reduction (lbs/year)	P Reduction (lbs/year)	BOD Reduction (lbs/year)	Sediment Reduction (tons/year)	% N Reduction	% P Reduction	% BOD Reduction	% Sediment Reduction
Metcalfe Canyon	2791.66	1303	25397.51	359.23	3.6	12.58	10.08	20.4
Los Gatos Creek	92.65	1442.59	45632.85	261.95	0.05	6.69	14.69	15.56
Permanente Creek	18.91	933.18	31855.96	165.53	0.04	11.93	17.48	15.49
TOTAL	2903.22	3678.77	102886.32	786.71	1.23	10.4	14.08	17.15

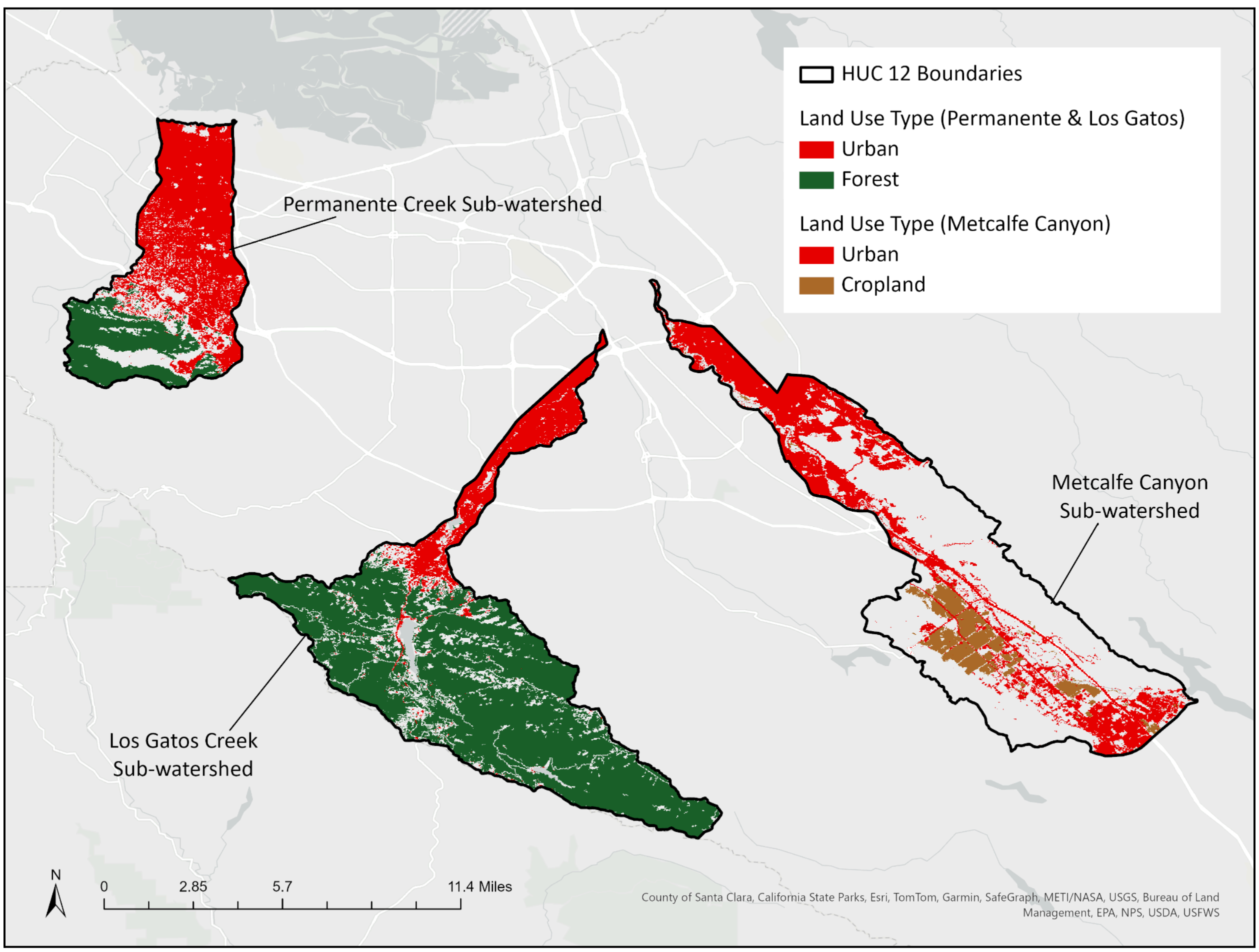

Figure 6.3. BMP implementation areas based on focal land use types. This map shows where urban BMPS can be implemented in each subwatershed, as well as the selected BMPs for forest and cropland land use types.

6.3 Summary

This analysis is crucial when developing a Watershed Management Plan, in order to be adequately knowledgeable about the water and pollutant movement within the watershed. In the Coyote Watershed, there are very few large storms, with 48 storms being the highest number recorded from 2000-2024. This number is a combination of strong and severe storms at the Fremont location. The frequency of these storms throughout the watershed is about 3-4% of total storms within a year. With this in mind, our main recommended BMPs would be land retirement and various types of site preparation, focusing on the crop and forest sections of the watershed. For urban BMPs, infiltration devices are the most effective when looking to reduce BOD, which we implemented in commercial and single family areas. These BMPs together will reduce nitrogen by 1.23%, phosphorus by 10.4%, BOD by 14.08%, and sediment by 17.15%. Adding these 50% land use BMPs into existing management plans will be fairly expensive, especially with land retirement being a highly suggested option. Infiltration devices, while highly effective, have high installation costs. The following maintenance costs, however, are much lower in comparison, and affordable over time. Site preparation is an easier and cheaper option, and should be practiced whenever possible.

Recommendations

Based on our analyses, we outline the following recommendations of best management practices (Table 1). These recommendations aim to address the critical challenges facing the Coyote Watershed: balancing water demand, pollution control, flood risk mitigation, and bridging existing gaps in monitoring and assessment.

Table 1. Recommended Best Management Practices. *Sources: Best Management Practice Definitions Document for Pollutant Load Estimation Tool, 2023; Valley Water, 2024a-c.* Best management practices to address key issues in Coyote Watershed are presented.

BMP	Description	Key Issue Addressed
Infiltration Devices	Infiltration trenches, infiltration basins, dry wells, leaching catch basins, porous pavement/ blocks, and infiltration islands within parking areas can reduce peak discharge rates, stormwater volume, and pollutants from runoff.	Pollution, Flood Risk
Site Preparation	Measures that can be used to stabilize soils for forest site preparation and road construction include placed straw rolled with a sheepfoot roller (crimp), fertilizer application, hydromulch application, netting secured on slope, seed spread, straw placement, and transplantation of locally grown plant species.	Pollution
Streambank Stabilization and Fencing	Reduce streambank erosion to lessen sedimentation and flood risk (ex. vegetated buffers)	Pollution, Flood Risk
Education Campaigns	Teach water-saving, pollution prevention, and stormwater management to protect resources and reduce flood risks near homes	Increased Water Demand, Pollution, Flood Risk
Increased monitoring	Adding more monitoring stations and consistently collecting data to provide accurate and timely insights into watershed conditions	Monitoring Data Gaps
Maintenance of monitoring devices	Cleaning sensors, calibrating equipment, and replacing batteries ensures consistent, accurate data collection	Monitoring Data Gaps
Valley Water Landscape Rebate Program	Provide financial incentives to convert to low-water use landscapes: $3,000 for each residential site and $100,000 for each commercial/multi-family site	Increased Water Demand
Valley Water Graywater Laundry to Landscape Rebate Program	Provide financial incentive to encourage more efficient graywater use: $200-400 for each residential site	Increased Water Demand
Valley Water Commercial & Facility Rebate Program	Provide financial incentive to adopt water efficient technology: $100,000 for each project	Increased Water Demand

Our evaluation of Coyote Watershed and its key issues highlighted the following areas to focus management action:

- Reduce reliance on imported water sources through increased water reuse, groundwater recharge, and water conservation campaigns
- Reduce pollution of impaired streams through BMPs and education campaigns
- Reduce flood risk through BMPs and flood prevention and safety campaigns
- Reduce data gaps through increased monitoring and maintenance of survey equipment

The Coyote Watershed serves as a critical resource for wildlife habitats, agricultural productivity, and urban communities. This preliminary watershed management plan provides a roadmap for addressing current challenges while promoting resilience to future pressures such as climate change, urbanization, and evolving water demands. Implementing the recommended management strategies will be central to preserving the integrity of the watershed's natural systems, protecting water quality and availability, and supporting community well-being. Looking forward, effective collaboration among stakeholders, adaptive management practices, and continued investment in monitoring and research will be essential to a sustainable future for the Coyote Watershed.

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