CLIMATE CHANGE VULNERABILITY ASSESSMENT AND MITIGATION PLAN

for

VENTURA COUNTY WATERWORKS DISTRICT NO. 1 MOORPARK WATER RECLAMATION FACILITY
MOORPARK, CALIFORNIA

Prepared by

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for submission to

California Regional
Water Quality Control Board
Los Angeles Region

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1.0 INTRODUCTION

1.1 Background

The Moorpark Water Reclamation Facility (MWRF or Facility) receives wastewater from the City of Moorpark and is designed to provide 5.0 million gallons per day (MGD) of secondary treated wastewater, and 3.0 MGD of tertiary treated wastewater effluent. MWRF is subject to Order R4-2023-0089 Waste Discharge Requirements (WDR) and Water Reclamation Requirements (WRR) issued to the MWRF by the Los Angeles Regional Water Quality Control Board (LARWQCB).

Current treated wastewater flows are 1.75 MGD. Waste sludge is dewatered, stockpiled onsite, and hauled to a licensed facility for composting or to a landfill. The MWRF discharges secondary treated effluent to on-site percolation ponds. A portion of the secondary treated wastewater receives filtration and disinfection (by chlorination) to meet tertiary wastewater requirement prior to reclaimed water use by commercial, agricultural, and institutional customers. Unused tertiary treated wastewater is returned to the percolation ponds.

1.1.1 MWRF Treatment Process

The MWRF has been undergoing a two-phase upgrade and expansion. The Facility was originally designed to provide secondary treatment to 3.0 million gallons per day (MGD) of wastewater, and tertiary treatment to 1.5 MGD of secondary treated effluent. The Phase I Facility upgrade was completed and has been in operation since July 2001. It included conversion of the aeration/polishing ponds secondary treatment system to an activated sludge process, and the construction of a solids dewatering facility, solar sludge drying beds, and a dewatered cake storage pad. The Phase I upgrade did not change the Facility's design capacity.

The upgraded primary and secondary treatment systems consist of an in-channel screening step (one Or-Tec Screen and one Vanguard screen), grit removal, Biolac® extended aeration system and secondary clarification. Secondary treated effluent is discharged to 30 onsite percolation/evaporation ponds. Waste sludge is either dewatered using a belt press or dried in sludge drying beds before being hauled away for land application to an approved facility or is transported off-site for landfill disposal when the contractor cannot accommodate land application use. The tertiary treatment system consists of up-flow Dynasand® filtration, and disinfection using sodium hypochlorite solution.

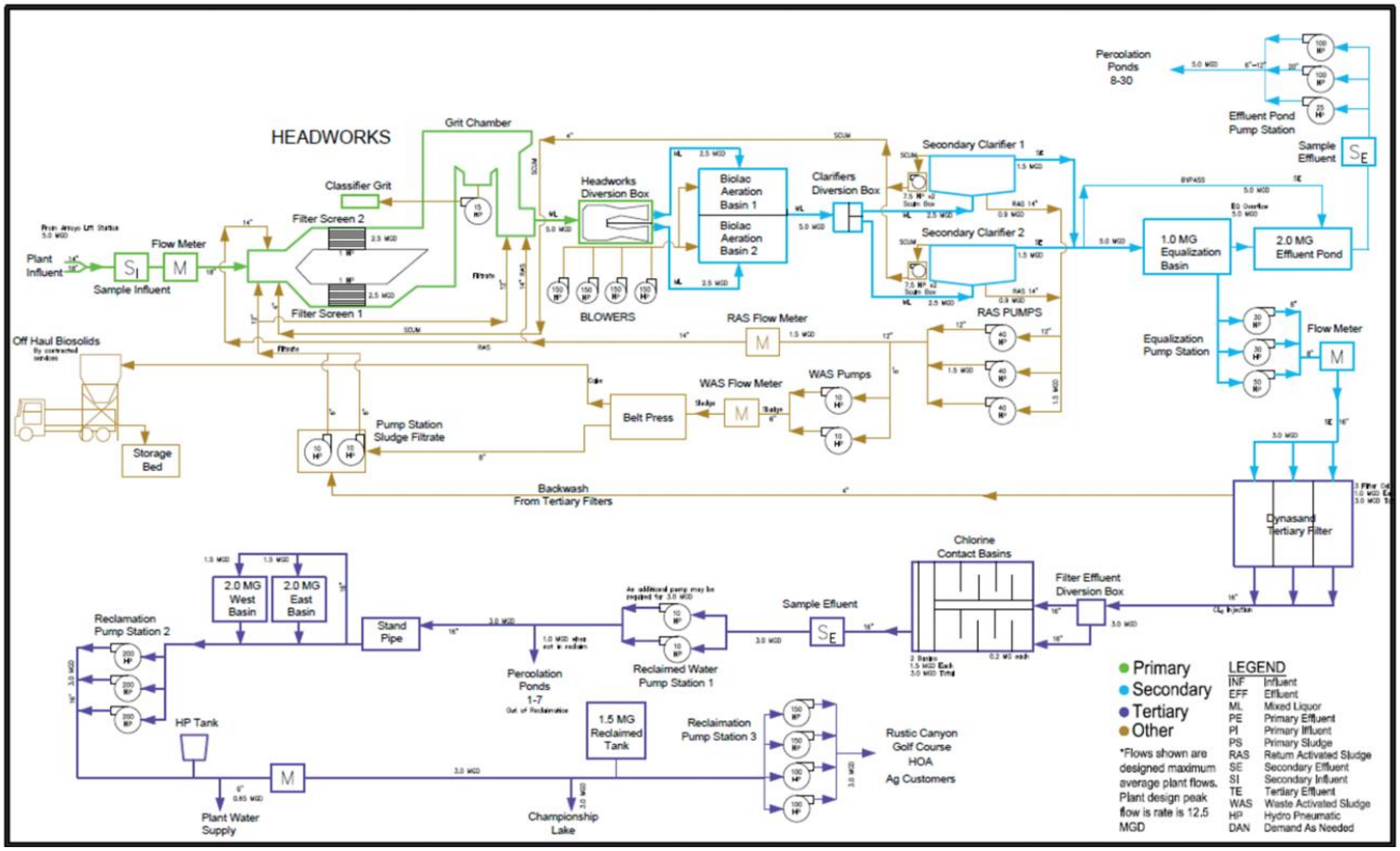
The Phase II Facility upgrades included increasing the secondary treatment capacity to 5 MGD by expanding the Biolac® extended aeration system, providing nitrogen removal, increasing the pumping capacity of the sewer lift station, and expanding the tertiary treatment capacity to 3 MGD. In addition, the MWRF made upgrades to improve the solids handling capacity, convert the Facility water system to recycled water, improve reliability with additional stand-by power capacity, and increase the building space for laboratory and operations. Figure 1-1, Moorpark Water Reclamation Facility Schematic, presents the current wastewater treatment processes.

Biosolids are managed by Nursery Products, LLC C/O Synagro Technologies, a company that transports the material (for Class B biosolids usage) to Nursery Products, LLC, located in San Bernadino County, at 14479 Cougar Road, Helendale, CA 92342.

1.1.2 MWRF Planned Treatment Process Changes

The MWRF's current WDR/WRR permit (LARWQCB Order R4-2023-0089) includes a requirement and associated schedule for the WRF to add ultraviolet (UV) disinfection facilities for the secondary treatment process effluent (to provide additional treatment for total coliform) and for tertiary treatment process effluent (to provide additional treatment for Total Trihalomethanes (TTHMs)). These new UV disinfection facilities are scheduled to be completed by May 27, 2025.

Figure 1-1: Moorpark Water Reclamation Facility Schematic



No additional treatment is anticipated within the next five years, except for adding additional reclaimed water distribution infrastructure (outside of the MWRF) to distribute current reclaimed water flows to new reclaimed water users, as specified and authorized under the current LARWQCB Order R4-2023-0089.

1.1.3 MWRF Surface Water Discharge

The Facility no longer has a physical connection to discharge treated effluent to the Arroyo Las Posas (tributary to Mugu Lagoon), and its NPDES Permit CA0063274 as LARWQCB Order R4-2003-0151 is no longer applicable.

1.1.4 MWRF Groundwater Discharge

The MWRF was designed and is currently permitted to provide secondary treatment of 5.0 million gallons per day (MGD) of wastewater. Under normal conditions, the MWRF discharges secondary treated effluent to 30 on-site percolation/evaporation ponds presented in Figure 1-2, Moorpark Water Reclamation Facility Aerial View. Undisinfected secondary-treated effluent is either discharged to groundwater via percolation ponds, or it can receive additional treatment (filtration and disinfection) so that it may be recycled by reclaimed water users. Excess disinfected tertiary recycled water may be discharged to the percolation ponds located at the east side of the MWRF, when the demand for recycled water use is low. During the summer, five to seven percolation ponds are used to discharge an average volume of 1.03 MDG of non-disinfected secondary-treated effluent. In the winter, eight to ten percolation ponds are used to discharge an average volume of 2.2 MGD of non-disinfected secondary-treated effluent, due to a lower demand in recycled water and lower evapotranspiration rates. Historically, the secondary-treated effluent discharged directly to the percolation ponds has not been disinfected and has not been a requirement in the historical WDRs.

Figure 1-2: Moorpark Water Reclamation Facility Aerial View

1.1.5 MWRF Reclaimed Water Uses

The MWRF was designed and is currently permitted under the LAWQRB-issued WDR/WRR permit to provide tertiary treatment to 3.0 MGD of secondary treated effluent. Once treated, disinfected tertiary recycled water is stored in concrete-lined basins, distributed via the recycled water pump station, and is used for landscape irrigation and other Title 22 non-potable recycled water applications. On occasion, when the actual reclaimed water demand is less than the projected reclaimed water demand, excess disinfected tertiary recycled water is conveyed to soft-bottom percolation ponds 1 through 7 for infiltration.

The Moorpark WRF is located within the South Las Posas area, and the recycled (reclaimed) water use areas are within the Las Posas Valley Groundwater Basin, which is a part of the Ventura Central Ground Water Basin. The State Water Resources Control Board's (State Water Board's) Division of Drinking Water (DDW) approved the Title 22 Engineering Report (dated May 29, 2019, submitted by the County to DDW on September 21, 2021, for the Moorpark WRF) on October 18, 2021. The Engineering Report approves the production of up to 3.0 MGD disinfected tertiary recycled water to comply with Title 22 water quality standards. The DDW approved reclaimed water uses, referenced in the 2019 Title 22 Engineering Report, were also approved under the MWRF's WDR/WRR, which now authorizes the following recycled water uses:

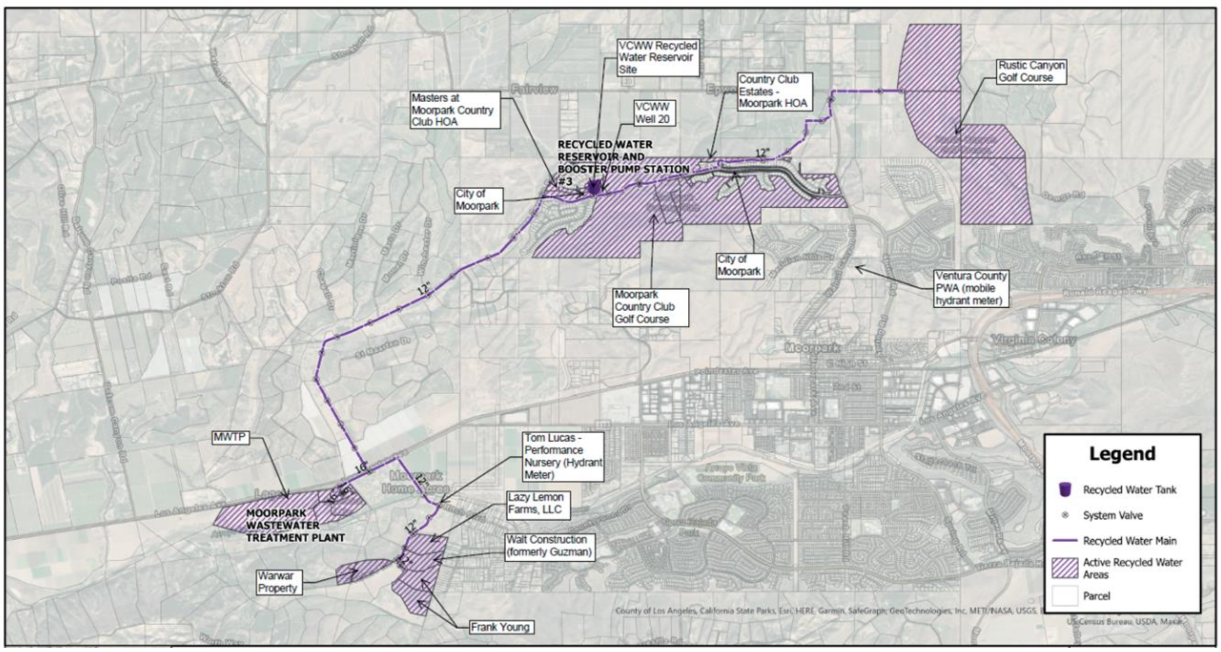
- Irrigation of turf, landscape, open space, nursery stock, citrus agriculture, and other food crops,
- Impoundment,
- Construction water or backfill consolidation, soil compaction, mixing concrete, dust control at construction sites, and
- On-site uses at the Moorpark WRF.

Reclaimed water from MWRF is sent to thirteen (13) current users, listed in Table 1.1 below. Figure 1-3, MWRF Reclaimed Water Users, presents the location of current reclaimed water users.

Table 1.1: MWRF Reclaimed Water Users

Reclaimed Water User	Use Type
Rustic Canyon Golf	Golf Course Irrigation
Moorpark WRF	Site Landscape irrigation and equipment cooling, dual plumbing building use
Country Club Estates - Moorpark HOA	Facility Operations, Urinal Flushing, and Landscape Irrigation
Guadalupe Guzman	Landscape Irrigation
Lazy Lemon Farms, LLC	Irrigation of Lemons
Frank Young	Irrigation of Lemons
Rustic Valley Farms	Irrigation of Lemons
VCWW Well 20	Irrigation of Lemons
City of Moorpark	Facility Operations and Landscape Irrigation
VCWW Recycled Water Reservoir Site	Landscape Irrigation
Tom Lucas	Facility Operations and Landscape Irrigation
Ventura County PWA	Irrigation of Nursery Stock
Warwar Property	Dust Control

Figure 1-3: MWRF Reclaimed Water Users



2.0 PURPOSE

2.1 Climate Action Plan

Human activities over the past century have resulted in releases of large quantities of carbon dioxide and other greenhouse gases into the atmosphere, leading to the onset of significant changes in the earth's climate that will have substantial impacts on water resources, including water quality. More specifically, the various predicted alterations to temperatures and precipitation could significantly affect water supplies in our region, as drought periods become more severe and snowpack levels decrease, leading to depleted groundwater levels and decreasing amounts of imported water available to the region.

In addition to water quantity, predicted changes to weather patterns and sea level could also drastically alter hydrological and ecosystem processes in the region. Such impacts could manifest in multiple ways, such as decreases in stream flow, reductions in, and changes to, aquatic habitats, increases in surface water temperature, increases in pollutant levels, sedimentation, and algal growth, and changes in salinity levels and acidification in coastal areas.

These impacts could affect many beneficial uses of our waters, including those protecting ecological habitats, recreational uses and commercial practices. Because preserving water quality is essential to protect both human populations and natural ecosystems, and to ensure their prosperity into the future, it is imperative to assess these impacts, and to develop strategies to adapt to the upcoming changes and mitigate their effects on water quality and on the beneficial uses of our waters.

This Climate Change Vulnerability Assessment and Mitigation Plan (Climate Change Plan), herein, was prepared pursuant to the requirements in Provisions Section 23.18.2 of Order R4-2023-0089 Waste Discharge Requirements and Water Reclamation Requirements issued to the MWRF by the Los Angeles Regional Water Quality Control Board (LARWQCB).

Under Section 23.18.2 of Order R4-2023-0089, Ventura County Waterworks District No. 1 (VCWD or District) is required to consider the impacts of climate change as they affect the operation of MWRF due to flooding, wildfire, or other climate-related changes. Furthermore, VCWD is required to develop a Climate Change Plan to assess and manage climate change-related effects that may impact the Facility's operation, water supplies, its collection system, and water quality, including any projected changes to the influent water temperature and pollutant concentrations, and beneficial uses.

Also, as part of the Climate Change Plan, VCWD is required to identify new or increased threats to the sewer system resulting from climate change that may impact desired levels of service in the next 50 years. To that end, VCWD is required to project upgrades to existing assets or new infrastructure projects, and associated costs, necessary to meet desired levels of service.

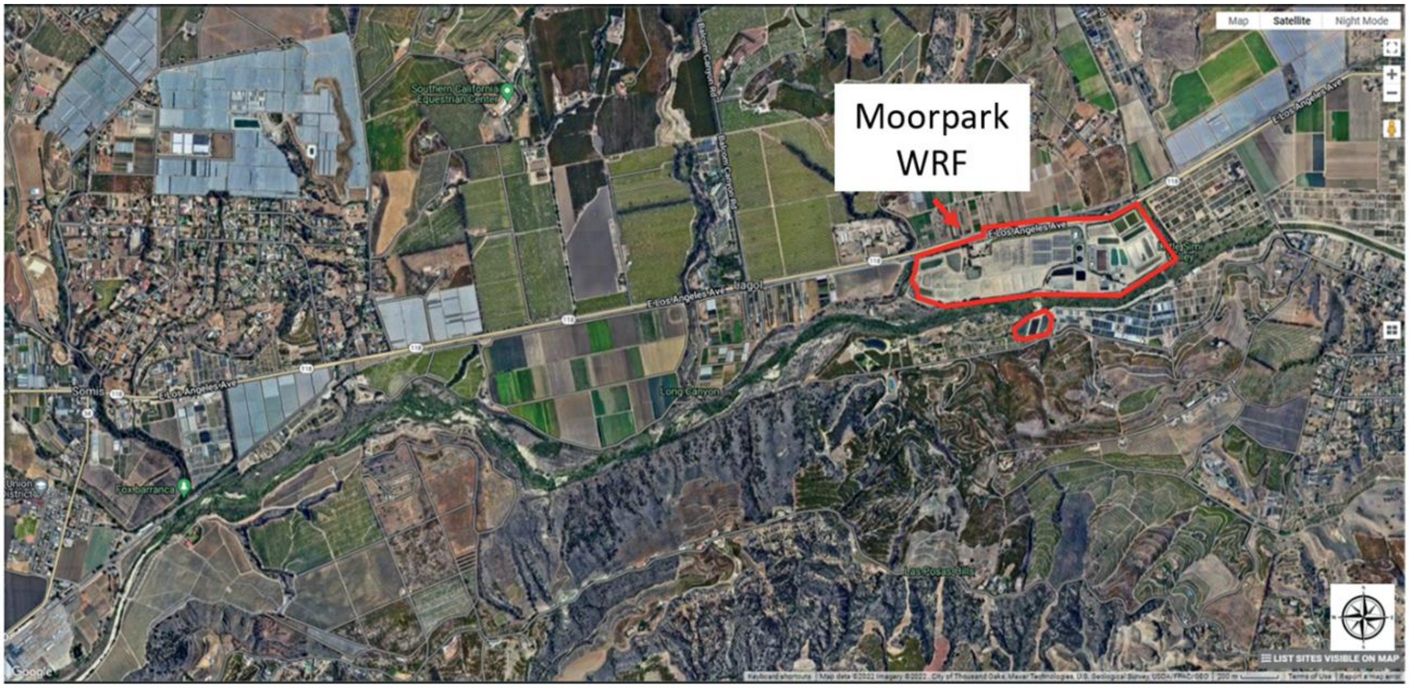
Furthermore, because climate change research indicates that the overarching driver of climate change is increased atmospheric carbon dioxide from human activity, the increased carbon dioxide emissions were evaluated. The emissions could trigger changes to climatic patterns, which increase the intensity of sea level rise and coastal storm surges, lead to more erratic rainfall and local weather patterns, trigger a gradual warming of freshwater and ocean temperatures, and trigger changes to ocean water chemistry. As such, the Climate Change Plan also identified steps being taken or planned to address greenhouse gas emissions attributable to the wastewater treatment at MWRF, as well as solids handling and effluent discharge processes at MWRF.

There are potential impacts from hazards that are related to climate change, but they are outside the control of the County of Ventura District 1. For example, risks to the regional electrical grid are beyond the control of the County of Ventura District 1, nonetheless, solar panels installed adjacent to the MWRF supply electricity to the Facility and the plan is to expand solar-generated electricity to meet the demand of the Facility.

2.2 MWRF Location

MWRF is located at 9550 Los Angeles Avenue, Moorpark, California, as presented in Figure 2-1 showing the facility location and surrounding area.

Figure 2-1: Location of the Moorpark Water Reclamation Facility



2.3 Report Organization

The report is organized as follows:

- Section 1.0 - Introduction: Presents the location and background information on the Moorpark Water Reclamation Facility.
- Section 2.0 – Purpose: Explains the climate change vulnerability assessment and mitigation plan in general and as it relates to the Moorpark Water Reclamation Facility.
- Section 3.0 - Historical Vulnerability Analysis: Presents the historical trends and a vulnerability analysis of their impacts on the Moorpark Water Reclamation Facility.
- Section 4.0 – Future Vulnerability Analysis: Presents the predicted impacts with a focus on precipitation and temperature as well as possible riverine flooding in the areas surrounding Moorpark.
- Section 5.0 – Impacts to MWRF: Presents impacts specific to the Moorpark Water Reclamation Facility.
- Section 6.0 – Summary: Presents a compilation of all the findings from the future vulnerability analysis of the Moorpark Water Reclamation Facility.
- Section 7.0 – References: Presents a list of all the sources of information used in preparing the climate change vulnerability assessment and mitigation plan.

3.0 HISTORICAL VULNERABILITY ANALYSIS

Like much of the Greater Los Angeles Area, Moorpark has a Subtropical-Mediterranean climate and receives just enough annual precipitation to avoid a semi-arid climate classification.

3.1 Climate Trends

Historical data was analyzed to explain existing vulnerabilities related to climate-driven hazards. Table 3.1 provides a summary of the findings of this analysis of the historical trends associated with each hydrometeorological parameter analyzed. Table 3.1 is followed by a discussion of the details of the methodology followed for identifying findings and the data and information used for that purpose.

While assessing climate change impacts on precipitation, temperature, riverine flooding, and wildfire in the region surrounding the Moorpark Water Reclamation Facility, leading data sources for the area were considered. Coastal flooding from sea rise was not addressed due to the distance separating the MWRF from the Pacific Ocean coast.

Table 3.1: Summary of Historical Trends and Impacts to MWRF

Hydrometeorological Parameters	Historical Trends and Impacts to Moorpark Water Reclamation Facility
Precipitation	Generally, in Moorpark, during the entire year, the rain falls for 51.5 days and collects up to 8.94" (227 mm) of precipitation. The month with the most rainfall is February, when the rain falls for 5.9 days and typically aggregates up to 1.89" (48 mm) of precipitation. The months with the least rainfall are June and August. Rain falls for 1.4 days and accumulates 0.08" (2 mm) of rain. January, February and December, with an average of 6.8 h of sunshine, are months with the least sunshine. The months with the most sunshine in Moorpark are June and July, with an average of 12.1 h of sunshine.
Temperature	August stands out as Moorpark's warmest month, with an average high-temperature of 81.1°F (27.3°C) and a low-temperature of 62.6°F (17°C). December, marked by an average high-temperature of 59.9°F (15.5°C) and a low-temperature of 46.9°F (8.3°C), is the coldest month.
Sea-level rise	Not addressed due to the distance separating the MWRF from the Pacific Ocean coast.
Riverine Flooding	The Arroyo Las Posas Creek, designated as a flood way, is located south of the Moorpark Water Reclamation Facility. Historically, the Facility has not been impacted by flood water.
Wildfire and post-fire debris flow	The Moorpark Water Reclamation Facility is located away from the very high fire hazard severity zone designated by the California Department of Forestry and Fire Protection. Likewise, the post-fire debris flow follows the Aroyo Las Posas Creek to the south of the Facility with minimal impact to the MWRF.
Landslide	The vicinity around the Facility does not have a historical susceptibility to landslides. However, the MWRF sewer shed, and in particular a main pipe, was impacted by a landslide which caused a discharge of untreated sewer water.
Water Quality	The Moorpark Water Reclamation Facility has been in compliance with the effluent limits imposed by the Los Angeles Water Quality Control Board.
Water Temperatures	Wastewater temperatures are aligned with seasonal temperature fluctuations. The current LARWQCB-issued permit does not contain a limit for temperature.

Table 3.2 provides the list of the historical hydrometeorological data analyzed including how it was used, the spatial and temporal resolution, and source for each dataset. Observed data was collected from stations closest to the Moorpark Water Reclamation Facility for all applicable parameters that were available. Modeling was used for parameters where observed data was lacking.

Table 3.2: Summary of Hydrometeorological Data Sources

Data	Used in Analysis	Spatial and Temporal Analysis	Source
Historical Precipitation And Temperature Data	Used for identifying trends for historical precipitation and minimum and	Annual (1921 to 2020) and monthly (1981 to 2010)	Parameter-elevation Regressions on Independent Slopes Model

	maximum temperatures near MWRF	point data	dataset (PRISM Climate Group, 2024)
Historical Sea- Level Rise Data	Not Applicable	Not Applicable	Not Applicable
Riverine flooding	Used for identifying trends in historical occurrences and vulnerabilities to riverine flooding near MWRF	Flood maps show areas with highest risk of flooding	Federal Emergency Management Agency (https://www.fema.gov/flood-maps/national-flood-hazard-layer) (FEMA, 2024)
Wildfire and post-fire debris flow	Used for identifying trends in historical occurrences and vulnerabilities of MWRF to wildfire and post-fire debris flow	Fire Hazard Severity Zones (FHSZ) classify a wildland zone as Moderate, High, or Very High fire hazard updated in September 2023 Likelihood of debris flow for Woolsey Fire started on Nov. 8, 2018, in Los Angeles and Ventura Counties, CA	California Department of Forestry and Fire Protection (https://osfm.fire.ca.gov/) (CalFire, 2024) and United States Geological Survey (https://landslides.usgs.gov/hazards/postfire_debrisflow/detail.php?objectid=239) (USGS, 2024)
Landslide	Used for identifying trends in historical occurrences and vulnerabilities of MWRF to landslides	U.S. Landslide Inventory updated in March 2022	United States Geological Survey (https://www.usgs.gov/tools/us-landslide-inventory) (Belair et al., 2022)

3.1.1 Precipitation and Temperature

Historical precipitation and temperature data were downloaded from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) data source developed by Oregon State University. PRISM is a widely used climate data source developed by applying modeling techniques and quality control measures to climate observations gathered from a wide range of monitoring networks (PRISM Climate Group, 2024). Historical annual and monthly data were compiled to provide a summary of trends in recent decades, as presented below.

Figure 3-1 illustrates historical total annual precipitation trends from 1896 to 2023, along with an 11-year rolling average starting in 1906. Precipitation in this region exhibits significant variability, ranging from less than five inches in some years to intense rainfall above 30 inches per year in some years. Recent decades have seen more frequent occurrences of both very low (below 10 inches) and very high (above 25 inches) rainfall, resulting in increased variability.

Notably, the most recent decade experienced similar variations as historical ones. In general, extended periods of low rainfall do not directly impact the Facility but they do increase the risk of wildfires.

Figure 3-1: Annual Total Precipitation from 1896 to 2023

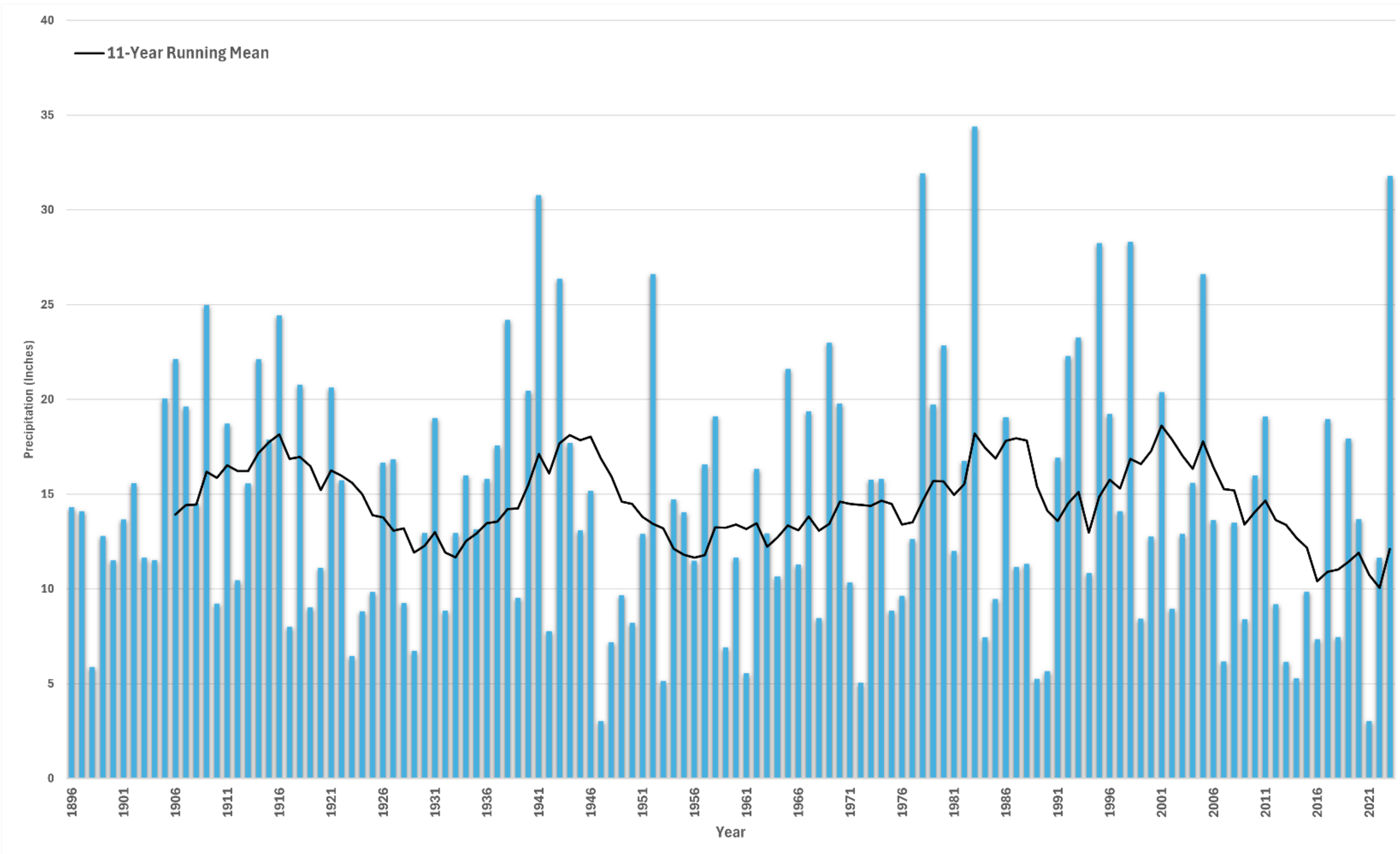


Figure 3-2 illustrates the monthly average precipitation spanning from 2009 to 2024. Peak rainfall occurs between December and March, with January receiving the highest amounts. During this period, the occurrence of flooding is most likely. Conversely, the summer months (June through September) witness sparse precipitation, typically totaling less than one-quarter of an inch on average. These dry conditions elevate the likelihood of wildfires, which are particularly prevalent during the summer season. Overall, the region has experienced an approximate mean annual rainfall of 14.5 inches since 1896 (PRISM Climate Group, 2024).

Figure 3-2: Monthly Average Precipitation from 2009 to 2004

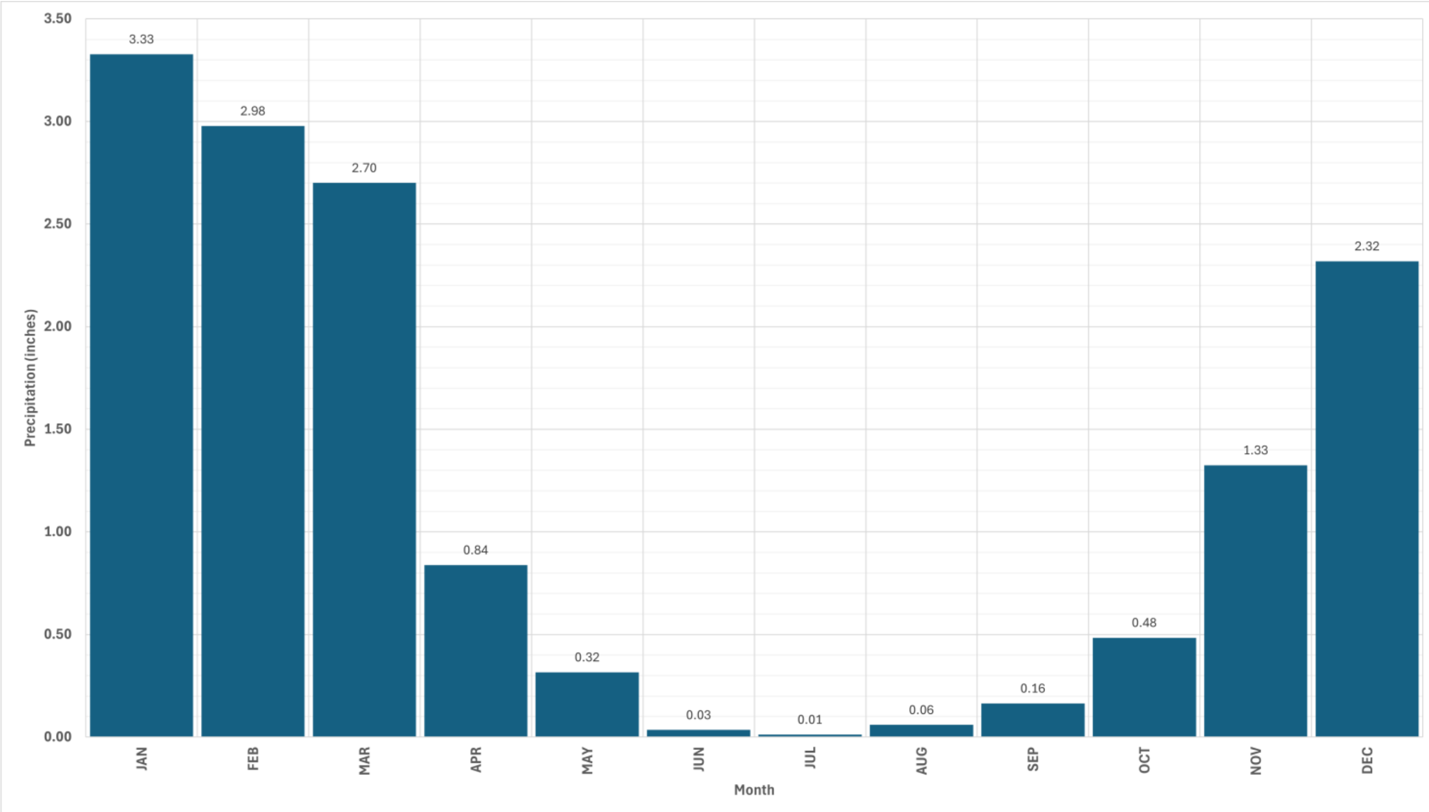


Figure 3-3 and Figure 3-4 display the annual average maximum daily temperature and the annual average minimum daily temperatures from 1896 to 2023, respectively. Both figures include an 11-year rolling average starting in 1906. Throughout this period, temperatures have remained moderate. The annual average maximum temperature typically fluctuates between 72°F and 75°F. There is an increasing trend in both temperatures over time. The annual average maximum temperature shows a slight increasing trend, increasing from approximately 71°F in the early decades to approximately 73°F in recent decades The annual average minimum temperature shows a slight increasing trend, rising from approximately 50°F in the early decades to approximately 51°F in recent decades.

While temperatures have steadily increased, they are expected to remain moderate. Higher temperatures indirectly impact the Moorpark Water Reclamation Facility by increasing the likelihood of other hazard occurrences such as wildfires. Climate change continues to drive an increase in temperature.

Figure 3-3: Annual Average Maximum Temperature from 1896 to 2023

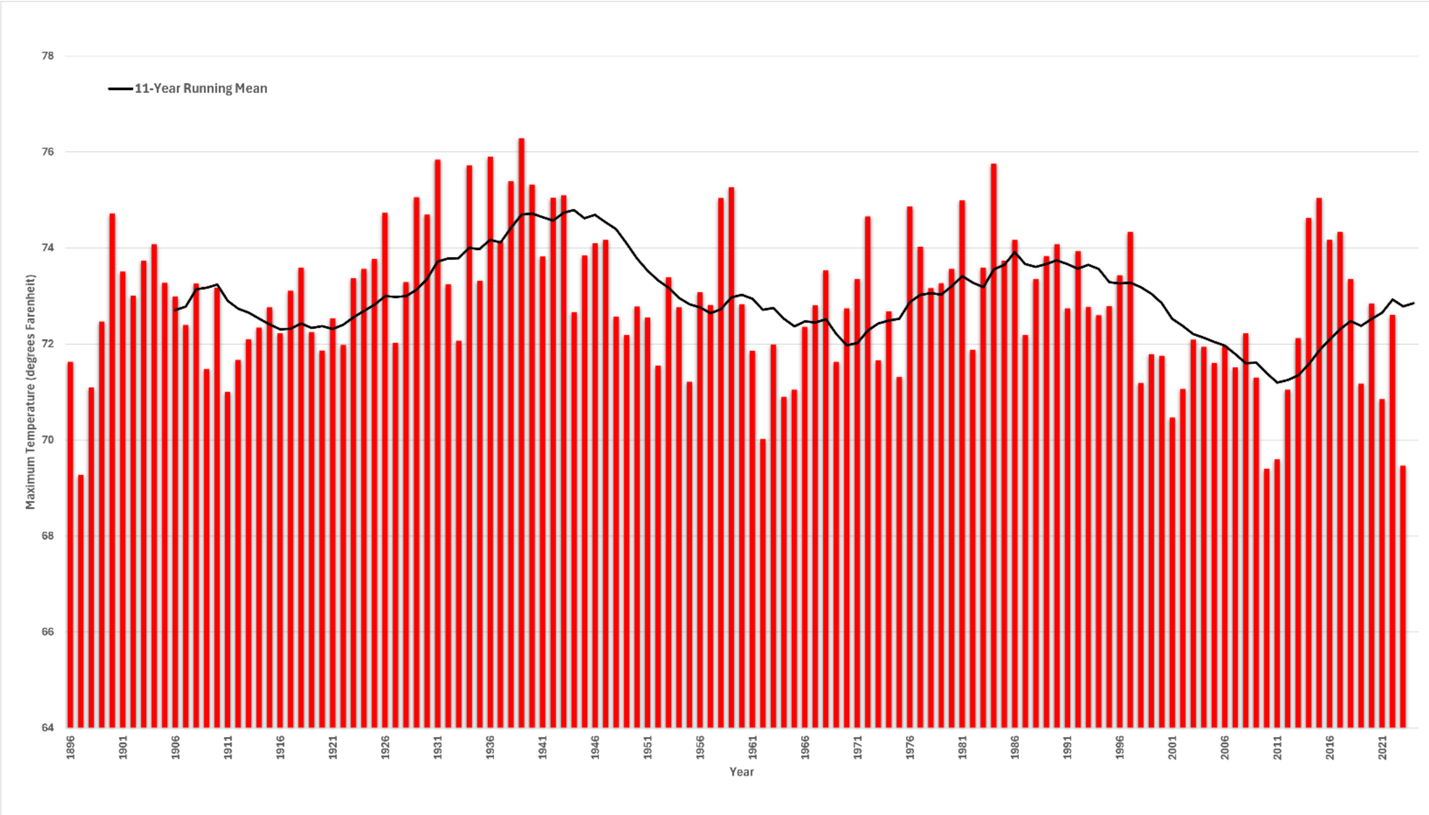
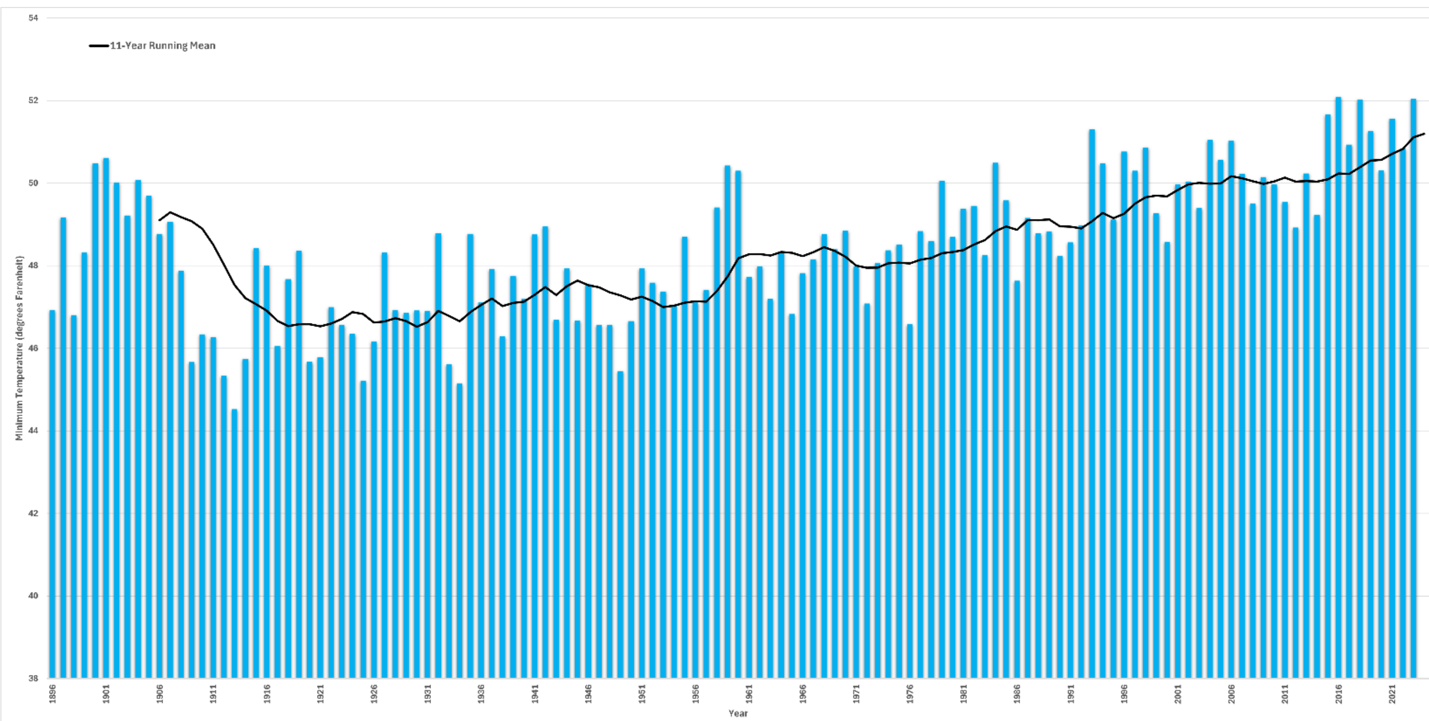
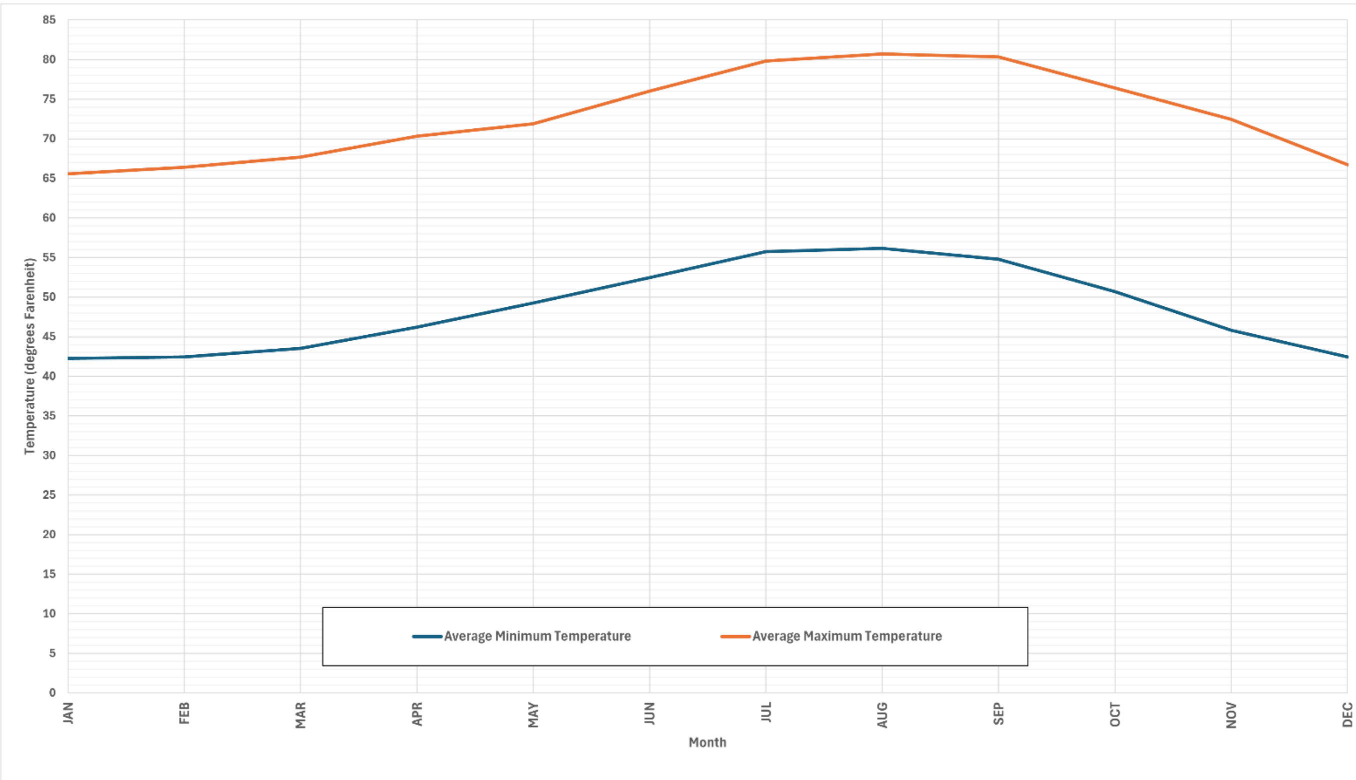


Figure 3-4: Annual Average Minimum Temperature from 1896 to 2023



Monthly average maximum and minimum temperatures between 2006 to 2024 are presented below (Figure 3-5). These values show low temperature values of approximately 42°F to 43°F during early winter months and a peak of 80°F to 82°F in the summer months. (PRISM Climate Group, 2024). The average minimum temperature varies between 42°F in the winter to 56°F in the summer, and the average maximum temperature varies between 66°F in the winter to 82°F in the summer. The temperatures are generally highest during summer months, which coincides with the driest period of the year. As with dry conditions, warmer temperatures can increase the likelihood of the occurrence of wildfire which is most prevalent in the summer months.

Figure 3-5: Monthly Average Maximum and Minimum Temperature from 2006 to 2024

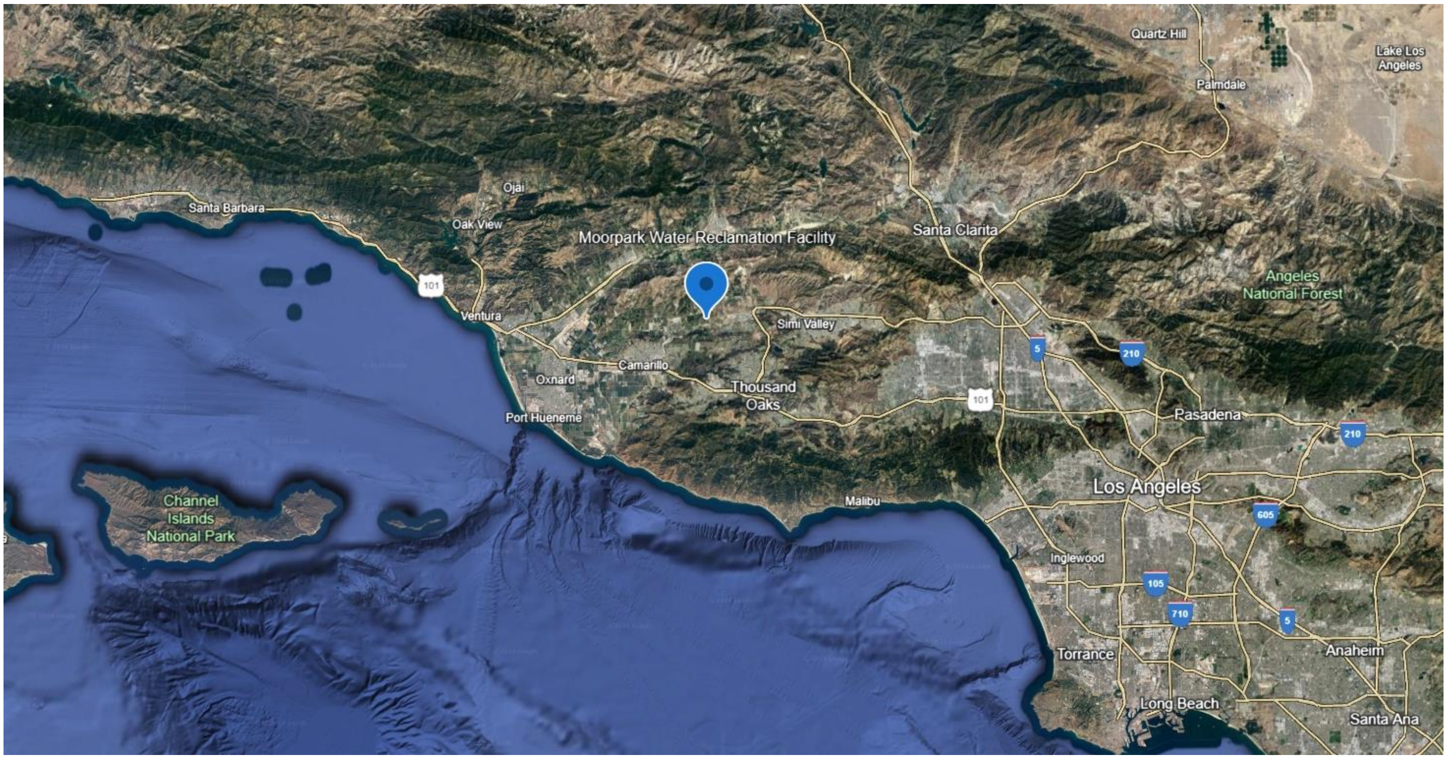


3.1.2 Sea Level Rise

Global and regional sea levels have been increasing over the past century and are expected to continue to increase throughout this century. However, because of geographical distance and topography, MWRF is not vulnerable to the impact from sea rise and therefore, sea level rise and the associated risk have been excluded from this Climate Change Vulnerability Assessment and Mitigation Plan.

With a distance of 9 miles from the Pacific Ocean coast, the Facility is far from coastal areas as shown in Figure 3-6, making it less likely to be directly affected by rising sea levels, which primarily impact coastal regions. Furthermore, with an elevation of 500 ft above sea level, the Facility is situated on higher ground, and therefore, it is less vulnerable to flooding from rising sea levels.

Figure 3-6: Distance Between MWRF and Pacific Ocean



3.1.3 Riverine Flooding

Riverine flooding can occur during and after heavy rainfall events when stream and river flows exceed the capacity of their natural or constructed channels, overtopping the banks and spilling out into adjacent low-lying, dry land. This is the most common type of flooding for locations distant from coastal areas and located on higher ground. Localized flooding due to intense rainfall, inadequate drainage, or even nearby construction projects may increase risks due to flooding.

Rainfall in the Matilija Wilderness, the river's headwaters, is the highest in Ventura County, with average annual rainfall that is over twice that of rainfall at the coast. The steep terrain of the Ventura River watershed, coupled with intense downpours that can occur in its upper portions, result in flash flood conditions where floodwaters rise and fall in a matter of hours. Major or moderate floods have occurred once every five years on average since 1933.

The most damaging flood recorded in the Ventura River watershed occurred in 1969. The watershed above Ojai received 43 inches (1,100 mm) of rain in nine days in January. The floodwaters and associated debris flooded homes in Casitas Springs and Live Oak Acres. Much agricultural land, primarily citrus groves, was seriously damaged or destroyed. All over Ventura County, transportation facilities, including roads, bridges, and railroad tracks, were damaged. The wastewater treatment plant below Foster Park was severely damaged and dumped raw sewage into the Ventura River. In addition, sewer trunk lines were broken along the Ventura River and San Antonio Creek. Untreated sewage polluted the river and beach. The capacity of the Matilija reservoir was significantly reduced by siltation from the flood.

The major river in Flood Zone 3 is Calleguas Creek with a watershed area of approximately 341 square miles. All stream flows in Zone 3 eventually end up in Mugu Lagoon before entering the Pacific Ocean. Major tributaries to Calleguas Creek include Revolon Slough (drains a portion of Flood Zone 2), Conejo Creek, Arroyo Santa Rosa, Arroyo Conejo, Arroyo Las Posas/Arroyo Simi (which flows westwardly south of the MWRF), Happy Camp Canyon, Lang Creek, and Tapo Canyon. Virtually the entire watershed is within Ventura County, with dozens of smaller creeks too numerous to name here.

Historically, Calleguas Creek and its tributaries were all intermittent streams that only flowed seasonally from headwaters near Santa Susana at the east end of Simi Valley onto the Oxnard Plain. Due to development, Calleguas Creek is now primarily a perennial stream predominantly fed continuously by treated wastewater flows, with secondary surface flows originating from rising groundwater, agricultural and urban runoff, and periodic stormwater flows (Calleguas Creek

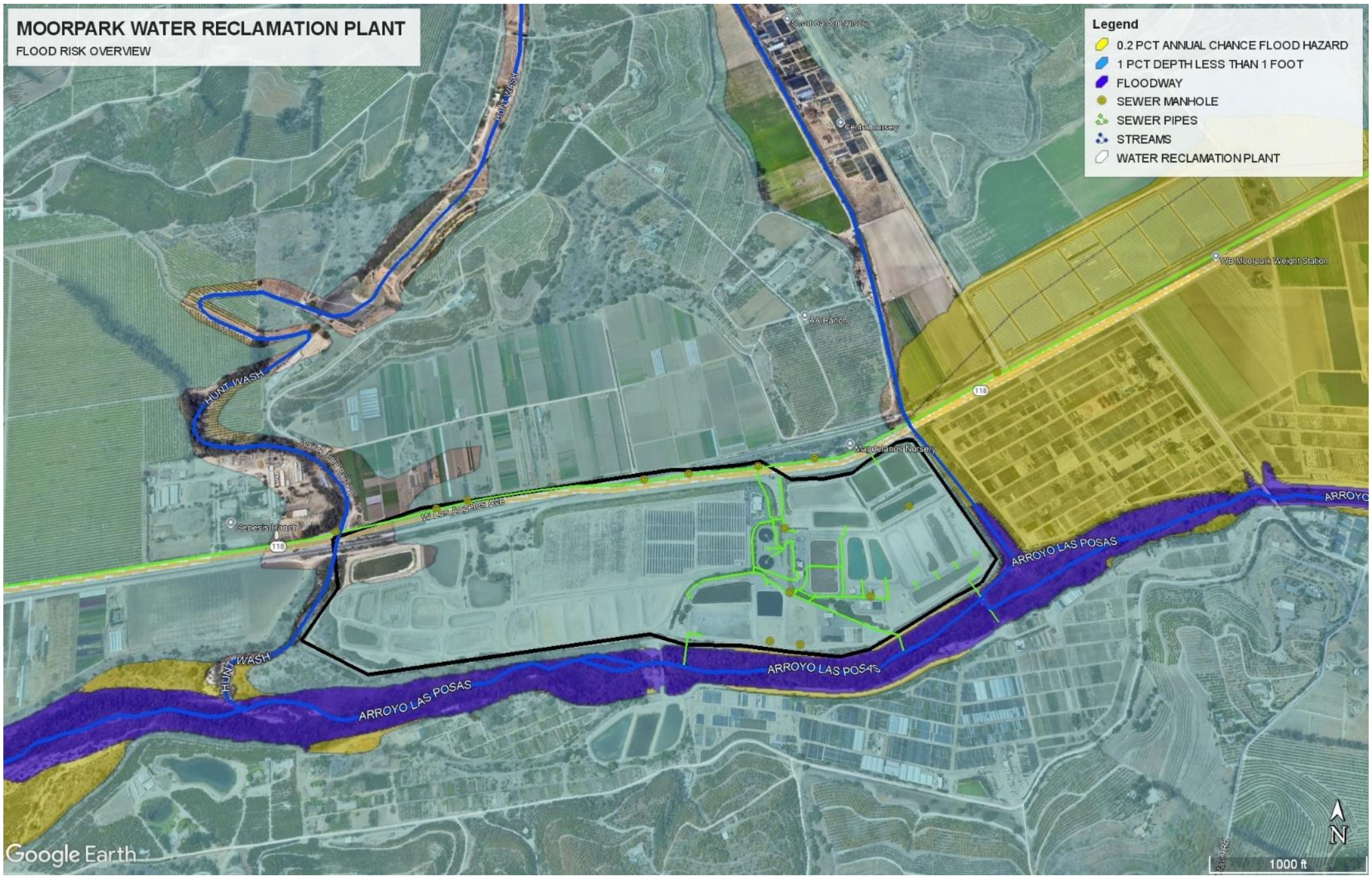
Watershed Management Plan, 2002). Zone 3 incorporates three of the five supervisorial districts in Ventura County. The majority of the zone falls within Supervisor District 4, with the rest of the zone falling within Supervisor Districts 2 and 3.

Current riverine and coastal flood vulnerabilities of the MWRF was assessed by collecting flood hazard data from the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). Figure 3-7 graphically shows the estimated flooded area due to a 100-year and 500-year storm event (i.e., storm event likely to occur once in every 100 and 500 years, respectively) in Moorpark according to the FEMA NFIP data. Figure 3-8 shows this same map, zoomed to show the area surrounding the Moorpark Water Reclamation Facility to show areas vulnerable to flooding from the 1% annual chance flood (100-year floodplain) and 0.2% annual chance flood (500-year floodplain) prepared by FEMA's NFIP.

In addition, a desktop review of historical reports of coastal flooding was conducted. No reports were identified for occurrences of riverine flooding.

Figure 3-7: Moorpark Hydrology Map

Figure 3-8: Flood Map Showing Areas Vulnerable to Flooding from the 1% Annual Chance Flood and 0.2% Annual Chance Flood

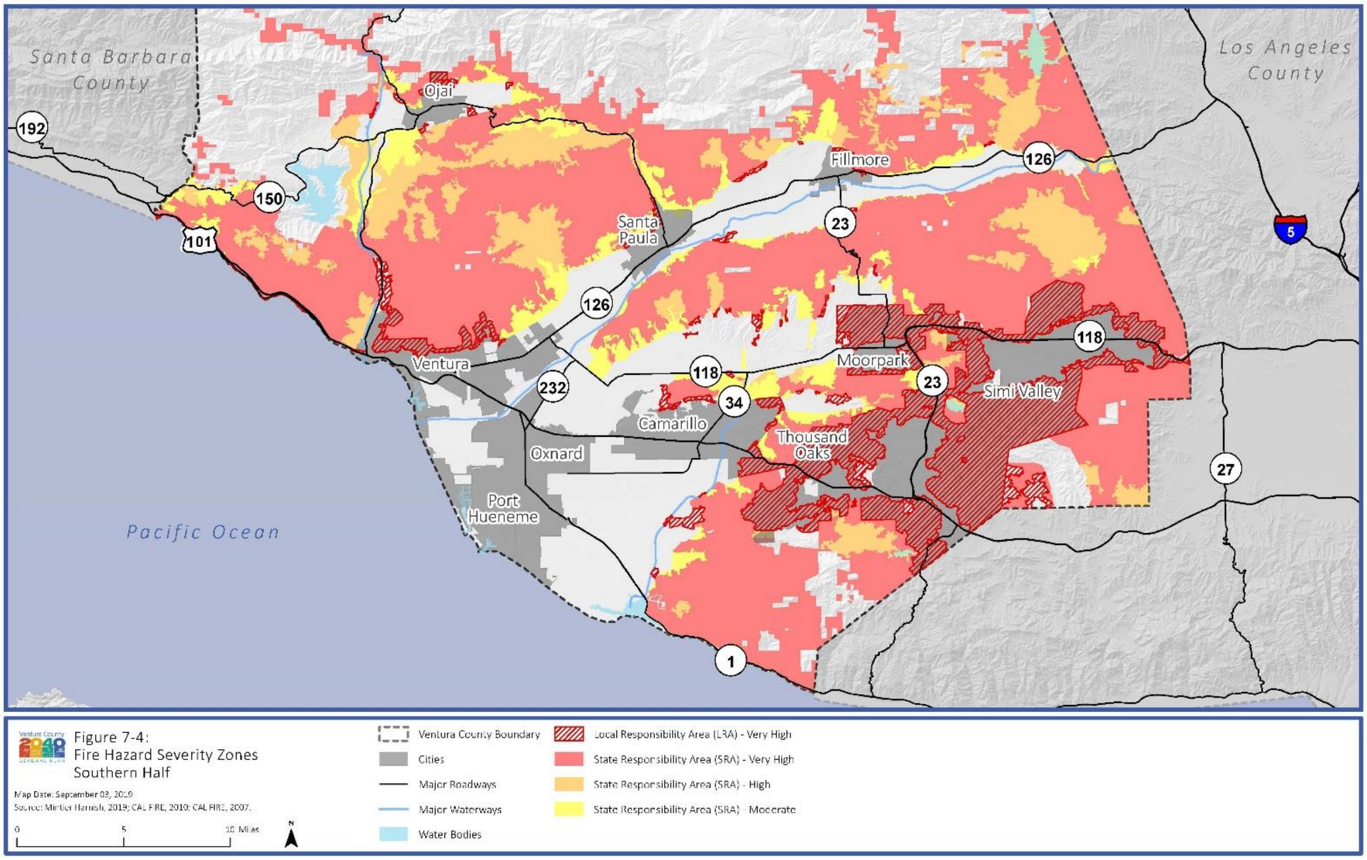


3.1.4 Wildfire and Post-Fire Debris Flow

Portions of Ventura County are at very high risk for wildfire with high concentrations on the northern coast leading inland between Santa Paula and Ojai. Additional high fire Hazard Severity Zones, as designated by the California Department of Forestry and Fire Protection (CAL FIRE), occur along the southern coast and continue inland toward Simi Valley. Figures 3-9 show areas of Ventura County, including the City of Moorpark, of significant fire hazards based on fuels, terrain, weather, and other relevant factors.

The map distinguishes these Fire Hazard Severity Zones based on local or State responsibility. Local responsibility areas generally include cities, cultivated agriculture lands, and portions of the desert. Local responsibility area fire protection is typically provided by city fire departments, fire protection districts, counties, and by Cal FIRE under contract to the local government. State responsibility area is a legal term defining the area where the state has financial responsibility for wildfire protection. Incorporated cities and federal ownership are not included. The prevention and suppression of fires in all areas that are not state responsibility areas are primarily the responsibility of federal or local agencies.

Figure 3-9: Areas of Ventura County of Significant Fire Hazards



Given rising temperatures combined with changes in precipitation patterns, the County of Ventura may continue to experience an increase in wildfire frequency and intensity as fuel loads become drier and more flammable. Furthermore, fires can cause acute damage to soil structure and moisture retention thus increasing susceptibility to erosion or landslides.

Although, as shown in Figure 3-10, the area near the City of Moorpark is prone to wildfires. These zones are typically designated as very high due to the dry climatic conditions, vegetation cover that is susceptible to ignition and rapid-fire spread, nearby steep slopes causing rapid uphill speed of the fire, and a history of repeated fire incidents. However, the Moorpark Water Reclamation Facility is not within the very high-risk area.

After wildfires, the landscape and natural environment undergo significant changes, which can lead to concerns about landslides and debris flows. The potential of post-fire debris flow in the vicinity of the Moorpark Water Reclamation facility and its surroundings is shown in Figure 3-10.

The map presents the likely results of debris flow based on factors in various geospatial data, including basin morphometry, burn severity, soil properties, and rainfall characteristics. These predictions are made at both the drainage basin scale and the individual stream segment scale. The assessment was conducted under the assumption of a plausible scenario of a storm of comparable strength to those typically encountered approximately every five years in the western United States and that occurs one to three months after a fire.

Figure 3-10: Fire Hazard Areas Around Near City of Moorpark

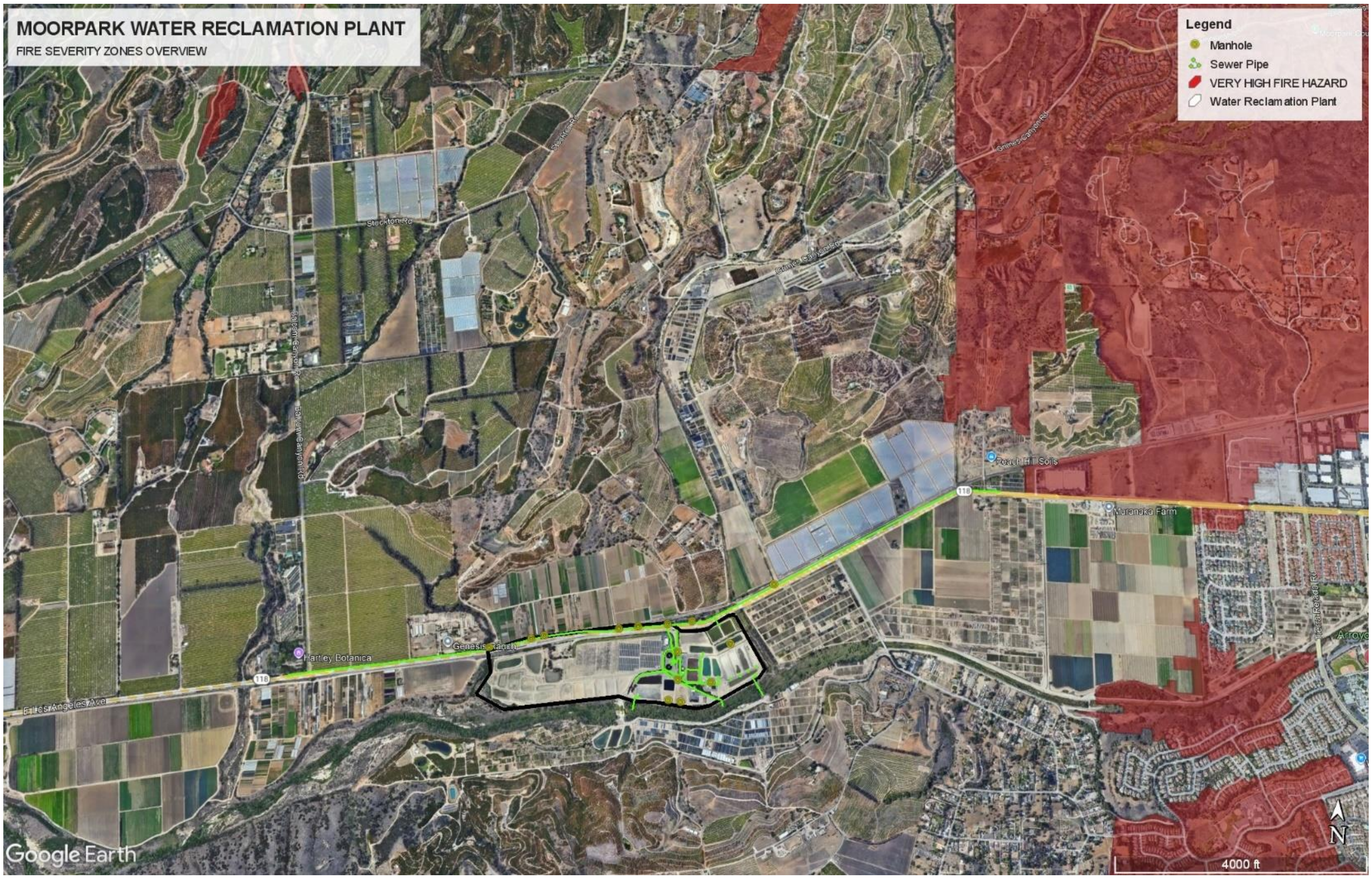


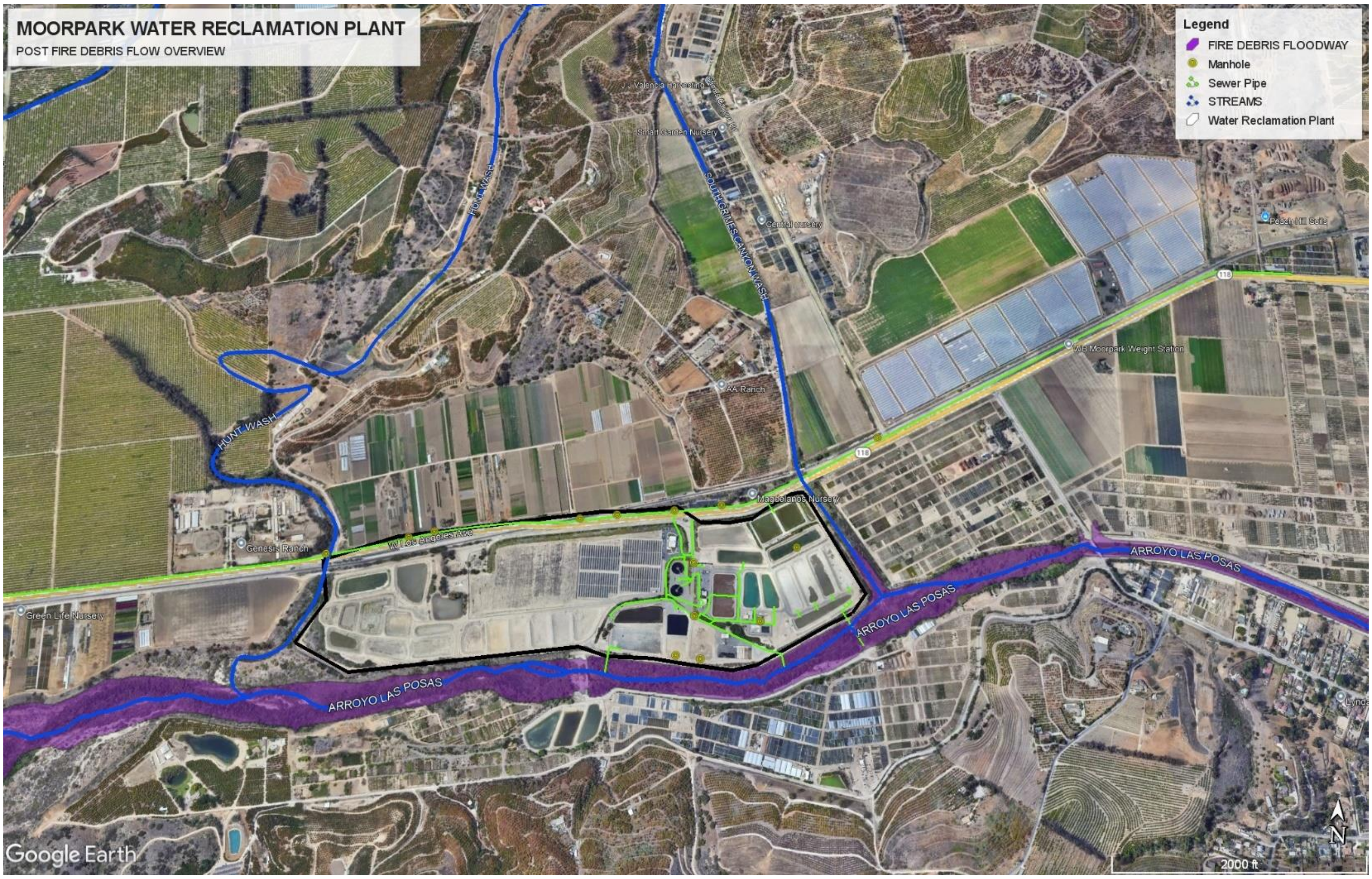
Figure 3-11 shows that post-fire debris flow is highly possible along the Arroyo Las Posas creek. Also, post-fire debris flow likelihood is high in tributaries near the sewer gravity pipes, manholes, and sewer force main that cross the pipes.

These models serve as valuable tools for understanding the vulnerabilities associated with post-fire debris flows in specific areas. However, the models do not predict downstream impacts, potential debris-flow runout paths, or the areal extent of debris-flow or flood inundation.

Other factors that contribute to post-fire debris flows include:

- Steep slopes
- Heavy rainfall
- Weak or loose rock and soil
- Earthquakes
- Changes in surface or sub-surface runoff patterns
- Improper construction and grading

Figure 3-11: Post Fire Debris Surrounding MWRF



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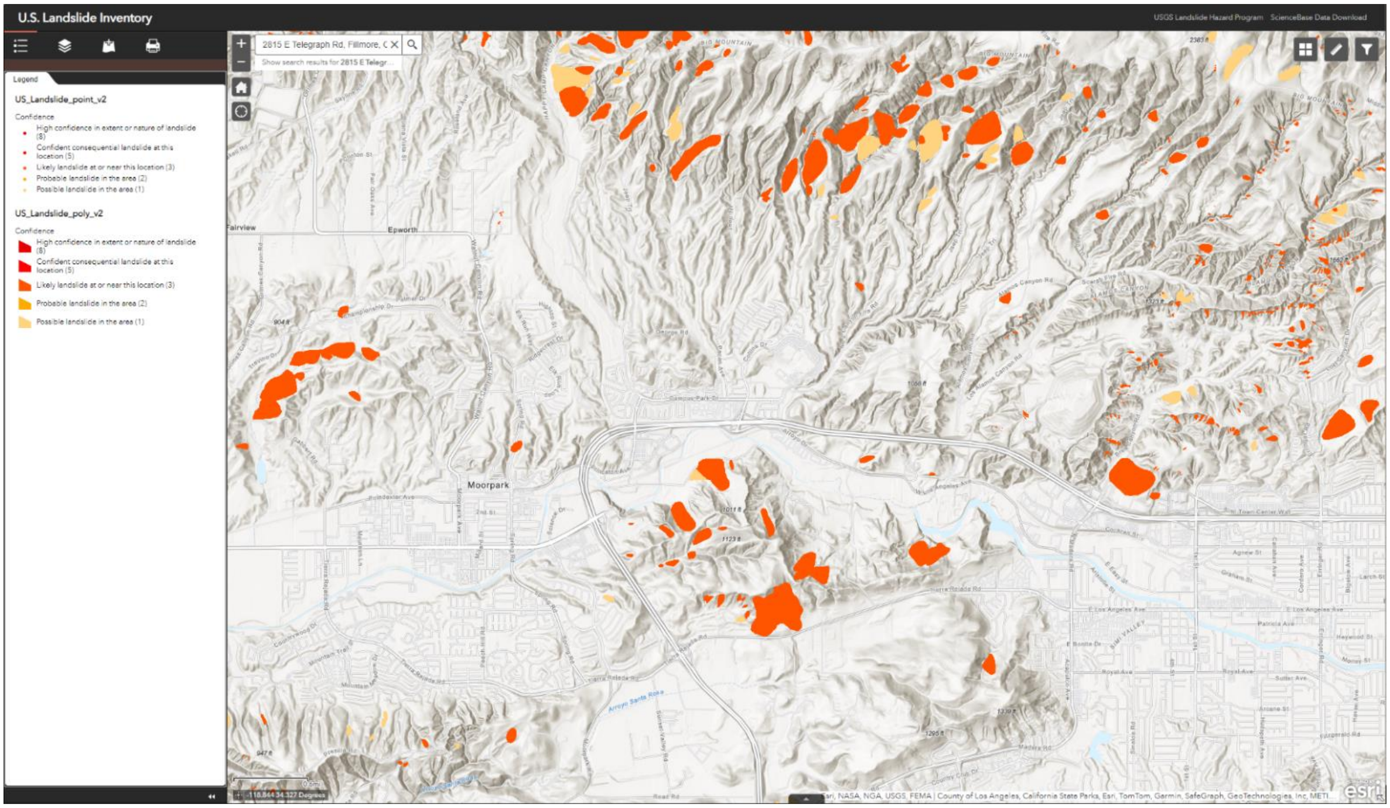
3.1.5 Landslides

A landslide is the movement downslope of a mass of rock, debris, earth, or soil. It occurs when gravitational and other types of shear stresses within a slope exceed the shear strength of the materials that form the slope. Landslides can be triggered by factors such as rain, earthquakes, and volcanic activity.

Figure 3-12 shows the landslide inventory in the vicinity of the Moorpark Water Reclamation Facility. More specifically, the figure shows the confidence levels of historical occurrences of landslides in the vicinity of the Moorpark Water Reclamation Facility and surrounding area, as inventoried by the United States Geological Survey (USGS).

The map indicates that the hills north and north-east of MWRF are prone to landslides, although MWRF does not appear to have been directly impacted by landslides previously. These conditions are expected to persist, but the precise magnitude of potential mass movement during a landslide remains uncertain. Consequently, accurately determining the likelihood of a landslide impacting MWRF remains challenging. Currently, information on anticipated climate change impacts to landslides is limited and the analysis utilizes the historic landslide inventory.

Figure 3-12: Landslide Inventory for MWRF



3.1.5.1 *Erosion-Caused SSO*

A sanitary sewer overflow (SSO) was discovered on May 2nd , 2023, and was attributed to an erosion that caused pipe breakage at 34.285034/-118.868174. The failure point location is an isolated area accessible only by crossing the Arroyo Simi or transiting along the adjacent railroad tracks.

The SSO was the result of Arroyo Simi streambank erosion resulting from significant (over 2.5 inches) rain on February 25, 2023. The streambank erosion undermined the trunkline gravity sewer within the Arroyo Simi flow channel. The trunk line in this location was installed in 1967. In addition to undermining the trunkline sewer, water flow undermined overhanging 6-foot diameter riprap used to armor the adjacent railroad. The undermined 6-foot riprap eventually fell, cascading onto sewer line. The broken sewer line was likely further dislodged by the high stormflows in the Arroyo Simi. Figures 3-13 and 3-14 show the broken pipe and associated 6-foot diameter riprap.

Prior to SSO repair activities, Arroyo Simi was impassable due to moving water, and dense Arundo at the failure point location. The only feasible access was via the railroad right of way. The final destination of the SSO is presumed to be the farthest downstream surface flow of Arroyo Simi at the time of the release.

On the afternoon of May 3, 2023, Public Works Administration (PWA) staff identified the farthest downstream surface flow to be at approximately 34.249082/-118.998220. The farthest downstream surface flow location is behind Hagle Lumber in Somis, CA. Figure 3-15 illustrates the streamline of Arroyo Simi including the failure point and final destination.

Figure 3-13: Broken 21" AC Sewer Piping

Figure 3-14: Damaged Sewer Pipe and Erosion

Figure 3-15: Arroyo Spill Map

Daily and weekly influent readings are checked by PWA Water and Sanitation Operators, who also give a copy to the Wastewater Superintendent weekly. Typical influent measurements range from 1.9 to 2.0 MGD.

Observed flows to the MWRF have been atypical for over a year. In March and May 2022, Gold Coast Environmental was hired to repair and calibrate the influent meter. On June 1, 2022, State drought-based water restrictions were mandated for Moorpark. The restrictions included public outreach as well as mandatory limit of one day per week outdoor irrigation. On July 1, 2022, the District implemented enforcement of the mandated water restrictions. Wastewater field operators and office staff observed a change in the MWRF influent flow patterns concomitant with the water restrictions. Daily peak high flows were reduced, and less daily (Mon-Sunday) variability was observed. Overall annual flows into the treatment plant decreased approximately 4% and low monthly flows decreased over 8% (Summer flows to 1.83 MGD versus typical flows of 1.9 to 2.0 MGD).

Between June 20 and October 26, 2022, occasional daily null sets were reported by the MWRF influent flow meter. The reason for the null sets is and was not fully understood. Between October 31, 2022, and March 29, 2023, anomalous high flows were reported by the MWRF influent meter. Wastewater operators, observing the anomalous data, requested the influent flow meter be inspected. The influent flow meter was inspected again on January 15, 2023, by Gold Coast Environmental. An auxiliary clamp-on flow meter was installed on January 18, 2023. Between February 28 and May 1, 2023, anomalous low flows were being reported. On March 8, 2023, operation crew reported that the influent flow meter was malfunctioning again. On March 17, 2023, Gold Coast Environmental repaired the influent chart recorder. Wastewater operators believed the anomalous low flow data in March and April was a result of faulty influent meter issues.

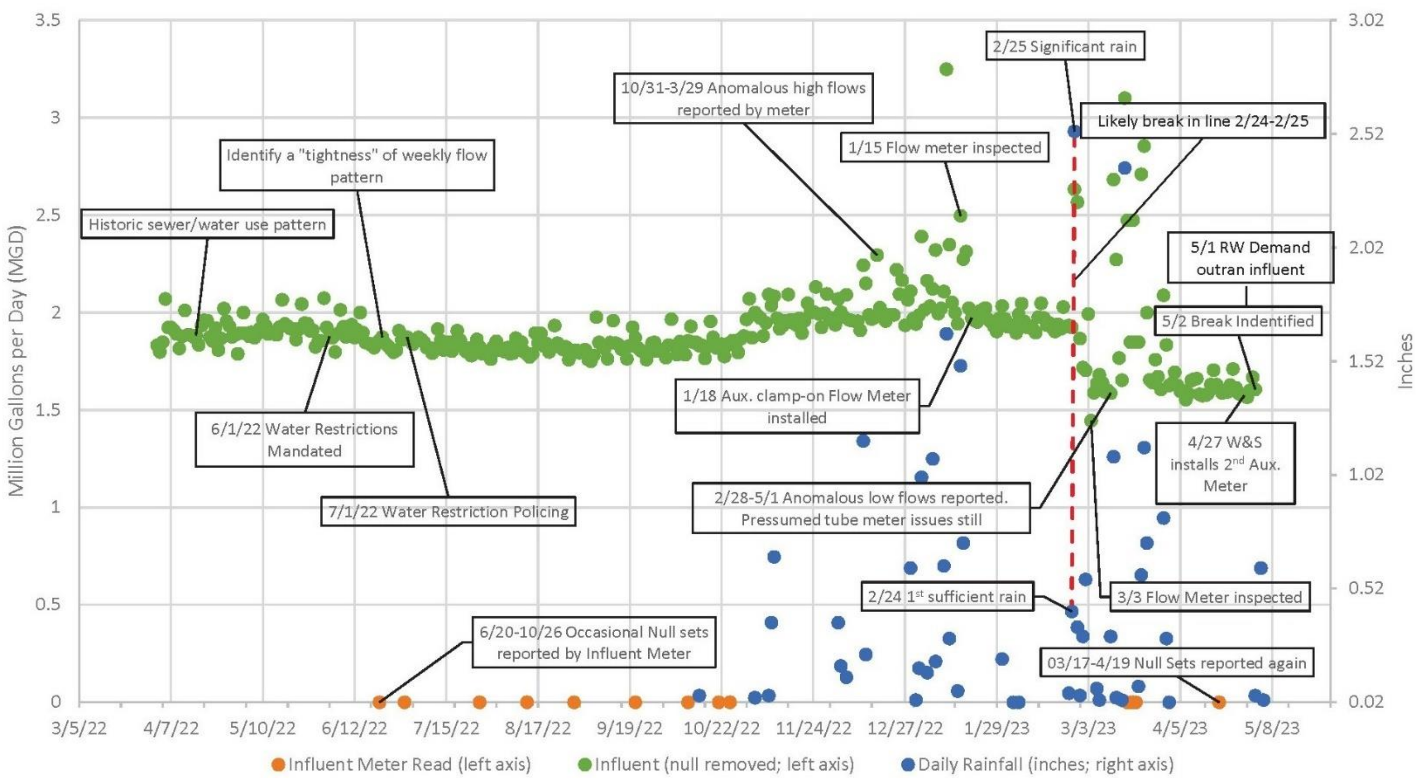
Wastewater operators did consider that there was an issue with the trunkline sewer conveyance system that lies within the Arroyo Simi watercourse and crosses Arroyo Simi. In late February and all of March, wastewater operators periodically inspected the six Arroyo crossings. On March 16, 2023, two wastewater operators began manhole trunkline inspections. Trunkline inspections also occurred on April 25 and 27, 2023.

On May 1 and 2, 2023, field operators observed historical low (less than 0.26 MGD) daily flows to percolation. Percolation is the remaining volume of treated wastewater that is not sold as recycled water and not used onsite. Given the low percolation volumes observed, and the nearly constant influent volumes at or exceeding 1.75 MGD in the past year, wastewater operators concluded that a breach in the influent sewer line may have occurred. The breach was identified during the trunkline inspection on May 2, 2023.

On May 2, 2023, during a review of end-of-month April data, a significantly low average monthly influent treatment Facility flow (1.61 MGD) was detected. Expected monthly average flows were in the range of 1.83 MGD to 2.05 MGD. While staff was reviewing the influent flow rates, field operators identified the actual failure.

Figure 3-16 illustrates reported historic influent flows, local daily rainfall amounts and outlines a timeline since April 2022. Review of Exhibit 1 indicates that the significant rain of 2.53 inches on February 25, 2023, likely caused the rupture during the storm event. The observed flows remained anomalous through March 30, 2023, when rainfall dissipated. Flows remained steady, yet abnormally low for April 2023.

Figure 3-16: MWRF Influent Meter ad Rain Data



3.1.5.2 SSMP Overflow Emergency Response Plan

PWA Operations crews followed the intent of both the existing 2009 Sanitary Sewer Management Plan (SSMP) and DRAFT 2023 SSMP, including making required notifications, following the PWA Water and Sanitation Emergency Procedures Manual, responding accordingly with appropriate remedial measures to the SSO, posting public warnings, sampling water quality and making required regulatory reporting.

3.1.5.3 Final Corrective Actions

Reconstruction of the damaged 21-inch asbestos concrete pipe (ACP) occurred between May 3rd and May 24th of 2023. The reconstructed portion consisted of approximately 100 feet of fully restrained 20-inch ductile iron pipe (DIP) with protecto 401 liner and asphalt coating. The replacement pipe was entirely encased and bedded in a 2-sack slurry. FieldLok gaskets were used for restrained joints. Each transition to an existing 21-inch ACP pipe was made with strapped rubber couplings also encased and bedded in a 2-sack slurry. This replacement product was chosen due to availability, robustness, and size compatibility with the existing 21-inch ACP.

Reconstruction of the embankment and armoring of the sewer pipeline was also performed. The electromagnetic flow tube and transmitter were replaced. The previous transmitter display was sun-damaged and damaged. A replacement ABB MaterWaster was installed in place of the damaged MagMaster Transmitter. The manufacturer was contacted to verify proper wiring, programming and meter reading. In addition, 4-20 mA scaling to SCADA was verified. Flow meter is reading flow correctly at this time.

4.0 FUTURE VULNERABILITY ANALYSIS

This section characterizes the anticipated vulnerabilities and challenges that the Moorpark Water Reclamation Facility may face as it relates to climate change impacts to hydrometeorological hazards. An assessment of both short- and long-term vulnerabilities of the Facility and operations is provided. The analysis was conducted for 2035-2064 for the short-term impacts assessment, and 2070-2099 for the long-term. The historical reference period for climate change analysis is 1961-1990.

4.1 Climate Change Impacts

Simulated climate change projection data was analyzed to illustrate plausible future, short-term and long-term vulnerabilities related to hydrometeorological hazards to the MWRF. Table 4.1 provides a summary of the findings of this analysis on the projected trends associated with each hydrometeorological parameter that was analyzed. The table is followed by discussion on the details of these findings, how they were derived, and the data utilized to evaluate them.

While assessing climate change impacts on precipitation, temperature, riverine flooding, and wildfire in the MWRF surrounding area, leading data sources for the region were considered.

Table 4.1: Summary of Projected Hydrometeorological Impacts to MWRF

Hydrometeorological Parameters	Climate Change Trends and Impacts to Moorpark Water Reclamation Facility
Precipitation	Both droughts and floods are expected to become more frequent as precipitation is expected to occur in fewer, more intense storms due to climate change. Although the City of Moorpark (City) is likely to experience only a slight increase in overall annual precipitation levels from climate change, the region is expected to see an increase in the number of extreme precipitation events, as well as droughts that last longer and are more intense. As a result, floods are expected to occur more often in Moorpark, and climate change may expand the parts of the city that are considered flood prone. The increase in frequency and severity of droughts will likely strain both habitats and water supplies in the City.
Temperature	Warmer temperatures are projected to cause an increase in extreme heat events. The number of extreme heat days is expected to rise in Moorpark, in addition to an increase in the average daily high temperatures. Energy delivery infrastructure and services may be damaged by very high temperatures, constraining their ability to meet community needs.
Sea-level rise	Not assessed because it is not necessary since MWRF is 9 miles from the Pacific Ocean coast and at 500 feet elevation.
Riverine Flooding	Arroyo Simi runs through the center of Moorpark, which is bordered to the north and south by a levee system managed by the Ventura County Public Works Agency. This levee system includes Ventura County Levee 10, Ventura County Levee 19, and AS-4, which combined protect 781 people, 336 buildings, and $245.9 million in property value. During heavy rainfall, these levees protect people and structures from floodwater along Arroyo Simi. However, more intense storms are likely to occur due to climate change, which can cause overtopping of the levee system and flooding of the areas behind the levees.
Wildfire and post-fire debris flow	The combination of complex terrain, Mediterranean climate, and productive natural plant communities next to developed areas has created conditions for extensive wildfires in Moorpark. Fire conditions arise from a combination of factors and changing conditions have created an extended fire season that lasts for most or all of the year. Fast and hot burning wildfires can destroy vegetation cover, leading to flooding and debris flows when precipitation does return.
Landslide	Historically, rain-induced landslides have occurred in the Santa Susanna mountains to the north of Moorpark, most recently after heavy rain events in the winter of 2003 and 2017. Climate change is likely to change precipitation patterns, increasing the frequency and intensity of heavy precipitation events, which can increase the risk of slope failures. These types of landslides or debris flows are most common on steep slopes made up of loose or fractured material. Landslides and mudslides can move fast enough to damage or destroy pipes and other structures in their path.
Water Quality	MWRF has maintained compliance with the Order issued by the Los Angeles Water Quality Control Board. In addition to the Facility, the District maintains the sewer

Hydrometeorological Parameters	Climate Change Trends and Impacts to Moorpark Water Reclamation Facility
	system throughout the City, which consists of seven sewer pump stations, force mains, standard and trunk manholes, and 368-miles of gravity sewer pipes. The MWRF serves as the primary wastewater treatment Facility for the City as well as provides for recycled water production for Title 22 reuse opportunities.

Table 4.2 provides an overview of the projected hydrometeorological data analyzed including how it was used, the spatial and temporal resolution, and source for each dataset. Observed data was collected from stations closest to the MWRF for parameters that were available. For parameters where observed data was lacking near MWRF, data was obtained from highly reputable models.

Table 4.2: Summary of Climate Projection Data Sources

Data	Used in Analysis	Spatial and Temporal Analysis	Source
Precipitation and Temperature Projections	Used for analyzing projected changes to precipitation and temperature to assess the potential impact on the facility location and its operation.	Daily data at 1/16-degree (approximately 6 kilometer) spatial resolution from 1950 to 2099	CMIP5 Downscaled Climate Model Simulations, per Cal-Adapt Local Climate Change Snapshot (https://cal-adapt.org/tools/local-climate-change-snapshot/)
Sea- Level Rise Projections	Not Applicable	Not Applicable	Not Applicable
Runoff	Used for analyzing total runoff and flood	Daily data from 1950 to 2099	Variable Infiltration Capacity (VIC) (Cal-Adapt located at https://cal-adapt.org/data/download/)
Wildfire	Used for analyzing wildfire decadal probabilities	1/16-degree (~6 kilometer) resolution from 1952 to 2099	Cal-Adapt (https://cal-adapt.org/tools/wildfire/)

4.1.1 Precipitation and Temperature

This section presents climate change projection estimates related to precipitation and temperature. Changes in precipitation are characterized and discussed as projected changes in annual precipitation depths, maximum one-day precipitation depths, 25- and 100-year return period event depths, and maximum length of dry spells. Changes in temperature are characterized and discussed as annual average maximum and minimum daily temperatures, number of extreme heat days, and number of warm nights.

4.1.2 Representative Concentration Pathways

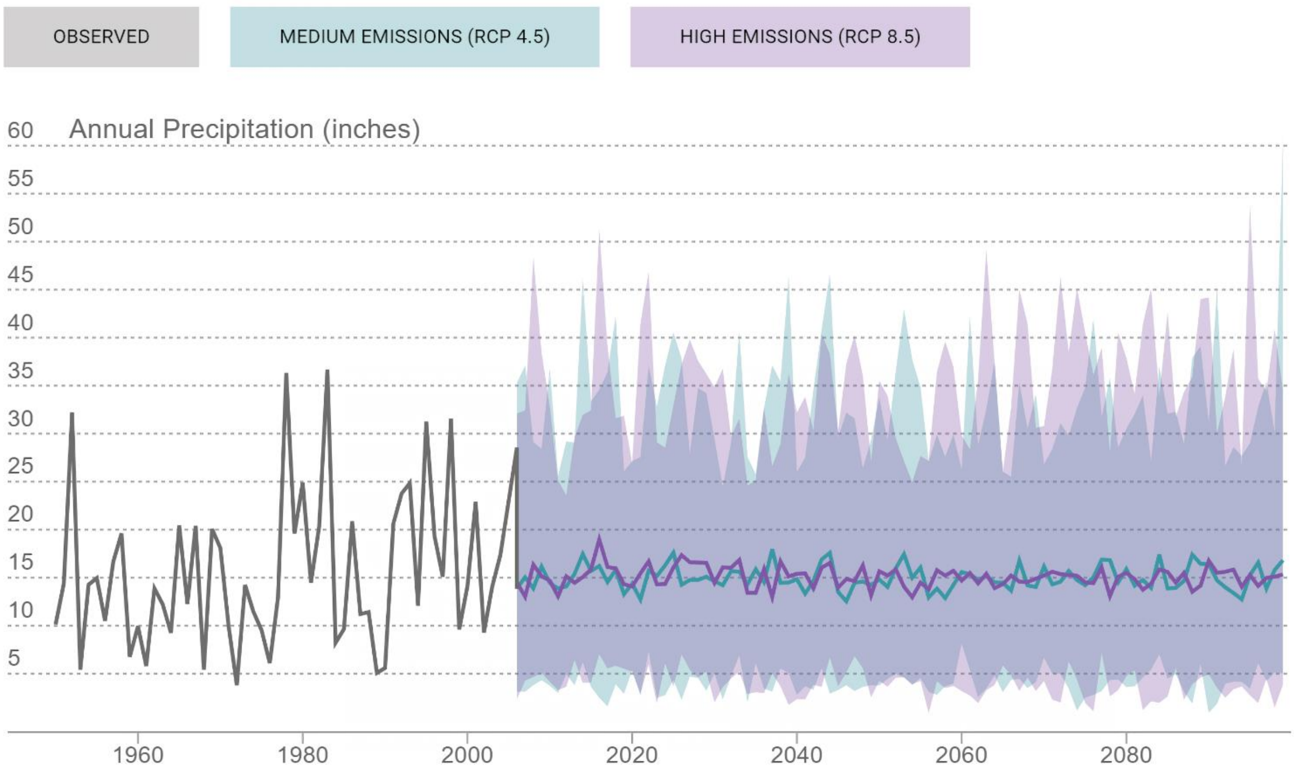
Representative Concentration Pathways (RCP) are climate change scenarios to project future greenhouse gas concentrations. These pathways (or trajectories) describe future greenhouse gas concentrations (not emissions) and have been formally adopted by the Intergovernmental Panel on Climate Change (IPCC). The pathways describe different climate change scenarios, all of which were considered possible depending on the amount of greenhouse gases (GHG) emitted in the years to come. The four RCPs – originally RCP2.6, RCP4.5, RCP6, and RCP8.5 – are labelled after the expected changes in radiative forcing from the year 1750 to the year 2100 (2.6, 4.5, 6, and 8.5 W/m2, respectively). The IPCC Fifth Assessment Report (AR5) began to use these four pathways for climate modeling and research in 2014. The higher values mean higher greenhouse gas emissions and therefore higher global surface temperatures and more pronounced effects of climate change. The lower RCP values, on the other hand, are more desirable for humans but would require more stringent climate change mitigation efforts to achieve them.

All projections are provided for both a medium greenhouse gas emissions scenario (RCP 4.5) and a high greenhouse gas emissions scenario (RCP 8.5). Projected changes in annual precipitation at the MWRF's location are projected to continue to remain highly variable under both RCP 4.5 and RCP 8.5. Figure 4-1 displays the future trends for both emissions scenarios.

Long-term trends indicate a minimal decrease of less than half an inch, but notably, the projections show that it is possible that the range in rainfall could become as high as 20.4 inches in the short-term and 23 inches in the long-term while only up to approximately 15.4 inches has been observed historically.

Table 4.3 summarizes precipitation data and shows that future projections of the long-term trend of annual precipitation on average remain almost identical to baseline conditions.

Figure 4-1: Projected Change in Annual Precipitation



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.3: Summary of Precipitation Data and Future Trends

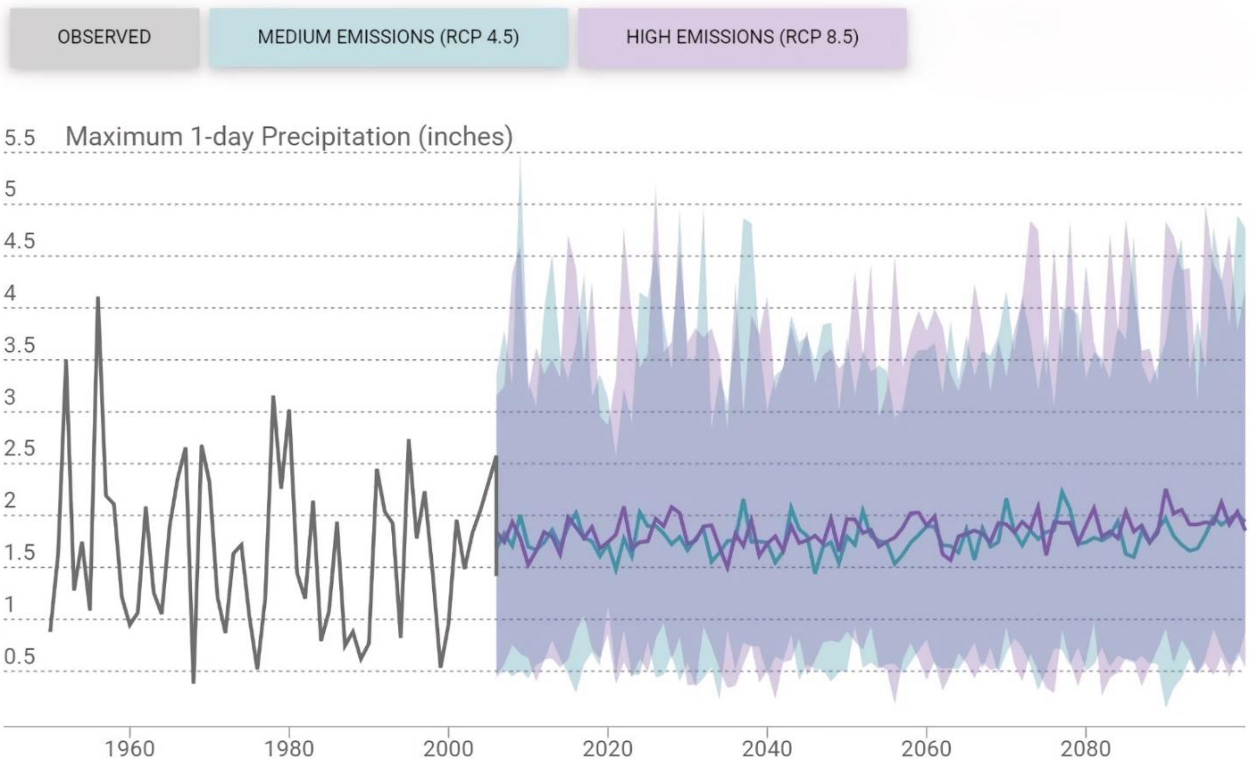
Observed (1961-1990) 30yr Average: 14.3 inches

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	15.4 inches	13.7 - 16.8 inches
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	-0.5 inches	14.9 inches	11.5 - 20.1 inches
HIGH EMISSIONS (RCP 8.5)	-0.5 inches	14.9 inches	11.5 - 20.4 inches
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	-0.2 inches	15.2 inches	11.5 - 18.6 inches
HIGH EMISSIONS (RCP 8.5)	-0.4 inches	15.0 inches	9.4 - 23.0 inches

Note: Projected change in annual precipitation during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end- century (2070-2099) refers to long-term impacts.

Figure 4-4 shows a very gradual increase in the projected maximum values for maximum 1-day precipitation at the MWRF's location. Maximum 1-day precipitation appears to increase slightly under future climate conditions for both RCP 4.5 and RCP 8.5. Table 4.4 shows, for the 30-year averages and range for the short-term increase, a slightly larger increase under the high emissions scenario. Compared to the baseline, maximum 1-day precipitation averages are projected to increase between 0.014 to 0.058 inches in the short-term and 0.101 to 0.178 inches in the long-term depending on emissions.

Figure 4-2: Projected Change in Maximum 1-Day Precipitation



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.4: Summary of 1-Day Precipitation Data and Future Trends

Observed (1961-1990) 30yr Average: 1.533 inches

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	1.743 inches	1.518 - 2.027 inches
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+0.014 inches	1.757 inches	1.488 - 2.017 inches
HIGH EMISSIONS (RCP 8.5)	+0.058 inches	1.801 inches	1.439 - 2.178 inches
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+0.101 inches	1.844 inches	1.554 - 2.218 inches
HIGH EMISSIONS (RCP 8.5)	+0.178 inches	1.921 inches	1.561 - 2.405 inches

Note: Projected change in maximum 1-day precipitation during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

In addition, the projected change in maximum 1-day precipitation for the 25- and 100-year return periods are shown in Figure 4-3 and Figure 4-4, respectively. The percent change is shown for the short-term and long-term aggregating results for both RCP 4.5 and 8.5 emission scenario projections. The 25-year return period daily maximum rainfall is projected to increase by 12.22 percent (%) in the short-term and 9.54% in the long-term, according to the median projection.

Figure 4-3: Projected Change in Short Term Return Precipitation Period

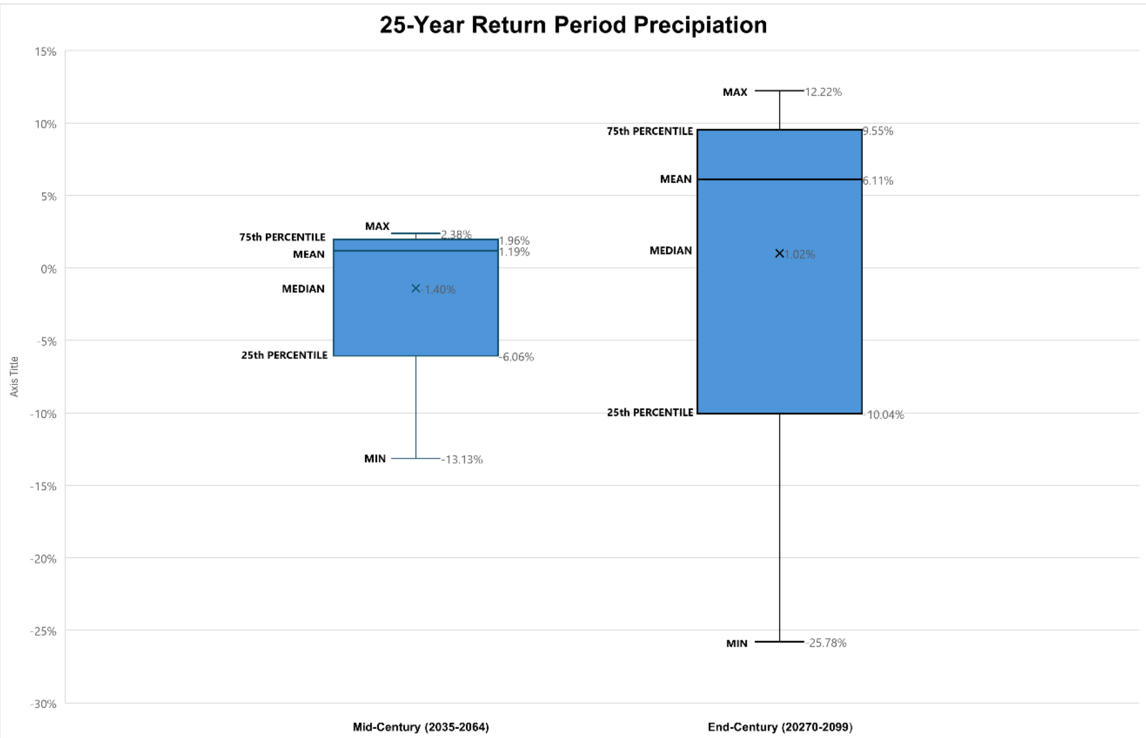
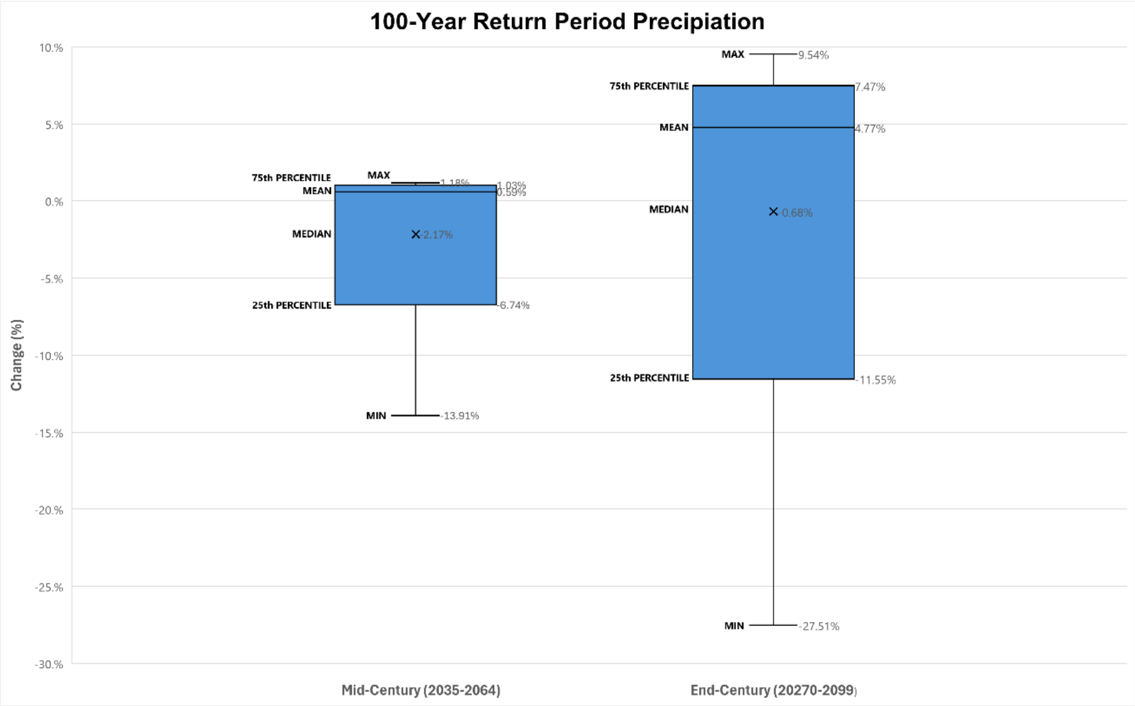


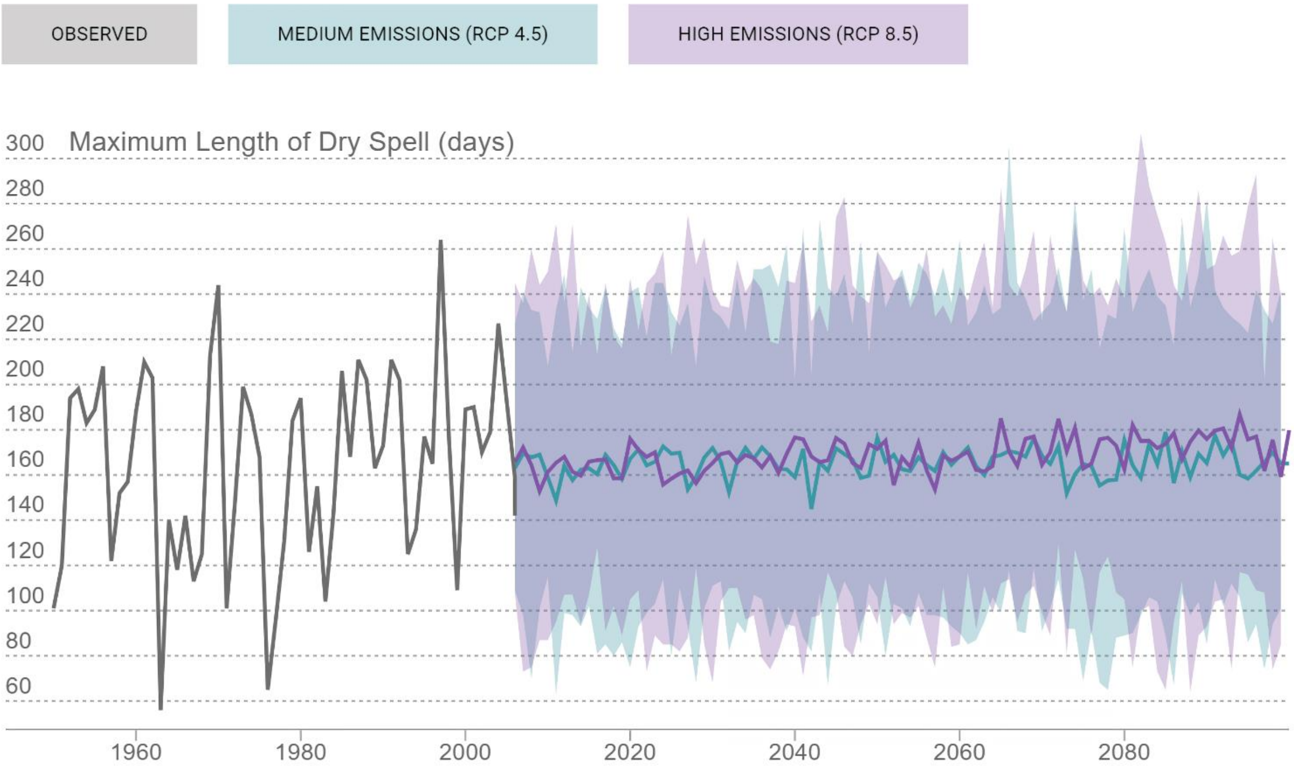
Figure 4-4: Projected Change in Long Term Return Precipitation Period



Note: Projected change in 100-year return period Precipitation during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 20 climate model projections from 10 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Historically, the average maximum length of a dry spell at this location is about 180 days. As the effects of climate change worsen, the duration of this occurrence is projected to increase slightly under both the medium (RCP 4.5) and high (RCP 8.5) emissions scenarios. Figure 4-5 provides an overview of these projected trends and Table 4.5 displays a quantitative description of these changes. In the short-term, the medium and high emissions scenario projects an average increase in maximum dry spell duration by 7 days, while the long-term high emissions scenario projects an increase of 17 days.

Figure 4-5: Projected Change in Maximum Length of Dry Spell



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.5: Summary of Projected Change in Maximum Length of Dry Spell

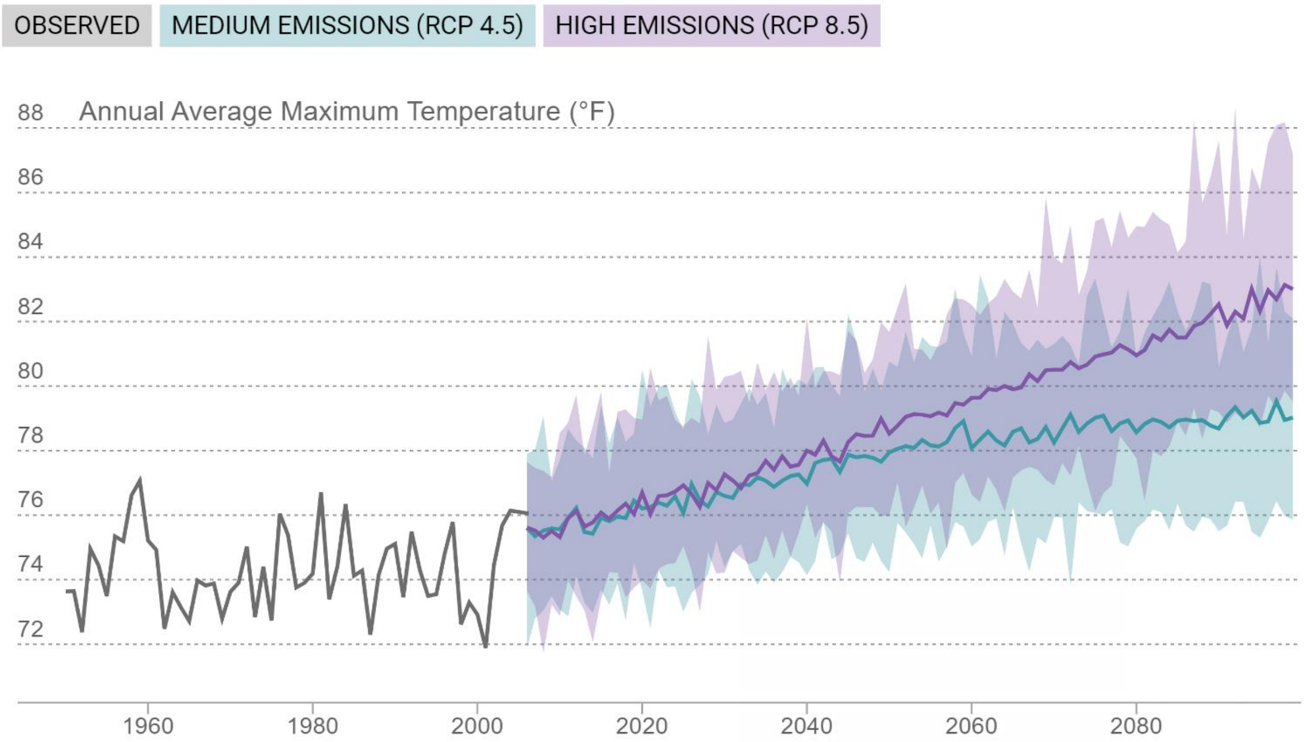
Observed (1961-1990) 30yr Average: 156 days

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	157 days	147 - 175 days
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+8 days	165 days	142 - 183 days
HIGH EMISSIONS (RCP 8.5)	+10 days	167 days	148 - 185 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+8 days	165 days	150 - 179 days
HIGH EMISSIONS (RCP 8.5)	+17 days	174 days	154 - 200 days

Note: Projected change in maximum length of dry spell during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

Annual average maximum temperatures are expected to increase under both the medium and high emissions scenarios because of climate change. RCP 4.5 and RCP 8.5 are roughly consistent through the short-term. Figure 4-6 highlights this increase over time. Table 4.6, presenting the medium and high emissions scenarios, predicts an average maximum temperature increase of 3.8°F and 4.6°F in the short term, respectively. The high emissions scenarios project an average maximum temperature increase of 7.6°F in the long-term.

Figure 4-6: Projected Change in Annual Average Maximum Daily Temperature



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.6: Summary of Annual Average Maximum Daily Temperature and Future Trends

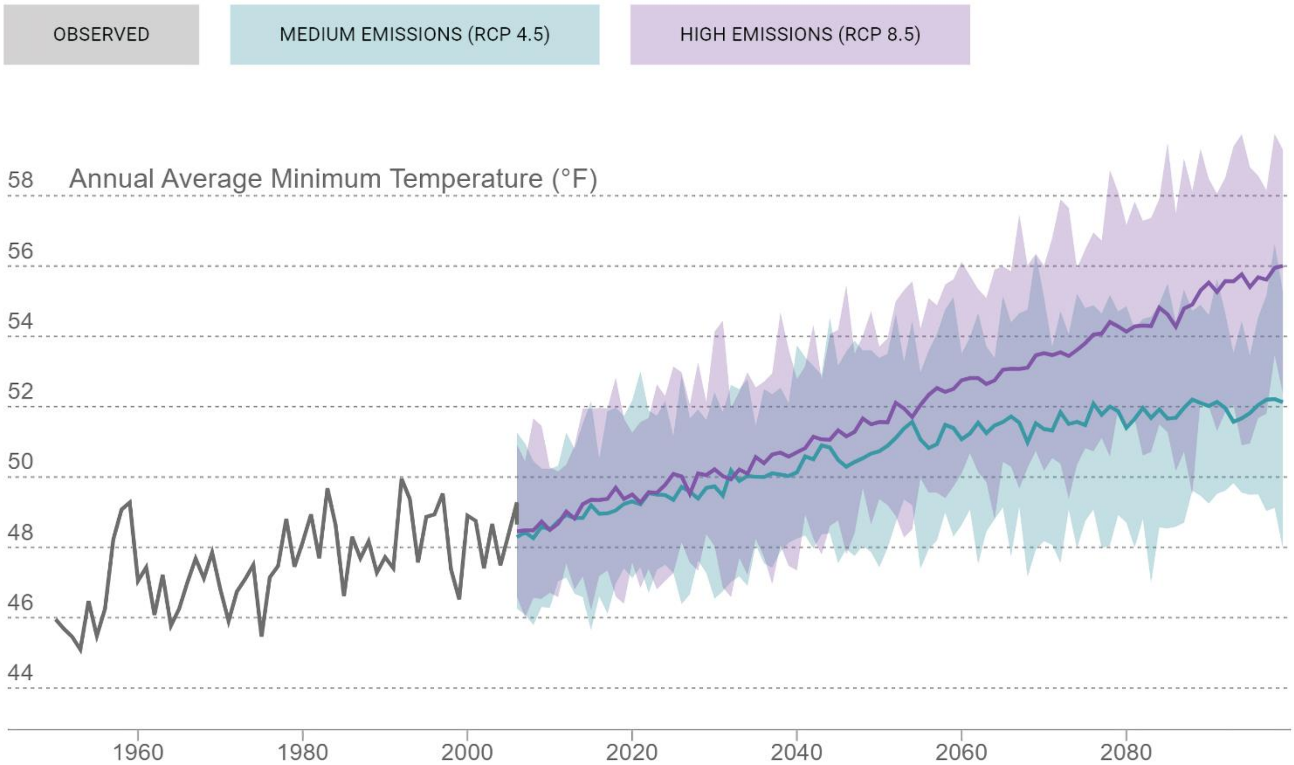
Observed (1961-1990) 30yr Average: 74.1 °F

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	74.1 °F	73.7 - 74.4 °F
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+3.8 °F	77.9 °F	75.8 - 80.0 °F
HIGH EMISSIONS (RCP 8.5)	+4.6 °F	78.7 °F	76.7 - 80.2 °F
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+4.8 °F	78.9 °F	77.0 - 81.4 °F
HIGH EMISSIONS (RCP 8.5)	+7.6 °F	81.7 °F	79.2 - 84.7 °F

Note: Projected change in annual average maximum daily temperature during Near Future (2035-2064) and Late Future (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

Similarly to the changes presented for annual average maximum temperature, annual average minimum temperatures are projected to increase in the same manner. Figure 4-7 and Table 4.7 present these changes. The medium and high emissions scenarios show an average increase in annual average minimum temperature of 3.4° and 4.2°F in the short-term, respectively. The high emissions scenarios project an average maximum temperature increase of 7.3°F in the long-term.

Figure 4-7: Projected Change in Annual Average Minimum Daily Temperature



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5

Table 4.7: Summary of Annual Average Minimum Daily Temperature and Future Trends

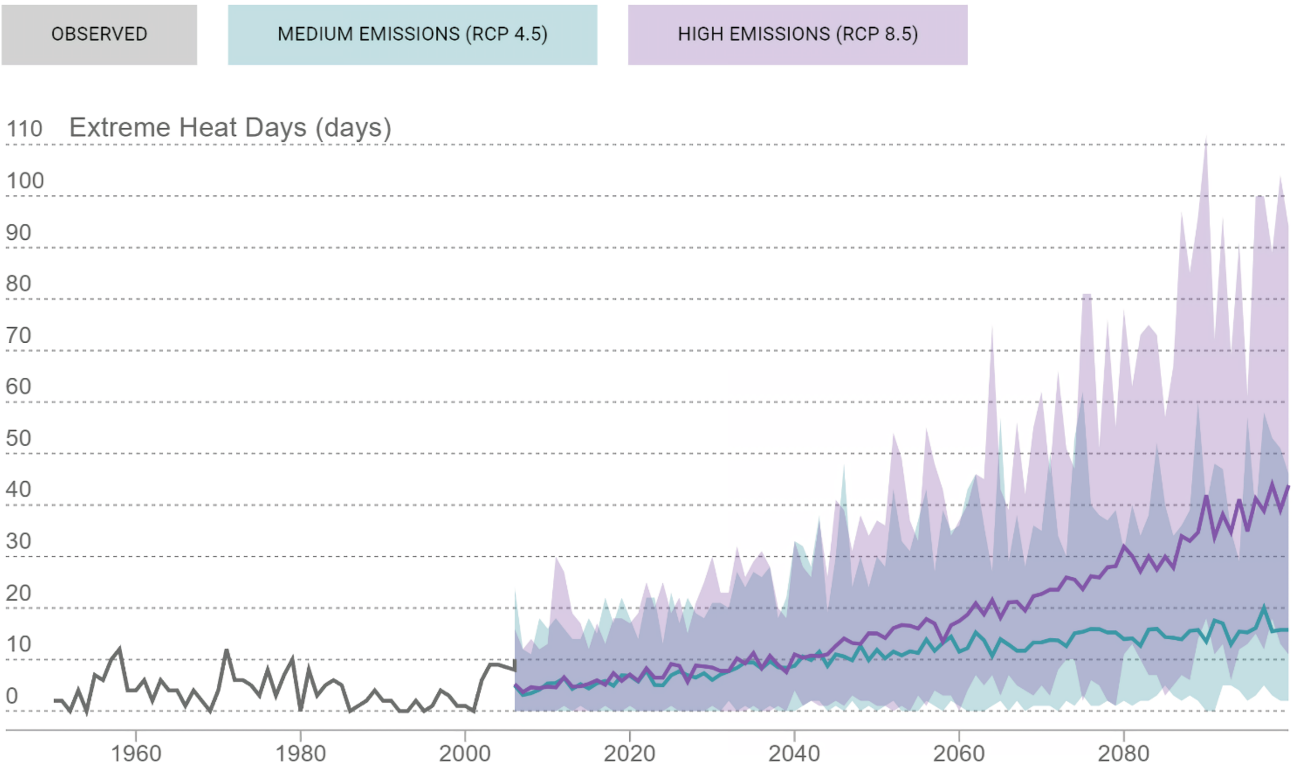
Observed (1961-1990) 30yr Average: 47.4 °F

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	47.4 °F	47.1 - 47.6 °F
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+3.4 °F	50.8 °F	49.2 - 52.2 °F
HIGH EMISSIONS (RCP 8.5)	+4.2 °F	51.6 °F	50.0 - 52.8 °F
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+4.4 °F	51.8 °F	49.6 - 53.2 °F
HIGH EMISSIONS (RCP 8.5)	+7.3 °F	54.7 °F	52.0 - 56.8 °F

Note: Projected change in annual average minimum daily temperature during Near Future (2035-2064) and Late Future (2070-2099) with respect to historic period (1961-1990). Data-derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

Given that the annual average maximum temperature is projected to increase under these emissions scenarios, the number of extreme heat days (defined as days with a maximum temperature greater than a threshold of 91°F) are expected to increase as well. Figure 4-8 provides context to these changes. Table 4.8 presents the data in a quantitative format. Historically, approximately 2 extreme heat days per year have been observed. In the short term, this is projected to increase by an average of 9 to 12 additional days under the medium to high emissions scenario. In the long-term, this is projected to increase by an average of 15 to 32 additional days under the medium to high emissions scenario.

Figure 4-8: Projected Change in Number of Extreme Heat Days



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.8: Projected Changes in Number of Extreme Heat Days

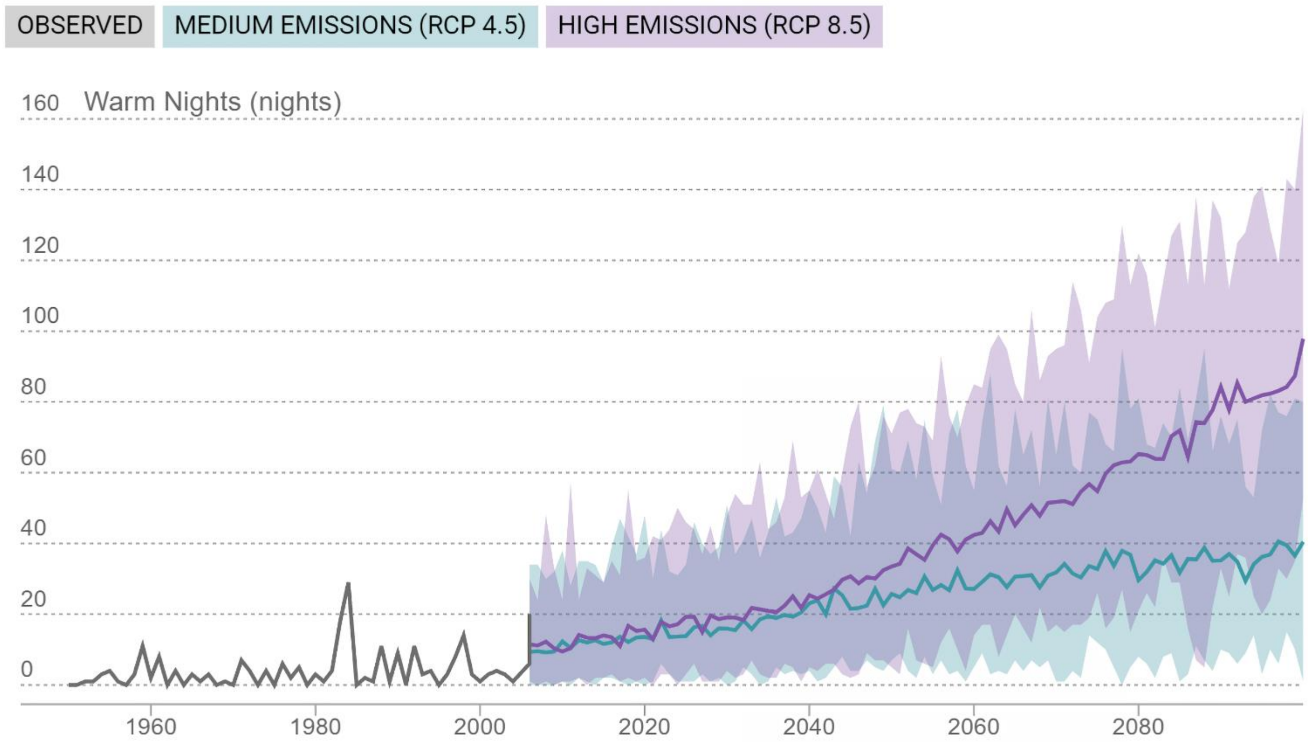
Observed (1961-1990) 30yr Average: 4 days

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	2 days	1 - 4 days
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+9 days	11 days	6 - 25 days
HIGH EMISSIONS (RCP 8.5)	+12 days	14 days	8 - 29 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+13 days	15 days	10 - 39 days
HIGH EMISSIONS (RCP 8.5)	+30 days	32 days	21 - 71 days

Note: Projected change in extreme heat days during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

An increase in the number of warm nights (defined as days with a minimum temperature greater than a threshold of 68.1°F) is expected as well. However, the increases seen here are much more substantial. On average, 6 warm nights have been observed each year historically. Under the impacts of climate change, an increase of 19 to 27 warm nights, on average, is projected in the short-term under the medium and high emissions scenarios and 35 to 70 under the high emissions scenarios. Figure 4-9 and Table 4.9 present these changes.

Figure 4-9: Projected Change in Number of Warm Nights



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.9: Projected Change in Number of Warm Nights

Observed (1961-1990) 30yr Average: 4 nights

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	6 nights	2 - 11 nights
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+19 nights	25 nights	10 - 40 nights
HIGH EMISSIONS (RCP 8.5)	+27 nights	33 nights	16 - 50 nights
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+29 nights	35 nights	14 - 53 nights
HIGH EMISSIONS (RCP 8.5)	+64 nights	70 nights	37 - 99 nights

4.1.3 Riverine Flooding

As 1-day maximum precipitation is projected to continue to increase in the future, riverine flooding vulnerabilities are also expected to increase. While projected flood flows in Aroyo Las Posas Creek was not directly available, its watershed-wide runoff was evaluated as a proxy for understanding potential climate change impacts to riverine flooding. It was evaluated using Variable Infiltration Capacity (VIC) hydrologic model using 20 CMIP5 Localized Constructed Analogs downscaled climate models obtained from CalAdapt. This VIC simulation was conducted at $1/16^{th}$ degree spatial resolution by Scripps Institution of Oceanography and obtained from CalAdapt for this report (Pierce et al., 2018). The total runoff from the upstream watershed of MWRF's location was estimated as the weighted average of the VIC grids over the HUC-12 boundary. Changes in runoff provides another indicator of projected changes in vulnerabilities to flood and drought conditions.

Projected changes in annual average runoff at the MWRF are small under both RCP 4.5 and RCP 8.5. Prolonged, heavy rainfall causes high peak flows of moderate duration and a large volume of runoff, filling Arroyo Simi with water. When the ground is saturated by previous rainfall, flooding can be more severe. In impervious areas, such as areas covered in asphalt or cement, stormwater cannot absorb into the ground and flows faster over the surface. This can cause more extensive flooding in low lying areas. Flooding susceptibility in Moorpark is primarily associated with areas adjacent to Arroyo Simi and in the canyons on the hillsides in northern Moorpark.

3.1.4 Wildfire and Post-Fire Debris Flow

As temperatures and duration of dry days are projected to continue increasing into the future, wildfire vulnerabilities are projected to become further exasperated. Wildfire is of most concern in the areas of the city with natural vegetation, such as undeveloped areas and larger lots with expansive un-irrigated vegetation. A large portion of these areas are covered by grasslands or brush, which are easily ignited, especially in the summer months. Grass and brush fires can be easier to control if they can be reached by fire equipment. However, fast and hot burning wildfires can destroy vegetation cover, leading to flooding and debris flows when precipitation does return.

5.0 IMPACTS TO MWRF

Previous sections detailed the short-term and long-term vulnerabilities related to hydrometeorological hazards that may impact MWRF. This section evaluates the impacts of the climate induced hazards on the MWRF, including impacts to water quality, permit compliance, receiving waters, and control measures for the identified climate-induced impacts at MWRF. This includes an evaluation of the MWRF-associated sewer shed, lift stations, treatment facility, recycled water system and distribution and MWRF's effluent discharge locations.

5.1 Impacts to Water Quality

Cumulative development projects will increase sewer flows by 1.5 MGD. Due to adequate capacity within the MWRF and the District's active management of sewer infrastructure throughout the city, there are no anticipated impacts related to sewer infrastructure or treatment capacity. With the future expansion of the MWRF, additional opportunities exist to grow purple pipe infrastructure and water reuse opportunities towards the city's OneWater goals and policies.

As a result of the potential increase in severity of both wet weather and dry weather events, effluent water quality may be impacted. One of the primary methods of water quality impacts evaluated was the potential increase in water quality fluctuations due to changes in inflow and infiltration within the system. Large wet weather events and coastal flooding may cause changes to the influent wastewater quality and strength as a result of high inflows and infiltration.

As temperature continues to increase, along with the potential for more severe droughts, the potential for wildfire impacts will also increase. Water quality may be impacted by an increase in local fire events, which may result in an increase in ash in the wastewater.

Maximum and minimum average air temperatures are projected to increase, which will result in an increase in the average influent wastewater temperature. Warmer wastewater temperatures will generally increase kinetics and result in higher microbial activity in the anoxic and aerobic zones, up to approximately 35 °C (95 °F), which corresponds to the upper limit of typical activated sludge bacteria. Above this threshold, nitrification and denitrification performance may decrease as the bacteria are inhibited. MWRF effluent temperature follows a seasonal pattern, with an approximate range of 55°F – 82°F). The wastewater temperatures are anticipated to remain within typical ranges and any impacts to the treatment system are anticipated to be managed by the wastewater treatment Facility operator.

Wastewater quality and strength may also fluctuate as a result of potential evacuations to the previously identified climate-induced impacts. Additionally, influent wastewater strength is anticipated to increase as the hydraulic loading is reduced due to water conservation measures while the nutrient loading remains stable, resulting in an increase in the concentration of various constituents in the wastewater influent. Potential fluctuations in wastewater quality and strength are anticipated to be managed by the existing wastewater treatment process and wastewater treatment Facility operator. Each process should continue to be monitored as wastewater concentrations fluctuate due to impacts from climate-induced events.

5.2 Impact to Compliance

As identified in previous sections, MWRF may be impacted by short-term and long-term vulnerabilities related to hydrometeorological hazards. These hazards may result in impacts to the treatment system, ultimately impacting the Facility's compliance with Order R4-2023-0089 Waste Discharge Requirements and Water Reclamation Requirements. This section will review the hazards identified in previous sections and their corresponding impacts to potential permit compliance at MWRF, including the collection system, treatment facility, and discharge locations. Permit compliance will be reviewed against Order R4-2023-0089.

5.3 Impact to Collection System

As discussed in Section 3.1.5.1, a sanitary sewer overflow was discovered on May 2nd , 2023, and was attributed to an erosion that caused pipe breakage. The SSO was the result of Arroyo Simi streambank erosion resulting from significant (over 2.5 inches) rain on February 25, 2023. The streambank erosion undermined the trunkline gravity sewer within the Arroyo Simi flow channel.

The corrective action included the reconstruction of the damaged 21-inch asbestos concrete pipe (ACP) occurred from May 3 to May 24, 2023. The reconstructed portion consists of approximately 100 feet of fully restrained 20-inch ductile iron pipe (DIP) with protecto 401 liner and asphalt coating. The replacement pipe was entirely encased and bedded in a 2-sack slurry. FieldLok gaskets were used for restrained joints. Each transition to an existing 21-inch ACP pipe was made with strapped rubber couplings also encased and bedded in a 2-sack slurry. This replacement product was chosen due to availability, robustness, and size compatibility with the existing 21-inch ACP.

Reconstruction of the embankment and armoring of the sewer pipeline was also performed. The electromagnetic flow tube and transmitter were replaced. The previous transmitter display was sun-damaged and broken. A replacement ABB

MaterWaster was installed in place of the damaged MagMaster Transmitter. The equipment manufacturer was contacted to verify proper wiring, programming and meter reading. In addition, 4-20 mA scaling to SCADA was verified. Flow meter is reading flow correctly at this time.

5.4 Impact from Power Outage

Adjacent to MWRF are 3,984 panels powering the Facility. They are part of the largest single solar facility in Ventura County, a system so high tech it actually follows the sun. The Hanwha SolarOne 285-watt solar panels produce more than 2.2 million kilowatt hours of electricity each year. A single axis tracking system rotates the solar panels that follow the sun throughout the day. The panels are propped up by vertically driven piers, rather than concrete put in the ground. The system has operated at the MWRF since 2013 and produces approximately 50% of the electricity used by the facility.

When sufficient sunlight is not available, a 1,000 kW diesel generator powers the Facility during emergency power outages. In addition, a Southern California Edison (SCE) power feed provides power when solar energy is not available. The battery storage and microgrid will integrate with the existing solar and diesel generator to isolate the facility during a power outage in order to maintain operations. Without the microgrid, the solar panels would otherwise turn off during an outage.

In April 2024, the District obtained approval from the Ventura County Board of Supervisors to retain Veolia Sustainable Buildings USA West, Inc. for the design, installation, and operation of a 410.9 kW photovoltaic system at MWRF. The expansion will increase on-site renewable energy production and MWRF's energy independence.

5.5 Impact on Influent Flow

MWRF may experience both high flow events and low flow events as a result of climate change related impacts. Of these two hydraulic extremes, sustained peak flow events provide greater challenge to MWRF and present a more significant risk. Peak flow events may be caused by large storm events, inundation, or riverine flooding.

A project is planned to build a storage building at MWRF. The new steel storage building will be across from the existing office and laboratory building. The proposed pad is roughly 16,000 square feet. The site is a vacant, relatively flat parcel with an approximately 9-foot-high earthen berm bordering the area on the north, south, and east sides. The storage building will be approximately 7000 square feet with a 35-foot driveway and 15-foot driveway setbacks around. This project is currently in the design phase.

Currently, for a sustained peak flow event, MWRF can continue to operate at the highest hydraulic flow rate possible. In addition, MWRF maintains a significant equalization and storage ability. The operators will continue to operate the Facility and will maintain the highest level of treatment possible. After the secondary clarifiers, secondary effluent can bypass the filters, if required, and be routed to the chlorine contact tank for disinfection prior to supplying the recycled water users. In the event of spills, overflows, or bypasses, MWRF staff will follow the response protocol prescribed in Order No R4-2023-0089 Waste Discharge Requirements and Water Reclamation Requirements.

6.0 SUMMARY

A summary of the main risks, likelihood of the potential risk, consequence of the potential risk, and mitigation strategies for the various climate change related impacts are presented in Table 6.1 for the Moorpark Water Reclamation Facility. As a result of the climate induced impacts evaluated, the risk of power outages (short-term and long-term), peak flow events, soil erosion/landslides and wildfires appear to be the most significant risks to MWRF. The control measures for these main risks are also provided.

Each risk for each major climate change impact was evaluated for likelihood of risk and consequence of risk using a Low, Medium, or High rating. The ratings were established based on the review of the MWRF emergency procedures, contingency plans, alarm/notification systems, training, backup power, and equipment and is based on discussions with District staff regarding the control measures for climate induced impacts.

As a result of the analysis of the short term and long-term vulnerability assessment, MWRF staff has become more aware of impacts of climate change as they affect the operation of the treatment system due to flooding, wildfire, or other climate-related changes. As identified in Order No. R4- 2023-0089 and as a result of the prescribed waste discharge requirements, the climate change-related effects as well as their impacts were analyzed. The analysis included impacts to the wastewater treatment and reclamation facility's operation, water supplies, the collection system, and water quality, including any projected changes to the influent water temperature and pollutant concentrations, and beneficial uses.

Also, new or increased threats to the sewer system resulting from climate change that may impact desired levels of service in the next 50 years were analyzed. The steps being taken or planned to address greenhouse gas emissions attributable to wastewater treatment plants, solids handling, and effluent discharge processes were also addressed. The overarching driver of climate change is the increased atmospheric carbon dioxide from human activity. Furthermore, the increased carbon dioxide emissions trigger changes to climatic patterns, which lead to more erratic rainfall and local weather patterns, and as discussed trigger landslides and impacts MWRF's sewer shed.

Table 6.1: Summary of Impacts and Mitigation Strategies

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Precipitation	SSO	Low	Medium	The region surrounding Moorpark is expected to see an increase in the number of extreme precipitation events, as well as droughts that last longer due to climate change. As a result, floods are expected to occur more often in Moorpark. Increased precipitation may result in an increased chance of a storm-related SSO. MWRF will continue to monitor SSO frequency and ensure the SSMP is updated frequently and is fully implemented.
Precipitation	Spills	High	High	Climate change is likely to change precipitation patterns, increasing the frequency and intensity of heavy precipitation events, which can increase the risk of slope failures. Landslides and mudslides can move fast enough to damage or destroy pipes and other structures in their path. MWRF will continue to ensure that influent flow monitoring is adequate, maintained and tested per manufacturer's recommendations. Redundancy was also introduced and the 4-20 mA scaling to SCADA is regularly verified.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Precipitation	Peak flow exceeding MWRF Capacity	Medium	Medium	MWRF may experience both high flow events and low flow events as a result of impact related to climate change. Of these two hydraulic extremes, sustained peak flow events provide greater challenge to MWRF and present a more significant risk. Peak flow events may be caused by large storm events, inundation, or riverine flooding. Increases in baseline flow from inflow and infiltration may compound peak flow events, resulting in greater potential peak flows that exceed the treatment system's rated capacity. MWRF will continue to monitor the influent hydraulic flows and Facility capacity and implement control measures including using the equalization ponds.
Temperature	Power Outage	Low	Medium	Warmer temperatures are projected to cause an increase in extreme heat events. The number of extreme heat days is expected to rise in Moorpark, in addition to an increase in the average daily high temperatures. Energy delivery infrastructure and services may be damaged by very high temperatures, constraining the utilities' ability to meet the energy need of its customers. In addition to the existing 3,984 panels powering the Facility, the District is planning to install a 410.9 kW photovoltaic system at MWRF. The expansion will increase on-site renewable energy production and MWRF's energy independence. Furthermore, Exposure to extreme heat may result in the failure (or reduction of lifespan) of equipment, including electrical equipment. MWRF staff will continue to monitor and maintain the equipment at the MWRF.
Temperature	Risk to Staff	Medium	High	Excessive heat in the workplace can cause many adverse health effects, including heat stroke and even death, if not treated properly. Workers in outdoor and indoor work settings without adequate climate controls are at risk of hazardous heat exposure. The District complies with California's Heat Illness Prevention Standard which requires employers to provide training, water, shade, and planning. A temperature of 80°F triggers the requirements. The District's heat illness prevention program is an ongoing system that plans for and ensures workplace heat safety.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Sea-level Rise and Coastal Erosion	None	Not Present	Not Present	Global and regional sea levels have been increasing over the past century and are expected to continue to increase throughout this century. However, because of geographical distance and topography, MWRF is not vulnerable to the impact from sea rise and therefore, sea level rise and the associated risk have been excluded from this Climate Change Vulnerability Assessment and Mitigation Plan. With a distance of 9 miles from the Pacific Ocean coast, the Facility is far from coastal areas as shown in Figure 3-6, making it less likely to be directly affected by rising sea levels, which primarily impact coastal regions. Furthermore, with an elevation of 500 ft above sea level, the Facility is situated on higher ground, and therefore, it is less vulnerable to flooding from rising sea levels.
Riverine Flooding	SSO	Low	Medium	Current riverine flooding vulnerabilities of the MWRF were assessed by collecting flood hazard data from the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). In addition, a desktop review of historical reports of riverine flooding was conducted. No reports were identified for occurrences of riverine flooding. However, the livelihood of riverine flooding causing SSOs in the future is low. MWRF will continue to monitor SSO frequency and ensure the SSMP is updated frequently and fully implemented.
Riverine Flooding	Peak flow exceeding MWRF Capacity	Low	Medium	Current riverine flooding vulnerabilities of the MWRF were assessed by collecting flood hazard data from the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). In addition, a desktop review of historical reports of riverine flooding was conducted. No reports were identified for occurrences of riverine flooding. However, the livelihood of riverine flooding causing the MWRF to exceed its maximum influent flow is low. WMRF to continue to monitor the influent hydraulic flows and Facility capacity and implement control measures including using the equalization ponds.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Riverine Flooding	Power Outage	Low	Medium	Riverine flooding may increase the likelihood of power outages. In addition to the existing 3,984 panels powering the Facility, the District is planning for a 750-kW battery energy storage system and smart microgrid to improve MWRF's resiliency during Edison power shutoff events and allow electric load shaving during high peak electric usage periods.
Wildfire	Wildfire impacts Facility and Offices	Low	Medium	The area near the City of Moorpark is prone to wildfires and is designated as very high due to the dry climatic conditions, vegetation cover that is susceptible to ignition and rapid-fire spread, nearby steep slopes causing rapid uphill speed of the fire, and a history of repeated fire incidents. However, the Facility is not within the very high-risk area. The District has created a defensible space as a buffer between the Facility and surrounding areas. It can slow or stop the spread of wildfire and help minimize destruction to the Facility. Furthermore, vegetation has been reduced or removed within a prescribed distance from the MWRF and associated offices to reduce fire intensity.
Post-Fire Debris Flow	Wildfire impacts facilities	Low	Medium	Post-fire debris flow is highly possible along the Arroyo Las Posas creek. Also, post-fire debris flow likelihood is high in tributaries near the sewer gravity pipes, manholes, and sewer force main that cross the pipes. MWRF staff can't stop or change the path of debris flow. However, they may be able to protect the sewer shed from floodwaters or mud by use of sandbags or by building channels or deflection walls to try to direct the flow around manholes.
Landslide	Broken pipes	High	High	The hills north and north-east of MWRF are prone to landslides, although MWRF does not appear to have been directly impacted by landslides previously, but the MWRF-associated sewer shed has. These conditions are expected to persist, but the precise magnitude of potential mass movement during a landslide remains uncertain. Consequently, accurately determining the likelihood of a landslide impacting MWRF remains challenging. Currently, information on anticipated climate change impacts to landslides is limited and the analysis utilizes the historic landslide inventory.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
				MWRF will continue to ensure that influent flow monitoring is adequate, maintained and tested per manufacturer's recommendations. Redundancy was also introduced and the 4-20 mA scaling to SCADA is regularly verified.
Water Quality	Limited supply of recycled water	Low	Low	MWRF has maintained compliance with the Order issued by the Los Angeles Water Quality Control Board. In addition to the Facility, the District maintains the sewer system throughout the City, which consists of seven sewer pump stations, force mains, standard and trunk manholes, and 368-miles of gravity sewer pipes. The MWRF serves as the primary wastewater treatment Facility for the City as well as provides for recycled water production for Title 22 reuse opportunities. No significant impacts are anticipated.
Water Temperature	Fluctuation in MWRF's influent and effluent water temperature	Low	Low	Maximum and minimum average air temperatures are projected to increase, which will result in an increase in the average influent wastewater temperature. Warmer wastewater temperatures will generally increase kinetics and result in higher microbial activity in the anoxic and aerobic zones, up to approximately 35 °C (95 °F), which corresponds to the upper limit of typical activated sludge bacteria. No significant impacts are anticipated.

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