Turlock Irrigation District Local Hazard Mitigation Plan

Prologue

This document, dated ##, 2025, constitutes the draft version of the Turlock Irrigation District (TID) Local Hazard Mitigation Plan ("Draft Plan"). The Draft Plan is disseminated for the purpose of facilitating review and input from partners, assisting and cooperating agencies, and members of the general public.

It is expressly noted that this Draft Plan contains certain incomplete or provisional information. Such content will be updated or finalized as necessary prior to the publication of the final version of the Plan ("Final Plan").

TID is committed to a transparent and inclusive process and, accordingly, welcomes comments and suggestions regarding the Draft Plan. TID will evaluate all comments received; however, the District explicitly reserves the right to determine, at its sole discretion, whether any particular comment or suggestion will be incorporated into the Final Plan.

The release of this Draft Plan does not constitute an endorsement, adoption, or commitment to any specific course of action, policy, or program contained herein. Furthermore, TID shall not be held liable for any errors, omissions, or reliance upon the Draft Plan prior to its finalization.

All comments must be submitted in accordance with the instructions provided and within the timeline established for public review and comment.

By making the Draft Plan available, TID seeks to foster collaboration and ensure that the Final Plan reflects comprehensive input while maintaining adherence to applicable laws, regulations, and procedural standards.

Contact Information

Name: Herb Smart

Title: Emergency Preparedness Coordinator

Address: 333 E. Canal Drive, Turlock, CA 95382

Phone: (209) 883-8213

Email: Hssmart@tid.org

Contents

Plan Adoption

This plan represents a full rewrite of TID's previously adopted 2020 Local Hazard Mitigation Plan.

In accordance with the requirements set forth in the Code of Federal Regulations, Title 44, Section 201.6(c)(5), Local Hazard Mitigation Plans (LHMPs) must be formally adopted by the governing body of the jurisdiction seeking Federal Emergency Management Agency (FEMA) approval.

To meet this requirement efficiently, the Turlock Irrigation District (TID) is utilizing FEMA's "Approvable Pending Adoption" process. This approach allows TID to submit the final draft LHMP to the California Governor's Office of Emergency Services (Cal OES) and FEMA for review prior to formal adoption. This process expedites plan approval by identifying any required revisions before the plan is presented to TID's Board of Directors for adoption at a public meeting.

If the submitted LHMP meets all federal and state criteria, FEMA will issue an "Approvable Pending Adoption" notification. Upon receipt of this notification, TID will bring the LHMP before the Board of Directors for formal adoption during a public meeting. Following adoption, TID will submit the signed resolution to FEMA to finalize the approval process.

Once FEMA issues a formal approval letter, the signed adoption resolution will be included in this plan as Appendix A on page ##.

Plan Expiration Date

This plan will expire five years from the date of FEMA's "Approvable Pending Adoption" notification letter to TID.

Executive Summary

The Turlock Irrigation District (TID) Local Hazard Mitigation Plan (LHMP) is a comprehensive, forward-looking planning document that identifies natural hazards affecting the District and outlines actions to reduce long-term risk to life, property, critical infrastructure, and essential services. The LHMP was prepared in accordance with the requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000 (DMA 2000), and implementing regulations at 44 CFR Part 201. The plan also aligns with guidance from the Federal Emergency Management Agency (FEMA) and the California Governor's Office of Emergency Services (Cal OES).

TID is a special district that provides electric power, irrigation water, and related services to portions of Stanislaus, Merced, and Tuolumne Counties. The District owns and operates a diverse portfolio of infrastructure, including generation facilities, substations, transmission and distribution systems, canals, pipelines, dams, reservoirs, and administrative and operations facilities. This infrastructure is exposed to a range of natural hazards that have the potential to disrupt operations, damage assets, and impact the communities TID serves.

The LHMP evaluates the hazards most relevant to TID's service area and operations, including but not limited to earthquakes, flooding, dam failure, drought, extreme heat, wildland fire, severe weather, and other climate-related hazards. For each hazard, the plan assesses historical occurrences, geographic extent, probability, and potential impacts on TID facilities, customers, and operations. The Risk Assessment also considers vulnerable populations and critical dependencies, recognizing the role TID infrastructure plays in supporting public health, safety, and economic stability throughout the region.

The planning process was led by TID's Emergency Management Planning Team (EMPT) with participation from internal departments, subject matter experts, external agencies, and community partners. A whole-community approach was used to ensure broad input and coordination, including engagement with local jurisdictions, regional organizations, and representatives of populations that may be disproportionately impacted during hazard events. Public outreach activities provided opportunities for stakeholders and community members to review draft materials and provide input, which was documented, evaluated, and incorporated into the plan where appropriate.

Based on the findings of the Risk Assessment, the LHMP identifies mitigation goals and objectives that reflect TID's mission, operational priorities, and regulatory responsibilities. The Mitigation Strategy includes a suite of actions designed to reduce risk to District assets and improve system resilience over time. These actions encompass infrastructure hardening, operational improvements, planning and policy enhancements, coordination with partner agencies, and ongoing monitoring of hazard conditions. Each mitigation action includes information on responsible departments, implementation status, and timeframes to support accountability and integration with District planning and capital improvement processes.

The LHMP is intended to be a living document that supports informed decision-making and continuous improvement. TID will monitor progress on mitigation actions, update the plan as conditions change, and maintain coordination with internal and external partners. Adoption of this LHMP by the TID Board of Directors enables the District to remain eligible for certain FEMA hazard mitigation grant programs and demonstrates TID's commitment to proactively managing risk and enhancing resilience for the communities it serves.

I. Introduction

Purpose of the LHMP

Natural disasters are a recurring reality in California, causing widespread damage to infrastructure, disrupting services, impacting the economy, and threatening public safety. While not all hazards can be eliminated, understanding the risks they pose—combined with proactive planning and targeted mitigation actions—can significantly reduce their long-term impacts.

Under Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000 (DMA 2000), local governments are required to develop and maintain a FEMA-approved Local Hazard Mitigation Plan (LHMP) to remain eligible for certain non-emergency disaster assistance programs, including Hazard Mitigation Assistance (HMA) grants.

As a Special District in the State of California, TID is required to maintain a current, adopted LHMP in compliance with Title 44 of the Code of Federal Regulations (44 CFR § 201.6) and the updated FEMA Local Mitigation Planning Policy Guide (FP-206-21-0002), which became effective April 11, 2025. This guidance establishes consistent standards for plan content, review, and approval, and reinforces the use of mitigation planning as the foundation for risk-informed investment decisions.

This document serves as a full update to TID's previously approved 2020 LHMP. It reflects current hazard conditions, updates to TID's facilities and operations, and incorporates new planning requirements introduced in the 2025 FEMA Policy Guide (FP-206-21-0002).

The Benefits of Hazard Mitigation Planning

FEMA recognizes a critical link between hazard mitigation planning and long-term community sustainability. By taking proactive steps to understand and reduce hazard risk, TID enhances its ability to protect lives, property, and essential services—and to recover more quickly after disasters occur.

FEMA defines hazard mitigation as any sustained action taken to reduce or eliminate long-term risk to human life and property from hazards. Mitigation planning serves as the foundation for identifying those actions and prioritizing investments that build resilience. By preparing and adopting this LHMP, TID is taking deliberate, forward-thinking steps to reduce the impact of future hazard events.

This plan allows TID to:

- Learn from past disaster events
- Coordinate effectively across departments and stakeholders
- Identify cost-effective strategies to protect infrastructure, services, and people
- Maintain eligibility for critical federal and state funding programs

In addition to reducing risk, hazard mitigation planning provides a significant financial return. According to the National Institute of Building Sciences, every dollar invested in mitigation saves an average of six dollars in future disaster-related costs. These savings stem from reduced damage, faster recovery, and minimized disruption to services and the local economy [(1)].

1. National Institute of Building Sciences. Natural Hazard Mitigation Saves: 2019 Report. Washington, D.C., 2019.

Direct Benefits of Hazard Mitigation Planning

- Reduced loss of life and injury
- Reduced property damage and service disruption
- Lower economic losses and reconstruction costs

- Shorter recovery timelines
- Improved eligibility and access to post-disaster funding
- Enhanced interagency coordination and public engagement

Indirect Benefits

- Stronger disaster resilience
- Preservation of environmental and natural resources
- Increased economic stability and investment readiness
- Improved quality of life for the communities TID serves

Through this 2025 LHMP update, TID reaffirms its commitment to reducing long-term risk, protecting critical assets, and building a safer, more resilient future for its employees, customers, and communities.

2025 Local Hazard Mitigation Planning Requirements

FEMA's Local Mitigation Planning Policy Guide (FP-206-21-0002), effective April 11, 2025, reaffirms that jurisdictions must maintain a current, approved LHMP to remain eligible for key federal mitigation funding programs. Similarly, Cal OES requires an approved LHMP for eligibility under state programs.

Although FEMA guidance no longer requires explicit DEI considerations, it emphasizes whole-community participation, social vulnerability, and climate impacts. These principles remain central to California's requirements and are strongly encouraged as part of inclusive and equitable risk reduction efforts.

Recognizing that disadvantaged and vulnerable populations are often disproportionately affected by disasters, TID has incorporated these considerations into its 2025 LHMP update as a responsible and forward-thinking planning practice. This approach supports long-term community resilience and ensures alignment with both federal and state guidance.

Scope

The purpose of hazard mitigation planning is to identify and implement policies, actions, and strategies that reduce long-term risks to life, property, and operations from future hazard events. Effective mitigation planning requires a collaborative process that engages community leaders, businesses, residents, and other stakeholders to assess potential hazards, evaluate vulnerabilities, and prioritize investments that enhance resilience. The most effective mitigation efforts are rooted in proactive, forward-looking plans developed well before a disaster strikes.

This 2025 Local Hazard Mitigation Plan (LHMP) is a full update of Turlock Irrigation District's (TID) previously approved 2020 LHMP. As part of the update process, the TID Planning Team reviewed the natural hazards identified in the 2020 plan to determine their continued relevance. To inform this evaluation, subject matter experts from across TID participated in an internal online survey. Six staff members responded, and results showed strong consensus for retaining all seven previously identified natural hazards in the updated plan. These hazards are:

- Aquatic Invasive Species
- Dam Failure
- Drought
- Earthquake
- Extreme Weather (including Damaging Winds, Tornadoes, Extreme Temperatures, Localized Extreme Rainfall, and Poor Air Quality)
- Flooding
- Landslide

- Public Health Emergency
- Wildland Fire

Survey results confirmed that these hazards continue to pose a credible risk to TID's infrastructure, operations, and service delivery. The full results of the survey are included in Appendix B- Meeting Documentation.

To meet these statutory requirements and ensure a comprehensive approach, TID developed this Local Hazard Mitigation Plan through a structured and inclusive planning process. This process brought together internal staff, external partners, and community stakeholders to identify hazards, assess risks, and develop strategies for reducing long-term vulnerability.

Section II describes the planning process, including how TID organized planning teams, engaged stakeholders, conducted public outreach, and incorporated feedback from partner agencies and the whole community. Together, these efforts ensure the LHMP is both technically sound and reflective of the needs and priorities of TID and its service area.

See Section II beginning on page 22.

District and Service Area Profile

The Turlock Irrigation District was established on June 6, 1887, as the first irrigation district formed in California under the Wright Act of 1887, a landmark law that enabled local communities to create publicly governed irrigation districts to manage and distribute water resources. Operating under California Water Code Division 11, TID has evolved into a multi-service special district providing both irrigation water and retail electric service. TID's irrigation service area encompasses approximately 196,499 acres in southern Stanislaus and northern Merced counties. Each year, TID delivers surface water to approximately 150,000 acres of active farmland, supporting one of the most productive agricultural regions in the state. Its electric service area spans about 423,500 acres, supplying electricity to residential, commercial, and industrial customers.

Figure 1- TID Service Area Map

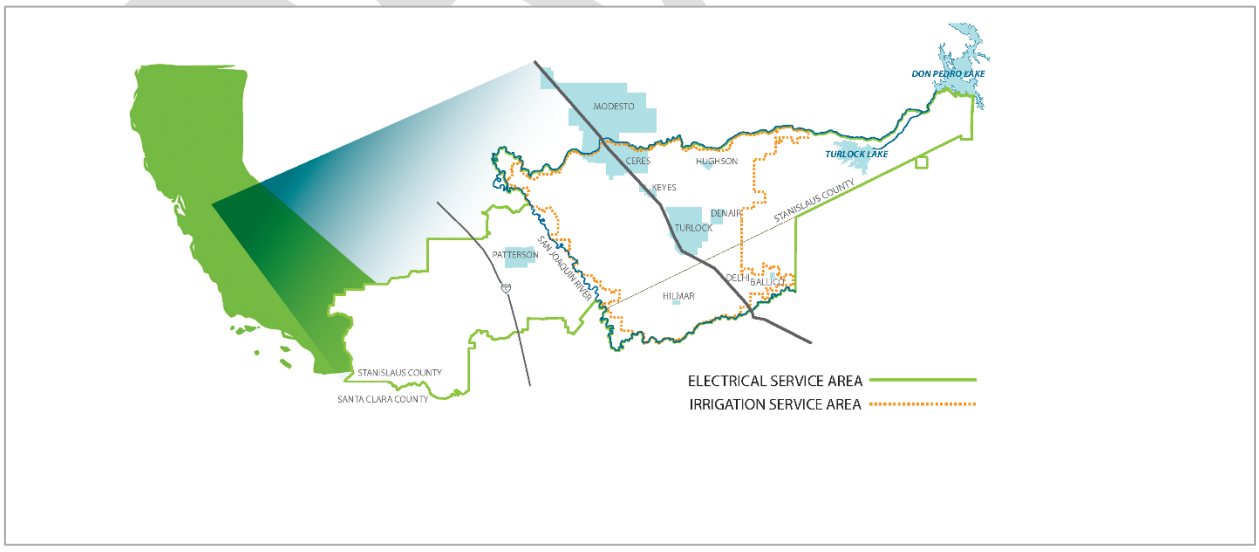
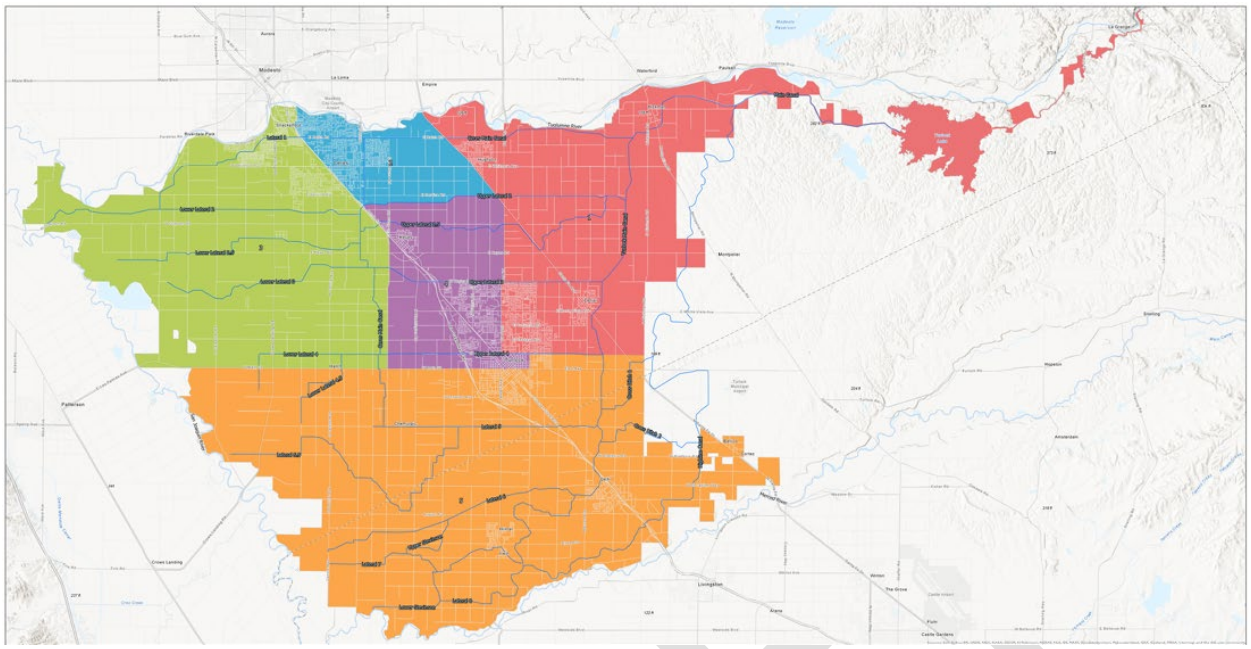


Figure 2-TID Board of Directors Map



Communities in TID's Electric Service Area

TID provides retail electric service to a diverse range of communities within its 662-square-mile service area, encompassing portions of Stanislaus, Merced, Tuolumne, and Mariposa counties. TID's electric service area includes the following cities, towns, and unincorporated communities:

Cities: Turlock, Ceres, Hughson, Patterson, and parts of Modesto

Census-Designated Places (CDPs): Ballico, Diablo Grande, Delhi, Denair, Hickman, Hilmar, Keyes, and La Grange

TID serves approximately 100,000 electric customers across this region, delivering power through an integrated system of generation, transmission, and distribution facilities on a not-for-profit basis.

Governance

TID is governed by a five-member Board of Directors, each elected from five geographic divisions within the District. Core services include the delivery of surface water through an extensive gravity-fed canal and lateral system, the generation and distribution of electricity, and the operation of hydroelectric facilities on the Tuolumne River through the Don Pedro Project. TID's jurisdiction includes the cities of Turlock, Ceres, Hughson, and portions of Modesto, along with several unincorporated communities such as Denair, Keyes, and Hickman [(2)].

2. Stanislaus Local Agency Formation Commission (LAFCO), Municipal Service Review and Sphere of Influence Update for the Turlock Irrigation District, 2011.

Water Operations

With deep roots in California's agricultural history, TID owns and manages one of the state's oldest and most essential water delivery systems. Anchored by senior water rights on the Tuolumne River—some dating back to the 1800s—TID's water infrastructure underpins irrigation, supports hydropower generation, and plays a key role in regional environmental and recreational management. The system spans major facilities such as Don Pedro Reservoir and an extensive network of canals that sustain farming operations throughout TID.

The Tuolumne River, fed largely by Sierra Nevada snowmelt, provides the primary water supply for TID. While typically dependable, the river is also subject to variability—ranging from multi-year droughts to high-flow flood events, as seen during the storms of 1997 and 2017. As the lead operator of Don Pedro Dam, TID is responsible for managing downstream releases that support fish and wildlife habitat while balancing agricultural demands and flood control. A thorough understanding of this infrastructure and its vulnerabilities is critical for identifying risks and implementing mitigation strategies that protect water reliability and system resilience.

Don Pedro Reservoir

Don Pedro Reservoir, located approximately two miles upstream of La Grange, is owned and operated primarily by TID. It is the sixth-largest reservoir in California, with a storage capacity of 2.03 million acre-feet. The 585-foot-tall dam is also one of the tallest in the nation and provides significant flood control for downstream communities. In addition to its operational importance, Don Pedro Reservoir supports extensive recreational use, including fishing, boating, camping, and water sports. Facilities developed with State support at Fleming Meadows, Blue Oaks, and Moccasin Point provide infrastructure for public use.

La Grange Diversion Dam

Built in partnership with the Modesto Irrigation District in 1893, the La Grange Dam serves as the diversion point for water from the Tuolumne River for both the Modesto and Turlock Irrigation Districts. TID operates a small powerplant on it canal system just downstream of the dam.

Turlock Lake

Turlock Lake serves as a critical balancing reservoir in the TID system. Located between Hickman and La Grange, it temporarily stores water released from Don Pedro before it enters TID's canal network. This arrangement provides operational flexibility by decoupling irrigation delivery schedules from upstream dam releases, allowing for more efficient and responsive water management during high-demand or emergency periods.

Lateral 8 Regulating Reservoir

The Lateral 8 Regulating Reservoir, completed in 2016 near Hilmar, is a 25-acre facility that stores approximately 130 acre-feet of irrigation water. This infrastructure helps improve delivery efficiency and service reliability to roughly 12,000 downstream acres. The reservoir also supports water conservation by stabilizing system flows and reducing operational spills, which allows surplus water to be retained in upstream reservoirs for future use.

Ceres Main Regulating Reservoir

The Ceres Main Regulating Reservoir is a 220 Acre-foot reservoir within TID's canal system. It is designed to capture and temporarily store flows from the Ceres Main Canal, allowing for controlled redistribution of water back into both the Ceres Main Canal and the Lower Lateral 3 Canal. This operational flexibility enhances downstream water deliveries, improves system efficiency, and supports more reliable irrigation service during peak demand periods.

Canal System

TID operates an extensive canal system that forms the foundation of its surface water delivery operations. The system includes more than 250 miles of open channels, consisting of main canals, laterals, and distribution turnouts that deliver irrigation water to agricultural users across TID's service area in Stanislaus and Merced counties.

Water released from Turlock Lake flows into TID's two main conveyance routes, the Main Canal and the Ceres Main Canal, which distributes water throughout the service territory. The system is gravity-fed, enabling efficient water delivery without the need for extensive pumping infrastructure. Numerous flow

control structures, check gates, siphons, and turnouts help regulate distribution and balance demand across a wide range of conditions.

To support operational oversight, many components of the canal network are equipped with remote monitoring and control systems, including Supervisory Control and Data Acquisition (SCADA) technology. These systems allow TID to monitor flow conditions in real time and make adjustments to improve efficiency and responsiveness.

The canal system plays a vital role in supporting the region's agricultural economy and water supply reliability. In recent years, TID has continued to modernize the network through lining projects, control structure upgrades, and the addition of regulating reservoirs such as the Lateral 8 facility, which enhances system performance during peak demand periods.

TID's canal infrastructure is integral to daily operations and regional water management, and it remains a critical component of TID's overall service capabilities.

TID's Irrigation Service Area

The TID services a diverse agricultural region in California's Central Valley, supporting a wide array of crops including:

Alfalfa	Grain	Sweet potatoes
Almonds	Grapes	Walnuts
Beans	Oats	
Corn	Peaches	

These crops reflect the region's Mediterranean climate and the fertile soils of the San Joaquin Valley, making it one of the most productive agricultural areas in the United States. TID's irrigation infrastructure, comprising approximately 250 miles of canals and laterals, supports this agricultural diversity by delivering water to around 7,500 parcels covering nearly 150,000 acres of farmland in Stanislaus and Merced counties [(3)].

3. Turlock Irrigation District. Irrigation Information. Accessed April 21, 2025.

Power Operations

The Turlock Irrigation District operates a diverse and strategically important power portfolio to meet the energy needs of its customers. TID owns and manages a combination of natural gas, hydroelectric, solar, geothermal, and biomass resources, along with power purchase agreements that support grid reliability and sustainability. These assets not only supply electricity to thousands of homes and businesses but also contribute to regional energy resilience. Understanding the role and vulnerability of TID's power infrastructure is essential to evaluating potential impacts from natural and human-caused hazards—and to identifying mitigation strategies that reduce risk to the power system and the communities that depend on it.

Almond Power Plant

Located in Turlock, Almond Power Plant is a natural gas-fired plant capable of generating 48 megawatts of electricity. This plant came on-line in 1995.

Almond 2 Power Plant (A2PP)

The Almond 2 Power Plant is located between the cities of Ceres and Modesto, CA, and consists of three rapid start simple cycle gas turbine generators assisting us in meeting reliability obligations as a Balancing Authority and improving the economy, efficiency, and flexibility of the electrical system, including the integration of intermittent renewable resources.

Walnut Energy Center

The Walnut Energy Center (WEC), which began commercial operation in 2006, is TID's largest power generation facility with a capacity of 250 megawatts. Using natural gas and advanced emissions control technology, WEC operates as one of the cleanest plants of its size in the nation, producing emissions up to 85 percent lower than older facilities in California. The plant uses up to 2 million gallons per day of recycled water from the City of Turlock's Wastewater Treatment Plant in a Zero Liquid Discharge system, ensuring no liquid waste returns to the city. WEC consists of two gas turbines and one steam turbine, with each gas turbine equipped with a combustion system to minimize pollutants and a Heat Recovery Steam Generator that captures exhaust heat to produce steam for the steam turbine. In its first year, WEC generated more than 960 million kilowatt hours, meeting up to 80 percent of TID's internal energy needs, and it continues to provide efficient, reliable, and environmentally responsible power for the growing demands of the service area.

Don Pedro Dam and Powerhouse

At the base of Don Pedro Dam, Don Pedro's power plant occupies the entire width of the river channel at the toe of the dam. It's an outdoor structure, constructed of reinforced concrete and originally constructed with three generators and a fourth unit was added in 1989 increasing total generation to 203 megawatts of hydroelectric power with 139 MW going to TID and 64 MW to MID. TID's portion of Don Pedro generates enough electricity to supply about 37,000 average homes.

Small Scale Hydroelectric Facilities

TID generates electricity on its irrigation canal system as well as surrounding irrigation district's canals through several small hydroelectric plants. Each of these renewable energy plants utilizes the power of irrigation water flowing through the gravity-fed system to create electricity.

Rosamond Solar Facility

In November 2015, TID entered into a 20-year agreement to purchase 54 megawatts of clean, renewable solar power from SunPower's newly constructed Rosamond Solar site located near Edwards Air Force Base in Kern County, CA. TID expects the plant to generate an equivalent amount of energy to power approximately 20,000 homes.

TID Parking Structure

TID installed a 70.7-kilowatt array of photovoltaic panels atop the parking structure at its offices on Canal Drive in Turlock. The array generates up to 132,460 kilowatt-hours a year.

Biomass

In order to reduce the wildland fire hazard posed by these dead trees and to dispose of the millions of trees already removed from the forest, the State of California has mandated that utilities buy power from biomass power plants that use these dead and dying trees for a significant portion of their fuel.

This mandate was part of a provision in Senate Bill 859, approved by the legislature and signed into law by Governor Brown on September 14, 2016. TID has entered into contracts with ARP-Loyalton Cogen LLC and Roseburg Forest Products Co. to purchase biomass as mandated by this law.

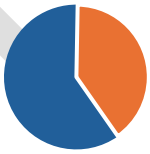
Geothermal

In 1984, TID acquired an interest in a geothermal power plant in the Geysers Steam Field, the world's largest geothermal field, located in California's Lake County approximately 70 miles north of San Francisco. The project has a capacity of generating 6.8 megawatts.

Power Content Label

The Energy Commission's Power Source Disclosure program provides consumers with a detailed view into the sources of energy purchased by their retail suppliers to power their homes and businesses. The result of this reporting is the Power Content Label, which resembles a nutrition label, with a breakdown of TID's energy sources. For comparison, the label includes a summary of California's energy mix, which is called total system power.

Figure 3-TID 2023 Power Content Label

2024 POWER CONTENT LABEL Turlock Irrigation District	Retail Power Supply	BGreen	CA Utility Average
Greenhouse Gas Emissions Intensity (lbs. of CO2e emitted per megawatt hour)	**404**	**404**	**359**
Electricity Sources ■ **Renewables and Zero-Carbon Resources** ■ **Fossil Fuels and Unspecified Power**			
RPS Eligible Renewables	**34%**	**34%**	**45%**
Biomass & Biogas	0%	0%	2%
Geothermal	2%	2%	5%
Eligible Hydroelectric	5%	5%	2%
Solar	6%	6%	23%
Wind	21%	21%	14%
Large Hydroelectric	**26%**	**26%**	**10%**
Nuclear	**0%**	**0%**	**11%**
Emerging Technologies	**0%**	**0%**	**0%**
Other	**6%**	**0%**	**0%**
Natural Gas	**39%**	**39%**	**10%**
Coal & Petroleum	**0%**	**0%**	**2%**
Unspecified Power (primarily fossil fuels)	**0%**	**0%**	**22%**
TOTAL	**100%**	**100%**	**100%**
Percentage of Retail Sales Covered by Retired and Unbundled RECs.	**2%**	**101%**	

- This label does not reflect compliance with the Renewable Portfolio Standard (RPS), which measures the use of tracking instruments called Renewable Energy Credits (RECs) over the course of multi-year compliance periods. RECs are purchased separately from the renewable energy ("Unbundled RECs") can be used for RPS compliance, but they do not factor into the power mixes of GHG emissions intensities above.
- GHG intensity figures exclude biogenic CO2 and emissions from geothermal sources and grandfathered imports of firmed-and-shaped energy. For detailed information about all GHG emissions from California's retail electricity suppliers, visit the CEC webpage at the link below.
- Unspecified power is electricity purchased from a generalized pool in the open market.

https://www.mid.org/power/power-resources/power-mix/	Want to learn more? Visit https:www.energy.ca.gov/programs-and-topics/programs/power-source-disclosure-program

Climate in the TID Service Area

The TID service area, situated in California's Central Valley, experiences a Mediterranean climate with hot, dry summers and mild, winters. The region receives about 12 inches of rainfall annually, with clear seasonal changes. Winters are typically cool, with average lows around 38 degrees Fahrenheit, while summers are hot and dry, with average highs reaching 94 degrees in July and August.

This climate creates optimal conditions for diverse crop cultivation, supporting the area's strong agricultural productivity and contributing to the region's economic growth.

While this overall climate is consistent, local variations, or microclimates, can occur due to factors such as topography, proximity to water bodies, and urban development.

In the TID region, these microclimatic differences may influence temperature, humidity, and precipitation levels across different locales. For instance, areas near the Tuolumne River or Turlock Lake might experience slightly cooler temperatures and higher humidity compared to more urbanized zones like Turlock, Ceres or Modesto. Additionally, agricultural lands with extensive irrigation can create localized cooling effects, altering the immediate microclimate.

TID has been recording rainfall and temperature since the 1800s. This extensive historical data provides valuable insights into weather patterns and microclimatic variations within TID.

Demographics of the TID Service Area

Table 1. Basic Demographic Information
(includes areas in both counties that are not inside TID boundaries)

Census Area	Total Population	Total Households	Employment Rate (employment rate in CA- 60.2%)	Median Household Income (Median in California- $95,521)	Race and Ethnicity (Hispanic or Latino of any race)	Bachelor's Degree or Higher (Bachelor's Degree or higher in CA- 37.5%)
Stanislaus County [4]	552,878	179,152	58.8%	$82,758	265,978	21%
Merced County[5]	291,202	88,053	54.7%	$57,570	173,857	14.5%

Census Area	Percentage of Population Living at or Below the Poverty Line	Percentage of Households Speaking a Language other than English at Home	Foreign Born Population	Average Family Size	Married, Not Separated	Unhoused Population – Sheltered and Unsheltered
Stanislaus County	12.3% [6]	44.9% [4]	21.7% [4]	3.53 [4]	48.2% [4]	2052 [10]

Merced County	19.1% [7]	51.4% [5]	25.8% [5]	3.85 [5]	43.3% [5]	717 [9]

Table 2. Disabled Population Information
(Non-Institutionalized Population - includes areas in both counties that are not inside TID boundaries)

Census Area	With a Hearing Difficulty	With a Vision Difficulty	With a Cognitive Difficulty	With an Ambulatory Difficulty	With a Self-Care Difficulty	With an Independent Living Difficulty
Stanislaus County	3.2% [10]	2.5% [10]	5.0% [10]	6.4% [10]	2.4% [10]	6.2% [10]
Merced County	2.7% [11]	2.5% [11]	6.8% [11]	6.9% [11]	3.5% [11]	6.6% [11]

1. Source: US Census Bureau (US Census Bureau Stanislaus County)
2. Source: US Census Bureau (US Census Bureau Merced County)
3. Source: US Census Bureau American Community Survey 2024 (Stanislaus County)
4. Source: US Census Bureau American Community Survey 2024 (Merced County)
5. Source: 2024 Stanislaus County Point in Time Count
6. Source: 2024 Merced County Point in Time Count
7. Source: US Census Bureau American Community Survey Disability Characteristics (Stanislaus County)
8. Source: US Census Bureau American Community Survey Disability Characteristics (Merced County)

Vulnerable Populations

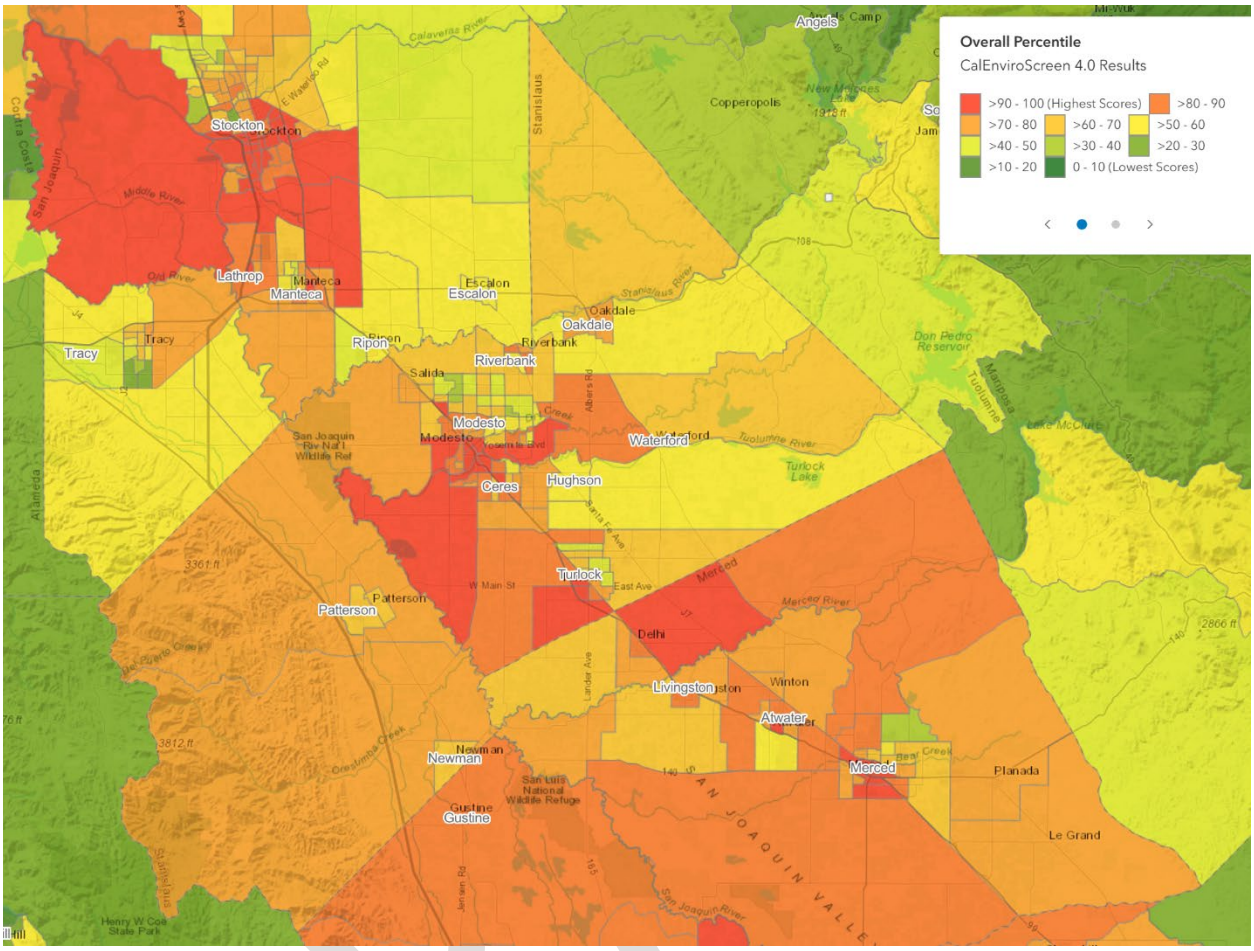
Social Vulnerability Indicators

In addition to its demographic and economic characteristics, TID's service area includes multiple census tracts identified by the California Office of Environmental Health Hazard Assessment (OEHHA) and the Centers for Disease Control and Prevention (CDC) as exhibiting elevated social vulnerability to natural hazards and climate-related stressors.

According to CalEnviroScreen 4.0 (CES), several census tracts within and adjacent to the cities of Turlock, Ceres, and south Modesto, as well as unincorporated communities such as Keyes and Denair, rank within the 75th to 95th percentile statewide for cumulative environmental and socioeconomic vulnerability. Factors driving these elevated scores include higher rates of poverty, linguistic isolation, asthma prevalence, and proximity to major transportation corridors and industrial emission sources.

Similarly, the CDC Social Vulnerability Index (SVI) identifies tracts in parts of Turlock, Ceres, and south Modesto as being within the top quartile (SVI ≥ 0.75) for overall social vulnerability based on socioeconomic status, household composition, minority status, and housing characteristics. These communities may face disproportionate impacts during and after hazard events, including challenges with transportation, access to financial resources, and the ability to participate fully in recovery programs.

Map 1. Cal Enviro-screen Cumulative Environmental and Socio-Economic Vulnerability Map



Understanding and mapping these vulnerability indicators helps TID and its partner agencies better target outreach, preparedness efforts, and mitigation investments toward communities that may face higher risk or slower recovery following hazard events. Figure 3 shows the geographic distribution of CalEnviroScreen and CDC Social Vulnerability Index quartiles within TID's electric and irrigation service areas.

Source: *California OEHHA, CalEnviroScreen 4.0 (2023); CDC/ATSDR Social Vulnerability Index (2022).*

Older Adults

Stanislaus County: In Stanislaus County, approximately 100,000 residents aged 60 and older live in the community, and 35% of adults aged 65+ do not earn enough income to meet basic needs, as measured by the Elder Index. A single older adult who rents requires an estimated $22,668 annually to maintain a minimal standard of living [(4)]. Many rely on public assistance: 7,204 older adults receive Supplemental Security Income (SSI), 4,154 receive In-Home Supportive Services (IHSS), and 24,637 are dually eligible for both Medicare and Medi-Cal [(4)]. Additionally, 954 adults aged 55+ interacted with the county's homeless response system, highlighting the housing instability faced by this population [(4)]. As California's senior population continues to rise, hazard mitigation and emergency planning must specifically address the vulnerabilities of low-income older adults to ensure equitable resilience.

4. Source: Justice in Aging *https://justiceinaging.org/wp-content/uploads/2023/03/Snapshot-of-Older-Adults-in-Stanislaus-County-Accessible-Outline.pdf*

Merced County: In Merced County, approximately 43,000 adults aged 60 and older reside in the community, and an estimated 20% live alone [5]. About 26% of residents aged 65 and older fall below 200% of the federal poverty level, and 8.7% experience food insecurity, and many rely on public support services, including the In-Home Supportive Services (IHSS) program and targeted assistance through the Multipurpose Senior Services Program (MSSP), caregiver support, legal aid, and meal delivery programs [6,7] . These figures highlight the economic vulnerability and service dependency of Merced's aging population and reinforce the importance of incorporating older adult needs into hazard mitigation and emergency planning.

5. Merced County Area Plan on Aging, 2024–2028
6. California Department of Aging, "County Data Snapshot: Merced"
7. Justice in Aging, "California Statewide Data Snapshots

Disadvantaged Neighborhoods

Several disadvantaged unincorporated communities (DUCs) are located within or adjacent to Turlock Irrigation District's (TID) service area. These include Keyes, Cowan Tract, Monterey Park Tract, Parklawn, Shackelford, and Bystrum in Stanislaus County, and Ballico, Bear Creek, Cressey, Delhi, Dos Palos, El Nido, Fergus, Hilmar-Irwin, Le Grand, Planada, Santa Nella, Snelling, South Dos Palos, Stevinson, The Grove, Volta, and Winton in Merced County [9,10,11,12]. These areas possess median household incomes below 80% of the statewide median and consist of at least 10 dwellings in proximity, meeting the SB 244 criteria for disadvantaged status [11]. Many lack full public infrastructure and rely on shared wells, septic systems, substandard roads, and limited public services, placing them at heightened risk during disasters and prolonged utility outages [12]. Integrating their needs is essential to equitable hazard mitigation planning, ensuring all residents have access to emergency support and recovery resources.

8. Stanislaus Local Agency Formation Commission (LAFCO), Municipal Service Review – Turlock Irrigation District, 2023.
9. PolicyLink, Mapping Disadvantaged Communities in the San Joaquin Valley (Merced County DUC list)
10. Stanislaus County Planning & Community Development Department, Disadvantaged Unincorporated Communities Report, 2015.
11. California Government Code § 65302.10 (SB 244) DUC definition
12. PolicyLink, technical methodology for identifying DUCs (infrastructure and service gaps)

Unhoused Populations

The unhoused population within and surrounding TID's service area represents one of the most vulnerable community groups during disasters. Individuals experiencing homelessness face heightened exposure to extreme weather, poor air quality, and public health threats, and often lack access to reliable communication channels, transportation, or shelter options during emergencies. Without stable housing, they are also excluded from many traditional planning and response systems. Incorporating the needs of unhoused individuals into hazard mitigation and emergency planning is essential to ensure equitable protection and delivery of life-sustaining services.

TID faces several challenges when addressing the needs of unhoused populations, who aren't direct water or electricity customers:

Lack of Customer Records & Notifications: Without billing accounts, TID cannot identify, contact, or promptly notify unhoused individuals—particularly during planned outages or increased flows in the Tuolumne River as a result of normal operations at Don Pedro and La Grange Dams.

Encampment Locations & Infrastructure Risks: Encampments sometimes develop near waterways or electrical facilities. Without oversight or sanitation infrastructure, they elevate public health and system integrity risks—but TID has no direct mechanisms for prevention or mitigation.

Implications for TID's Emergency Planning:

- **Emergency Alerts & Support**: TID must rely on community partners (e.g., outreach teams, shelters) for notification and assistance plans during outages.
- **Public Health Risks**: Lack of hygiene and water access in encampments may lead to contamination near canals or reservoirs, necessitating broader monitoring and security strategies for protection of critical infrastructure and District employees working in remote areas.
- **Collaboration Is Vital:** Addressing these challenges requires coordination with local agencies, public health, sanitation districts, and nonprofits.

In summary, unhoused populations fall outside the reach of TID's typical utility-based systems and scope of responsibilities, creating significant gaps in service delivery, communication, and infrastructure safety. Effective hazard mitigation will demand proactive partnerships and new approaches beyond standard utility-customer relationships.

Tribal Nations

Within the TID Service Area

No federally recognized tribal reservations or rancherias are located within TID's service area.

Adjacent to the TID Service Area

Tuolumne County: Tuolumne Band of Me-Wuk Indians: A federally recognized Miwok tribe whose reservation—the Tuolumne Rancheria—is situated near the Sierra Nevada foothills in Tuolumne County, just north of the township of Tuolumne. They maintain a tribal government, health services, fire department, and law enforcement.

Chicken Ranch Rancheria of Me-Wuk Indians: Another federally recognized Sierra Miwok tribe based in Jamestown, Tuolumne County. Though smaller, they operate the Chicken Ranch Casino on their land.

Special or Sensitive Locations

Stanislaus County Fairgrounds

Operated by the County, hosts public events and infrastructure.

Turlock Municipal Airport

A public, general aviation airport located approximately 8 mi east of Turlock, partially within TID's territory.

The Stanislaus County Public Safety Center

Often referred to as the county's main jail at 200 East Hackett Road, Modesto, CA 95358, is located within TID's electric service territory. This facility serves as the primary medium/maximum security center and booking facility for the county.

Mount Oso Communications Facilities

Located in the western hills of Stanislaus County, Mount Oso is a critical communications hub supporting a wide range of public safety, governmental, and commercial telecommunications systems. The site hosts numerous radio towers, microwave links, and repeater infrastructure essential to regional emergency response coordination, law enforcement communications, and data transmission. Mount Oso lies within TID's electric service territory and is highly dependent on continuous power to maintain system functionality. A loss of electrical service, especially during wildland fire, severe weather, or seismic events,

could disrupt critical communications across Stanislaus, San Joaquin, and neighboring counties. As such, Mount Oso is considered a priority facility for outage prevention, backup power assurance, and rapid service restoration within TID's hazard mitigation and emergency response planning efforts.

Data Centers in TID's Service Area

Data Center 209 LLC

Located at 202 West Main Street in downtown Turlock, this facility provides managed data and telecommunications services to local businesses.

Community Lifelines

Community Lifelines represent the essential services that allow a community to function. These integrated networks of assets, services, and capabilities support daily needs and ensure the continuity of critical government and business operations. They are vital to human health, safety, and economic security, as outlined in the **National Response Framework, 4th Edition (October 28, 2019)**. Within TID's service territory, the Federal Emergency Management Agency (FEMA) identifies seven key Community Lifelines that are crucial for maintaining community functionality and resilience:

1. **Safety and Security:** This lifeline includes law enforcement, fire services, search and rescue operations, and government services that ensure public safety and maintain order.
2. **Food, Water, Shelter:** This encompasses the provision of food, potable water, shelter, and agriculture services. In the TID service area, the district supplies untreated Tuolumne River water to the Stanislaus Regional Water Authority (SRWA), a Joint Powers Authority which includes the cities of Ceres and Turlock. The SRWA treats and distributes it to the cities of Ceres and Turlock for municipal use.
3. **Health and Medical:** This lifeline covers medical care, public health services, patient movement, medical supply chains, and fatality management.
4. **Energy (Power & Fuel):** These are critical community lifelines that support the functioning of essential services and infrastructure. They are fundamental to daily life, emergency response, and recovery efforts during disasters. TID supplies electric power in its service territory from its generation facilities.
5. **Communications:** This lifeline includes infrastructure for responder communications, public alerts, financial services, and emergency dispatch systems.
6. **Transportation:** This involves the maintenance and operation of highways, roadways, mass transit, railways, aviation, and maritime systems.
7. **Hazardous Materials:** This lifeline pertains to the management of facilities handling hazardous materials, pollution control, and containment of contaminants.

During community outreach for developing this LHMP, key Community Lifelines, along with public safety agencies, critical infrastructure providers, and other essential service organizations, were included.

For specific agencies identified, see Table 6. External Partner Agencies, NGOs, Community Groups, and Public and Private Non-Profits beginning on page 24.

Development and Hazard Vulnerability Since 2020

Since the adoption of the 2020 Local Hazard Mitigation Plan (LHMP), approved by FEMA in 2021, the Turlock Irrigation District (TID) has observed ongoing development across its service area in both Stanislaus and Merced counties. Urban growth in cities such as Turlock, Ceres, Patterson, Livingston, and Atwater has increased service demand, although most development has remained within incorporated boundaries.

In the unincorporated areas of Stanislaus County, growth has been limited, with one notable exception: the Diablo Grande planned community west of Patterson. Originally developed in the 1990s but never fully built out, the County approved a revised development plan in 2017 that reduced residential density and limited hillside development. This area was evacuated during the 2020 SCU Lightning Complex Fire, illustrating its ongoing wildland fire risk [13].

In Merced County, development has remained moderate, with growth centered in Livingston and Atwater. Although most new housing is within cities, expansion of impervious surfaces has led to increased runoff and heightened flood risk in some low-lying areas. The county projected a 1.3% average annual population growth rate through 2025, which may strain existing infrastructure and emergency services [14].

These development trends have also contributed to ongoing exposure to PM2.5 (fine particulate matter) across the region. Sources include:

- Increased vehicle traffic and construction activity from residential expansion, both of which generate PM2.5 through tailpipe emissions and airborne dust [15].
- Agricultural operations—traditionally a significant source of PM2.5 through open burning of orchard prunings, vineyard removals, and other biomass have seen a regulatory shift. As of January 1, 2025, nearly all open agricultural burning has been banned in Stanislaus and Merced counties under Senate Bill 705 and San Joaquin Valley Air Pollution Control District regulations [16]. Only limited, permitted burns (e.g., for pest control or disease prevention) are allowed on designated burn days under strict air quality and meteorological conditions [16,17].
- Expansion into the wildland-urban interface, particularly around Diablo Grande, increases wildland fire risk. Wildland fire remains a major contributor to PM2.5, as illustrated during the 2020 SCU Lightning Complex Fire [18].

Recent monitoring data shows that PM2.5 concentrations have declined over time, but the region remains out of compliance with the most recent federal standards. Average annual PM2.5 levels in the San Joaquin Valley dropped from ~27.6 µg/m³ (micrograms per cubic meter – a microgram equals 1 millionth of a gram) in 1999 to ~13.5 µg/m³ in 2023, bringing the area into attainment of the 1997 15 µg/m³ standard—but not the 12 µg/m³ (2012) or 9 µg/m³ (2024) federal standards [19, 20].

From 2022–2024, Turlock's design value averaged approximately 10.1 µg/m [15, 16]. Winter temperature inversions, wildland fire smoke, and regional emissions continue to challenge attainment goals.

These combined factors have modestly increased TID's overall hazard exposure:

- **Flooding:** Urbanization in flood-prone zones elevates risk to canals, substations, and other infrastructure.
- **Wildland fire:** Interface development heightens wildland fire risk and the need for proactive vegetation management.
- **Seismic Risk:** Continued infrastructure investment reinforces the importance of earthquake resilience for critical systems.
- **Service Demand:** Population and agricultural growth place additional pressure on water and power delivery systems.
- **Air Quality/Public Health:** Persistent PM2.5 exposure, especially during wildland fire and winter seasons, poses increasing risks to public health, particularly for vulnerable populations and outdoor workers.

As of this update, development since 2020 has not significantly impacted TID's operational capacity or reliability. However, TID continues to track growth, hazard exposure, and environmental conditions to inform mitigation strategies and capital planning.

13. Stanislaus County. Multi-Jurisdictional Hazard Mitigation Plan, 2021 Update
14. Merced County. Multi-Jurisdictional Hazard Mitigation Plan, 2021-2026
15. California Air Resources Board. “Inhalable Particulate Matter and Health.”
16. San Joaquin Valley Air Pollution Control District. Agricultural Burning Program Update
17. City of Merced Fire Department. “Burn Day Information.”
18. U.S. EPA AirNow. “SCU Lightning Complex Fire Smoke Impacts – 2020.”
19. Turlock Journal. “Report: San Joaquin Valley Reaches Air Quality Milestone.” March 2024.
20. U.S. EPA. Federal Register, July 2025. “Determination of Attainment by the Attainment Date and Clean Data Determination: California—San Joaquin Valley PM2.5 Nonattainment Area.”

Projected Changes in Development in the TID Service Area

Over the next five years, the TID service area is expected to experience steady growth in housing, energy infrastructure, and transportation development. These trends will increase demand for TID services and may influence TID’s exposure to hazards such as flooding, wildland fire, and air quality degradation.

Residential and Population Growth

According to the Regional Housing Needs Allocation Plan: 2023–2031, Stanislaus County jurisdictions are expected to accommodate thousands of new housing units over the current planning cycle. The plan identifies housing growth targets for cities within the TID service area, including Turlock, Ceres, and Patterson, to address projected population increases and regional housing demand [21]. In Merced County, UC Merced population forecasts estimate a 19% to 21% increase between 2018 and 2030, which will contribute to continued development pressure, particularly in Atwater and Livingston [22].

Energy and Infrastructure Expansion

TID’s 2023 Integrated Resource Plan outlines major investments in energy infrastructure through 2030 to meet growing electric demand and align with California’s clean energy goals. Planned projects include:

- A 94 MW solar photovoltaic facility with battery storage capabilities.
- Hydroelectric generation upgrades at Don Pedro Reservoir between 2025 and 2028, expected to add approximately 41 MW of capacity.
- Exploratory efforts into additional renewable and emerging technologies such as wind, geothermal, small modular reactors (SMRs), and green hydrogen [23].

Transportation Development and Transit-Oriented Growth

The Altamont Corridor Express (ACE) service is being extended from Ceres to Merced under the Valley Rail program. According to the ACE Ceres–Merced Extension Draft Environmental Impact Report (EIR) prepared by the San Joaquin Regional Rail Commission, this Phase II project includes constructing or upgrading tracks and at least three new stations in Turlock, Livingston (or Atwater alternative), and Merced along approximately 34 miles of the Union Pacific Fresno Subdivision. Construction was approved in April 2021, with phased service expected to begin in the mid-2020s, including a Turlock station by around 2027–2029 [24].

Implications for Hazard Exposure and District Operations

These projected development trends may elevate:

- Flooding risks due to increased impervious surfaces and stormwater runoff.
- Wildfire exposure where growth encroaches on wildland-urban interface areas, especially in western Stanislaus County.
- PM2.5 emissions, particularly from construction and transportation activity, unless offset by clean energy and emissions control strategies.
- Water and electric demand, which will require system upgrades and operational planning to maintain resilience and reliability during hazard events.

TID will need to integrate these land use and infrastructure forecasts into mitigation strategies, capital improvement planning, and emergency preparedness efforts to remain responsive to future growth and associated hazards.

21. Stanislaus Council of Governments. Regional Housing Needs Allocation Plan: 2023–2031. Adopted February 15, 2023
22. University of California, Merced. Population and Housing Growth Projections – Merced County, 2020.
23. Turlock Irrigation District. 2023 Integrated Resource Plan Filing with the California Energy Commission, 2023.
24. San Joaquin Regional Rail Commission, ACE Ceres–Merced Extension Draft EIR, April 2021, p. 1-1 to 1-4, detailing new station locations and track improvements.

Impacts of Projected Changes in Development on TID

TID provides retail electric service across approximately 662 square miles, encompassing portions of Stanislaus, Merced, and Tuolumne counties. This territory includes urban centers such as Turlock and Ceres as well as unincorporated agricultural communities. Over the next several years, anticipated residential growth, electrification, and infrastructure expansion will continue to increase electric demand and expand TID's exposure to natural hazards.

Population and Housing Growth

The Stanislaus Council of Governments (StanCOG) projects that jurisdictions within TID's electric service area will need to accommodate thousands of new housing units by 2031 to meet state housing targets [(25)]. Most of this growth is expected in and around Turlock, Ceres, and Keyes, with additional infill development in unincorporated areas. New development will require electric service extensions and may increase exposure to wildland fire, flooding, and extreme heat.

Electric Load and Infrastructure Expansion

According to the 2023 TID Annual Report, TID recorded a peak retail system load of 692 MW in August 2023 [(26)]. Separately, the TID Balancing Authority, which includes additional generation and load entities within its footprint—recorded a peak load of 735 MW during 2022 [(27)].

TID's 2023 Integrated Resource Plan (IRP) forecasts that peak retail load will grow from 597 MW in 2023 to approximately 623 MW by 2030, reflecting steady demand growth associated with population increases, electrification, and regional economic activity [28]. To support this, TID plans to construct at least two new substations and undertake significant distribution system upgrades [29].

Electric Vehicle Infrastructure and Energy Transition

StanCOG's Electric Vehicle Infrastructure Study projects that up to 60,000 electric vehicles will be operating in Stanislaus County by 2035, requiring large-scale deployment of residential and commercial charging infrastructure [30]. EV adoption is expected to shift peak load patterns and increase total electricity demand.

TID is also piloting Project Nexus, which explores the use of canal-top solar installations to reduce evaporation and generate renewable energy. If expanded, the project would introduce a new class of distributed generation assets across TID's service area [31].

Implications for Risk and Resilience Planning

As electric infrastructure expands and demand increases, the risk to critical systems statewide from natural hazards including flooding, wildland fire, extreme heat, and public safety power shutoffs (PSPS) will grow. TID continues to coordinate with local jurisdictions and leverage GIS-based hazard overlays to ensure that system upgrades and new facilities are sited with resilience in mind.

25. Stanislaus Council of Governments (StanCOG), Regional Housing Needs Allocation Projections, 2024.
26. Turlock Irrigation District, 2023 Annual Report, p. 2 – "692 MW peak load in August 2023."
27. Turlock Irrigation District, 2022 Annual Operations Review, p. 10 – "TID Balancing Authority 2022 peak load of 735 MW."
28. Turlock Irrigation District, Integrated Resource Plan (IRP), 2023 – load forecast from 597 MW in 2023 to 623 MW by 2030.
29. Turlock Irrigation District, Board Presentations and Capital Projects Updates, 2023–2024.
30. StanCOG, Electric Vehicle Infrastructure Study, 2023 – EV adoption forecast for Stanislaus County.
31. California Department of Water Resources & TID, Project Nexus Pilot Overview, 2023.

II. Planning Process

TID recognizes and prepares for potential hazards that could impact its service area through a comprehensive planning process. As part of its LHMP, TID is committed to a comprehensive planning process that involves a wide range of stakeholders. The TID LHMP outlines the internal and external stakeholders involved in the emergency planning process, hazard and risk assessments, mitigation capabilities and projects, the public outreach strategy to engage the community effectively, and the project timeline.

The planning process for the TID LHMP began in consulation with the EMPT by conducting an Initial Plan Kickoff meeting on October 31, 2024.

The EMPT created an outline using FEMA/Cal OES guidance updated in 2022 and implemented in 2023. Although planning began under that guidance, this LHMP aligns with FEMA's most recent Local Mitigation Planning Policy Guide (FP-206-21-0002), effective April 11, 2025. The Expanded Outline followed the updated FEMA/Cal OES Standard Elements A through G. The EMPT reviewed required elements and brainstormed ideas from local knowledge and previous planning experience to serve as a guide to meet all requirements.

The EMPT created a timeline for plan development to keep the project moving forward while addressing all the requirements.

32. The FEMA Local Mitigation Planning Policy Guide (FP-206-21-0002), effective April 11, 2025

Internal Stakeholders

The TID's planning process team, in consultation with the TID Management Team, expands to include a LHMP Steering Committee with representatives from multiple divisions across the water and power departments. This group ensures that all TID departments have their perspectives represented while maintaining a small, cohesive body to guide development and implementation of the LHMP.

The Steering Committee and EMPT meet regularly, sometimes separately and sometimes jointly to review progress, share insights, and make decisions related to the plan. The Steering Committee also identifies staff to serve as subject matter experts (SMEs), providing technical assistance, practical guidance, and expertise in their respective areas. The TID Internal Stakeholders are assembled as follows:

Emergency Management Planning Team

Provides overall coordination, direction, and integration of the LHMP process.

Table 3. Emergency Management Planning Team Members

Name	Position
Jason Hicks	TID- Manager of Security and Emergency Preparedness
Herb Smart	TID- Emergency Preparedness Coordinator
Brannon Gomes	Don Pedro Recreation Agency- Recreation Division Manager
Dave Funk	Consultant- Dave L. Funk Emergency Management Consulting
Calvin Curtin	Consultant- C3 Crisis Solutions

Steering Committee

Comprised of representatives from key water and power divisions; the Steering Committee is responsible for reviewing progress, ensuring departmental input, and shaping the plan's development.

Table 4. LHMP Steering Committee Members

Name	Position
Carlos Agueda	Environmental Health and Safety Division Manager
Dave Arounsack	IT Services Department Manager
Brett Bodine	Electrical Engineering and Operations Department Manager
Mario Castrejon	Maintenance and Operations Department Manager
Michael Clipper	Risk and Investment Analyst
Olivia Cramer	Chief Hydrologist
Sukhdeep Gill	Electrical Engineering and Operations Department Manager
Brannon Gomes	DPRA Recreation Division Manager
Jason Hicks	Manager of Security and Emergency Preparedness
Karl Kobrock	Electrical Engineering and Operations Department Manager
Keith Larson	Supervising Engineering Technician-Civil Engineering
Brandon McMillan	Communications Specialist
Bill Penney	Civil Engineering Department Manager
Herb Smart	Emergency Preparedness Coordinator
Pat Straubinger	Security Specialist
Mike Tehada	Combustion Turbine Department Manager

Internal Stakeholders and Subject Matter Experts

The LHMP Steering Committee and Subject Matter Experts (SMEs) provided strategic guidance and technical input throughout the development of this plan. The committee was composed of representatives from TID departments with operational responsibilities or assets that may be affected by the hazards identified in this plan. Each SME contributed specialized expertise within their respective discipline to ensure that the mitigation strategies developed are accurate, technically sound, and aligned with District operations and regulatory requirements. In addition, the SMEs played a critical role in reviewing and validating the hazard assessments, offering insight on past impacts, potential vulnerabilities, and the relative significance of each hazard to TID's infrastructure and operations. Their feedback was incorporated into the final risk rankings, vulnerability summaries, and the identification of mitigation priorities that form the foundation of this plan.

Internal Stakeholders and SME Meeting

TID held an Internal Stakeholders/SME Kickoff Meeting on June 16, 2025 via Microsoft Teams to review the project scope, requirements, and the 2020 LHMP.

Table 5. LHMP Internal Stakeholders and Subject Matter Experts

Name	Position
Mario Castrejon	Maintenance and Operations Department Manager
Michael Clipper	Risk and Investment Analyst
Olivia Cramer	Chief Hydrologist
Sukhdeep Gill	Electrical Engineering and Operations Department Manager
Brannon Gomes	DPRA Recreation Division Manager
Karl Kobrock	Electrical Engineering and Operations Department Manager
Keith Larson	Supervising Engineering Technician-Civil Engineering

Brandon McMillan	Communications Specialist
Bill Penney	Civil Engineering Department Manager
Herb Smart	Regulatory & Emergency Planning Coordinator I
Pat Straubinger	Security Specialist
Mike Tehada	Combustion Turbine Department Manager

Initiation of the LHMP Planning Process

To initiate the LHMP update process, TID convened key staff and subject matter experts to establish the planning framework, confirm project objectives, and outline the methodology for assessing hazards and vulnerabilities across District operations. Early coordination focused on aligning the plan with FEMA and Cal OES requirements under 44 CFR §201.6 to ensure compliance, future grant eligibility, and consistency with state and federal standards. Initial discussions included confirming the planning timeline, identifying data sources, and defining the roles of the Steering Committee and SME Working Groups throughout plan development.

The first LHMP meetings began with participant introductions and an overview of the purpose and benefits of hazard mitigation planning. The project team provided an outline of the planning process, including FEMA and Cal OES requirements, the expected project schedule, and an overview of TID's existing 2020 LHMP and its mitigation action framework. The presentation also introduced hazard identification and risk assessment methods, supported by sample maps illustrating wildfire, flood, and earthquake exposures within TID's electric and irrigation service areas. Discussion centered on refining the list of hazards for analysis, identifying external partners and community stakeholders, and ensuring that considerations related to vulnerable populations, critical infrastructure, and interagency coordination were fully integrated into the planning approach.

Participants emphasized the importance of collaboration with local, state, and federal agencies; special districts; non-governmental organizations; and community representatives to support a coordinated mitigation strategy and ensure equitable consideration of populations at greater risk. These include low-income households, older adults, non-English speakers, and individuals with disabilities who may experience greater challenges during disaster events or recovery.

The TID Emergency Management Planning Team (EMPT), Steering Committee, and SME groups compiled a preliminary list of partner agencies, community groups, and stakeholders representing the District's diverse service area. These entities will help inform data collection, support hazard analysis, and contribute to mitigation strategy development. A detailed description of stakeholder engagement appears in the following section.

External Stakeholders

TID includes external agencies, non-governmental organizations (NGOs), community groups, service providers for vulnerable populations, public/private partners, and other key stakeholders in this Local Hazard Mitigation Plan to ensure a comprehensive and inclusive approach to risk reduction. Engaging these stakeholders ensures the plan incorporates diverse expertise, addresses community vulnerabilities, and supports coordination across sectors. This approach allows TID to develop strategies that reflect community needs and strengthen resilience across the District.

The table below lists the entities and groups that received an electronic copy of the initial draft of the plan and whose expertise, feedback, and input are incorporated into the plan's development.

Table 6. External Partner Agencies, NGOs, Community Groups, and Public and Private Non-Profits

Al-Misbaah Community Resource Center for Northern CA	Denair Fire Protection District	Merced Irrigation District	Stanislaus County Fairgrounds
Alzheimer/Dementia Support Center	Denair Municipal Advisory Council	Modesto Chamber of Commerce	Stanislaus County Farm Bureau
Burbank Paradise Fire Protection District	Disability Resources Agency for Independent Living	Modesto Gospel Mission	Stanislaus County Free Library Board
CA Department of Fish and Wildlife	District 1 Supervisor, Merced County	Modesto Rotary	Stanislaus County OES
Ca State University Stanislaus	District 2 Supervisor, Merced County	Modesto Sunrise Rotary	Stanislaus County Office of Education
Cal OES Mitigation Planning	District 3 Supervisor, Merced County	Monterey Park Tract Community Services District	Stanislaus County Operational Area Council
California Highway Patrol - Merced	District 4 Supervisor, Merced County	Mountain View Volunteer Fire Protection District	Stanislaus County Parks and Recreation Commission
California Highway Patrol - Modesto	District 5 Supervisor, Merced County	NAACP Modesto/Stanislaus Branch	Stanislaus County Planning Department
California Highway Patrol - Sonora	Doctor’s Hospital of Manteca	National Weather Service	Stanislaus County Public Health
California State Parks	Doctor’s Hospital of Modesto	Newman Drainage District	Stanislaus County Veteran's Service Office
Center For Human Services	East Side Mosquito Abatement District	Newman Fire Dept	Stanislaus County Workforce Development Board
Ceres Chamber of Commerce	East Side Water District	Oakdale Irrigation District	Stanislaus Local Agency Formation Commission
Ceres Rotary	East Stanislaus Resource Conservation District	Oakdale Rural Fire District	Stanislaus Regional 911
Chabad of Modesto	Economic Development Action Committee	Patterson Cemetery District	Stanislaus Regional Water Authority
City and County of San Francisco/Hetch Hetchy	EJ Gallo	Patterson Irrigation District	Stanislaus Senior Foundation
City of Ceres	El Concilio of California Coalition	Portuguese Society of America	Stanislaus State University
City of Ceres City Manager	El Soyo Water District	Reclamation District 2063	Suntex (Don Pedro concessionaire)
City of Ceres/Ceres Fire Protection District	Emanuel Medical Center	Reclamation District 2091	Tuolumne Co Sheriff's Office
City of Hughson	Empire Municipal Advisory Council	Reclamation District 2092	Tuolumne Co Sheriff's Office
City of Hughson Chief of Police Services	Grayson Community Services District	Red Cross	Tuolumne County Board of Supervisors
City of Modesto Emergency Manager	Habitat For Humanity	Riverdale Park Tract Community Services District	Tuolumne County Farm Bureau
City of Modesto Fire Dept	Hickman Municipal Advisory Council	Salida Fire Protection District	Tuolumne County OES

City of Newman	Hickman Schools	Salvation Army Modesto	Tuolumne River Regional Park Citizens Advisory Committee
City of Oakdale	Hickman Schools	San Joaquin County Board of Supervisors	Turlock Certified Farmers Market
City of Oakdale Fire Dept	Hickman Schools	San Joaquin County Farm Bureau	Turlock Chamber of Commerce
City of Patterson	Hilmar MAC	San Joaquin Valley Air Pollution Control District	Turlock Mosquito Abatement District
City of Patterson Fire Dept	Hughson Fire Protection District	Sand Creek Flood Control District	Turlock Rotary
City of Ripon Emergency Manager	In-Home Supportive Services Advisory Committee	Santa Clara County Board of Supervisors	Turlock Rural Fire District
City of Riverbank	Keyes Community Services District	Senior Coalition of Stanislaus County	Turlock Unified School District
City of Riverbank Planning Dept.	Keyes Fire District	Society for disABILITIES	United Way of Stanislaus County
City of Turlock City Clerk	Keyes Municipal Advisory Council	South Modesto Municipal Advisory Council	University of California Merced
City of Turlock Fire Dept	Knights Ferry Municipal Advisory Council	Stanislaus Co Office of Emergency Services	Veterans of Foreign Wars
City of Turlock Planning Dept.	Lake Don Pedro Community Services District	Stanislaus Consolidated Fire Protection District	Visually Impaired Persons Support
City of Turlock Police	Lake Don Pedro Homeowners Association	Stanislaus County Agricultural Advisory Board	West Modesto Community Collaborative
City of Waterford	Manufacturers Council of the Central Valley	Stanislaus County Behavioral Health and Recovery Services	West Stanislaus Fire Protection District
Community Housing-Shelter Services	Mariposa County Board of Supervisors	Stanislaus County Board of Supervisors	West Stanislaus Irrigation District
Community Impact Central Valley	Merced Co Office of Emergency Services Merced-Mariposa Joint Dispatch	Stanislaus County CERT Coordinator	Western Hills Water District
Crows Landing Community Services District	Merced County Farm Bureau	Stanislaus County Community Services Agency	Westley Community Services District
Del Puerto Community Health Care District	Merced County OES	Stanislaus County Equal Rights Commission	Westport Fire Protection District
Del Puerto Water District	Merced County Office of Education	Stanislaus County Fairgrounds	Wood Colony Municipal Advisory Council
Delhi Municipal Advisory Council	Merced County Planning	Stanislaus County Farm Bureau	Woodland Ave Fire Protection District
Denair Community Services District	Modesto Irrigation District	Stanislaus County Free Library Board	

Involvement of Cities, Counties, Special Districts, and Partner Agencies

As shown in the comprehensive contact table above, the development of TID's LHMP incorporated input from cities, counties, special districts, and partner agencies to strengthen coordination across jurisdictions and enhance regional resilience. This collaboration provided valuable expertise, supported the identification of shared hazards, and helped align TID's mitigation strategies with broader local and regional emergency management efforts.

TID engaged agency partners, broader stakeholder groups, and community organizations to support an inclusive planning process. As part of this outreach, TID participated in the Stanislaus County Operational Area Council meeting and coordinated with El Concilio/Latino Emergency Council. These efforts ensured that the planning process incorporated diverse perspectives and addressed community needs, consistent with FEMA and Cal OES requirements for whole-community participation.

Feedback and input received from these partners were carefully reviewed and incorporated throughout the planning process. Comments informed updates to hazard assessments, refinement of risk rankings, and the identification of feasible and locally supported mitigation actions. Partner agencies also provided data on critical facilities, infrastructure, and previous hazard events, which improved the accuracy of exposure mapping and vulnerability analysis. Incorporating this input helped ensure that TID's LHMP reflects a coordinated, data-driven approach consistent with regional priorities and supports the District's commitment to ongoing interagency collaboration and community resilience.

The stakeholder engagement and coordination efforts described above laid the foundation for the plan's public review and adoption process, ensuring transparency, accessibility, and community involvement in the final stages of plan development.

Stanislaus County Operational Area Council Meeting

To support a coordinated and inclusive planning process consistent with FEMA and CalOES outreach requirements, TID conducted targeted engagement with local government partners through the Stanislaus County Operational Area Council (OAC). On May 28, 2025, TID participated in the regularly scheduled OAC meeting to formally announce the initiation of its LHMP update.

The OAC serves as the regional coordinating body for emergency planning and disaster response across the Stanislaus Operational Area. It provides policy guidance and technical review to ensure consistency with the Incident Command System (ICS), Standardized Emergency Management System (SEMS), National Incident Management System (NIMS), and Homeland Security Presidential Directives (HSPD) 5 and 8. The Council includes 10 voting members: the Stanislaus County Assistant Director of Emergency Services and one representative from each of the nine incorporated cities in the county.

At the meeting, TID announced its intent to update the LHMP and presented the preliminary hazard list. TID requested that OAC members support outreach by connecting the District with local agencies, community organizations, and other stakeholders representing a broad cross-section of the community. TID informed attendees that it would circulate draft plan materials for review and comment during key phases of the planning process, including hazard identification, risk assessment, and mitigation strategy development. This outreach supports interagency coordination and ensures whole-community engagement in LHMP development.

See Appendix B for meeting documentation.

> "I WANT TO COMMEND THE TID DEPARTMENT FOR THEIR THOROUGH AND KNOWLEDGEABLE PRESENTATION ON THE LHMP. THE PRESENTERS DEMONSTRATED A DEEP UNDERSTANDING OF OUR REGION'S SPECIFIC HAZARD PROFILES AND PROVIDED A ROADMAP FOR MITIGATION THAT WAS BOTH COMPREHENSIVE AND EASY TO FOLLOW. THIS LEVEL OF TRANSPARENCY AND INFORMATION-SHARING IS VITAL FOR BUILDING A RESILIENT COMMUNITY."
> *-JOSE MORENO, EL CONCILIO*

El Concilio/Latino Emergency Council Meeting

As part of its whole community approach, TID conducted targeted outreach to El Concilio/Latino Emergency Council during a virtual meeting on June 4, 2025. TID shared information about the LHMP update, presented the plan's purpose, and outlined the hazards under consideration. TID emphasized the importance of inclusive engagement to ensure that the perspectives of historically underserved populations are incorporated into the planning process. Attendees provided community-specific concerns, identified vulnerable populations, and supported outreach efforts.

TID invited participants to review draft materials as they become available and to provide feedback through email or the project website (tid.org/LHMP). This outreach advanced the LHMP's goal of developing equitable and locally informed mitigation strategies.

See Appendix B for meeting documentation.

Public Outreach and Engagement

TID implemented a public outreach strategy grounded in a whole-community approach to engage diverse stakeholders and gather input throughout the planning process. The Emergency Management Planning Team (EMPT) and the TID External Affairs Communications staff collaborated to develop multiple outreach methods intended to maximize public participation and transparency throughout the planning process.

Outreach included engagement with external agencies, partner organizations, community groups, and service providers, as documented in the External Stakeholders section and corresponding stakeholder contact table.

To ensure accessibility, the draft LHMP was made available electronically through TID's website for public review and comment. TID distributed public notices announcing the draft plan's availability through District communication channels and invited stakeholders and residents to review the plan and provide feedback. Stakeholders and residents were encouraged to review the plan and provide feedback regarding hazard identification, risk priorities, and proposed mitigation actions. Printed copies of the draft LHMP were also made available for public review in TID's Customer Service Lobbies in Turlock and Ceres, CA.

Public and stakeholder feedback directly informed updates to hazard identification, risk prioritization, and mitigation strategy development.This process not only ensured compliance with state and federal

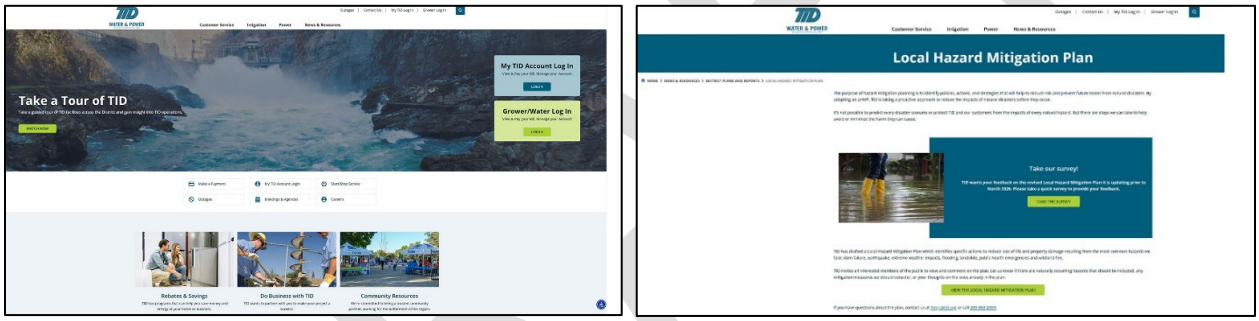
standards but also reinforced TID's commitment to transparency, public engagement, and the integration of community input into long-term risk reduction and resilience planning.

Moving forward, TID will continue to promote public participation throughout the plan maintenance cycle. The District will provide opportunities for stakeholders, partner agencies, and community members to review progress, recommend updates, and propose new mitigation actions during future plan evaluations and revisions. Public involvement will be maintained through the District's website, social media platforms, and participation in regional coordination forums, ensuring the LHMP remains a living document that reflects evolving conditions, emerging hazards, and community priorities.

TID.org

TID uses its official website (tid.org) as a central hub for information about the LHMP. A permanent, dedicated page at **tid.org/LHMP** provides an overview of the plan's purpose, updates on its progress, and opportunities for public engagement and comment. The page has been active since mid-2018, originally hosting the prior LHMP, and now serves as the platform for this plan update. Maintaining this page over an extended period has built community familiarity, reinforced transparency, and established a trusted source where stakeholders know they can find accurate information and provide feedback. In addition, TID maintains a dedicated email address (LHMP@Tid.org) for direct communication.

Figure 3. TID.org Homepage and LHMP Page



Community Survey

As part of the plan update process, TID hosted an online community survey on its LHMP webpage to gather input from customers, residents, and stakeholders within the District's service area. The survey was designed to collect feedback on natural hazards that may impact TID's operations and facilities, identify perceived vulnerabilities, and solicit suggestions for feasible mitigation actions and strategies. Responses submitted through the survey were reviewed by the EMPT and incorporated into the planning process, ensuring that the updated LHMP reflects community priorities, operational considerations, and public concerns.

Survey Questions

- What city or unincorporated area of the TID service territory do you live or work in?
- Are you responding as a resident, community organization, nonprofit, or a local business?
- Do you consider the area that you live or work in to be a vulnerable community or underserved population?
- From the below list of identified Hazards, are there any hazards that we should add and/or that should be removed?
    - Dam Failure
    - Earthquake
    - Extreme Weather (including Damaging Winds, Tornadoes, Extreme Temperatures, Localized Extreme Rainfall, and Poor Air Quality)

    - Flooding
    - Landslide
    - Public Health Emergency
- Wildland Fire
- Which of the above hazards do you feel is the biggest risk?
- Please tell us how important each one of the following risk-reducing activities are for your community (rank the following with either *very important, somewhat important, or not important*):
    - **Prevention:** Potential projects to reduce or eliminate hazardous conditions
    - **Property Protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or remove them from the hazard area
    - **Public Education and Awareness:** Actions to inform and educate residents, elected officials, and property owners, about the hazards and potential ways to reduce the hazard
    - **Disaster Response:** Are there any other additional services that TID could provide during an emergency or disaster?
- Any additional information or comments you would like to provide?

Dedicated Contact Information for Public Feedback

To promote public engagement in the LHMP process, TID has established a dedicated phone number and email address for feedback. These provide a direct line of communication with TID's Emergency Planning Coordinator, who serves as the Plan Administrator. The Administrator's TID phone number and email address are included in all public-facing materials to ensure the community can easily share comments, questions, and suggestions.

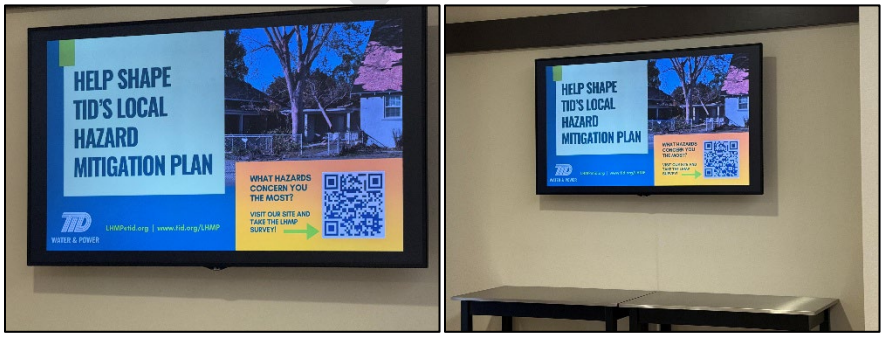
- Email address: lhmp@tid.org
- Phone number: 209-883-8359

Public Review Opportunities

In addition to online surveys and direct outreach, TID provided multiple opportunities for the public to review and comment on the LHMP through physical locations and digital notices. TID provided multiple opportunities for the public to review and comment on the LHMP. TID placed hard copies of both the adopted 2020 LHMP and the draft update at its customer service offices in Turlock and Ceres. Electronic message boards in each lobby display rotating notices alerting customers of the plan's availability.

TID also maintains a dedicated LHMP webpage at TID.org/LHMP where the plan is posted, explains the update process, and outlines ways to submit feedback. In addition, the District promoted the plan's availability through newsletters and social media. These actions supported FEMA's "whole community" approach by ensuring broad access and meaningful opportunities for public involvement.

Figure 4. Lobby Electronic Signage



Social Media

TID used its official social media platforms to promote awareness of the LHMP update, notify the public of review opportunities, and direct community members to the LHMP webpage and online survey. These efforts expanded outreach beyond traditional meetings and supported broader participation consistent with FEMA guidance.

INSERT SM POSTINGS

TID Board of Directors Informational Briefing

TID conducted an informational workshop with the TID Board of Directors during plan development to provide an overview of the LHMP purpose, planning process, identified hazards, and proposed mitigation priorities. The workshop was informational in nature, and no formal action was taken at that time. [PROVIDE DATE OF MEETING]

Following completion of the public outreach period, the final LHMP was presented to the TID Board of Directors and adopted by resolution in accordance with 44 CFR §201.6(c)(5).

Local Radio Interview

As part of its public outreach, TID featured the Local Hazard Mitigation Plan (LHMP) in a live interview on *The Michael Douglas Show* on KFIV radio on June 23, 2025. Jason Hicks, TID's Manager of Security and Emergency Preparedness, explained how the LHMP identifies natural disasters that could impact TID's ability to provide reliable water and power, and outlined the mitigation strategies being considered. Hicks emphasized that the planning process depends on public input, encouraging listeners to visit **tid.org/LHMP** to complete a survey, provide feedback, and stay connected throughout the plan's development. During the interview, Michael Douglas emphasized the importance of community involvement. Hicks highlighted that public engagement strengthens the plan and supports TID's ability to remain resilient and responsive to customer needs.

See Appendix B for a transcript of the interview.

The Grower Newsletter

As part of its public outreach strategy, TID included information about the LHMP update in the July 2025 issue of The Grower, the District's monthly newsletter distributed to 2,070 irrigation customers by email. The newsletter, which provides updates on water policies, scheduling, and operational news for agricultural users, raised awareness about the LHMP and encouraged stakeholder participation. The July issue invited readers to complete the LHMP survey and provide feedback on identified hazards. In addition to the digital version, TID made printed copies available in the lobbies of the Main Office and Ceres Customer Service Center to ensure access for customers who prefer or require in-person materials.

See Appendix B for a copy of the email to growers and a sample of the printed version.

Public EventsThese events were selected to reach a broad cross-section of the community, including older adults, agricultural stakeholders, families, and individuals who may be disproportionately impacted during hazard events.

National Night Out

On August 1, 2025, TID representatives Jason Hicks and Herb Smart participated in National Night Out at Smyrna Park in Ceres, engaging directly with residents on safety and emergency preparedness while promoting TID's Local Hazard Mitigation Plan (LHMP). The event provided an opportunity to distribute information, answer questions, and encourage public input on hazard mitigation planning.

Figure 5. National Night Out at Smyrna Park

Turlock Certified Farmer's Market

On August 16, 2025, TID staff participated in the Turlock Certified Farmer's Market, where they spoke with residents in an informal community setting. The market provided a chance to connect with people as they shopped locally, explain how the Local Hazard Mitigation Plan (LHMP) guides TID's preparedness efforts, and gather input on community priorities. By using a popular weekend event in the heart of downtown, TID reached a wide range of residents who might not typically attend government meetings, broadening participation in the planning process.

Figure 6. Turlock Certified Farmer's Market

Stanislaus County Public Safety Fair

On September 20, 2025, TID staff attended the Stanislaus County Public Safety Fair, held at Enslen Park in Modesto from 10:00 am to 2:00 pm. At the event, attended by multiple county emergency management agencies, public safety departments, utilities and others, TID had displays and a booth where they advertised the Local Hazard Mitigation Plan and invited public input and feedback on its draft contents. The event was well attended and offered TID the opportunity to engage stakeholders and members of the community regarding the risks and hazards facing their communities.

Figure 7. Stanislaus County Public Safety Fair

Across these in-person, whole community outreach events within TID's service area, TID staff participated in hundreds of conversations with customers. Conversations typically discussed hazards faced in the region, along with standard mitigation strategies to help limit the effects of such hazards. Many customers were able to reflect in past instances of flood, wildfire, earthquakes or extreme weather, sharing past stories of where they were when these events took place, and commenting on the damage that occurred as a result of natural hazards occurring within the region, California or the nation. In general, customers expressed gratitude for TID taking a proactive approach to these events that concern them and would affect them in an emergency. Several customers shared with TID staff that a reactive approach to hazards

was the old way of doing things and they are much happier and feel more confident with agencies such as TID being proactive in matters involving their safety and welfare.

Tracking Public Comments

A comment tracking log was maintained to document each comment received, the date of submission, and the disposition of the comment (accepted, modified, combined, or not incorporated), along with a brief rationale. A redacted version of this log is retained by TID and is available upon request.

Review and Incorporation of Existing Plans

The planning team reviewed existing plans, policies, and technical documents to integrate hazard data, historical impacts, and mitigation strategies into the LHMP. These resources, from TID and partner agencies, provided essential information on hazard risks, historical impacts, mitigation strategies, and operational context. The team integrated key elements such as hazard maps, impact data, graphs, and charts to ensure consistency and alignment with ongoing planning efforts.

Internal TID Plans

The planning team referenced a variety of internal TID plans to compile detailed information about District operations, infrastructure, and facilities. These documents provided valuable insights, including system maps, operational charts and tables, historical disaster data, and other technical content essential for hazard identification and risk assessment.

Table 7. Internal TID Plans

TID Local Hazard Mitigation Plan 2020	TID Strategic Plan, 2020-2025
TID 2023 Integrated Resource Plan	TID Sustainability Plan
TID 2020 Agricultural Water Management Plan	TID Emergency Operations Plan 2021
Don Pedro Dam, La Grange Dam, and Turlock Lake Powerhouse Emergency Action Plans	TID Wildfire Mitigation Plan 2023
TID Continuity of District/Continuity of Operations Plan (COD/COOP)	TID Crisis Communication Plan
TID Wildland Fire Emergency Response Plan	TID Increased Flows Emergency Response Plan
TID Emergency Management Strategic Plan	TID Major Power Outage Emergency Response Plan
TID Canal System Failure Emergency Response Plan	TID Significant Storm Floatable Debris Emergency Response Plan
TID Emergency Management Strategic Plan	

Regional Hazard Mitigation Plans

To ensure consistency and alignment with broader regional mitigation efforts, the planning team reviewed approved Multi-Jurisdictional Hazard Mitigation Plans (MJHMPs) from the three counties in which TID operates. The team evaluated these plans to identify shared hazards, regional impacts, and demographic trends relevant to TID's service area. The following MJHMPs were reviewed:

- Stanislaus County 2022 Multi-Jurisdictional Hazard Mitigation Plan (MJHMP)
- Merced County MJHMP 2021-2026
- Tuolumne County MJHMP 2024

External Agency Plans and Information Resources

In addition to county-level mitigation plans, the LHMP planning team reviewed a variety of external resources, technical studies, and regional planning documents. These materials provided supporting information on topics such as air quality, disadvantaged communities, population trends, aging services, and infrastructure vulnerabilities. Together, they helped define TID's risk profile and ensure that local hazards were evaluated within a regional context.

The primary plans and data sources reviewed are shown in the table below. Other references used during plan development are cited within the text of this document.

Table 8. External Plans and Information Resources

US Census Bureau 2020 Census	Stanislaus Local Agency Formation Commission (LAFCO), Municipal Service Review and Sphere of Influence Update for the Turlock Irrigation District, 2022
US Census Bureau American Community Survey 2024	2024 Stanislaus County Point in Time Count
FEMA Public Assistance Program and Policy Guide (PAPPG) version 5	2024 Merced County Point in Time Count
FEMA Public Assistance Program and Policy Guide (PAPPG) version 5	US Geological Survey Earthquake Hazards Program, Earthquake Catalog
FEMA/CalOES Local Mitigation Plan Review Tool (2023)	FEMA National Risk Index for Natural Hazards
NOAA Centers for Environmental Information, Storm Events Database	

Status of Mitigation Priorities

Since the adoption of the 2020 TID LHMP, the District's mitigation priorities have remained consistent. TID continues to emphasize the protection of critical infrastructure, the delivery of reliable water and energy services, and the reduction of vulnerability to natural hazards. No significant changes have been made to these goals or associated mitigation efforts, and the current LHMP reaffirms TID's ongoing commitment to these core strategies.

III. Risk Assessments

This section identifies and evaluates the natural hazards that pose the greatest risk to TID. The assessment follows FEMA's Local Mitigation Planning Policy Guide (FP-206-21-0002) and Cal OES standards to define each hazard's location, extent, previous occurrences, probability of future events, and potential impacts on TID facilities, operations, and customers.

Hazard Types

The Turlock Irrigation District operates across parts of Stanislaus, Merced and Tuolumne counties. Each of these counties has an approved Multi-Jurisdictional Local Hazard Mitigation Plan (MJLHMP) filed with CalOES and FEMA, identifying hazards affecting their jurisdictions. These plans address natural hazards and, in some cases, man-made or technical hazards. However, it is common practice, particularly for single-jurisdiction LHMPs, to focus solely on natural hazards. As such, TID's plan only includes natural hazards, except for High-Hazard Dam Failure (required by Cal OES/FEMA). The table below outlines the natural hazards identified in each county's MJLHMP and their inclusion or exclusion in TID's plan. For those excluded from TID's plan, an explanation is provided.

Table 9. County-Identified Natural Hazards and their inclusion in the TID LHMP

Identified Hazard	Jurisdiction Reporting the Hazard	Included in TID's LHMP?	Reason for Exclusion (if not included)
Dam Failure (or Incidents)	Merced, Stanislaus, and Tuolumne Counties	Yes	
Drought	Merced, Stanislaus, and Tuolumne Counties	Yes	
Earthquake	Merced, Stanislaus, and Tuolumne Counties	Yes	
Extreme (or Severe) Weather	Merced, Stanislaus, and Tuolumne Counties	Yes	
Flooding	Merced, Stanislaus, and Tuolumne Counties	Yes	
Landslide	Merced and Stanislaus Counties	Yes	
Public Health Emergency (or Pandemic/Epidemic)	Merced and Stanislaus Counties	Yes	
Wildland Fire (or Wildfire)	Merced, Stanislaus, and Tuolumne Counties	Yes	
Aquatic Invasive Species	Stanislaus County	Yes	
Agriculture Pest and Disease	Merced and Stanislaus Counties	No	TID does not have any assets that are vulnerable to this specific hazard.
Cyber Attacks	Merced and Stanislaus Counties	No	This is a human-caused or technological hazard and as such is not included in this plan.
Levee Failure	Merced County	No	This is an impact caused by a hazard (such as earthquake) and is addressed in the vulnerability assessment under each hazard as appropriate.
Hazardous Materials	Merced County	No	This is a human-caused or technological hazard and as such is not included in this plan.
Subsidence	Merced County	No	TID does not have any assets that are vulnerable to this specific hazard.
Volcano	Tuolumne County	No	TID does not have any assets that are vulnerable to this specific hazard.

Identified Hazard	Jurisdiction Reporting the Hazard	Included in TID's LHMP?	Reason for Exclusion (if not included)
Sink Holes	Tuolumne County	No	TID does not have any assets that are vulnerable to this specific hazard.

As detailed in the Planning Process section, TID identified internal SMEs responsible for contributing to the development of this plan and for responding to incidents it addresses. On June 16, 2025, these SMEs participated in a meeting to review and discuss the hazards initially proposed for inclusion in the LHMP.

See Appendix "B" for meeting details.

During the meeting, the TID Emergency Management Planning Team presented the identified risks, and the SMEs were encouraged to provide feedback, suggest exclusions, and propose additional threats not yet considered. Based on their input, the following hazards were selected for inclusion in this Local Hazard Mitigation Plan.

Table 10. TID LHMP Included Hazards

Dam Failure	Flooding
Drought	Landslide
Earthquake	Public Health Emergency
Extreme Weather including: • Damaging Winds • Tornado • Extreme Temperatures • Localized Extreme Rainfall • Poor Air Quality	Wildland Fire Aquatic Invasive Species

The Risk Assessment section includes the following subsections for each identified hazard:

- **Identifying the Hazard:** Provides a description of all types of natural hazards.
- **Profiling the Hazard:** Details the hazard's location, extent, previous and recent occurrences, and the likelihood of future events.
- **Vulnerability Assessment:** Summarizes the jurisdiction's overall vulnerability to each hazard and the potential impact. It also addresses the National Flood Insurance Program for structures repeatedly damaged by floods.
- **Identifying Structures and Estimating Potential Losses:** A summary of the structures, facilities, and equipment that could be damaged or destroyed by the identified hazard, and an estimate of the damage to each should the hazard occur.
- **Analyzing Development Trends:** Examines land use and development trends in hazard areas.
- **Impact of Climate Change:** Identifies the potential impacts of climate change on each hazard, as discussed in the individual risk assessments.
- **New Occurrences:** New instances of hazard occurrence since the previous LHMP was adopted.
- **Probability of Future Events:** Defines the likelihood of future events for each hazard, based on the chances of the hazard recurring within a specified time frame. Historical information on the hazard occurring is used to determine the probability. (See definitions of probability below)

Probability Definitions

The following definitions are used to describe the probability of future events in the Risk Assessment for each hazard.

Table 11. Probability Definitions

Probability	Frequency
Highly Likely	Occurring every 1 to 10 years
Likely	Occurring every 10-50 years
Unlikely	Occurring less than once every 50 years

State and Federal Disaster Declarations

The table below summarizes state and federal disaster declarations affecting TID's service area from 2020 through 2025. These declarations include events that warranted significant response efforts and resource allocations. It is important to note that these declarations represent only a subset of incidents; additional events not meeting the criteria for state or federal declarations have also significantly impacted TID operations during this period.

Table 12. Summary of State and Federal Disaster Declarations (2020–2025) [33 34]

Date Declared	Disaster Type	Designation Number	Jurisdiction(s) Affected	Relevant Hazard
March 13, 2020	Federal Emergency Declaration	EM-3428-CA	All California Counties	Biological (COVID-19)
March 22, 2020	Federal Major Disaster Declaration	DR-4482-CA	All California Counties	Biological (COVID-19)
June 16, 2020	USDA Drought Declaration	S-4697	Stanislaus and Merced Counties	Drought
August 22, 2020	Federal Major Disaster Declaration	DR-4558-CA	Stanislaus, Merced, and Tuolumne Counties	Wildfire
October 19, 2021	State of Emergency	N/A	All California Counties	Drought
January 13, 2022	USDA Excessive High Temperature Declaration	S-5353	Stanislaus and Merced Counties	Excessive Heat
April 8, 2022	USDA Drought Declaration	S-5146	Stanislaus and Merced Counties	Drought
July 1, 2022	USDA Freeze Declaration	S-5229	Stanislaus and Merced Counties	Extreme Cold
November 4, 2022	USDA Freeze Declaration	S-5332	Stanislaus County	Extreme Cold
Jan 14, 2023	Federal Major Disaster Declaration	DR-4683-CA	Stanislaus, Merced, and Tuolumne counties	Severe Winter Storms, Flooding, Landslides, and Mudslides
March 10, 2023	Federal Emergency Declaration	EM-3592-CA	Stanislaus, Merced, and Tuolumne counties	Severe Winter Storms, Flooding, Landslides, and Mudslides
March 17, 2023	USDA Drought Declaration	S-5371	Stanislaus and Merced Counties	Drought
April 3, 2023	Federal Major Disaster Declaration	DR-4699-CA	Stanislaus, Merced, and Tuolumne counties	Severe Winter Storm, Straight Line Winds, Flooding,

Date Declared	Disaster Type	Designation Number	Jurisdiction(s) Affected	Relevant Hazard
				Landslides, and Mudslides

33. FEMA Disasters and Other Declarations - fema.gov/disaster/declarations
34. USDA Disaster Designation Information - fsa.usda.gov/resources

Hazard Profiles

Dam Failure

Vulnerability Overview

A dam failure is the breakdown, collapse, or other structural malfunction of a dam resulting in the uncontrolled release of impounded water. Such an event can cause rapid downstream flooding with the potential for significant loss of life, damage to property and infrastructure, and disruption to community lifelines. A catastrophic dam failure involves the sudden, uncontrolled release of large volumes of stored water or the imminent likelihood of such a release. Lesser degrees of failure such as seepage, abnormal settlement, or partial loss of function are also considered dam failures, as they can degrade a dam's ability to safely impound water and may increase the probability of a catastrophic failure over time.

Table 13. Basis for Hazard Identification and Inclusion – Dam Failure

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Dam Failure	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus, Merced, and Tuolumne Counties. • Supported by input and consensus from the TID Planning Team. • Confirmed through review of the California Department of Water Resources (DWR) Division of Safety of Dams (DSOD) inventory, inundation maps, and U.S. Army Corps of Engineers (USACE) National Inventory of Dams (NID). • Evaluated using the TID Don Pedro Emergency Action Plan (EAP) and dam safety studies.	• Documented presence of major water storage facilities, including Don Pedro Reservoir and Turlock Lake, that could pose downstream risks in the event of a structural failure or uncontrolled release. • Continued potential for life safety, property damage, and disruption to TID water delivery and power generation operations in a Dam Failure scenario. • Included due to regulatory requirements for evaluating Dam Failure hazards within TID's service area, per FEMA and Cal OES LHMP guidance. • Recognized by DWR and USACE as critical infrastructure subject to ongoing inspection, maintenance, and seismic stability review. • Dam failure scenarios could impact downstream communities, agricultural lands, and District facilities within mapped inundation zones. • Aligns with state dam safety legislation and emergency planning standards, including California Water Code §6161 and Title 23, Division 3, Chapter 1, Article 9, which require periodic update of dam inundation mapping and EAP coordination with downstream stakeholders.

TID-Owned and Operated Dams

Turlock Irrigation District owns or operates several major facilities, including Don Pedro Dam, La Grange Dam (both Don Pedro and La Grange are co-owned with the Modesto Irrigation District), Dawson Dam, and Turlock Lake Dam. These structures are critical to TID's water storage, power generation, and delivery systems. They are designed, operated, and maintained under rigorous regulatory oversight, including the Federal Energy Regulatory Commission (FERC) and the California Division of Safety of Dams (DSOD). Regular inspections, continuous monitoring, and capital improvements are key mitigation measures to ensure these structures continue to operate safely and minimize the risk of failure.

Causes of Dam Failure

Dam failures can result from a variety of causes. According to FEMA, the most common include:

- Overtopping due to floods exceeding design capacity
- Structural failure of construction materials
- Foundation movement or instability

- Settlement, cracking, or deformation of embankment or concrete structures
- Piping and internal erosion of soils within embankment dams
- Inadequate maintenance or deterioration over time
- Deliberate acts of sabotage or terrorism

Hydrologic conditions, such as extreme rainfall or rapid snowmelt, are often contributing factors that exceed reservoir storage capacity and stress dam systems.

Upstream Risks

In addition to direct risks to District-owned facilities, TID must account for potential impacts from upstream dams on the Tuolumne River that are owned and operated by the City and County of San Francisco. The failure of an upstream facility could release water into Don Pedro Reservoir at volumes and rates sufficient to exceed the design capacity of Don Pedro Dam. The extent of impact would depend on multiple variables, including reservoir elevation at Don Pedro at the time of inflow, the volume of water released upstream, and the timing of flows arriving at the reservoir.

Recent Context

Dam safety remains a critical public concern in California. The 2017 Oroville Dam spillway incident highlighted vulnerabilities in large dam infrastructure and emphasized the importance of ongoing inspection, monitoring, and risk management. For TID, proactive maintenance, regulatory compliance, and emergency action planning are essential components of hazard mitigation for Dam Failure risk and have always been at the forefront of its dam safety program.

Location

Don Pedro Dam and Powerhouse

The Don Pedro Hydroelectric Project (FERC Project No. 2299) is jointly owned by Turlock Irrigation District (68.46%) and Modesto Irrigation District (31.54%), with TID serving as the operating agency. The project is located on the Tuolumne River approximately four miles upstream of the town of La Grange and 30 miles east of Modesto, California, in the Sierra Nevada foothills.

Completed in 1971, Don Pedro Dam is an earth and rock-fill structure measuring 1,900 feet in length and 585 feet in height. The project includes the main dam, a powerhouse, three auxiliary dikes, and a spillway system with both controlled and emergency (uncontrolled) components. At maximum pool elevation of 830.0 feet AMSL, [43] Don Pedro Reservoir has a surface area of approximately 13,000 acres and a storage capacity of 2,030,000 acre-feet. The reservoir is operated for multiple purposes, including irrigation storage, flood control, recreation, hydroelectric generation, and fish and wildlife benefits, in accordance with U.S. Army Corps of Engineers reservoir regulations.

The controlled spillway consists of three gates with a combined discharge capacity of 77,000 cubic feet per second (cfs), while the emergency spillway provides additional release capacity of 419,000 cfs at nominal top of dam. Together, the total spillway capacity is approximately 609,000 cfs. Three saddle dikes (Dikes A, B, and C) provide additional impoundment, and the Gasburg Creek Dike directs spillway flows toward the Tuolumne River to reduce downstream flooding impacts.

La Grange Dam and Powerhouse

La Grange Dam, constructed in 1893, is located approximately one mile downstream of Don Pedro Dam on the Tuolumne River and is jointly owned by TID and MID (50% by each district). The dam is a 131-foot-high stone masonry arch structure designed to divert water into the irrigation canal systems of both TID and MID. La Grange is an overflow dam with a maximum pool of less than 100 acre-feet.

In 1923, TID constructed the La Grange Powerhouse (FERC Project No. 14581) immediately below the dam adjacent to its canal system on the south side of the Tuolumne River. The facility is capable of

generating 5 megawatts (MW) with a maximum flow of 550 cfs, with discharges re-entering the river immediately below the powerhouse.

Dawson Reservoir

Dawson Reservoir is located within TID's canal system and is not part of the Tuolumne River. The facility consists of three dams that form the Upper and Lower Dawson Reservoirs, with the main dam measuring 22 feet high and 287 feet long. The reservoir has a total storage capacity of approximately 960 acre-feet.

The Dawson Powerhouse (FERC Project No. 3136) was constructed in 1983 and provides a capacity of 4.4 MW. The powerhouse typically operates during the irrigation season, which is generally March through October.

Turlock Lake

Turlock Lake (FERC Project No. 2871) is an off-stream reservoir located along TID's Upper Main Canal system. The facility is impounded by a series of 18 earthen dams (labeled A through S, excluding I), with Dam H being the highest at 32 feet and Dam A containing a 36-foot-high outlet structure and a powerhouse. Some embankments incorporate concrete facing and splash walls, later modified with earth fill to address seepage concerns. All 18 dams are rated by the Division of Safety of Dams (DSOD) as High as a failure of any of them could cause a loss of life and/or significant property damage. Inundation maps for all the dams making up Turlock Lake are publicly available at https://water.ca.gov/programs/all-programs/division-of-safety-of-dams/inundation-maps.

The lake functions as a balancing reservoir for irrigation water deliveries, hydroelectric generation, and fish and wildlife habitat. Inflows are largely controlled by TID's canal operations, with the exception of contributions from McDonald Creek. Turlock Lake does not have a spillway; all releases are made through the outlet works or powerhouse. The facility is operated under a DSOD Certificate of Operation with an authorized maximum operating elevation of 240.6 feet AMSL*.

*All elevations cited in this section are in feet above mean sea-level (AMSL) in NGVD29 datum

Extent

Dam failure can result from multiple causes, including severe storms, seismic activity, erosion of embankment materials, or structural deficiencies. In addition to complete structural failure, there are scenarios that can cause downstream inundation without the catastrophic collapse of the dam itself. These include landslides entering a reservoir, seismically induced waves (seiches) overtopping a dam, or debris obstructing spillway structures and preventing them from operating properly. Each of these conditions may cause downstream flooding and damage even in the absence of a full structural failure.

FEMA classifies downstream hazard potential using a three-tier system: Low, Significant, and High Hazard Potential. These categories are based solely on the expected consequences to life and property should a dam fail under full reservoir conditions. They do not reflect the structural condition of the dam or its appurtenant facilities.

The State of California's Division of Safety of Dams (DSOD) adopts these three categories and adds a fourth classification—Extremely High Hazard Potential—to address dams whose failure could cause exceptionally severe impacts, including extensive loss of life, widespread property destruction, and long-term economic disruption.

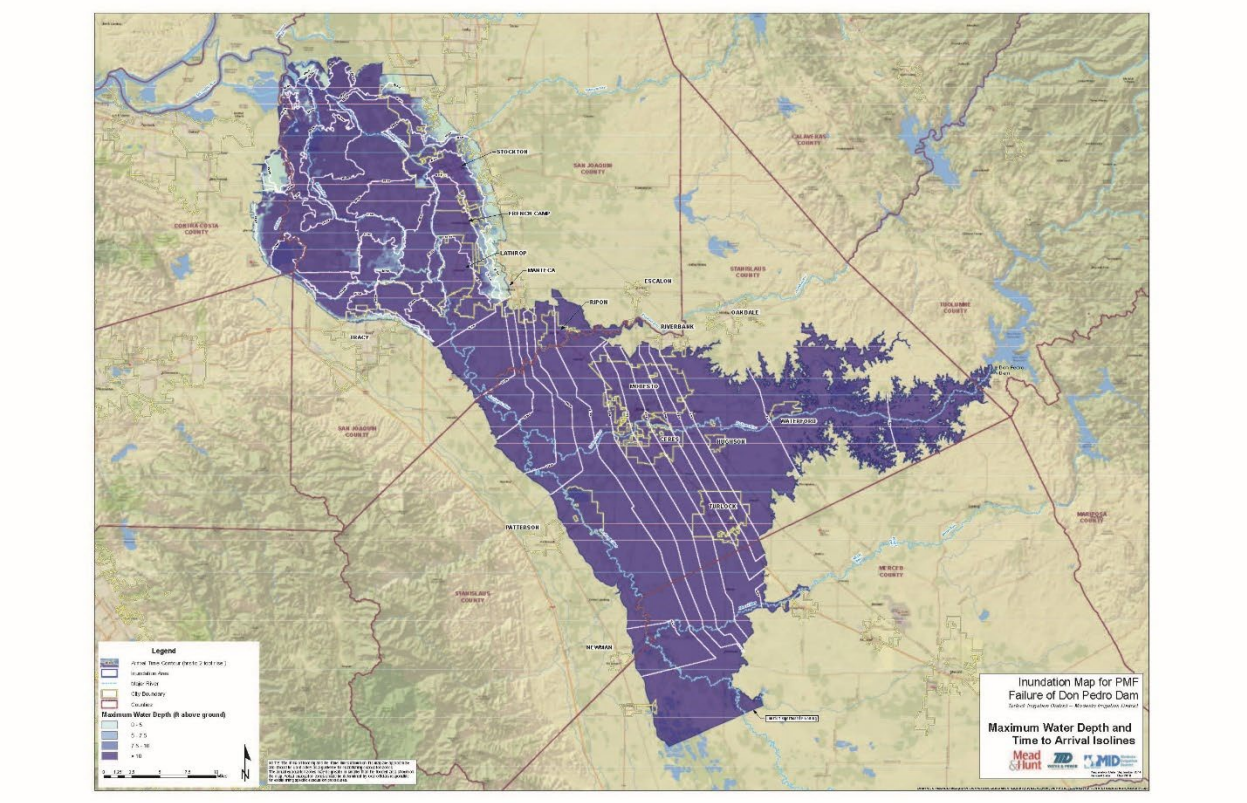
Hazard Potential Classifications:

- **Low –** Failure is not expected to cause loss of life, and property damage would be minimal and confined to the immediate area.
- **Significant –** Failure would not be expected to cause loss of life but could result in appreciable property damage, environmental impacts, or disruption of lifelines.

- **High –** Failure would likely cause loss of life and significant property damage.
- **Extremely High (California DSOD only) –** Failure would be expected to cause considerable loss of life and catastrophic property damage over a wide area, with prolonged economic and environmental consequences.

Dams owned or operated by Turlock Irrigation District are classified by DSOD across this range of hazard potential. For example, Dawson Reservoir is rated Low Hazard Potential, as failure would not be expected to result in loss of life and property damage would be limited. In contrast, Don Pedro Dam is classified as Extremely High Hazard Potential due to the severity of potential downstream consequences. A catastrophic failure of Don Pedro would cause major flooding, injuries, loss of life, and extensive property damage. Long-term consequences would also include severe economic impacts to the agricultural sector and loss of surface water storage for irrigation, compounding recovery challenges over an extended period.

Map 2. Don Pedro Dam Failure Inundation Map



Development Since 2020 and the Impact on Dam Failure

Turlock Lake

The Turlock Lake Dam Failure inundation area extends downstream along the Tuolumne River through eastern and central Stanislaus County. The footprint primarily includes rural agricultural lands, portions of the La Grange area, and limited residential development near Waterford and along the lower river corridor.

Since adoption of the 2020 LHMP, development within this area has remained modest. Agricultural operations continue to dominate land use, with some incremental residential construction and infrastructure improvements associated with existing communities. No major new subdivisions, commercial centers, or critical facilities have been built within the mapped inundation zone. However,

continued rural infill and expansion of supporting transportation and utility infrastructure slightly increase overall exposure.

Although the probability of catastrophic dam failure remains low, even limited downstream population growth reinforces the importance of maintaining current inundation mapping, ensuring the effectiveness of emergency action plans, and coordinating with Stanislaus County for land-use review within identified dam-failure hazard areas.

Don Pedro

The Don Pedro Dam Failure inundation zone extends across Stanislaus, San Joaquin, Merced, Alameda, and Tuolumne Counties [35]. Development trends since adoption of the 2020 LHMP have varied across these jurisdictions:

- **Stanislaus, San Joaquin, and Merced Counties:** These areas have experienced continued residential growth, commercial development, and agricultural investment. While much of the inundation footprint remains rural and agricultural, new housing subdivisions, supporting commercial activity, and infrastructure improvements have modestly increased overall exposure to Dam Failure impacts. Critical facilities such as schools, health care facilities, and public safety infrastructure remain within or adjacent to the mapped inundation area, placing additional population and essential services at potential risk [35, 36, 37, 38, 41,42].
- **Alameda County:** A very small portion of the inundation zone extends into the far southeastern corner of Alameda County. This area is rural, agricultural in character, and has seen no measurable new development since 2020 [40].
- **Tuolumne County:** The inundation zone includes the immediate area around the Don Pedro Dam and spillways. This area is rural and sparsely populated, with no significant residential, commercial, or critical facility development since 2020 [39].

Overall, development since 2020 has resulted in a modest increase in exposure within the multi-county inundation footprint, primarily in the more urbanized portions of Stanislaus, San Joaquin, and Merced Counties. While growth has been limited in Alameda and Tuolumne Counties, the presence of even low-density rural populations in these areas underscores the importance of maintaining updated inundation mapping, emergency action planning, and coordinated land use review.

35. California Division of Safety of Dams (DSOD). Dam Breach Inundation Maps Portal. Accessed October 2025.
36. Stanislaus County Planning and Community Development. Building Permit Activity Reports (2020–2025).
37. San Joaquin County Community Development Department. Building Permit Database. Accessed October 2025.
38. Merced County. General Plan Annual Progress Report 2024.
39. Tuolumne County Community Resources Agency. General Plan – Safety Element.
40. Alameda County Community Development Agency. East County Area Plan.
41. California Department of Education (CDE). Public Schools and Districts Data Files, 2024–25.
42. California Department of Health Care Access and Information (HCAI). Licensed Health Care Facilities Database.

The Impact of Future Development Trends on Dam Failure

Turlock Lake

Future development within the Turlock Lake Dam inundation zone will continue to be shaped by population growth, agricultural investment, and land use planning decisions in Stanislaus County. The inundation footprint generally follows the Tuolumne River corridor downstream from La Grange toward Waterford and Modesto, encompassing primarily rural and agricultural lands with limited residential concentrations.

- **Stanislaus County:** Modest residential and agricultural-related growth is anticipated within and near the inundation footprint, particularly around the fringe areas of Waterford and the unincorporated La Grange community. While these areas remain predominantly rural, incremental housing development, farmworker accommodations, and associated infrastructure projects could slightly increase population and asset exposure to potential dam failure impacts.
- **Downstream Urban Areas**: Although the primary urban centers of Modesto and Turlock lie outside the mapped inundation zone, growth pressures in eastern Stanislaus County may lead to future expansion of transportation and utility networks that cross or border the hazard area.

Overall, future development trends indicate that exposure to Turlock Lake dam failure inundation will likely remain limited, with only marginal increases tied to rural residential infill and agricultural infrastructure improvements.

Don Pedro

Future development within the Don Pedro Dam inundation zone will continue to be influenced by population growth, housing demand, and land use planning decisions across Stanislaus, San Joaquin, Merced, Alameda, and Tuolumne Counties.

- **Stanislaus County** is projected to continue experiencing residential growth near the Modesto urban area, with housing element updates identifying additional capacity for new subdivisions. While much of the inundation footprint remains agricultural, incremental increases in residential and commercial construction are expected to modestly raise exposure to dam inundation risk ([43, 44]).
- **San Joaquin County** anticipates continued population and economic growth, particularly related to logistics and agricultural support industries. While the inundation zone in this county is largely rural, growth pressures in the region may incrementally extend development into areas of mapped hazard [45, 46].
- **Merced County** has prioritized additional residential and mixed-use development in unincorporated communities such as Delhi, Hilmar, and Le Grand, which lie near portions of the inundation zone. These projects could increase population exposure in areas previously characterized by low density and agricultural land use [47, 48].
- **Alameda County's southeastern corner** is rural and agricultural in character. No significant urban development is anticipated in the small portion of the inundation footprint that extends into the county [49].
- **Tuolumne County's portion of the inundation zone** includes the immediate dam and spillway area, which remains rural and is not projected to experience measurable residential, commercial, or critical facility growth [50, 51].

Overall, future development trends indicate that population and infrastructure exposure to Dam Failure inundation will likely increase modestly in Stanislaus, San Joaquin, and Merced Counties, while remaining stable in Alameda and Tuolumne Counties. Because the Don Pedro inundation footprint spans multiple jurisdictions, TID will continue to coordinate with county planning authorities to monitor growth and support hazard-aware land use decisions. Integration of dam safety considerations into future planning efforts is essential to ensure that new development does not increase vulnerability to catastrophic flooding should a dam failure occur.

43. Stanislaus County General Plan Update and Housing Element (2023).
44. Stanislaus Council of Governments (StanCOG). Regional Transportation Plan / Sustainable Communities Strategy (RTP/SCS), 2022–2046.
45. San Joaquin County General Plan 2035.

46. San Joaquin Council of Governments (SJCOG). Regional Transportation Plan / Sustainable Communities Strategy, 2022–2046.
47. Merced County General Plan 2030 (as amended 2022).Merced County Housing Element, 2023–2031.
48. Merced County Association of Governments (MCAG). 2022 RTP/SCS.
49. Alameda County General Plan – East County Area Plan (as amended 2022).
50. Tuolumne County General Plan 2040 (adopted 2019, amended 2021).
51. Tuolumne County Housing Element, 2019–2027.

New Occurrences of Dam Failure Since 2020

Since adoption of the 2020 Local Hazard Mitigation Plan, there have been no recorded dam failures involving Turlock Irrigation District–owned or operated facilities, including Don Pedro, La Grange, Dawson, or Turlock Lake. All dams remain in compliance with regulatory inspection and monitoring requirements administered by the California Division of Safety of Dams and the Federal Energy Regulatory Commission.

While no failures have occurred, dam safety remains a priority at both the state and federal levels. The 2017 Oroville Dam spillway incident continues to serve as a reminder of the potential consequences of structural deficiencies and extreme hydrologic events. Since that time, DSOD and FERC have maintained heightened oversight of large dams in California, including those owned and operated by TID. Regular inspections, safety reviews, and capital improvement projects are ongoing and are designed to ensure continued safe operations and to minimize the likelihood of future failures.

Probability of Future Dam Failure Events

The TID service area has experienced only one documented instance of catastrophic Dam Failure. On June 27, 1914, a section of concrete-covered fill at Turlock Lake, approximately fifty feet south of the outlet gate, gave way in the early morning hours. The released water traveled down the main canal until it overtopped the banks, carved a new channel, and ultimately rejoined the Tuolumne River near Roberts Ferry.

Since that time, dam safety practices and oversight have advanced significantly. Today, TID has a robust dam safety program and all TID's dams are regulated and inspected by the California Division of Safety of Dams (DSOD) and the Federal Energy Regulatory Commission (FERC). In addition to these state and federal requirements, TID conducts its own regular inspections, and engages engineering consultants to identify and address potential deficiencies. Records of inspections, maintenance, and repairs are maintained to ensure long-term structural integrity.

Based on this regulatory framework, inspection frequency, and TID's proactive maintenance practices, the probability of a future catastrophic Dam Failure within the TID system is: **Unlikely.**

Identifying Structures and Estimating Potential Losses from Dam Failure

In the unlikely event of a complete failure of Don Pedro Dam, the consequences for TID would be catastrophic. Because Don Pedro serves as TID's primary storage facility, its failure would impact the entire irrigation service area. Most, if not all, of TID's irrigation infrastructure, electrical distribution equipment, power plants, and key operational facilities, including the Canal Campus and Broadway Yard, would be damaged or destroyed. While this is considered a low-probability but high-consequence hazard, the potential financial and operational losses are substantial.

The value of TID's facilities and **assets at risk from a catastrophic failure of Don Pedro Dam is estimated to exceed $2 billion.** This estimate includes major infrastructure such as canals, pipelines, substations, generating facilities, and operations centers. Beyond direct asset losses, TID would face prolonged disruptions to its ability to deliver irrigation water and generate hydroelectric power, both of which are essential to its operations and financial stability.

By comparison, the failure of smaller District-owned dams including Dawson Reservoir and Turlock Lake would not cause widespread inundation or regional devastation. However, such failures would impair TID's ability to reliably deliver surface water supplies for agriculture. Similarly, failure of La Grange Dam, jointly operated with Modesto Irrigation District, would disrupt water diversions into both districts' canal systems.

Methodology for Exposure, Vulnerability, and Loss Estimation

Dam failure differs from other hazards because it represents a low-probability but catastrophic event. A complete failure of Don Pedro Dam would result in widespread inundation and destruction of District-owned infrastructure. TID applied the following methodology to estimate exposure and potential losses:

I. Inventory of Assets

- Identified District-owned facilities most at risk, including Don Pedro Dam, La Grange Dam, Dawson Reservoir, Turlock Lake, irrigation canals, substations, powerhouses, pipelines, the Canal Campus, and Broadway Yard.
- Applied current replacement values for each asset class.

II. Hazard Footprint and Exposure

- Overlaid the California DSOD inundation maps for Don Pedro and other District dams with TID's infrastructure inventory.
- Classified exposed assets by type and location to determine those most vulnerable to inundation.

III. Vulnerability and Loss Estimation

- Evaluated likely damage to facilities using depth and velocity factors for structures such as canals, substations, pipelines, and powerhouses.
- Estimated direct losses as replacement or repair costs, with total TID assets at risk exceeding $2 billion in a catastrophic failure of Don Pedro Dam.
- Considered operational consequences, including loss of water delivery capacity and hydropower generation.

IV. Mitigation and Management Considerations

- Recognized that failure probability remains low due to regulatory oversight by FERC and DSOD, routine inspections, and required Emergency Action Plans (EAPs).
- Documented the role of EAPs, inundation mapping, and annual exercises in limiting vulnerability through preparedness and response coordination.

Drought

Vulnerability Overview

Drought in the TID service area is a continual challenge due to the region's Mediterranean climate. Rainfall in the valley where TID's service irrigation service area is located, and snowfall in the Tuolumne River Watershed can vary with some years being above to way above average and others being dry to extremely dry. When dry years occur, especially if they are consecutive, without above average years between them, drought conditions can form and, in some instances, become severe. Drought conditions can persist for extended periods of time with the most recent example of extreme drought being the period between 2012 and 2017.

Prolonged droughts can lead to water restrictions, increased demand for limited supply, and stress on TID's water delivery infrastructure. As temperatures rise and precipitation patterns become more unpredictable due to climate change, droughts in the region are expected to become more frequent and severe, further straining water management efforts.

Table 14. Basis for Hazard Identification and Inclusion – Drought

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Drought	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus, Merced, and Tuolumne Counties. • Supported by input and consensus from the TID Planning Team. • Confirmed through review of U.S. Drought Monitor data, California Department of Water Resources (DWR) reports, and historical drought impact records for the Central Valley.	• Documented history of multi-year droughts affecting water supply reliability, agricultural production, and power generation. • Continued potential for future drought events due to regional hydrologic variability and long-term aridification trends. • Included due to the potential for operational, financial, and environmental impacts to TID's water and energy systems. • Recognized by FEMA, DWR, and Cal OES as a high-priority hazard for California's water-dependent infrastructure sectors. • Drought can reduce surface water availability, strain groundwater supplies, and increase reliance on imported water and pumping, elevating operational costs. • Aligns with statewide drought preparedness and mitigation initiatives, including the California Water Resilience Portfolio and DWR's Climate Change Vulnerability Assessment.

Location

Drought is most likely to occur across the entirety of the TID service area, which includes Stanislaus and Merced Counties. These counties are among some of the most productive agricultural areas in the nation.

With its reliance on a water supply based upon a significant Sierra snowpack, the region can find itself in dry to drought conditions with only a few years of below average rain and snow. Drought conditions, especially when they become persistent, can significantly impact water supplies for domestic and agricultural use as well as water destined for local ecosystems.

Extent

The California Department of Water Resources (DWR) has identified multiple drought periods that have impacted the region served by TID, including:

- **1976–1977 Drought-** This was one of the driest two-year periods on record for California. The Tuolumne River watershed, which supplies TID's Don Pedro Reservoir, had extremely low runoff. TID and neighboring districts faced severe water allocation shortages.
- **1987–1992 Drought-** A prolonged, six-year drought reduced Sierra Nevada snowpack and river flows. TID implemented reduced water deliveries to growers during several years of this period.

- **2007–2009 Drought-** Central Valley irrigation districts, including TID, saw reduced allocations and had to manage water shortages. While some restrictions were focused on urban agencies, agricultural users in TID's service area also felt the impacts.
- **2012–2016 Drought-** This was one of California's most severe droughts in modern history. The Tuolumne River watershed saw record-low snowpack (near zero in 2015), forcing TID to cut irrigation deliveries, adopt conservation programs, and closely coordinate Don Pedro operations with the Modesto Irrigation District.
- **2020–2023 Drought-** Again, Sierra Nevada runoff into Don Pedro Reservoir was far below average. TID reduced irrigation allotments, issued drought updates, and promoted water conservation. Emergency drought declarations from the State of California directly applied to TID's service area. The drought deepened and extended, particularly in 2022, which saw critically low runoff and reservoir storage. For TID, this resulted in additional irrigation delivery cutbacks and more aggressive conservation messaging. Relief only came with the historic atmospheric rivers and snowpack of winter 2022–2023.

These drought events have contributed to ongoing water management challenges in the region, requiring strategic planning to balance water use for agriculture, urban needs, and environmental uses.

Extent Rating: The extent of drought hazards in the TID service area is classified as severe to extreme, based on historical and modeled conditions observed in multi-year statewide droughts. The U.S. Drought Monitor has routinely classified the area under D2 (Severe Drought) to D4 (Exceptional Drought) during events such as 2012–2016 and 2020–2023. Impacts at these levels have included significant surface water shortages, reduced reservoir storage, increased reliance on groundwater pumping, fallowing of farmland, increased energy demand, and financial strain on agricultural operations.

Figure 8. U.S. Drought Map for California

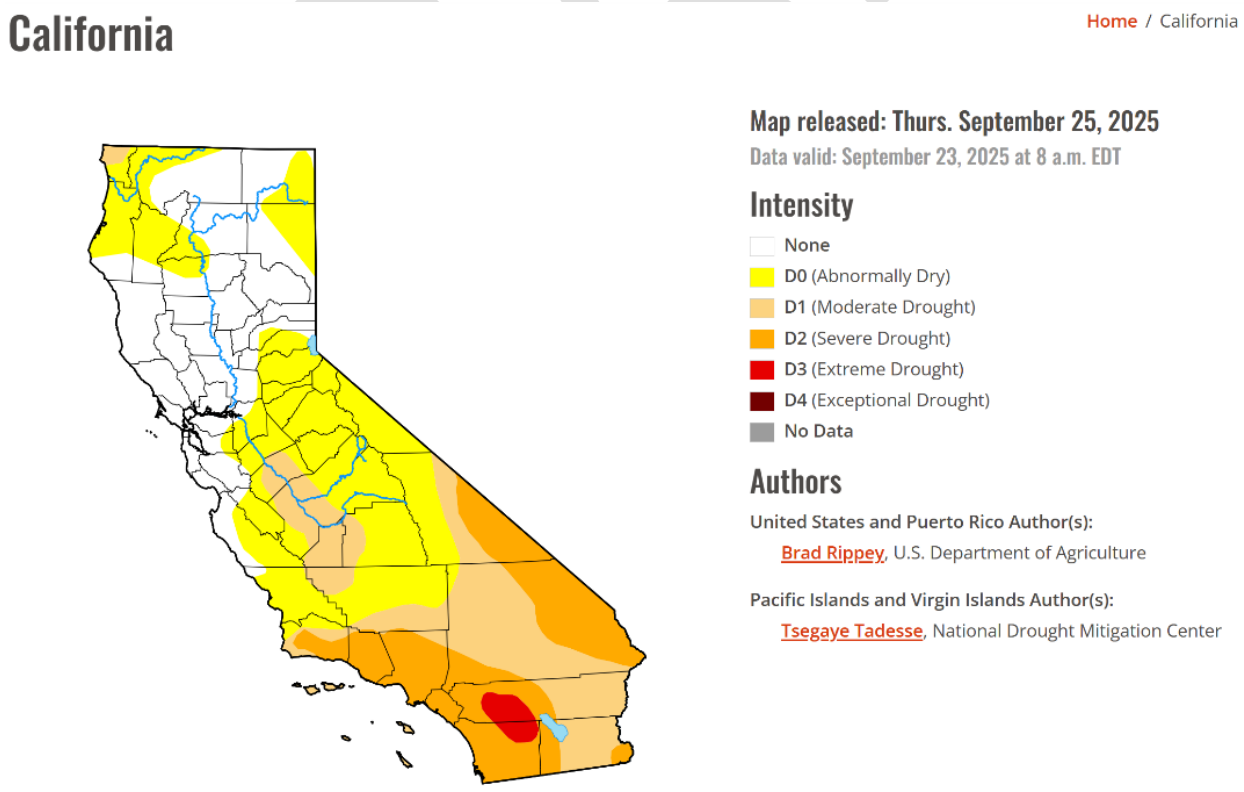
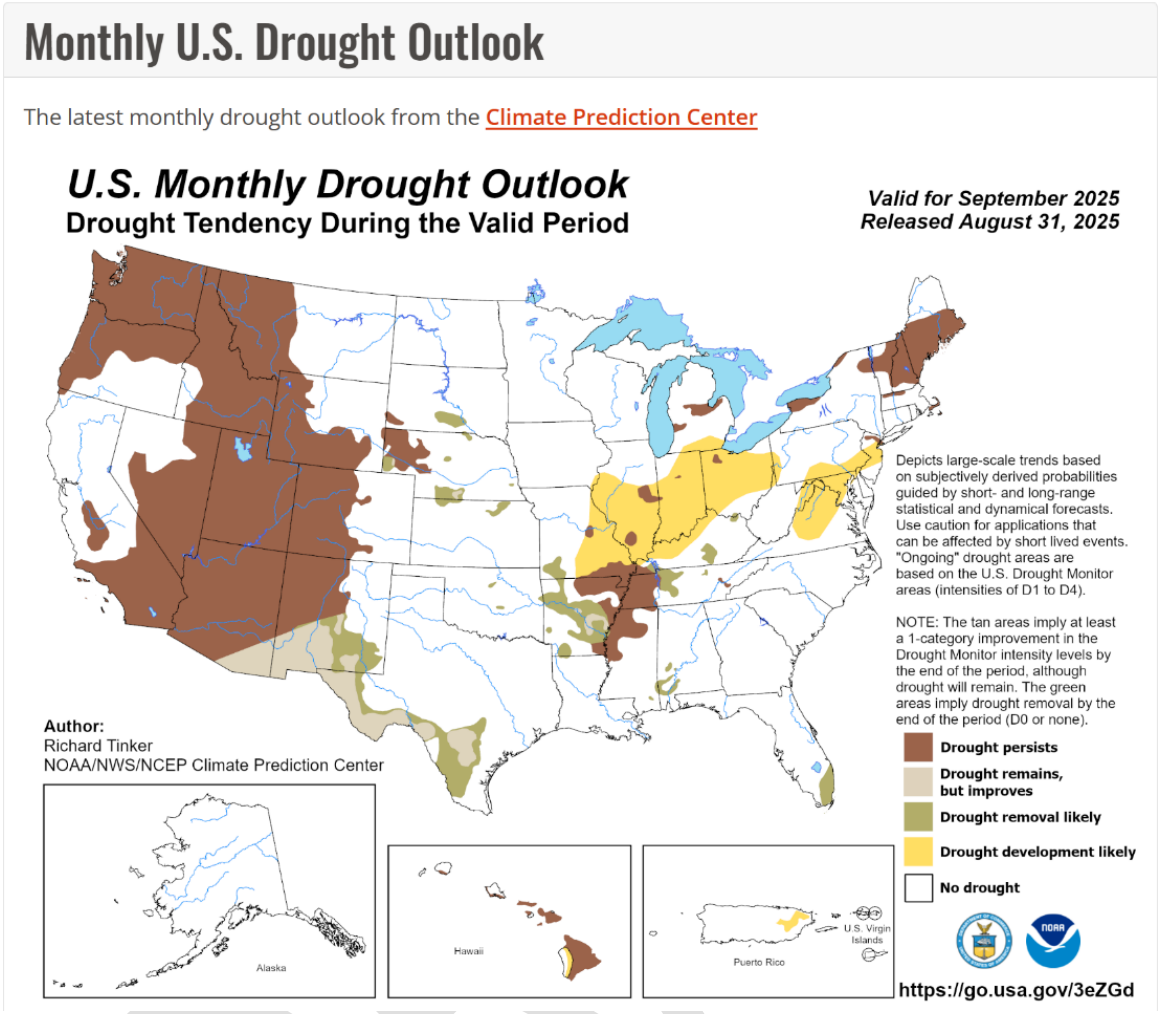


Figure 9. U.S. Drought Outlook



Development Since 2020 and its Impact on Drought

While overall irrigation demand has remained steady, development since 2017, such as changes to agricultural operations, infrastructure, and rural land use, have increased the complexity of TID's canal system. As a result, recurring drought conditions now present greater operational challenges. During dry periods, reduced water availability and lower canal flows make it more difficult to serve outlying areas consistently. Droughts can cause service disruptions due to increased sedimentation, algae growth, and reduced hydraulic efficiency. These conditions require more intensive maintenance and increase the risk of delivery delays, compounding the impacts of drought across a geographically dispersed service area.

The Impact of Future Development Trends on Drought

Historic droughts in California, including the 1976–1977, 1987–1992, 2007–2009, 2012–2016, and 2020–2023 periods have demonstrated the vulnerability of the Turlock Irrigation District's water supply system.

Reduced inflows to Don Pedro Reservoir during these events limited available storage and required reductions in irrigation deliveries. Secondary impacts, such as increased sedimentation, algae growth, and reduced hydraulic efficiency in canals, created service disruptions and heightened maintenance demands.

Since 2017, ongoing development and changes in agricultural practices, cropping patterns, infrastructure, and rural land use have increased the operational complexity of TID's delivery system. As a result,

recurring drought conditions now present greater challenges than in previous decades. Outlying areas of TID are more difficult to serve reliably during dry periods and expanded maintenance needs increase the likelihood of delivery delays.

Development has amplified both the operational and reliability impacts of drought across TID's geographically extensive service area. Looking ahead, continued regional growth is expected to further compound the effects of drought on TID operations and service reliability.

Climate change is expected to intensify drought conditions in the TID service area by increasing the frequency, severity, and duration of dry periods. Rising temperatures will accelerate evaporation rates, reduce soil moisture, and decrease the reliability of snowpack accumulation in the Sierra Nevada, the primary source of inflows to Don Pedro Reservoir. These changes will likely cause greater fluctuations in reservoir storage and canal flows, straining TID's ability to deliver water consistently across its service territory. Over time, climate change may magnify the impacts of development and create cascading challenges for both agricultural operations and water infrastructure management.

New Occurrences of Drought

Using the U.S. Drought Monitor and regional water management data as references, the period since the last approved LHMP in 2020 has included one significant drought event affecting the Turlock Irrigation District. Between 2020 and 2022, California experienced severe and widespread drought conditions, with critically low precipitation and near-record low Sierra Nevada snowpack. These conditions resulted in reduced inflows to Don Pedro Reservoir, forcing TID to cut irrigation allocations and implement water conservation measures. Although the historically wet winter of 2022–2023 provided substantial recovery, this multi-year drought highlighted TID's ongoing vulnerability to extended dry conditions.

Probability of Future Droughts

Droughts in the Turlock Irrigation District service area occur with varying frequency and generally align with statewide or regional drought cycles. Historically, significant drought events have affected the Central Valley approximately once every decade, with some periods being more prolonged and severe than others. Notable droughts impacting TID's service area include 1976–1977, 1987–1992, 2007–2009, 2012–2016, and 2020–2023. These events reduced inflows to Don Pedro Reservoir, limited irrigation deliveries, and required increased operational adjustments to sustain service reliability.

Looking forward, the combination of recurring statewide droughts, increased irrigation demand complexity, and climate change–driven variability in Sierra Nevada snowpack suggest that droughts will continue to affect TID with regularity. Future droughts are expected to increase in severity and duration, placing additional stress on reservoir storage, canal operations, and water delivery reliability.

Considering TID's reliance on the Tuolumne River watershed as its primary water supply, the probability of future droughts impacting the TID service area is assessed as: **HIGHLY LIKELY.**

Identifying Structures and Estimating Potential Losses from Drought

Drought does not typically result in large-scale, physical damage to District-owned infrastructure. Instead, the primary impacts to TID involve increased operating costs and lost revenue. Reduced surface water availability limits TID's ability to deliver water through its canal system and decreases hydroelectric generation capacity, particularly at the small hydroelectric plants integrated into the irrigation canal system. In such conditions, TID must rely more heavily on alternative water management practices and

power procurement strategies, which increases operating costs and reduces revenue from normal water and hydroelectric sales.

The greater potential for economic loss lies with TID's agricultural customers. Reduced water deliveries result in decreased crop yields, fallowed acreage, and increased reliance on groundwater pumping or other costly alternatives. These conditions elevate the costs of operation for growers and can lead to significant regional economic impacts. Agriculture is the economic backbone of the TID service area, and sustained droughts have cascading effects on related sectors including food processing, labor, and transportation.

For mitigation planning purposes, losses associated with drought are therefore characterized as operational and financial impacts to TID and economic and agricultural losses to the broader community. While TID has limited ability to mitigate agricultural production losses directly, TID plays a critical role in managing available water supplies, maintaining infrastructure efficiency, and implementing conservation and demand-management measures that can reduce the severity of drought impacts for both the utility and its customers.

Table 15. Summary of At-Risk Assets and Replacement Values

Water Delivery	0
Pumping & Drainage	0
Generation	0
Substations	0
Transmission	0
Distribution	0
Other Buildings and Real Property	0
Vehicles & Equipment	0

Methodology for Exposure, Vulnerability, and Loss Estimation

Drought impacts differ from other natural hazards because they do not typically cause direct, large-scale, physical damage to infrastructure. Instead, drought produces operational and financial consequences for TID and significant economic losses for the agricultural sector. TID applied the following methodology to estimate drought-related exposure and losses.

I. Inventory of Assets and Operations

- Identified District-owned facilities and operations most sensitive to drought, including hydroelectric plants integrated into the canal system and water delivery infrastructure.
- Assessed potential impacts to water deliveries and hydropower production under reduced surface water availability.

II. Operational Exposure and Utility Vulnerability

- Evaluated the potential for reduced surface water supplies to limit irrigation deliveries.
- Estimated impacts to hydroelectric generation capacity, with particular focus on small canal-embedded hydro facilities.
- Considered operational adjustments and increased reliance on purchased power or groundwater pumping to maintain service.

III. Financial and Economic Losses

- Quantified potential District-level impacts as increased operating costs (e.g., supplemental power purchases, groundwater pumping costs) and lost revenue from reduced sales of water and hydropower.
- Documented potential regional economic impacts by identifying losses to agricultural customers, including reduced crop production, fallowed acreage, and increased costs of operation.
- Recognized cascading impacts to supporting industries such as food processing, labor markets, and transportation.

IV. Mitigation and Management Considerations

- Identified drought mitigation measures within TID's control, including conservation programs, water efficiency improvements, and infrastructure maintenance to maximize delivery capacity.
- Recognized limitations in mitigating agricultural production losses directly, but emphasized the District's role in reducing severity through resource management and planning.

This methodology provides a consistent, repeatable process for evaluating the potential impacts of drought on TID's infrastructure and supports prioritization of mitigation actions.

Earthquake

Vulnerability Overview

Earthquakes are a well-documented hazard in California, with significant seismic activity recorded statewide since 1769. However, the risk profile for the TID service area differs from that of coastal and southern regions, where damaging earthquakes occur more frequently. Within the Central Valley, and particularly across most of the TID territory, damaging earthquakes are rare.

The TID service area lies east of the state's primary seismic sources, including the San Andreas, Calaveras, and Hayward fault systems. These major faults are capable of producing large, damaging earthquakes, but their distance from Stanislaus and Merced counties generally reduces the likelihood of direct, severe impacts to TID. As a result, while shaking from regional earthquakes can be felt in the valley, historical evidence shows that the frequency of destructive earthquakes within TID's core service area is low.

That said, TID does have localized exposure in the far western portion of its service territory, particularly in the coastal mountain area near Adobe Springs and along the boundary with Santa Clara County. These areas are closer to active fault systems, and as such, have a slightly higher seismic risk compared to the remainder of TID. Although damaging earthquakes remain infrequent, these western facilities and service connections could be more directly affected by seismic activity originating from Bay Area or Coast Range faults.

Overall, the likelihood of a major earthquake directly beneath TID facilities is low, but TID remains vulnerable to indirect and secondary impacts from regional seismic events. A large earthquake on the San Andreas, Hayward, or Calaveras faults could generate extended ground shaking across the Central Valley, potentially affecting critical TID infrastructure such as canals, levees, substations, and water conveyance systems. For this reason, earthquakes remain a recognized hazard for TID planning, even though the frequency of locally damaging events is significantly less than in California's coastal regions.

Table 16. Basis for Hazard Identification and Inclusion – Damaging Winds

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Earthquake	• Supported by input and consensus from the TID Planning Team. • Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus, Merced, and Tuolumne Counties. • Confirmed through review of regional seismic hazard mapping and U.S. Geological Survey (USGS) fault data. • Validated using California Geological Survey (CGS) fault rupture and ground shaking hazard zones. • Cross-referenced with FEMA's National Risk Index and Hazus datasets to confirm regional exposure and historical event data. • Corroborated by past earthquake activity in the Central Valley and adjacent fault systems (e.g., Calaveras, Greenville, and San Andreas faults). • Identified through infrastructure review identifying critical facilities potentially affected by seismic ground motion or liquefaction.	• Documented history of seismic activity affecting the Central Valley and surrounding fault systems. • Ongoing potential for moderate to strong ground shaking from nearby and regional fault zones, including the San Andreas, Calaveras, and Greenville faults. • Included due to the potential for widespread damage to critical infrastructure, lifelines, and essential services. • Recognized by FEMA, USGS, and the California Geological Survey as a primary hazard of concern across the state. • TID's extensive network of canals, dams, substations, and transmission infrastructure is vulnerable to shaking, ground settlement, and potential liquefaction impacts. • Seismic events could disrupt water delivery, electrical generation, and system control operations, creating cascading impacts across TID service areas. • Inclusion ensures consistency with neighboring county LHMPs and statewide seismic risk reduction priorities. • The hazard remains a planning priority due to the low predictability of earthquakes and their potential for catastrophic impacts even from distant events.

Location

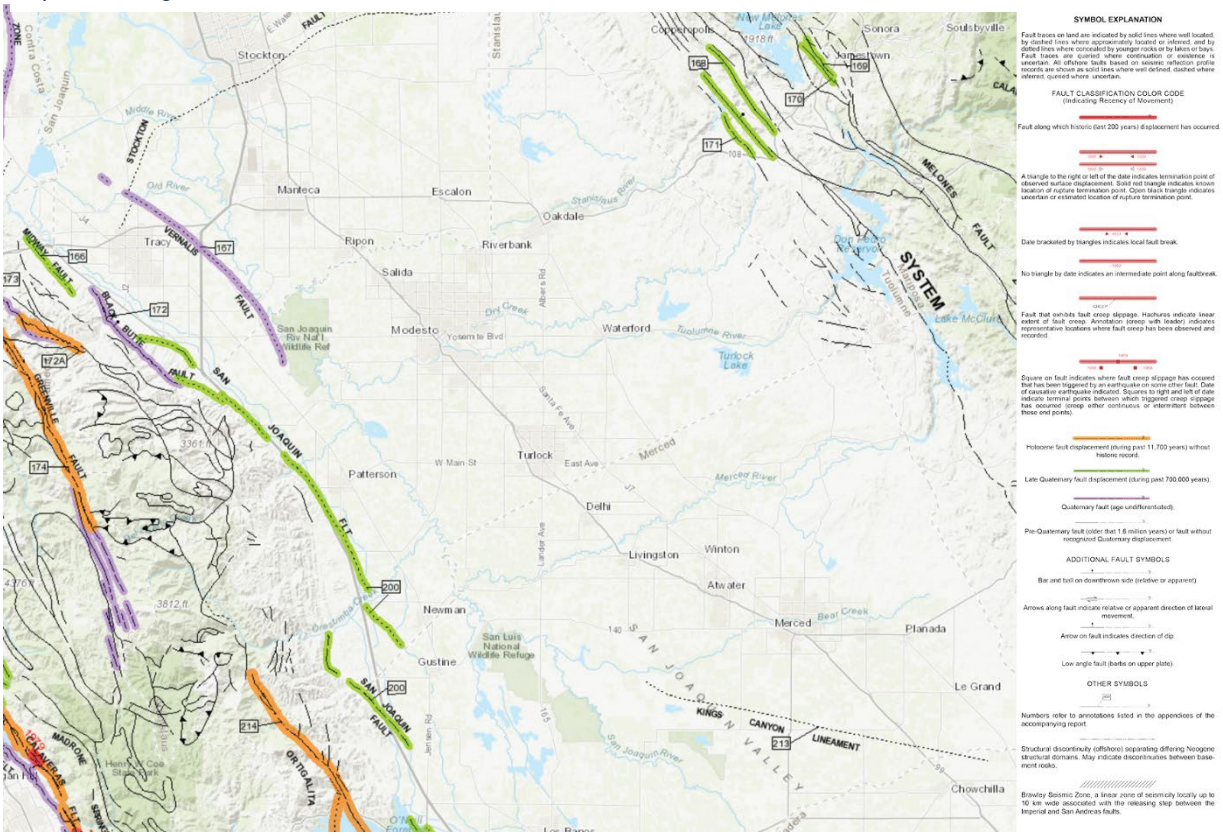
Within the TID service area, no active earthquake faults have been identified on the valley floor or in the eastern portion of TID. The only mapped fault system in TID's western service boundary is the San Joaquin Fault Zone, located in the hills west of Patterson. This zone has shown limited activity and is not considered a major seismic source. The nearest active fault with a history of producing damaging earthquakes is the Greenville Fault, located approximately 21 miles west of Patterson. The Greenville Fault generated a magnitude 5.5 event near Livermore in 1980 and has been associated with earlier earthquakes of magnitude 6.0 and 6.3 in the late 1800s [52].

Beyond the immediate District, larger regional faults present the greatest potential for significant seismic impacts. The Hayward Fault, approximately 63 miles west of Turlock, can produce large earthquakes with far-reaching effects.

The USGS Haywired Scenario, which models a magnitude 7.0 earthquake centered in Oakland, demonstrates that strong shaking would extend into the western portion of TID's service area. In addition to structural impacts, such an event could disrupt natural gas pipelines and transportation routes that supply TID's power plants and fuel systems, resulting in extended interruptions to energy generation and vehicle fueling. Secondary effects could include an influx of displaced Bay Area residents temporarily relocating to Central Valley communities, including areas served by TID [53].

52. Greenville Fault – Historical Earthquakes, U.S. Geological Survey (USGS), Earthquake Catalog: 1980 Livermore Earthquakes (M5.8 and M5.4), Greenville Fault Zone. USGS Earthquake Hazards Program.
53. Hayward Fault and Haywired Scenario - U.S. Geological Survey (USGS), The HayWired Earthquake Scenario—Engineering Implications. U.S. Geological Survey Scientific Investigations Report 2017–5013. Reston, VA: USGS, 2017.

Map 3. Existing Faults in the TID Service Area



Source: CA Geological Survey- https://maps.conservation.ca.gov/cgs/fam/App/

Modified Mercalli Intensity Scale

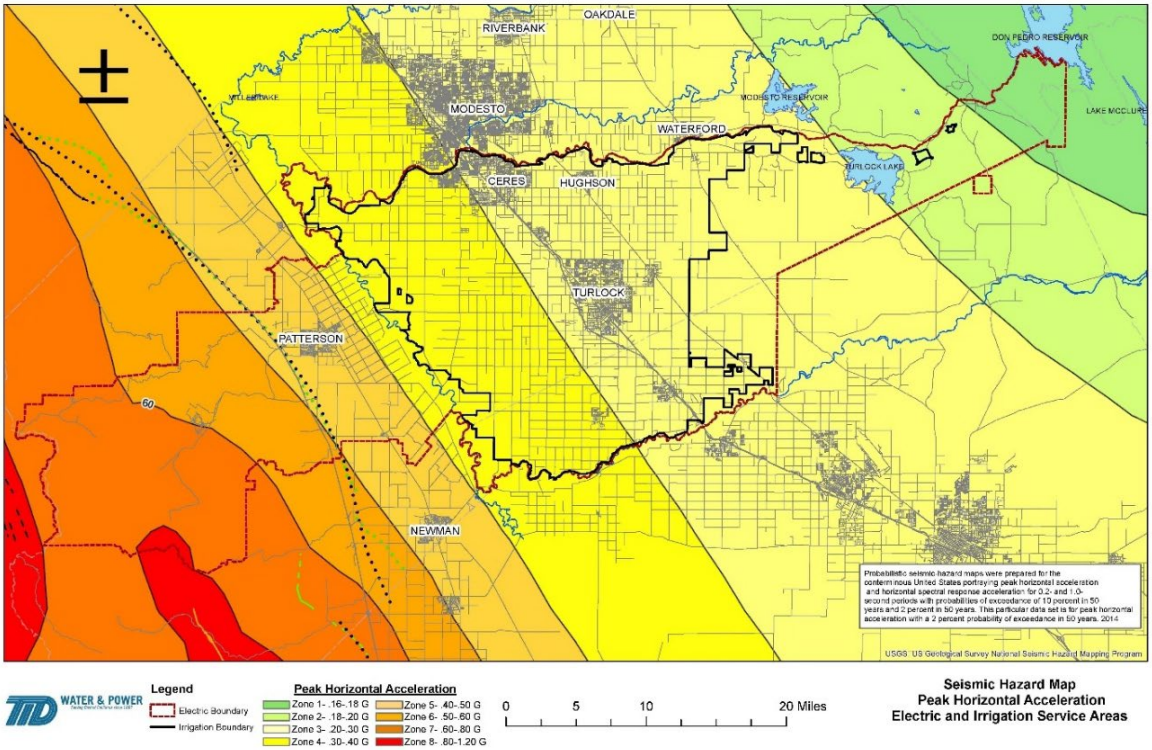
Earthquake severity can be described using several different scales. The Moment Magnitude (Mw) and Richter scales quantify the total energy released by an earthquake at its source. In contrast, the Modified Mercalli Intensity (MMI) scale measures the intensity of ground shaking experienced at specific locations, based on observed effects on people, structures, and the natural environment [54]. While more subjective than energy-based magnitude scales, the MMI scale is useful for describing the local impacts of an earthquake in terms that are easily understood. It ranges from MMI I (not felt) to MMI XII (total destruction) and is frequently used by the U.S. Geological Survey (USGS) to estimate expected damage patterns during seismic events.

54. Modified Mercalli Intensity Scale - Wood, H.O., and Neumann, F., 1931. Modified Mercalli Intensity Scale of 1931. Bulletin of the Seismological Society of America, Vol. 21, pp. 277–283.

Table 17. Modified Mercalli Intensity Scale

Intensity	Shaking	Description or Actual Damage
I	Not Felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by people indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars my rock slightly. Vibrations are similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed, walls make a cracking sound. Sensation like a heavy truck striking a building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone, many awakened. Some dishes and windows are broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved, a few instances of fallen plaster. Slight damage.
VII	Very Strong	Damage is negligible in buildings of good design, slight to moderate in well-built ordinary structures, considerable in poorly built or badly designed structures, some chimneys broken.
VIII	Severe	Damage slight in specially designed structures, considerable in ordinary substantial buildings with some partially collapsed. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.
IX	Violent	Damage is considerable in specially designed structures, well-designed frame structures thrown out of plumb. Great damage in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed, most masonry and frame structures destroyed including their foundations. Rail traffic disrupted due to bent rails.
XI	Extreme	Few if any structures remain standing. Bridges destroyed, rails bent greatly.
XII	Extreme	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Map 4. Mercalli Shaking Intensity Map



Seismic hazard mapping from the USGS National Seismic Hazard Mapping Program indicates varying levels of ground shaking potential across TID, measured using the Modified Mercalli Intensity (MMI) scale. The eastern portion of the service area could experience MMI V–VII shaking, capable of light to moderate damage. The valley floor, including much of TID's central service territory, could experience MMI VII–VIII shaking, considered strong to severe with the potential for significant structural damage. The highest levels of risk are in the western portion of TID near Interstate 5 and the City of Newman, where shaking intensities could reach MMI IX, a level capable of causing partial building collapse and widespread service disruption.

Extent

Earthquakes occur frequently along California's major fault systems, although their severity and impacts vary based on magnitude, depth, and proximity to population centers. The faults with the greatest potential to affect Stanislaus County and the TID service area include the San Andreas, Calaveras, and Hayward Faults. Because of its location, the western portion of Stanislaus County and the western edge of TID's service area near the Diablo Range and Interstate 5 has a higher potential for strong ground shaking than the eastern portion of TID. Since 1950, no earthquakes in Stanislaus County have resulted in a federally declared disaster.

Structures, infrastructure, and populations along the I-5 corridor and within the Diablo Range are most vulnerable to damage from strong ground shaking. While damaging earthquakes within TID's core service area are rare, a large regional event could result in widespread service disruption and secondary impacts.

One potential secondary effect is a seiche, an earthquake-induced wave within enclosed or partially enclosed bodies of water such as reservoirs and swimming pools. Seiches pose the greatest hazard when reservoirs are in active recreational use or when water levels are high enough to overtop a dam or spillway. Most TID reservoirs are in the eastern portion of the service territory, where seismic risk is lower,

reducing the likelihood of significant seiche impacts. Seiches could also occur within TID canals during the irrigation season, although expected impacts would be minimal.

Earthquakes can also trigger other secondary hazards, including dam failure, landslides, and wildfires, which are addressed separately in this plan. Notably, since 1930, only one earthquake with a magnitude greater than 4.0 has had its epicenter within Stanislaus County, underscoring the rarity of locally damaging events.

Extent Rating: The extent of earthquake hazards in the TID service area is classified as low to moderate in the central and eastern portions of TID, and moderate to severe in the western region, based on expected ground shaking intensities ranging from Modified Mercalli Intensity (MMI) V to IX.

Seiches

A seiche is a standing wave that forms in an enclosed or partially enclosed body of water when external forces such as strong winds, rapid atmospheric pressure changes, or seismic activity cause water to oscillate back and forth within the basin. This effect is comparable to water sloshing in a bathtub, where levels rise at one end while falling at the other.

Within the TID service area, seiches are most relevant to TID's reservoirs, regulating lakes, canals, and storage ponds. TID operates a network of water conveyance and storage infrastructure that could be affected if a significant seiche event occurs.

Seiches may be generated by several means including:

- Wind or Atmospheric Pressure Changes – Strong, sustained winds or rapid shifts in air pressure can displace water to one side of a reservoir, canal, or pond. When the force subsides, the water oscillates, sometimes causing shoreline overtopping or localized flooding.
- Seismic Activity – Earthquakes or strong ground motions can displace water within reservoirs or canals, initiating oscillations that move through the system.

The amplitude of a seiche can range from a few inches to several feet, depending on the size of the water body and the magnitude of the initiating force. Even small oscillations can pose risks in canals or ponds where freeboard is limited. Larger seiches may lead to:

- Overtopping or localized flooding at reservoirs, regulating lakes, or ponds.
- Damage to canal banks, levees, or adjacent infrastructure.
- Disruption of water deliveries or operational challenges to irrigation and power generation systems.
- Hazards to recreation, boating, or maintenance activities on reservoirs and lakes.

In severe cases, enclosed or narrow water bodies could experience wave heights that amplify within the basin, creating tsunami-like conditions on a smaller scale. For TID, these conditions could impact operational safety, require emergency repairs, and threaten critical water management functions.

Development Since 2020 and the Impact on Earthquake Risk

Since adoption of the 2020 Local Hazard Mitigation Plan, there has been incremental development within the TID service area that modestly increases exposure to earthquake impacts. Growth has primarily consisted of new substations, distribution lines, pumping facilities, and agricultural improvements, along with continued expansion of water and power infrastructure to support District operations. While no major urbanization has occurred, these additions expand the inventory of assets that could be disrupted by earthquake activity.

Several capital improvement projects related to water delivery and power generation have also been completed or initiated since 2020. These facilities were designed and constructed in accordance with

state and federal seismic safety standards, which reduce vulnerability compared to older infrastructure. Nonetheless, their presence represents an increase in the overall number of District assets that could experience service interruption or require post-event inspection and repair following an earthquake.

Overall, while the probability of locally damaging seismic events remains low, new developments since 2020 have modestly increased TID's potential exposure. This incremental growth reinforces the importance of maintaining seismic design requirements, monitoring infrastructure condition, and integrating earthquake considerations and mitigation measures into both operations and emergency planning.

The Impact of Future Development Trends on Earthquake Risk

Future development within the TID service area has the potential to increase overall exposure to earthquake impacts, even though the likelihood of locally damaging events remains low. Since 2017, rural community growth, agricultural expansion, and construction of new water and power infrastructure have placed more people, assets, and facilities in areas where earthquake shaking from regional faults could cause service disruptions.

Major facilities such as the Don Pedro Dam and Reservoir, power plants, water storage facilities, and conveyance structures were constructed to meet established seismic safety standards. However, continued development including substations, distribution lines, pumping facilities, and agricultural improvements represents additional exposure to seismic risk and increases the number of assets potentially vulnerable to earthquake impacts.

As development continues, even minor to moderate earthquakes could result in damage to distribution systems, delays in service restoration, and increased demands on emergency response and recovery resources. Although the probability of severe, direct impacts remains low, the cumulative effect of growth across TID means that the consequences of a regional earthquake could be more disruptive in the future.

To address these risks, TID will continue to apply seismic design standards, invest in infrastructure hardening, and integrate earthquake response considerations into its operational and emergency planning processes.

The Impact of Climate Change on Earthquake

Unlike hazards such as drought or flooding, earthquakes are not directly influenced by climate change. However, climate change can interact with earthquake impacts by intensifying secondary hazards. For example, more intense precipitation events projected under climate models may increase the risk of landslides on earthquake-weakened slopes, while prolonged drought may reduce soil cohesion, amplifying ground-shaking effects in certain areas. These combined stressors could complicate emergency response and infrastructure recovery in the event of a significant earthquake affecting TID's service territory.

New Occurrences of Earthquakes

Since the adoption of the Turlock Irrigation District's Local Hazard Mitigation Plan in 2021, no new earthquake events have been recorded within TID's service area or its immediate vicinity. The absence of recent occurrences does not reduce the overall seismic risk to TID. Earthquakes remain a significant hazard due to the region's proximity to multiple active fault systems, and future events could still cause substantial impacts to District facilities, infrastructure, and operations.

Probability of Future Earthquake Events

Due to the location of major, known faults, the geology of the soils and proximity to groundwater in portions of TID's service territory, and the potential for damage, the probability of an earthquake impacting TID is: **Likely.**

Methodology for Exposure, Vulnerability, and Loss Estimation

To evaluate potential earthquake losses to District facilities, TID applied the following methodology consistent with FEMA's Local Mitigation Planning Handbook and Cal OES guidance:

I. Inventory of Assets

- Compiled a comprehensive inventory of District-owned infrastructure, buildings, and equipment.
- Assets were categorized into functional groups consistent with TID's accounting structure.

II. Hazard Overlay and Exposure Analysis

- Used the U.S. Geological Survey (USGS) National Seismic Hazard Maps and California Geological Survey (CGS) seismic hazard data to identify areas within TID exposed to varying levels of ground shaking.
- Applied a 50-year planning horizon consistent with FEMA and USGS probabilistic hazard assessments.
- Assigned District assets to hazard zones using Geographic Information System (GIS) overlays.

III. Vulnerability Assessment

- Identified assets constructed prior to 1976 (pre-modern seismic code era) as more vulnerable to damage.
- Incorporated facility type and construction material to determine sensitivity to ground shaking and related hazards such as liquefaction and landslides.

IV. Loss Estimation

- Applied standard replacement cost methodologies to asset groups.
- Replacement values were summarized in the "Replacement Cost Summary" table by facility type and hazard zone.
- For planning purposes, approximate Modified Mercalli Intensity (MMI) values were assigned to hazard zones to illustrate the relative severity of shaking and likely effects.

This methodology provides a consistent, repeatable process for evaluating the potential impacts of earthquakes on TID's infrastructure and supports prioritization of mitigation actions.

Identifying Structures and Estimating Potential Losses from Earthquakes

TID owns and operates a wide range of facilities that are potentially exposed to seismic hazards. Most District facilities, including power plants, substations, and irrigation canals, are located on the floor of the Central Valley. Additional electrical distribution and transmission facilities are located in both the western and eastern portions of the service area. The eastern portion of TID contains major water storage and hydroelectric facilities, including Turlock Lake, Don Pedro Reservoir, hydro-generation facilities, and the diversion dam and powerhouse at La Grange.

Although there are no identified active faults within the valley portion of TID and no mapped active faults within the eastern service area, active fault systems are present in the western portion of the territory, particularly within the adjacent Coast Ranges. Since TID's establishment in 1887, there have been no recorded instances of major earthquake damage to District facilities. However, after the 1989 Loma Prieta Earthquake (magnitude 6.9, centered in the Santa Cruz Mountains), TID experienced some minor damage and a higher-than-normal incidence of crack repair along its concrete-lined irrigation canal system, demonstrating the potential for damage even from seismic events occurring outside the immediate service area.

TID facilities include a combination of assets that are particularly vulnerable to strong ground shaking or secondary hazards such as landslides. These assets include transmission and distribution poles embedded in the ground, above-grade concrete-lined canals, below-grade concrete pipelines, the Lateral 8 and Ceres regulating reservoirs, and related infrastructure, and the newly installed solar panels of Project Nexus. While newly constructed irrigation and electric facilities are designed and built to meet current engineering standards and remain serviceable for identified seismic risks, older facilities, particularly those constructed prior to 1976 seismic code updates, remain more vulnerable.

Facilities regulated by the Federal Energy Regulatory Commission (FERC), such as Don Pedro Dam, are designed, constructed, and maintained under stringent federal safety standards intended to mitigate seismic risk to acceptable levels.

For hazard mitigation planning purposes, this section is based on an inventory of existing District-owned

buildings, infrastructure, and critical facilities most likely to be impacted by seismic hazards. Due to the unique nature of its operations, TID groups facilities into the following categories, consistent with its accounting structure:

- Water Storage
- Water Delivery
- Pumping and Drainage
- Generation
- Substations
- Transmission Lines
- Distribution Lines
- Other Buildings and Real Property
- Vehicles and Equipment

Grouping assets in this manner allows TID to evaluate facilities that span hazard boundaries and to calculate their values using standard replacement cost methodologies. Replacement costs for District assets are summarized in Table 18, which is organized by asset type and location within mapped shaking intensity zones.

All property within TID is subject to seismic activity. To estimate potential losses, District assets were compared against probabilistic seismic hazard maps that define expected levels of shaking over a 50-year planning horizon. These maps reflect the probability of exceeding specific levels of ground motion but are not predictions of earthquake occurrence or fault activity.

Earthquake shaking typically occurs in three directions—vertical (up and down) and horizontal (side to side). Peak Ground Acceleration (PGA) is commonly used to measure shaking intensity at a given location and is a key input for seismic engineering and hazard mapping. While magnitude measures the overall energy released by an earthquake, PGA measures how hard the ground shakes at a specific site. Peak Horizontal Acceleration (PHA), expressed as a percentage of gravity (g-force), is the most widely used intensity measure in seismic building codes and engineering design. Higher percentages of acceleration generally correlate with greater potential damage to buildings and infrastructure.

For illustrative purposes, the seismic hazard zones used in this plan were also assigned approximate Modified Mercalli Intensity values to help characterize the expected effects of ground shaking on people, structures, and infrastructure. These values are not intended to predict specific damage outcomes but serve as a planning tool to estimate potential loss.

By overlaying the location of TID's assets with mapped seismic hazard zones, TID developed the Replacement Cost Summary presented in Table 19. This summary provides estimated replacement values of District facilities by category and shaking zone, offering a baseline for evaluating potential impacts from future earthquake events.

Table 18. Summary of At-Risk Assets and Replacement Values

Peak horizontal acceleration expressed as a percentage of the force of gravity (G)	Zone 1 16-18% G	Zone 2 18-20% G	Zone 3 20-30% G	Zone 4 30-40% G	Zone 5 40-50% G	Zone 6 50-60% G	Zone 7 60-80% G	Zone 8 80-120%
Approximate Modified Mercalli Index Shaking Intensity	V Moderate	VI-VII Strong - Very Strong	VII Very strong	VII-VIII Very Strong - Severe	VIII Severe	VIII Severe	IX Violent	IX Violent
Water Delivery	$250,725,547	$92,767,256	$497,828,201	$133,605,617	$0	$0	$0	$0
Pumping & Drainage	$0	$0	$14,393,500	$14,393,500	$0	$0	$0	$0
Generation	$200,802,285	$26,661,757	$508,085,039	$0	$0	$0	$0	$0
Substations	$2,231,442	$0	$136,462,297	$16,124,498	$19,056,318	$0	$0	$0
Transmission	$2,625,000	$2,625,000	$98,250,000	$20,000,000	$1,500,000	$0	$0	$0
Distribution	$2,895,126	$2,895,126	$173,642,824	$88,060,643	$5,320,835	$3,379,126	$701,061	$0
Other Buildings and Real Property	$9,739,823	$0	$92,751,533	$0	$0	$0	$0	$0
Vehicles & Equipment	$5,123,973	$0	$32,010,471	$0	$0	$0	$0	$0

Extreme Weather Hazard Group

Extreme weather refers to severe or unusual atmospheric events that can significantly affect people, property, and the environment. Extreme weather can disrupt utility and transportation infrastructure, damage buildings and equipment, and threaten public health and safety.

Although extreme weather occurs nationwide, the types of events most relevant to the TID service area include:

- Damaging winds
- Extreme temperatures (heat and cold)
- Localized extreme rainfall
- Poor air quality
- Tornado

Each of these hazards is profiled in detail in the following sections. While the probability and intensity of extreme weather vary by hazard, the potential for disruption to TID operations, water delivery systems, power generation, and community services makes this an ongoing concern. Climate variability and long-term climate change may also increase the frequency or severity of these events, underscoring the importance of continued monitoring, preparedness, and mitigation planning.

Damaging Winds

Vulnerability Overview

The National Weather Service (NWS) defines a high wind event as a period of sustained winds or frequent gusts reaching speeds that pose safety risks or potential damage. Specifically, a high wind event is characterized by:

- Sustained winds of 40 mph or greater lasting for one hour or more, or
- Frequent wind gusts of 58 mph or greater, regardless of duration.

When these thresholds are expected or observed, the NWS issues a High Wind Warning, indicating hazardous winds are imminent or occurring. For less severe but still impactful conditions, the NWS issues a Wind Advisory.

High wind events in the TID service area can result in downed power lines, damaged substations, toppled trees, and blocked canals or access routes, creating operational and safety hazards. These winds most often occur in association with strong storm systems, frontal passages, or localized thunderstorms. Beyond infrastructure damage, high winds can disrupt travel, increase wildfire risk during dry conditions, and complicate District emergency response operations.

Table 19. Basis for Hazard Identification and Inclusion – Damaging Winds

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Damaging Winds	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus, Merced, and Tuolumne Counties. • Supported by input and consensus from the TID Planning Team. • Documented previous damaging wind occurrences within the region.	• Documented previous occurrences of damaging wind events within the region. • Continued potential for future high-wind events capable of causing widespread service disruptions. • Included due to the potential for power outages, property damage, and operational impacts to TID infrastructure and transmission systems. • Recognized in regional LHMPs as a recurring and, in some cases, intensifying hazard influenced by changing climate and weather patterns. • High winds can down trees, damage utility poles, and disrupt water and power service across broad areas of TID's service territory. • TID's extensive electrical transmission, distribution, and water delivery systems increase exposure to wind-related damage and cascading system impacts. • Wind-related events may compound other hazards such as wildfires, extreme temperatures, or localized flooding, warranting continued inclusion and monitoring.

Location

Damaging winds are a District-wide hazard that can occur anywhere within the TID service area. The relatively flat terrain of the San Joaquin Valley provides little natural protection, allowing storm systems, frontal passages, and localized thunderstorm outflows to generate hazardous wind conditions across both urban and agricultural areas.

The eastern portion of TID, located in the foothills of the Sierra Nevada near Don Pedro Reservoir and La Grange, is more susceptible to localized wind acceleration due to canyon and ridgeline effects. Strong winds in these areas can affect communications infrastructure, powerhouses, transmission lines, and water conveyance systems.

Similarly, the western edge of TID, which extends into the lower foothills of the Coast Range, experiences localized gusts during strong frontal systems and downslope wind events. These winds can increase risk to distribution lines, substations, and agricultural operations located in exposed areas.

On the valley floor, which encompasses the majority of TID's service territory, broad open terrain allows wind to travel unimpeded. This can result in widespread exposure for urban centers such as Turlock, Ceres, and Hughson as well as extensive agricultural lands. Downed power lines, toppled trees, and damage to farm structures or irrigation equipment are the most common consequences of valley wind events.

Extent

The severity of damaging winds in the Turlock Irrigation District varies across the valley floor, eastern foothills, and western foothills. The NWS defines a high wind event as sustained winds of 40 mph or greater for at least one hour, or frequent gusts of 58 mph or greater, regardless of duration. These thresholds are used to characterize wind hazards that may cause property damage, downed trees and power lines, and hazardous travel conditions.

Valley Floor: The broad, flat terrain of the San Joaquin Valley allows strong winds to move unimpeded and can cause widespread impacts. On the valley floor, sustained winds of 30–40 mph with higher gusts are not uncommon during frontal passages. These events can topple trees, damage farm structures, and cause power outages, sometimes widespread ones.

Eastern Foothills (Sierra Nevada): In the elevated terrain near Don Pedro Reservoir and La Grange, canyons and ridgelines can funnel and accelerate winds, producing localized gusts that exceed those observed on the valley floor. High winds in this area pose risks to communications infrastructure, powerhouses, transmission infrastructure, and canal systems, where damage could lead to prolonged service interruptions.

Western Foothills (Coast Range): Along TID's western boundary, downslope winds and strong frontal systems can create hazardous gusts, particularly in exposed ridgeline areas. Distribution lines, substations, and communications infrastructure are at elevated risk of wind-related damage.

While damaging winds are a recurring hazard across the entire service area, the greatest operational consequences occur when strong winds cause simultaneous outages or infrastructure failures in multiple parts of TID. These events can disrupt both electric service and irrigation deliveries, requiring extensive resources for repair and restoration.

Development Since 2020 and the Impact on Damaging Wind Events

Since adoption of the TID 2020 LHMP, incremental development within the District's service area has modestly increased its overall exposure to damaging wind events. Growth has been concentrated in new substations, distribution lines, pumping facilities, and agricultural improvements, along with residential and commercial expansion in urban centers such as Turlock, Ceres, and Hughson. These additions expand the number of assets and populations that could be impacted by wind-related outages or infrastructure damage.

In rural areas, continued agricultural investment has introduced additional structures vulnerable to wind damage, including farm buildings, irrigation equipment, and crop-support infrastructure. The increasing reliance on mechanical and electrical systems in modern agricultural operations also heightens the potential for operational disruptions when power outages occur.

Development in the eastern and western foothill areas remains limited, but any new facilities constructed in these regions are exposed to localized high-wind conditions influenced by terrain.

Because these areas contain critical assets such as dams, powerhouses, and transmission lines, even small-scale development contributes to greater exposure.

The Impact of Future Development Trends on Damaging Wind Events

Looking forward, continued incremental growth across the TID service area will likely increase the number of people, facilities, and assets exposed to damaging wind events. While new infrastructure is designed and constructed to meet modern engineering and safety standards, the cumulative effect of additional development expands TID's overall vulnerability.

New substations, pumping plants, and distribution lines will add to the inventory of critical facilities that could be disrupted by high wind events, while residential and commercial expansion in communities such as Turlock, Ceres, and Hughson will increase the number of people and businesses dependent on reliable service. In rural areas, agricultural investment and modernization introduce more structures such as greenhouses, farm buildings, and irrigation systems that are sensitive to wind damage or power outages.

The eastern Sierra Nevada foothills and western Coast Range foothills will remain areas of concern, as terrain features can amplify localized wind speeds. Any new development in these areas, whether energy infrastructure, agricultural improvements, or support facilities will be inherently more vulnerable to damaging wind events than comparable facilities located on the valley floor.

New Occurrences of Damaging Wind Events Since 2020

Since adoption of the 2020 Local Hazard Mitigation Plan, TID has experienced multiple damaging wind events associated with strong winter storm systems, cold frontal passages, and severe thunderstorm outflows. These events produced sustained winds and gusts at or above NWS advisory and warning thresholds, resulting in localized infrastructure damage and temporary service disruptions.

High winds during drought years were frequently associated with dry frontal systems, which increased wildfire danger and created hazardous conditions for District operations. More recently, during the 2022–2023 and 2023–2024 winter storm seasons, several atmospheric river events generated strong winds across the San Joaquin Valley, leading to downed trees, power line damage, and localized outages within the TID service area.

While no single event since 2020 has resulted in catastrophic system-wide damage, the cumulative effect of repeated high wind incidents has required emergency response, vegetation clearance, and infrastructure repair efforts by TID Line Division staff. These occurrences confirm that damaging winds remain a recurring hazard of concern for TID, with the potential for significant operational and financial impacts if future events coincide with peak demand periods or occur simultaneously across multiple parts of the service area.

Probability of Future Damaging Wind Events

Damaging wind events are expected to continue to affect the TID service area and may increase in frequency or intensity as regional climate patterns evolve. While the Central Valley does not experience the same level of wind hazards as coastal or mountainous regions, strong wind events associated with winter storms, frontal passages, and convective activity are anticipated to recur on a regular basis. Future development, combined with potential climate variability, may amplify the impacts of these events on both District infrastructure and surrounding communities. The probability of future events is: **Highly Likely**.

For information regarding the identification of structures and Estimates of potential losses due to a damaging wind event, see page 80.

Extreme Temperatures

Vulnerability Overview

Extreme temperature hazards include both excessive heat and extreme cold events, each of which can create significant risks for public health, safety, and infrastructure. What constitutes “extreme” conditions is relative and depends on the acclimatization of the local population; for example, temperatures that might be considered moderate in one region can be hazardous in another.

Extreme heat can place dangerous stress on the human body, particularly among vulnerable populations such as those with preexisting or underlying health conditions, and people working outdoors or in unconditioned spaces. Prolonged exposure without taking the proper precautions, may lead to heat exhaustion, heatstroke, and even death. Extreme cold, while less frequent in the region, can also be life-threatening by increasing the risk of hypothermia, frostbite, and cardiovascular stress.

In addition to impacts on human health, extreme temperatures can disrupt critical systems and services. High heat events can strain energy infrastructure, increasing electricity demand for cooling and raising the risk of power outages.

Extreme cold events can damage water systems, compromise transportation, and create hazardous working conditions. Both types of events highlight the importance of mitigation strategies that strengthen system resilience, protect vulnerable populations, and support effective emergency response.

Table 20. Basis for Hazard Identification and Inclusion – Extreme Temperatures

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Extreme Temperatures	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus and Merced Counties. • Supported by input from the TID Planning Team. • Documented previous occurrences within Stanislaus, Merced, and Tuolumne Counties.	• Documented previous occurrences of extreme heat and cold events within the TID service area and surrounding region. • Continued potential for future periods of prolonged high or low temperatures, which may increase in frequency or intensity due to climate variability. • Included due to the potential for loss of life, health impacts, and infrastructure disruption during sustained temperature extremes. • Extreme heat events can strain power generation and distribution systems, increasing peak energy demand, transformer loading, and the risk of localized outages. • Extreme cold events, though less common, can damage irrigation infrastructure, affect canal flow, and create hazardous field and road conditions for operations and maintenance personnel. • High temperatures may accelerate canal evaporation and reduce water conveyance efficiency, while prolonged heat can degrade equipment performance and shorten component lifespan. • Recognized in regional and state hazard mitigation plans as an increasing concern linked to long-term climate change, rising summer temperatures, and more frequent extreme heat episodes across the Central Valley.

Location

Extreme temperature events affect the entire TID service area, though the degree of impact can vary by geography, population density, and land use.

Extreme heat is most acute in urbanized areas where the built environment contributes to the “urban heat island effect.” Communities within Turlock, Ceres, and Modesto are particularly susceptible due to extensive pavement, limited tree canopy, and higher population density. Agricultural workers in rural areas are also at elevated risk due to prolonged outdoor exposure.

Extreme cold is less common, but when it occurs, rural areas and low-lying locations within TID tend to experience the lowest temperatures. These conditions can impact both households with limited heating resources and agricultural operations reliant on frost-sensitive crops.

Extent

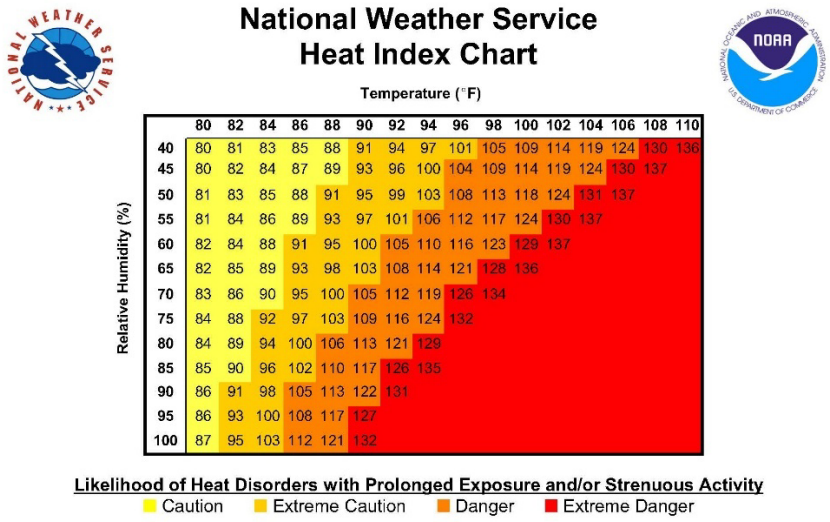
The severity of extreme temperature events in the TID service area is measured using established indices.

Excessive Heat: The severity of excessive heat is measured not only by temperature but also by humidity and duration. The National Weather Service (NWS) uses the Heat Index to describe how hot it feels when relative humidity is factored in with air temperature. For example, if the air temperature is 90°F and the humidity is 75%, the Heat Index, often referred to as the “apparent temperature”, or “Feels Like Temperature” is 109°F.

The NWS issues heat advisories, excessive heat watches, and excessive heat warnings based on forecasted conditions. In Stanislaus County, excessive heat warnings are generally issued when maximum daytime temperatures exceed 105°F for multiple consecutive days with little overnight cooling, or when the Heat Index is expected to rise above 105–110°F (depending on local climate) for at least two consecutive days. These conditions pose significant health risks, particularly for vulnerable populations, and can also strain energy and water infrastructure.

Figure 15 illustrates the relationship between air temperature, relative humidity, and the resulting apparent, or “Feels like” temperature as used by NWS in issuing heat alerts.

Figure 10. NWS Heat Index Chart



Extreme Cold: Extreme cold conditions are less common in the region served by TID compared to other regions of the country, but when they occur, they can still cause notable impacts. Extremely cold air is often intensified by wind chill, which combines low temperatures and wind speed to produce colder

apparent temperatures. Fortunately, dangerous wind chill conditions are rare in the Central Valley due to its relatively mild winters.

Nevertheless, winter temperatures in the TID service territory do occasionally drop low enough to damage crops, stress agricultural operations, and affect infrastructure. Extended cold snaps can disrupt water delivery systems, impact transportation, and pose risks to vulnerable populations with limited access to adequate heating.

The NWS issues several types of warnings and advisories related to cold weather:

- **Frost Advisory –** areas of frost are expected or occurring, posing a threat to sensitive vegetation.
- **Freeze Watch –** the potential for significant, widespread freezing temperatures within the next 24-36 hours.
- **Freeze Warning –** temperatures are forecast to fall below 32°F for an extended period.
- **Hard Freeze Warning –** temperatures are forecast to fall below 28°F for a prolonged duration.

These NWS thresholds provide a standardized method for assessing the severity of cold weather hazards in the region. While extreme cold events are typically short-lived, their potential to disrupt agriculture and infrastructure underscores the importance of monitoring and preparedness.

New Occurrences of Extreme Temperatures Since 2020

The TID service area has experienced multiple extreme temperature events over the past two decades:

Extreme Heat

- In June 2021, a prolonged heat wave brought daily highs of 105–110°F across the Central Valley, straining energy supplies and prompting widespread heat advisories.
- The summer of 2022 included record-breaking temperatures exceeding 112°F in parts of Stanislaus County, triggering an NWS excessive heat warning and leading to expanded cooling center operations.

Extreme Cold

- For several nights in January 2022, overnight temperatures dipped below, prompting frost warnings and minor impacts to agriculture.

Development Since 2020 and the Impact on Extreme Temperatures

Since 2020, development within the TID service area has continued to be characterized by steady population growth and incremental expansion of residential, commercial, and light industrial uses [55]. Urbanized areas within Turlock, Ceres, Modesto, and other population centers have seen infill development as well as outward expansion into formerly agricultural or undeveloped lands. These trends increase the number of residents, structures, and public facilities exposed to periods of extreme heat and cold [56].

Urban growth has contributed to the expansion of heat-retaining surfaces such as pavement, rooftops, and other impervious materials [57]. This development pattern has the effect of intensifying the urban heat island effect, in which temperatures within developed areas remain significantly higher than surrounding rural areas, especially at night [58]. At the same time, rural agricultural development continues to be vulnerable to frost and freeze conditions that may damage crops and irrigation infrastructure during periodic cold weather events [59].

The Impact of Future Development Trends on Extreme Temperatures

Looking ahead, continued population growth and urban expansion in the TID service area will likely increase the overall exposure of people and assets to extreme temperature hazards. While new construction generally incorporates modern building codes and improved energy efficiency standards that can mitigate some risks, the cumulative effect of additional development adds to system demand and potential vulnerability [60].

Key considerations include:
Increased Exposure: More households, schools, businesses, and public facilities will be directly exposed to extreme heat events, increasing reliance on energy and water systems during periods of peak demand [56].

Infrastructure Strain: Higher electricity demand for air conditioning during heat waves may stress TID's power supply and distribution infrastructure, while cold events can challenge water and energy systems in localized areas [59, 60].

Urban Heat Island Effects: Expanded development, particularly in urbanized portions of TID, may amplify localized heat hazards unless offset by mitigation measures such as expanded tree canopy, reflective surfaces, or green infrastructure [57, 58].

Agricultural Impacts: Continued agricultural production in TID remains vulnerable to frost and freeze events that can damage crops and irrigation systems, with potential economic ripple effects for the regional economy [61, 62].

55. California Department of Finance, Demographic Research Unit – population projections for Stanislaus County and cities.
56. FEMA, Threat and Hazard Identification and Risk Assessment (THIRA) guidance.
57. U.S. EPA, Heat Island Effect overview and mitigation strategies.
58. Cal-Adapt, Urban Heat Island Projections for California (California Fourth Climate Change Assessment).
59. NOAA National Centers for Environmental Information, Freeze and Frost Climatology for California's Central Valley.
60. California Building Standards Commission – Title 24, Part 6 (Energy Code).
61. California Energy Commission, Electricity Demand Forecasts and Climate Impacts on Grid Reliability.
62. California Department of Food and Agriculture, Economic Impacts of Extreme Weather on California Agriculture.

Probability of Future Extreme Temperature Events

Extreme temperature events are expected to continue and may increase in frequency and severity due to climate change.

Extreme Heat: Based on historic patterns and climate projections, the TID service area will likely experience more frequent and longer-duration heat waves, particularly during summer months. The likelihood of an extreme heat event occurring in the future is: **Highly Likely**.

Extreme Cold: While less common, frost and freeze conditions are expected to occur intermittently, especially during winter months. These events are generally short in duration and localized, but, the impacts from them can be significant in structures and facilities not built to withstand extremely cold temperatures. The likelihood of an extreme cold event occurring in the future is: **Likely**.

For information regarding the identification of structures and Estimates of potential losses due to an extreme temperature event, see page 80.

Localized Extreme Rainfall

Vulnerability Overview

Localized extreme rainfall refers to short-duration, high-intensity precipitation events that can overwhelm natural and built drainage systems. While there is no single universal definition, a commonly used benchmark is a month's worth of rain for a given location falling within a single day. These events typically occur when high moisture content in the atmosphere combines with a disturbance, such as a frontal boundary or convective storm system. The longer these conditions persist over the same area, the greater the likelihood of extreme rainfall and subsequent impacts.

Data from recent national climate assessments indicate that episodes of heavy precipitation are increasing in both frequency and intensity across much of the United States, including California. At the same time, vulnerability to extreme rainfall is rising due to population growth in low-lying areas, as well as land use changes that alter natural drainage and increase stormwater runoff.

When extreme rainfall exceeds the soil's ability to absorb water, runoff quickly accumulates in rivers, creeks, and storm drains. This can overwhelm culverts, stormwater infrastructure, and localized channels, resulting in flash flooding. The severity of impacts is influenced by several factors, including rainfall rate, soil type, terrain, and pre-existing soil moisture. These combined conditions highlight the importance of considering localized extreme rainfall as a hazard distinct from more widespread riverine flooding.

Table 21. Basis for Hazard Identification and Inclusion – Localized Extreme Rainfall

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Localized Extreme Rainfall	• Identified as a hazard of concern in the TID 2020 Local Hazard Mitigation Plan (LHMP). • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus and Merced Counties. • Supported by input from the TID Planning Team. • Documented previous occurrences within Stanislaus and Tuolumne Counties.	• Documented previous occurrences • Continued potential for future high-intensity rainfall events. • Due to the potential for loss of life and widespread property damage. • Localized extreme rainfall can quickly exceed the capacity of stormwater and canal systems, resulting in flash flooding, erosion, and infrastructure damage. • Short-duration, high-intensity storms have increased in frequency across the Central Valley and can overwhelm drainage facilities and unlined channels. • Potential exists for cascading impacts to TID operations, including power outages, canal overtopping, and access disruptions to facilities. • Recognized in regional LHMPs as an emerging hazard influenced by changing climate patterns and seasonal atmospheric river events.

Location

Several intense localized precipitation events have affected areas within and adjacent to the TID region, particularly in foothill zones east of Don Pedro Reservoir, the Dry Creek watershed north of TID, and across the Sierra Nevada foothills of Tuolumne and neighboring counties. These events illustrate how extreme rainfall can quickly overwhelm natural and engineered drainage systems.

- March 21–22, 2018 (Atmospheric River + Convective Showers): A strong atmospheric river system moved into California and, combined with convective thunderstorms, delivered unusually heavy precipitation. In the higher elevations of the Sierra, 8–9 inches of rain were recorded, while the hills above Don Pedro Reservoir saw 4–5 inches in short order. This intense rainfall produced rapid runoff, triggering flooding, erosion, and infrastructure failure across Tuolumne County. In Groveland, downtown streets were inundated. Roads, culverts, and bridges were damaged;

erosion undermined roadbeds; and water and sewer conveyance systems were overwhelmed by debris and silt loading.

The storm also caused partial failure of the Moccasin Reservoir spillway, owned and operated by the San Francisco Public Utilities Commission. At approximately 2:45 p.m. on March 22, the National Weather Service issued a Flash Flood Warning due to imminent dam failure concerns. A section of the earthen spillway was eroded, resulting in an uncontrolled release of water into Moccasin Creek. The surge inundated the Moccasin fish hatchery, deposited mud and debris into Moccasin Bay, and undercut a section of Highway 49, causing it to collapse. Downstream facilities were evacuated as a precaution.

Overall, Tuolumne County reported damage estimates exceeding $74 million, and two storm-related fatalities were recorded when drivers were swept from roadways [63].

- Atmospheric River–Driven Storms in the Sierra Foothills (General): Over time, atmospheric river events have periodically delivered concentrated precipitation to the Sierra foothills and portions of Stanislaus, Merced, San Joaquin, and Tuolumne counties. Such storms have been linked to localized flooding, debris flows, and washouts of smaller roads or drainage infrastructure.

63. Tuolumne County Community Resources Agency, Memorandum to the Tuolumne County Board of Supervisors, March 28, 2018. Available at tuolumnecounty.ca.gov/DocumentCenter/View/10316/Memorandum-to-the-Board-of-Supervisors-regarding-Storm-damages

Extent

The severity of localized extreme rainfall events in the TID service area is influenced by several factors, including the intensity and duration of precipitation, topography, soil saturation, and the capacity of natural and engineered drainage systems. While any community within TID may be affected, areas with limited stormwater conveyance, steep terrain in nearby foothills, or proximity to creeks and smaller tributaries are especially vulnerable.

Localized extreme rainfall is often associated with atmospheric river events, which can deliver several inches of precipitation over a 24- to 48-hour period. A commonly used benchmark for defining extreme rainfall is the occurrence of a month’s worth of precipitation falling in a single day. In practice, rainfall totals of 3-5 inches within 24 hours in lowland areas, and 6-9 inches in foothill watersheds, can produce flash flooding, slope failures, and severe erosion in the region.

Localized flooding is most likely to occur when rainfall rates exceed the capacity of culverts, storm drains, and creeks to convey water, leading to ponding, roadway washouts, and damage to water and sewer systems. The impacts are magnified in areas where development has altered natural drainage patterns or where soils are already saturated.

In addition, extreme rainfall events can interact with other hazards. For example, intense precipitation following wildfire can trigger debris flows, while storm-driven runoff into reservoirs can stress spillways and dam infrastructure, as was observed at Moccasin Reservoir during the March 2018 atmospheric river event.

The extent of localized extreme rainfall in the TID service area is therefore considered moderate to high, with the potential to cause localized infrastructure damage, agricultural losses, and threats to public safety, particularly during multi-day storm systems or back-to-back atmospheric river events.

Development Since 2020 and the Impact on Localized Extreme Rainfall

Since 2020, the TID service area has continued to see incremental population growth and new development, particularly in urbanized centers such as Turlock, Ceres, and Modesto. Much of this growth

has occurred through infill development and expansion at the urban–rural fringe, converting agricultural or open land to residential, commercial, and light industrial uses.

These development patterns have added impervious surfaces such as pavement, rooftops, and parking lots, which increase stormwater runoff during periods of heavy rainfall.

At the same time, drainage infrastructure in many older neighborhoods and rural areas remains limited in capacity and was not designed for the more intense rainfall events projected under current climate conditions. While new subdivisions and commercial areas are generally constructed to modern stormwater management standards, older areas of TID are increasingly vulnerable to localized flooding when high-intensity storms occur.

The Impact of Future Development Trends on Localized Extreme Rainfall

Future development in the TID service area will continue to expand the built environment, increasing both exposure to localized extreme rainfall and potential consequences when these events occur. Key considerations include:

- **Increased Runoff:** The addition of impervious surfaces from new housing, retail, and industrial projects will reduce infiltration and increase the volume and speed of stormwater runoff, placing greater stress on culverts, storm drains, and localized waterways [64, 65].
- **Urban Flooding Risks:** Densification in urban areas may heighten the risk of street and neighborhood flooding, particularly in locations with older or undersized drainage systems [64].
- **Agricultural Impacts:** Development in agricultural areas may alter natural drainage patterns, potentially increasing flood risks for adjacent farmland or irrigation infrastructure [66, 67].
- **Infrastructure Strain:** Expanded development will increase demand on stormwater, water, and sewer systems that are already challenged by high-intensity rainfall [64].
- **Climate Variability:** Projected increases in the frequency and intensity of extreme precipitation events will compound these vulnerabilities, emphasizing the need for resilient land use planning and stormwater management practices [68, 69].

Overall, while new projects incorporate modern design standards, the cumulative effect of continued growth combined with climate-driven precipitation extremes will increase TID's vulnerability to localized extreme rainfall.

64. U.S. EPA, Stormwater Management and Impervious Surface Impacts on Flooding.
65. FEMA, Local Mitigation Planning Handbook (infrastructure vulnerability to localized flooding).
66. NOAA National Centers for Environmental Information (NCEI), Storm Events Database - Heavy Rain/Flood Events in Central California.
67. USDA Natural Resources Conservation Service, Soil Drainage and Agricultural Flooding Risk in the Central Valley.
68. Cal-Adapt, Extreme Precipitation Projections for California (based on LOCA downscaled climate models).
69. California Fourth Climate Change Assessment, Statewide Summary Report (2018) – Precipitation Extremes.

New Occurrences of Localized Extreme Rainfall Since 2020

Since the March 2018 atmospheric river event that caused significant flooding, erosion, and infrastructure damage in Tuolumne County, there have been no documented instances of localized extreme rainfall causing measurable damage within the TID service area. While widespread atmospheric river events have impacted California since 2020, including major storms in the winter of 2022–2023, localized damage events of the type described in 2018 have not been recorded in TID or its immediate surroundings.

Probability of Future Events

The probability of localized extreme rainfall in the TID service area is challenging to quantify due to the variability of storm tracks and rainfall intensity. However, recent climate observations highlight a pattern of

increasing volatility. Within a five-year span, the region has experienced both the driest period of annual precipitation in the past 1,500 years and two of the wettest years on record.

These conditions suggest a trend toward greater extremes between wet and dry years, consistent with broader climate change assessments for California.

Given this history and the demonstrated potential for high-intensity storm systems, the probability of future localized extreme rainfall events in the TID service area is considered: **Highly Likely.**

For information regarding the identification of structures and Estimates of potential losses due to a localized extreme rainfall event, see page 80.

Poor Air Quality

Vulnerability Overview

The San Joaquin Valley remains among the nation's most air-polluted regions, repeatedly failing to meet federal health standards for both ozone (smog) and fine particulate matter ($PM_{2.5}$). The Valley's geography, temperature inversions, and persistent pollutant sources contribute to baseline poor air quality conditions.

These conditions are further exacerbated when wildfire smoke drifts into the region. Smoke from wildfires carries high concentrations of $PM_{2.5}$ particles, especially those under 2.5 microns in diameter, that penetrate deeply into the lungs and bloodstream. These fine particulates are strongly associated with respiratory illness, cardiovascular stress, aggravated asthma, and in severe cases, premature death.

Recent wildfire events have magnified the risk. Two notable examples include the Creek Fire and the SCU Lightning Complex fires, both in 2020. Smoke from these large fires penetrated deep into the Valley, elevating ambient $PM_{2.5}$ levels for days at a time. The SCU Lightning Complex, in particular, burned across parts of Stanislaus, Merced, San Joaquin, and adjacent counties, causing sustained smoke intrusions inland at times completely obscuring the sun.

Air quality in the TID service area frequently reaches unhealthy levels during both wildfire smoke intrusions and stagnant weather patterns. During these episodes, the general population may begin to experience health effects, while sensitive groups including children, older adults, and individuals with respiratory or cardiovascular conditions face heightened risks.

Given the persistent baseline pollution, increasing wildfire frequency and intensity, and historical patterns of exceedance, poor air quality remains a chronic and episodic hazard in the TID service area.

Table 22. Basis for Hazard Identification and Inclusion – Poor Air Quality

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Poor Air Quality	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus, Merced, and Tuolumne Counties as part of their respective wildfire risk assessments. • Supported by input from the TID Planning Team. • Documented previous occurrences of poor air quality within Stanislaus County.	• Previous occurrences of poor air quality during regional wildfire events. • The San Joaquin Valley is consistently ranked among the most air-polluted regions in the United States. • The region experiences numerous days each year that fail to meet federal air quality health standards. • Environmental and geographic conditions within the TID service area contribute to recurring episodes of degraded air quality.

Location

Poor air quality is a regionwide hazard that affects the entire TID service area. The San Joaquin Valley's unique geography and meteorology make it particularly susceptible: mountain ranges on three sides trap air masses, while frequent temperature inversions prevent pollutants from dispersing. As a result, ozone and particulate matter concentrations accumulate over broad areas, impacting both rural and urban communities alike.

Within TID, population centers such as Turlock, Ceres, and Modesto are especially affected due to higher concentrations of vehicular traffic, industrial activity, and residential development. Rural areas are also vulnerable during wildfire smoke events, which can blanket large portions of the Valley with high levels of $PM_{2.5}$ regardless of local emission sources. Because of this, the entire TID service territory is considered uniformly exposed to poor air quality hazards.

Extent

The severity of poor air quality events is measured using the Air Quality Index (AQI), a standardized scale developed by the U.S. Environmental Protection Agency (EPA). The AQI incorporates pollutant concentrations including ozone, PM_{10}, and $PM_{2.5}$ and translates them into categories reflecting health concern levels.

Ozone (Smog): Ground-level ozone forms when certain airborne pollutants react in sunlight. Elevated ozone concentrations are most common in summer and can trigger asthma, reduce lung function, and cause respiratory irritation.

Particulate Matter ($PM_{2.5}$): Fine particulates, particularly those associated with wildfire smoke, pose the most significant health risks because of their ability to penetrate deeply into the lungs and enter the bloodstream directly. Elevated $PM_{2.5}$ episodes often occur during the fall and winter, or during wildfire seasons.

Table 23. EPA AQI Categories

AQI Range	Category	Health Implications
0–50	Good	Air quality poses little or no risk.
51–100	Moderate	Acceptable air quality; some pollutants may affect very sensitive individuals.
101–150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects; general public is less likely to be affected.
151–200	Unhealthy	Health effects may be experienced by all; more serious impacts for sensitive groups.
201–300	Very Unhealthy	Health alert: everyone may experience more serious health effects.
301–500	Hazardous	Health warnings of emergency conditions; entire population is more likely to be affected.

In the TID service area, AQI values routinely reach the Unhealthy for Sensitive Groups (101–150) category during summer ozone episodes and wildfire smoke intrusions, and occasionally escalate to the Unhealthy (151–200) category during severe smoke events. While hazardous (AQI 301+) conditions are rare, the increasing intensity of wildfires across California elevates the risk of such extremes occurring in the future.

Development Since 2020 and the Impact on Poor Air Quality

Since 2020, the TID service area has experienced steady growth in residential, commercial, and light industrial uses concentrated in and around Turlock, Ceres, and Modesto with ongoing infill and fringe expansion [70]. These patterns affect air quality in several ways:

- **More on-road activity:** New housing and commercial areas add vehicle miles traveled (VMT), increasing ozone precursors (NO_x and VOCs) and primary particulates from brake/tire wear and exhaust [71, 72].
- **Freight and distribution growth:** Expansion along the Highway-99 corridor and near major arterials brings additional diesel truck activity, elevating localized NO_2 and diesel particulate matter near logistics, light industrial sites, and rail spurs [73].
- **Construction emissions and dust:** Continuous site preparation and building activity generate short-term combustion emissions and fugitive dust (PM_{10}/$PM_{2.5}$), especially during dry seasons and wind events [74].
- **Neighborhood exposure patterns:** Higher densities near busy corridors, interchanges, and industrial clusters increase the number of people living, working, or attending school in areas with elevated pollutant concentrations [75].

- **Smoke vulnerability:** Population growth does not create wildfire smoke, but it increases the number of residents exposed when regional smoke intrudes (e.g., from Sierra/North State fires) into the Valley's inversion layer [76, 77].

Overall, post-2020 development has expanded the number of people and assets exposed to poor air quality episodes (ozone in summer, $PM_{2.5}$ in winter and during smoke events) and modestly increased local precursor emissions tied to transportation, construction, and goods movement.

The Impact of Future Development Trends on Poor Air Quality

Looking ahead, continued growth across TID is expected to increase exposure to poor air quality unless mitigated.

Key implications:

- **Higher cumulative emissions:** Added vehicle miles traveled, construction cycles, and incremental goods-movement activity will continue to contribute to ozone precursors and particulate matter [72, 73, 74].
- **Localized "hot spots":** New logistics, warehousing, and light industrial sites may create concentrated diesel PM and NO_2 near facility driveways, queueing lanes, and along truck routes [73, 75].
- **Built-environment exposure:** As residential and mixed-use projects infill near high-traffic corridors, more residents may be subject to elevated near-road pollutant levels, particularly during stagnation events and summer ozone episodes [72].
- **Compounded smoke impacts:** Future growth increases the number of people requiring protection during regional wildfire smoke intrusions (e.g., need for clean-air shelters, filtration, and risk communication) [77].
- **Infrastructure demand:** More facilities (schools, clinics, senior housing) raise the need for reliable, filtered indoor air during severe AQI days and for continuity plans that minimize outdoor work exposure for sensitive groups and outdoor workers [70].

70. California Department of Finance, Demographic Research Unit – Population Projections for Stanislaus County and Cities (2023).
71. U.S. EPA, Air Quality and Vehicle Miles Traveled (VMT): Connections Between Transportation and Emissions (2020).
72. California Air Resources Board (CARB), 2022 State Implementation Plan for Ozone and $PM_{2.5}$ – Emissions inventories.
73. San Joaquin Valley Air Pollution Control District, Indirect Source Review Program (2021) – Freight, warehousing, diesel emissions.
74. U.S. EPA, Dust Emissions from Construction Activities and Air Quality Impacts (2019).
75. Health Effects Institute, Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects (2010, widely cited).
76. California Fourth Climate Change Assessment, San Joaquin Valley Summary Report (2018) – Wildfire smoke and $PM_{2.5}$ impacts.
77. U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials (2021) – Indoor air quality and sensitive populations.

New Occurrences of Poor Air Quality Since 2020

Poor air quality is a chronic, recurring condition in the San Joaquin Valley and the TID service area, with both ozone and particulate matter ($PM_{2.5}$) levels routinely exceeding state and federal health standards. Unlike episodic hazards such as floods or earthquakes, poor air quality occurs with regularity and varies seasonally, often reaching Unhealthy for Sensitive Groups or worse during summer ozone episodes and during wildfire season.

Since 2020, multiple large wildfire events across California have significantly worsened air quality in the TID region:

- **SCU Lightning Complex (August–September 2020):** Burned over 390,000 acres across parts of Stanislaus, Merced, San Joaquin, and neighboring counties, producing dense smoke that degraded air quality across the Valley for days.
- **Creek Fire (September–December 2020):** One of the largest single-ignition fires in California history. Though the fire was located in the Sierra Nevada, smoke plumes extended into the Valley, resulting in sustained AQI levels well above 150 (Unhealthy).
- **Dixie Fire (July–October 2021):** Though located in Northern California, smoke from this megafire drifted into the Valley multiple times, contributing to prolonged $PM_{2.5}$ exceedances.
- **Regional wildfire activity (2022–2023):** A series of smaller wildfires and prescribed burns again led to episodic air quality deterioration, especially during summer and fall, with AQI levels frequently reaching the Moderate to Unhealthy for Sensitive Groups categories across Stanislaus County.

In addition to wildfire smoke, summer ozone concentrations remain a persistent issue in the region. According to data from the San Joaquin Valley Air Pollution Control District and California Air Resources Board, the Valley continues to register dozens of exceedance days each year above the federal 8-hour ozone standard. These trends are expected to continue, particularly as high temperatures and stagnant atmospheric conditions increase with climate change.

Given the combination of long-standing regional air pollution sources and increasing frequency of wildfire smoke events, poor air quality remains one of the most consistent and widespread hazards affecting the TID service area.

Probability of Future Events

Poor air quality is a chronic condition in the San Joaquin Valley, driven by persistent emissions, land use patterns, and recurring wildfire smoke intrusions. As the underlying causes remain unchanged, or are intensifying due to climate-related factors the likelihood of future poor air quality episodes is: **Highly Likely.**

For information regarding the identification of structures and Estimates of potential losses due to poor air quality events, see page 80.

Tornado

Vulnerability Overview

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. Tornadoes are often visible as a funnel cloud or condensation funnel composed of water droplets, dust, and debris, but they may also be obscured by heavy rain or low clouds. These storms are considered the most violent of atmospheric hazards due to their ability to generate wind speeds exceeding 200 miles per hour. At their most intense, tornadoes can uproot trees, lift debris, damage infrastructure, and destroy buildings, leaving wide paths of destruction.

Tornadoes are classified using the Enhanced Fujita (EF) Scale, which rates events based on estimated wind speeds and the type and severity of damage caused, ranging from EF0 (weak) to EF5 (devastating).

The TID service area is considered at low risk for tornado activity compared to many other regions of the United States. However, tornadoes do occur in the Central Valley. In November 2015, an EF1 tornado, with wind speeds between 86 and 110 mph, touched down in the community of Denair, California. The storm produced visible funnel clouds, caused minor damage to structures and property, and resulted in significant impacts to the community's electrical infrastructure. Although such events are rare, their occurrence confirms that tornadoes are a potential hazard within TID's service territory. Accordingly, tornadoes remain a hazard of concern for planning purposes despite their relatively low probability.

Table 24. The Enhanced Fujita Scale

EF Rating	Estimated Wind Speed (mph)	Typical Damage Description
EF0	65–85	Light damage. Shallow-rooted trees pushed over, branches broken, minor roof damage, signs bent.
EF1	86–110	Moderate damage. Roofs stripped, mobile homes pushed off foundations or overturned, windows broken.
EF2	111-135	Considerable damage. Roofs torn off well-constructed homes, mobile homes destroyed, large trees uprooted, cars lifted off the ground.
EF3	136-165	Severe damage. Entire stories of well-constructed houses destroyed, trains overturned, trees debarked.
EF4	166-200	Devastating damage. Well-built houses leveled, cars thrown significant distances, structural deformation of steel-framed buildings.
EF5	Over 200	Incredible damage. Strong frame houses swept away, automobile-sized objects become airborne missiles, concrete structures severely damaged.

Table 25. Basis for Hazard Identification and Inclusion – Tornado

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Tornado	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus and Merced Counties. • Supported by input from the TID Planning Team. • Documented previous tornado occurrences within Stanislaus County.	• Documented previous tornado occurrences within the region. • Ongoing potential for future tornado events. • Included due to the potential for extreme damage resulting from a tornado. • Tornadoes, while infrequent, have historically occurred in the Central Valley and can cause significant localized damage to structures, power infrastructure, and agricultural assets. • TID's extensive electrical transmission and distribution systems are exposed to high-wind impacts associated with tornado activity. • Regional climate and topographic conditions can occasionally produce convective storms capable of generating short-lived but damaging tornadoes. • Tornado risk is recognized in the Stanislaus and Merced County Multi-Jurisdictional LHMPs, warranting consistency in regional hazard identification.

Location

Tornadoes are rare but possible throughout the TID service area. The District's electric and water service territory spans portions of Stanislaus, Merced, and Tuolumne Counties, regions characterized by broad, open agricultural landscapes that offer few natural barriers to severe convective weather. Although the Central Valley experiences far fewer tornadoes than the Midwest or Southeast, localized twisters can occur during strong frontal systems, intense spring or fall thunderstorms, or remnants of tropical systems.

Historic tornado occurrences in Stanislaus and Merced Counties demonstrate that these events are not limited to any specific part of the District. Tornadoes have been recorded near Ceres, Modesto, and Turlock, as well as in rural areas south toward Hilmar and Delhi. The flat topography of the region allows for long sight distances but provides little natural protection from rotating storm cells capable of generating damaging winds.

Within TID's service area, all facilities, especially transmission and distribution infrastructure, water conveyance systems, and open-air substations, are considered uniformly exposed to the tornado hazard. Because of the small footprint and highly localized nature of tornado tracks, no portion of the District can be categorically excluded from potential exposure, although the probability of direct impact on any single facility remains low.

Extent

The severity of a tornado is measured by the Enhanced Fujita (EF) Scale, which classifies tornadoes based on estimated wind speeds and the resulting level of damage to structures and vegetation. The scale ranges from EF0 (weak) to EF5 (violent), with higher ratings indicating greater destructive potential.

Tornadoes that occur in California's Central Valley are generally rated at the lower end of the scale (EF0 to EF1), producing minor to moderate damage [78]. The November 2015 Denair tornado, for example, was classified as an EF1, resulting in property damage and significant impacts to local electrical infrastructure. While rare, stronger tornadoes (EF2 or above) are possible, though historically uncommon in the region.

78. Midwest Regional Climate Center - mrcc.purdue.edu

Development Since 2020 and the Impact on Tornadoes

Since 2020, the TID service area has experienced incremental growth in residential, commercial, and light industrial development, particularly in and around the cities of Turlock, Ceres, and Hughson. This growth has added population density and expanded the built environment into areas that were previously agricultural or open space. While tornadoes remain rare in the Central Valley, this pattern of development increases the number of people, structures, and critical facilities that could be affected should a tornado occur.

In addition, new residential neighborhoods, retail centers, and schools increase the potential for localized damage and disruption. The expansion of power lines, substations, and other electrical distribution infrastructure since 2020 also increases exposure, given the sensitivity of electrical systems to high winds and airborne debris during tornado events.

The Impact of Future Development Trends on Tornadoes

Looking forward, continued growth across the TID service territory will likely increase exposure to tornado hazards, even though the overall probability of occurrence remains low.

Key considerations include:

- **Increased Exposure of People and Structures:** As more homes, businesses, and public facilities are built, a larger population base and more assets are subject to potential tornado impacts.

- **Infrastructure Vulnerability:** Expansion of power distribution and communications systems raises the likelihood of service disruptions if a tornado strikes near key facilities or corridors.
- **Agricultural Impacts:** While tornado tracks are typically narrow, future development on the urban–rural fringe may increase overlap between agricultural operations and developed areas, creating potential for combined impacts to crops, equipment, and adjacent neighborhoods.

Although tornadoes are infrequent in the Central Valley, the cumulative effects of development increase potential consequences when they do occur. For this reason, future planning should emphasize resilient construction, public awareness, and coordination with local emergency management partners to ensure preparedness for these rare but high-impact events.

New Occurrences of Tornadoes Since 2020

Since the EF1 tornado that struck Denair in 2015, there have been no documented tornadoes within the TID service area that resulted in measurable property damage or infrastructure impacts. However, on April 1, 2025, the National Weather Service confirmed an EF0 tornado just east of Salida in Stanislaus County, immediately north of TID's service territory. The tornado was on the ground from approximately 2:13 to 2:15 p.m. PDT, tracking nearly 0.9 miles with a width of about 70 yards and producing peak estimated winds of 76 mph.

The event uprooted almond trees, snapped large branches, displaced fencing and outbuildings, damaged roofing and windows, and moved a large trailer approximately 20 feet [(79)].

Although the tornado caused only minor localized damage, its proximity highlights that tornadic activity does occur in the region and that similar storms could affect TID communities under comparable conditions.

79. kcra.com/article/tornado-stanislaus-county-national-weather-service

Probability of Future Events

Tornadoes are expected to continue occurring within the broader Central Valley and may impact the TID service area in the future. While the occurrence of a high-intensity tornado (EF2 or greater) in TID is considered unlikely, lower-intensity tornadoes (EF0 to EF1) have been recorded in the region and are expected to occur again.

Historical examples, such as the EF1 tornado in Denair (2015) and the EF0 tornado near Salida (2025), demonstrate that tornadoes are a recurring hazard in Stanislaus County. For this reason, the probability of at least one tornado event occurring in or near TID in the future is considered: **Highly Likely.**

For information regarding the identification of structures and Estimates of potential losses due to a tornado, see page 8o.

Methodology for Exposure, Vulnerability, and Loss Estimation

To evaluate the potential impacts of extreme weather hazards on District facilities TID utilized a consistent, FEMA-aligned methodology adapted to the characteristics of these atmospheric events:

I. Inventory of Assets

- Developed a comprehensive inventory of TID-owned infrastructure, buildings, and equipment.
- Assets were grouped by operational function consistent with District accounting categories (e.g., Substations, Transmission/Distribution, Generation, Water Infrastructure, Vehicles/Equipment, Other Real Property).

II. Hazard Definition and Exposure Mapping

- Used National Weather Service (NWS), FEMA, and Cal OES hazard definitions to characterize the nature and extent of each weather hazard.
- Identified areas of historical or modeled exposure based on climatological records, flood-prone locations, elevation, vegetation cover, and prior event data.
- For spatial hazards (e.g., tornadoes, extreme rainfall), geographic overlays were used to identify potentially affected assets.
- For non-spatial hazards (e.g., poor air quality, extreme heat), exposure was considered system-wide.

III. Vulnerability Assessment

- Assessed asset sensitivity based on location, design standards, and operational function.
- Identified outdoor or unshielded assets (e.g., poles, substations, vehicles, canal infrastructure) as more vulnerable to high winds, heat, or particulate accumulation.
- Considered operational disruption, equipment stress, and worker safety as key vulnerability factors for high-heat and poor air quality scenarios.

IV. Loss Estimation

- Estimated potential replacement costs for vulnerable assets using standard cost assumptions and TID financial records.
- Presented loss estimates by hazard type and asset group in the associated Replacement Cost Summary Tables.
- Where appropriate, qualitative loss indicators (e.g., potential service interruptions, downtime, maintenance costs) were also identified.

This methodology provides a consistent, repeatable process for evaluating the potential impacts of earthquakes on TID's infrastructure and supports prioritization of mitigation actions.

Identifying Structures and Estimating Potential Losses from Extreme Weather-Related Events

This section is based on an inventory of existing and future buildings, infrastructure, and critical facilities that would most likely be impacted by an extreme weather-related event. Due to the unique nature of its facilities and assets, the TID has grouped them into the following categories:

- Water Storage
- Water Delivery
- Pumping and Drainage
- Transmission Lines
- Distribution Lines
- Other Buildings and Real Property
- Vehicles and Equipment

These groupings are consistent with TID's accounting structure and allow it to address portions of facilities which crossed hazard boundaries. Within groupings, the value of the individual assets has been calculated using standard replacement cost methodologies.

For purposes of identifying structures and estimating potential losses in this risk assessment, each identified extreme weather phenomena has been listed separately with the associated structures and exposure levels.

Table 26. Damaging Winds Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 0
Pumping & Drainage	$ 0
Generation	$ 0
Substations	$ 0
Transmission	$ 125,000,000
Distribution	$ 149,300,379
Other Buildings and Real Property	47,089
Vehicles & Equipment	$ 0

Table 27. Extreme Temperatures Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 0
Pumping & Drainage	$ 0
Generation	$ 0
Substations	$ 0
Transmission	$ 0
Distribution	$ 27,594,361
Other Buildings and Real Property	$ 4,190,107
Vehicles & Equipment	$ 0

Table 28. Localized Extreme Rainfall Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 465,717,348
Pumping & Drainage	$ 0
Generation	$ 227,464,042
Substations	$ 2,231,442
Transmission	$ 0
Distribution	$ 0
Other Buildings and Real Property	$ 2,340,893
Vehicles & Equipment	$ 0

Table 29. Poor Air Quality Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 0
Pumping & Drainage	$ 0
Generation	$ 0
Substations	$ 0
Transmission	$ 0
Distribution	$ 0
Other Buildings and Real Property	$ 0
Vehicles & Equipment	$ 0

Table 30. Tornado Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 0
Pumping & Drainage	$ 0
Generation	$ 0
Substations	$ 0
Transmission	$ 0
Distribution	$ 0
Other Buildings and Real Property	$ 0
Vehicles & Equipment	$ 0

Flooding

Vulnerability Overview

Flooding is the temporary inundation of land that is normally dry, caused by the overflow of rivers, lakes, or other bodies of water, or by the accumulation of surface water that cannot be absorbed into the ground. Floods may result from prolonged rainfall, rapid snowmelt, or controlled and uncontrolled releases from upstream reservoirs. When river flows exceed channel capacity—particularly along bends or meandering sections—water may overtop banks and spread into adjacent areas.

Flooding can occur gradually, following extended periods of rainfall, or develop rapidly with little warning during intense storms. These sudden events, known as flash floods, are more common in desert environments but can occur anywhere conditions cause heavy rainfall to overwhelm local drainage capacity.

Urban flooding occurs when precipitation exceeds the capacity of stormwater systems in developed areas. Impervious surfaces such as roads, parking lots, and rooftops prevent infiltration, leading to rapid runoff. When storm drains or culverts are undersized or obstructed by debris, localized flooding can inundate streets, damage property, and disrupt transportation.

Within the TID service area, the most significant flood hazards are associated with the Tuolumne, Merced, and San Joaquin Rivers, which can overflow their banks during high-flow conditions resulting from heavy rainfall, snowmelt, or flood-control releases from upstream reservoirs including Friant, Exchequer, and Don Pedro dams. Floodwaters from these sources can impact agricultural lands, roadways, substations, canal embankments, and other District infrastructure located within or near riverine floodplains.

Localized flooding also occurs throughout the TID service area during high-intensity storms, particularly in low-lying agricultural areas and older urban drainage systems where stormwater conveyance is limited. While flood-control projects and levee systems along the Tuolumne and San Joaquin Rivers provide a degree of protection, these systems require ongoing maintenance and coordination among local, state, and federal partners to manage flood risk effectively.

Table 31. Basis for Hazard Identification and Inclusion – Flooding

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Flooding	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus, Merced, and Tuolumne Counties. • Supported by input from the TID Planning Team. • Documented previous flood occurrences within Stanislaus County.	• Documented previous flood occurrences within the region. • Continued potential for future flooding events. • Included due to the potential for loss of life and widespread property damage. • Potential for localized flooding along TID canals, laterals, and drainage infrastructure resulting from heavy rainfall, levee breaches, or infrastructure failure. • Flooding identified as a recurring regional hazard in adjacent county and state-level mitigation plans. • Exposure of TID facilities and critical assets located within or near FEMA Special Flood Hazard Areas (SFHAs) or areas of poor drainage. • Potential for flood events to disrupt power generation, transmission, and water delivery operations. • Considered a high-priority hazard due to TID's role in water conveyance and flood management coordination with local jurisdictions.

Location

Flooding within TID's service area is primarily associated with the Tuolumne, San Joaquin, and Merced Rivers and their tributary and drainage systems. Flood control operations at Don Pedro Reservoir substantially reduce downstream flood risk along the Tuolumne River but do not eliminate it. The river can produce significant flows during major winter storms and snowmelt events, with typical winter and early spring inflows into Don Pedro Reservoir ranging between 50,000 and 75,000 cubic feet per second (cfs). Flows exceeding 100,000 cfs have been recorded during large regional storm systems.

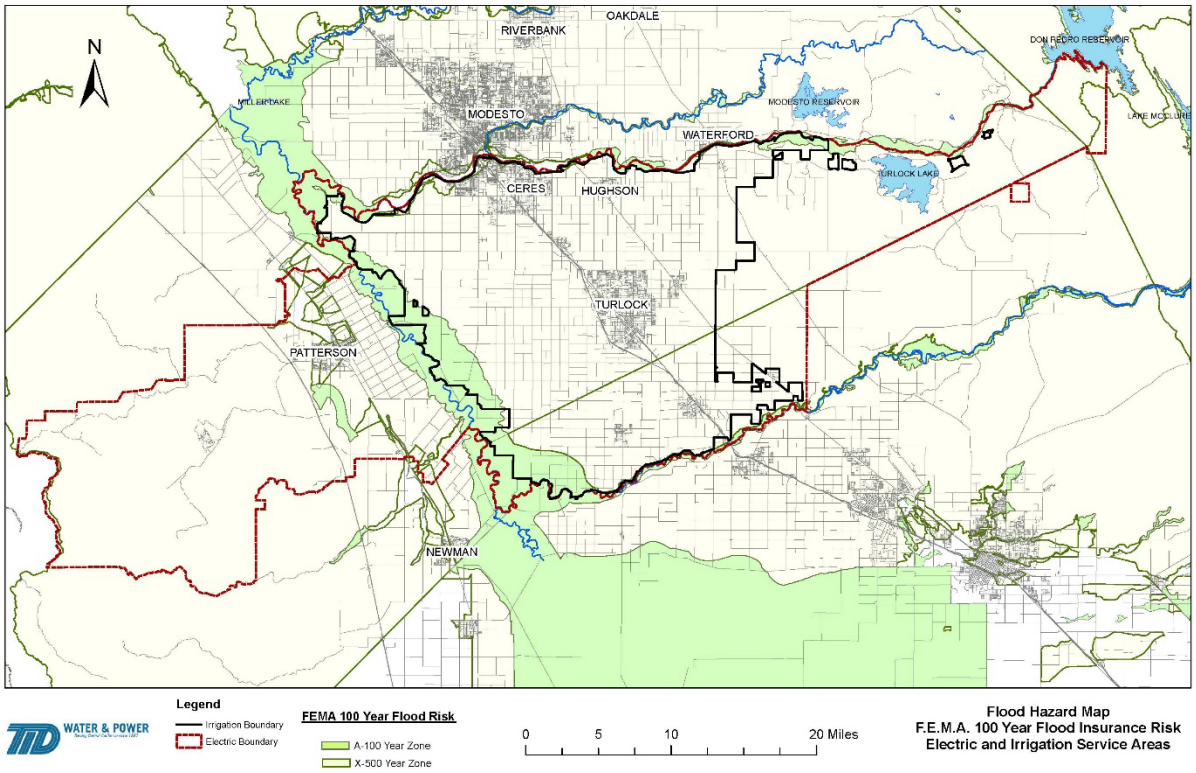
TID continuously monitors conditions on the Tuolumne River using USGS stream gauge 11290000, located near the Ninth Street Bridge in Modesto. Flood stage at this gauge is defined as 55 feet above sea level (ASL), and releases from Don Pedro are managed to maintain river levels below flood stage whenever possible. Just upstream of the gauge, Dry Creek, an uncontrolled tributary draining portions of eastern Stanislaus County, enters the Tuolumne and can significantly increase river stages in Modesto. Because Dry Creek lacks any regulating reservoir or flood-control infrastructure, runoff from intense rainfall can rise rapidly and contribute substantial additional flow to the Tuolumne. When Dry Creek flows are elevated, TID adjusts Don Pedro operations to account for these uncontrolled inflows.

The Tuolumne River joins the San Joaquin River near Vernalis, west of Modesto. Coordination among operators managing the Tuolumne, Merced, and other San Joaquin River tributaries, including Friant, Exchequer, and New Melones Dams, is essential to maintaining downstream flood system capacity. During large regional events or atmospheric river conditions, simultaneous reservoir releases can create complex hydrologic interactions throughout the San Joaquin Valley floodplain.

Flood-prone areas within TID are generally located along the Tuolumne and San Joaquin River corridors, in low-lying agricultural areas, and within urbanized stormwater basins where drainage is limited. FEMA Flood Insurance Rate Maps (FIRMs) identify substantial portions of these river corridors within Zone AE (1-percent-annual-chance floodplain) and Zone X (shaded) areas subject to 0.2-percent-annual-chance flooding. The FEMA Digital Flood Insurance Rate Map (DFIRM) update completed in 2020 reflects the most recent delineations of these zones, supplemented by the California Department of Water Resources Awareness Floodplain Mapping Program. Localized ponding and urban drainage flooding also occur in developed areas of Turlock, Ceres, and Modesto where stormwater systems are undersized or obstructed.

As an uncontrolled tributary, Dry Creek can rise quickly in response to localized heavy rainfall, causing sudden increases in Tuolumne River stage levels through Modesto and downstream areas. The timing and magnitude of these inflows can complicate flood management operations at Don Pedro, particularly during regional storm systems or atmospheric river events when multiple tributaries experience high runoff simultaneously. Consequently, the extent and severity of flooding in the service area depend not only on storm intensity and basin saturation, but also on the timing and interaction of uncontrolled tributary inflows with coordinated reservoir operations across the Tuolumne and San Joaquin watersheds.

Map 5. FEMA Firm Map



Extent

Flooding has historically posed a recurring hazard in Stanislaus County, particularly as urban development has expanded into natural floodplains. Major floods were recorded in 1861, 1938, 1950, 1955, 1969, 1983, 1995, 1997, and 1998, with the 1997 event representing the flood of record for the Don Pedro Project [80]. More recent flooding occurred in 2017, affecting low-lying areas along the Tuolumne River and its confluence with the San Joaquin River [80]. Minor flooding was also documented in 2006. Seasonal flooding along Dry Creek, the San Joaquin River, and the Tuolumne River is common during very wet years [80].

Flood control operations at Don Pedro Reservoir substantially reduce downstream flood risk but cannot fully eliminate it. The Tuolumne River can produce large flows during major winter storms and snowmelt events, with typical winter and early spring inflows into Don Pedro ranging between 50,000 and 75,000 cfs. Flows exceeding 100,000 cfs have been recorded during major regional storm systems [82]. Dry Creek, an uncontrolled tributary that drains portions of eastern Stanislaus County, enters the Tuolumne near Modesto and contributes to increased flood potential within the urbanized corridor. Because Dry Creek lacks a regulating reservoir or flood-control structures, it can rise rapidly in response to localized rainfall, complicating flood management operations at Don Pedro [80, 82].

The State Reclamation Board, now the Central Valley Flood Protection Board, has designated regulated floodways, expressed in cubic feet per second of flow, along the San Joaquin, Stanislaus, and Tuolumne Rivers and portions of Dry Creek. [70] These defined floodways help maintain conveyance capacity and guide development restrictions in high-hazard corridors. Under the Central Valley Flood Protection Plan (CVFPP), Stanislaus County and its cities must maintain a 200-year level of flood protection for areas developed or planned for populations exceeding 10,000 [80].

According to the 2022 Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, approximately 100,447 acres of the county lie within FEMA-designated floodplains, representing 10.3 percent of the county's total land area [80].

Flood severity within TID varies with storm intensity, basin saturation, and the timing of reservoir releases throughout the Tuolumne and San Joaquin watersheds. Depths of inundation within mapped floodplains range from less than one foot in low-lying agricultural areas to more than six feet along primary river channels and oxbow areas near Modesto [82, 83]. Flood duration can extend for several days when backwater effects from the San Joaquin River limit drainage from the Tuolumne system [82, 83].

Vulnerable populations include residents of low-lying mobile home parks along the rivers and individuals experiencing homelessness, particularly in encampments within the Modesto and Ceres floodplains [80]. The Sutter Wastewater Treatment Plant in Modesto is also located near the floodplain and may experience operational impacts from rising floodwater during major events [80].

Flooding could have significant economic consequences for the region. TID's irrigation infrastructure, including canals, diversion works, and pumping stations, could sustain damage from erosion or prolonged inundation, especially if a major flood occurred prior to the irrigation season [80, 82].

A disruption of deliveries from the Tuolumne River would impact agricultural operations that generate hundreds of millions of dollars in annual crop value. Based on economic data from the Don Pedro Project Relicensing Socioeconomics Study Report (2014) [81], agriculture supported by TID contributes approximately $359 million in annual crop production value and over $850 million in total economic output, sustaining roughly 7,300 jobs across Stanislaus, Merced, and Tuolumne Counties [81].

80. Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, 2022–2027 Update
81. Turlock and Modesto Irrigation Districts. Don Pedro Project Relicensing Socioeconomics Study Report. April 2014.
82. FEMA. Flood Insurance Study for Stanislaus County, California. 2018.
83. U.S. Army Corps of Engineers. Central Valley Hydrology Study. 2019.

Development Since 2020 and the Impact on Flooding

Since the last update of Stanislaus County's Local Hazard Mitigation Plan in 2022, development within TID's service area has remained largely limited to infill and redevelopment projects within existing city limits. There has been no significant new development within mapped flood hazard zones or other areas that would materially increase flood risk or exposure [84].

Incorporated areas such as Turlock, Ceres, and Modesto continue to direct growth toward previously urbanized parcels served by existing infrastructure, consistent with the principles of the Stanislaus County General Plan and the Sustainable Communities Strategy adopted by the Stanislaus Council of Governments (StanCOG). Agricultural land and open space within TID's rural service area remain largely unchanged, preserving their role as natural flood buffers and percolation zones [84, 85].

Stanislaus County and its incorporated cities have adopted comprehensive floodplain management regulations consistent with federal and state standards. Development in unincorporated areas is regulated under Chapter 16.50 (Flood Damage Protection) of the Stanislaus County Code, which requires:

- Prohibition of new structures or substantial improvements within designated floodways, except for facilities authorized by the Central Valley Flood Protection Board.
- Compliance with FEMA 100-year floodplain elevation and floodproofing requirements, including elevation of the lowest floor above the base flood elevation.
- Review and approval of all development proposals within special flood hazard areas to ensure compliance with National Flood Insurance Program (NFIP) standards [84, 86].

The County also uses the California Environmental Quality Act (CEQA) process to identify and mitigate potential flood hazards for discretionary development projects. CEQA review ensures that projects susceptible to flooding incorporate adequate mitigation measures, such as improved drainage, floodproofing, or elevation above mapped flood levels [85, 86].

In addition, Stanislaus County participates in the National Flood Insurance Program (NFIP), enabling eligible property owners to purchase federally backed flood insurance. The County also promotes flood hazard awareness among residents and supports the formation of local improvement districts and flood control districts to address localized flood concerns and infrastructure improvements.

Under the Central Valley Flood Protection Plan (CVFPP) and associated SB 5 (2007) legislation, all urbanized areas within the County are required to maintain a 200-year level of flood protection for areas with populations exceeding 10,000. These standards are implemented through the County's floodplain management ordinances and are consistent with the 2022 Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan [85, 86].

84. Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, 2022–2027 Update
85. Stanislaus Council of Governments (StanCOG). Sustainable Communities Strategy. Adopted 2018; reaffirmed 2022.
86. Stanislaus County Code of Ordinances, Chapter 16.50 Flood Damage Protection. Current through Ordinance 2024-02.

The Impact of Future Development Trends on Flooding

Future development within TID's service area is expected to remain modest and focused primarily on infill and redevelopment within existing urban boundaries. No major land use changes or large-scale urban expansion into mapped flood hazard areas are anticipated through the next planning cycle [87]. Ongoing coordination between TID, Stanislaus County, and local jurisdictions ensures that future growth remains consistent with the Stanislaus County General Plan, StanCOG Sustainable Communities Strategy, and 2022 Multi-Jurisdictional Hazard Mitigation Plan, all of which emphasize directing development away from special flood hazard areas and maintaining agricultural and open space uses in flood-prone zones [87, 88].

As climate variability increases the frequency of high-intensity precipitation events, the County and its cities continue to integrate low-impact development (LID) design standards, stormwater detention, and green infrastructure into new projects to reduce surface runoff and localized flooding. Any future development within unincorporated areas will remain subject to Chapter 16.50 of the Stanislaus County Code (Flood Damage Protection) and Central Valley Flood Protection Plan (CVFPP) requirements to achieve and maintain a 200-year level of flood protection [87, 89, 90]. These measures, combined with continued county participation in the National Flood Insurance Program (NFIP), are expected to limit increases in flood exposure resulting from future development.

87. Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, 2022–2027 Update, Section 4.3.9 Flooding.
88. Stanislaus Council of Governments (StanCOG). Sustainable Communities Strategy. Adopted 2018; reaffirmed 2022.
89. Stanislaus County Code of Ordinances, Chapter 16.50 Flood Damage Protection. Current through Ordinance 2024-02.
90. California Department of Water Resources. Central Valley Flood Protection Plan (CVFPP): 2022 Update.

New Occurrences of Flooding Since 2020

Since completion of the 2020 Local Hazard Mitigation Plan, several significant precipitation events have affected Stanislaus County and portions of TID's service area. While no catastrophic flooding has occurred within TID's facilities, multiple regional storm systems between 2022 and 2023 produced localized flooding and operational impacts, particularly during the series of atmospheric river events that affected much of California in early 2023 [91]. These events resulted in documented damage to TID facilities and regional infrastructure.

During January and March 2023, successive atmospheric rivers resulted in record rainfall totals across the San Joaquin Valley. The Tuolumne and San Joaquin Rivers reached elevated stages, and localized flooding occurred in low-lying agricultural areas, drainage laterals, and rural roadways throughout TID's western and southern boundaries [91, 92]. Although coordinated flood operations at Don Pedro Reservoir successfully reduced peak downstream flows, some TID canals, laterals, and access roads experienced temporary overtopping and erosion requiring repairs [91].

Localized ponding was also reported within portions of Ceres, Modesto, and Turlock, primarily where urban stormwater systems became overwhelmed by short-duration, high-intensity rainfall. The 2022 Stanislaus County MJLHMP noted these events as representative of the increasing frequency of extreme precipitation patterns driven by atmospheric rivers and emphasized the importance of continued coordination with regional flood agencies [91, 92].

A Presidential Disaster Declaration (DR-4683-CA) was issued in January 2023 for flood-related damages across multiple counties, including Stanislaus County. TID applied for and received disaster assistance under this declaration to support recovery and repair of affected facilities. [93].

Overall, recent flood activity underscores the continuing importance of reservoir operations, levee maintenance, and stormwater system coordination to protect both District assets and downstream communities. These events also reinforce the need for ongoing assessment of potential climate-driven changes in precipitation intensity and runoff characteristics across the Tuolumne River watershed [91, 92, 93].

91. Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, 2022–2027 Update, Section 4.3.9 Flooding.
92. National Weather Service, Hanford CA. 2023 Atmospheric River Event Summaries and Hydrologic Outlooks, January-March 2023.
93. Federal Emergency Management Agency (FEMA). Presidential Disaster Declaration DR-4683-CA, January 2023.

Probability of Future Flooding Events

Flooding remains one of the most significant and recurring natural hazards affecting Stanislaus County and TID's service area. Historical records show that flooding has occurred repeatedly across the region, with notable events in 1861, 1938, 1950, 1955, 1969, 1983, 1995, 1997, 1998, and 2017 [94]. More recent atmospheric river storms in 2023 again produced high river stages and localized flooding along the Tuolumne and San Joaquin Rivers [95].

Flood risk persists along multiple waterways in and adjacent to TID, including Dry Creek, Orestimba Creek, Del Puerto Canyon, Salado Creek, the Tuolumne River, and the San Joaquin River. The greatest and most frequent impacts occur along Dry Creek, the Tuolumne River, and the San Joaquin River, where floodwaters can affect urbanized and agricultural areas as well as District infrastructure.

The Dry Creek watershed remains a key factor influencing flood potential in eastern Stanislaus County and the Modesto area. As an uncontrolled tributary, it can rise quickly during periods of intense rainfall and contribute substantial inflows to the Tuolumne River. To improve situational awareness and flood monitoring, Stanislaus County operates a Remote Automated Weather Station (RAWS) near Crabtree Road, and the Turlock Irrigation District maintains an additional weather station on the upper Dry Creek watershed to assist in monitoring rainfall and runoff conditions [94].

Given the region's hydrologic characteristics, history of recurring flood events, and the uncontrolled nature of tributaries such as Dry Creek, the probability of future flooding within TID's service area is considered: **Highly Likely**.

94. Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, 2022–2027 Update, Section 4.3.9 Flooding.
95. National Weather Service, Hanford CA. 2023 Atmospheric River Event Summaries and Hydrologic Outlooks, January–March 2023.

Repetitive Loss Properties

According to Stanislaus County's Repetitive Loss Area Maps, several locations within TID's service area contain properties that have sustained multiple flood insurance claims under the National Flood Insurance Program (NFIP) [96]. While TID maintains irrigation and electrical infrastructure in and around these identified areas, no TID-owned facilities have experienced repetitive flood-related losses and TID does not participate in the NFIP. Ongoing maintenance of canal embankments, drainage structures, and electrical assets in flood-prone areas continues to reduce the potential for repetitive loss.

96. Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, 2022–2027 Update, Section 4.3.9 Flooding.

Identifying Structures and Estimating Potential Losses from Flooding

Flooding presents one of the most consistent and costly threats to District infrastructure due to the close proximity of many TID assets to natural waterways, canals, and drainage systems. Flood events can result from heavy rainfall, riverine overflow, or releases from upstream reservoirs and have the potential to cause erosion, structural damage, and operational disruptions.

This section evaluates District facilities and infrastructure that could be affected by a major flooding event and

Methodology for Exposure, Vulnerability, and Loss Estimation

To evaluate the potential impacts of flooding on District facilities, TID applied a consistent, FEMA-aligned methodology adapted to the characteristics of hydrologic and hydraulic hazards.

I. Inventory of Assets

- Using a comprehensive inventory of TID-owned infrastructure, facilities, and equipment, assets were grouped by operational function consistent with TID's accounting categories.
- Asset valuation was based on current replacement costs derived from TID financial records and industry cost benchmarks.

II. Hazard Definition and Exposure Mapping

- Defined the flood hazard using FEMA Flood Insurance Rate Maps (FIRMs), DWR Awareness Floodplain Maps, and U.S. Geological Survey (USGS) hydrologic data.
- Identified areas of potential inundation corresponding to the 100-year and 500-year floodplains.
- Overlaid floodplain boundaries with District asset locations using GIS-based mapping.
- Incorporated topography, levee locations, and reservoir release scenarios to refine the exposure of critical infrastructure, particularly along the Tuolumne River, Dry Creek, and San Joaquin River.

III. Vulnerability Assessment

- Evaluated each asset's flood sensitivity based on proximity to waterways, elevation, drainage capacity, and construction type.
- Identified facilities most susceptible to inundation or erosion.
- Considered secondary vulnerabilities such as access limitations, electrical system interruptions, and sediment or debris accumulation. .

IV. Loss Estimation

- Estimated potential replacement costs for assets located within mapped flood hazard zones using standard cost assumptions and FEMA's Hazus-based methodology.
- Where detailed replacement values were available, site-specific loss estimates were applied; otherwise, proportional exposure values were derived from comparable facility types.
- Loss estimates by facility groups shown in the Flood Replacement Cost Summary Table include potential service interruptions, and long-term maintenance requirements.
- Recognized that losses from flooding are most often associated with infrastructure damage and service disruption, rather than total structural loss of occupied buildings.

This approach allows TID to consistently estimate flood-related losses across its diverse infrastructure portfolio, ensuring comparability with other hazard types and supporting data-driven prioritization of mitigation investments throughout TID.

estimates potential replacement costs based on exposure within mapped flood hazard areas.

Because of the unique nature of District-owned assets, TID categorizes its facilities into the following functional groups:

- Water Storage
- Water Delivery
- Pumping and Drainage
- Transmission Lines
- Distribution Lines
- Other Buildings and Real Property
- Vehicles and Equipment

These categories are consistent with TID's internal accounting and asset management structure and allow for the assessment of facilities that cross multiple hazard boundaries. Within each grouping, the value of individual assets has been estimated using standard replacement cost methodologies consistent with FEMA and Cal OES guidance.

For flood hazard analysis, TID's asset inventory was compared against FEMA FIRMs and DWR Awareness Floodplain Maps to determine exposure within the 1-percent-annual-chance (100-year) and 0.2-percent-annual-chance (500-year) floodplains. Facilities located within or adjacent to these mapped flood zones were considered at risk of inundation or secondary impacts such as erosion, electrical system interruption, and limited facility access.

TID's water storage and delivery systems are most susceptible to flooding due to their proximity to natural and constructed waterways, including the Tuolumne River, Ceres Main Canal, and associated laterals and drains. Pumping and drainage facilities may also be affected when high water levels reduce discharge capacity or cause localized overtopping.

Electrical transmission and distribution assets are less likely to sustain direct flood damage but may be impacted by prolonged submersion of access routes or support structures.

Potential losses were estimated based on the replacement cost of exposed assets within mapped flood hazard areas. Because flooding primarily affects infrastructure and not occupied buildings, estimated losses reflect physical damage to canals, pumping plants, substations, and associated appurtenances rather than displacement or structural loss of personnel facilities.

Table 32. Flooding Summary of At-Risk Assets and Replacement Values

	100 Year Flood	500 Year Flood
Water Delivery	$ 15,364,914	$ 15,364,914
Pumping & Drainage	$ 0	$ 0
Generation	$ 0	$ 0
Substations	$ 23,043,034	$ 35,180,816
Transmission	$ 5,700,000	$ 10,700,000
Distribution	$ 27,689,474	$ 27,689,474
Other Buildings and Real Property	$ 0	$ 0
Vehicles & Equipment	$ 0	$ 0

Landslides

Vulnerability Overview

A landslide is the downslope movement of soil, rock, or debris under the influence of gravity. Landslides are a form of mass wasting, a broader term describing any movement of earth materials down a slope. The term “landslide” includes several distinct types of movement: falls, topples, slides, spreads, and flows, which are further classified by the geologic material involved (bedrock, debris, or earth). Common examples affecting developed or natural areas include debris flows (often referred to as mudslides or mudflows) and rockfalls.

Landslides typically result from a combination of natural and human-induced factors. Slope failure occurs when the forces driving material downslope exceed the strength of the slope materials resisting movement. Contributing factors may include increased soil saturation due to rainfall or snowmelt, rapid changes in groundwater levels, stream or canal erosion, seismic shaking, loss of vegetation, and human activities such as grading, excavation, or drainage alteration. Earthquakes can also trigger underwater slope failures known as submarine landslides, which in some cases generate tsunamis that threaten coastal areas.

Within and adjacent to TID’s service area, landslide potential is generally limited to the hilly or steeply sloped terrain near the eastern and western boundaries of TID. Although the majority of the service area lies on relatively flat valley floor, localized slope movement can still occur along canal embankments, levees, and drainage channels where soils become saturated or destabilized.

Post-wildfire conditions significantly increase landslide susceptibility, particularly in areas where vegetation loss and soil hydrophobicity occur. Following a wildfire, intense rainfall can trigger fast-moving debris flows capable of causing severe damage to infrastructure and endangering lives. These events may continue to pose hazards for several years as root systems decay and soil cohesion decreases. Post-fire debris flows can obstruct waterways, damage transportation corridors, and threaten downstream facilities and communities.

Table 33. Basis for Hazard Identification and Inclusion – Landslide

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Landslide	• Recognized in the Multi-Jurisdictional LHMPs for Stanislaus, Merced, and Tuolumne Counties. • Documented previous landslide occurrences within Stanislaus County.	• Documented previous landslide occurrences within the region. • Continued potential for future slope instability and landslide events. • Included due to potential impacts on TID infrastructure located near hillsides, canals, or other sloped terrain. • Recognized in neighboring county hazard mitigation plans as a regional concern that could indirectly affect District operations and service continuity. • Retained for monitoring and coordination purposes, even though overall probability and exposure remain limited compared to other hazards.

Location

Landslide risk within the TID service area is generally confined to foothill zones along the western and eastern areas of TID. On the west side, the TID boundary extends into the Diablo Range where much of the terrain west of Interstate 5 is underlain by geological formations that, because of steep slopes, structural weaknesses, high runoff potential, limited vegetative cover, seismic activity, and soil disturbance, are considered highly susceptible to slope failure.

On the eastern side, portions of TID lie within the western foothills of the Sierra Nevada (Tuolumne County). In the vicinity of Turlock Lake and La Grange, geological conditions suggest elevated susceptibility to landslides and debris flows, especially around the upper reaches of the Tuolumne River canyon above Don Pedro Reservoir. The 2013 Rim Fire burned over 400 square miles in the watershed, creating zones of hydrophobic soil that repel water and fail to absorb rainfall, increasing post-fire debris flow potential (e.g., steep burned drainages unable to infiltrate rainwater may generate rapid runoff and sediment transport).

Wildfire-induced changes to slope hydrology are a recognized trigger for debris flows after high-intensity storms. In recently burned terrains, the rainfall threshold to initiate mass movement can be significantly lower, as vegetation and organic matter are removed and soils become more erodible [97]. Further, post-fire landscapes with burn scars often show elevated debris-flow hazards, especially during atmospheric river events or localized intense storms [98].

97. Culler, E. S., Livneh, B., Rajagopalan, B., & Tiampo, K. F. (2023). A data-driven evaluation of post-fire landslide susceptibility. Natural Hazards and Earth System Sciences.
98. USGS. Assessment of Landslide and Debris-Flow Impacts from California Wildfires

Extent

Landslides in the TID service area vary in scale and velocity, ranging from slow-moving earth slumps to rapid debris avalanches capable of causing significant localized damage. The extent of landslide impacts is typically confined to foothill regions along TID's western and eastern boundaries, where steep slopes, weathered geologic formations, and limited vegetation increase susceptibility. Landslides are often triggered by other natural hazards, most commonly heavy rainfall, earthquakes, flooding, or post-wildfire conditions, and their frequency closely correlates with the recurrence of those events.

In Stanislaus County, landslides most frequently occur during or immediately following major winter storms, when sequential rainfall events saturate steep and unstable soils. The winters of 1982–1983 and 1997 provide two well-documented examples. During the 1982–1983 El Niño season, extensive soil saturation in the Diablo Range resulted in multiple slope failures and roadway damage along Del Puerto Canyon Road. Similarly, the 1997 winter storms triggered an approximately 0.1-mile landslide of mud, rock, and boulders in the same area, closing one lane for several months while repairs were completed. These types of failures are typical of steep road cuts and drainages in the Diablo Range, where stormwater runoff rapidly saturates soils and weak sedimentary layers.

The most common and damaging types of slope movement in the region are debris flows and debris avalanches; rapid, shallow landslides that occur when soil and rock become saturated with water and move downslope as a slurry of mud, rock, and vegetation. Debris flows can initiate on slopes as shallow as 15 degrees but are more hazardous and mobile on steeper gradients exceeding 30 degrees. About two-thirds of debris avalanches begin in small hollows or troughs at the heads of drainage courses, then accelerate downslope following stream channels and natural gullies. When rainfall intensity exceeds the soil's infiltration capacity, particularly after prolonged wet periods, localized debris flows can occur with little or no warning.

Post-wildfire landscapes are especially vulnerable. Burned and hydrophobic soils in the Tuolumne River watershed, created by the 2013 Rim Fire, continue to pose a long-term debris-flow hazard during intense or prolonged rainfall events. Wildfire-damaged slopes lose stabilizing vegetation and develop water-repellent surface layers that promote rapid runoff and slope failure [99]. Following high-intensity storms or atmospheric river events, such areas can experience debris flows capable of transporting large volumes of sediment and vegetation into downstream reservoirs such as Don Pedro [100].

While most landslides within the TID service area are localized and small in scale, the potential exists for larger debris-flow events in foothill zones where steep slopes, thin soils, and post-fire conditions converge. These events can obstruct roadways, damage canals or pipelines, and increase sediment loads in water conveyance systems. The extent of landslide impacts is therefore classified as limited to moderate under FEMA's qualitative scale—affecting isolated facilities and transportation corridors but unlikely to cause widespread system-wide damage.

99. California Geological Survey (CGS). Landslide Hazards in California: Causes and Mitigation. (2022).
100. U.S. Geological Survey. Post-Fire Debris Flow Hazards in the Sierra Nevada and Central California Foothills.

Development Since 2020 and the Impact on Landslides

Since 2020, incremental development and land-use change within and around the TID service area have introduced new factors that can exacerbate landslide vulnerability, particularly in foothill and canyon settings. While major urbanization remains limited in steep zones, the following considerations merit inclusion in the hazard profile:

- **Increased impervious surfaces and altered drainage.** New development (residential, agricultural infrastructure, road expansions) increases areas of impermeable cover (pavement, rooftops), reducing infiltration and increasing runoff volumes and peak flows. This can concentrate flow in drainage channels adjacent to slopes, elevating the triggering potential for shallow slope failures or debris flows [101].
- **Road and utility corridor expansions.** New or widened roads, cut-and-fill slopes, or utility corridors through foothill terrain can produce steepened cut slopes, reduce lateral support, and alter subsurface water pathways, destabilizing previously stable slopes.
- **Land grading and vegetation removal.** Clearing of vegetation for development or maintenance including land cleared for fire safety and the creation of defensible space, reduces slope reinforcement by plant and tree roots and increases erosion potential during storms.
- **Stormwater infrastructure upgrades and channel modifications.** As flood control or drainage improvements are built, modifications to drainage networks (conveyance channels, culverts, retention basins) may redirect water flows or concentrate runoff, which can influence slope-adjacent hydrology and increase landslide risk in some areas.
- **Post-fire burn scar effects.** Burned areas resulting from wildfires (which have continued since 2020) remain susceptible to hydrophobic soils, decreased vegetative cover, and destabilized slopes. As additional wildfires occur, the cumulative burned acreage expands the zone of elevated landslide susceptibility. The post-fire conditions in these zones can persist for several years, raising debris-flow risk during high-intensity rain [102].
- **Climate-driven intensification of precipitation extremes.** Recent regional trends and climate projections suggest an increase in extreme rainfall events, especially during atmospheric river conditions, which places additional stress on slopes—particularly those with modified land cover or altered drainage [103].
- **Cumulative stress and slope fatigue.** Repeated cycles of wetting, drying, freeze/thaw, and minor slope movements can weaken soils and underlying layers over time. New development may accelerate this cumulative stress by altering subsurface hydrology or imposing new loadings.
- **New residential and infrastructure exposure in marginal terrains.** Some new development encroaches nearer to foothill slopes or drainage channels, increasing the number of assets (roads, houses, pipelines) exposed if a landslide or debris flow occurs. Even if slopes do not move, runout zones or sediment deposition pathways may cross new developments.

The incremental effect of these changes does not necessarily guarantee increased large-scale landslides, particularly in the relatively moderate terrain of TID. However, they heighten the probability and potential consequences of localized shallow failures or debris flows, particularly in vulnerable foothill areas.

101. White, M. D., & Greer, K. A. (2006). The effects of watershed urbanization on stream hydrology and riparian systems.
102. Semnani, S. J., Han, Y., Bonfils, C. J., & White, J. A. (2025). Assessing the impact of climate change on rainfall-triggered landslides in California.
103. Johnston, E. C., et al. (2021). Quantifying the Effect of Precipitation on Landslide Hazard in Urbanized Areas.

The Impact of Future Development Trends on Landslides

Future development within the TID service area is expected to remain largely concentrated in the valley floor, where slope instability hazards are minimal. However, limited development continues to occur in the foothill regions at the western and eastern edges of TID, where landslide susceptibility is higher due to steep topography, erosive soils, and proximity to drainages.

The Diablo Grande Community, located west of Interstate 5 in the Diablo Range, remains the most significant area of planned development in terrain susceptible to slope instability. Originally approved in 1993 for approximately 5,000 residential units, the project has experienced slow build-out over the past two decades, with only a portion of the planned development completed. Recent activity indicates moderate construction is expected to continue over the next several years. Although large-scale expansion west of Interstate 5 is not currently anticipated, any future proposals for significant development beyond the currently permitted density of two dwellings per 160 acres should include site-specific geotechnical and slope stability evaluations, consistent with recommendations in the Stanislaus County LHMP and county development policies [104].

On the eastern side of TID, incremental rural residential construction and infrastructure upgrades continue near La Grange and Turlock Lake in the lower Sierra Nevada foothills. These areas, while not heavily developed, contain slopes and drainages that could be affected by runoff concentration, grading activities, and vegetation removal associated with small-scale development [105].

Looking forward, potential slope disturbance and erosion hazards may be influenced by:

- Increased rural residential and recreational development pressure near existing foothill communities.
- Expansion of transportation or utility infrastructure that requires slope modification or cut-and-fill construction.
- Continued vegetation management and wildfire fuel reduction projects that temporarily expose soils to erosion and runoff.
- Changing precipitation patterns and storm intensity, which may increase the frequency of short-duration, high-intensity rainfall capable of triggering slope failures [106].

Overall, future development is expected to have a limited but localized impact on landslide potential within the TID service area. Adherence to geotechnical study requirements, slope stabilization standards, and stormwater best management practices will remain essential in mitigating risk for any new hillside or canyon development. TID should continue coordinating with Stanislaus and Tuolumne Counties to ensure that new projects in hillside areas incorporate appropriate design and mitigation measures to minimize long-term slope instability.

104. Stanislaus County Office of Emergency Services. Stanislaus County Multi-Jurisdictional Local Hazard Mitigation Plan Update (2023).
105. Tuolumne County Office of Emergency Services. Tuolumne County Multi-Jurisdictional Hazard Mitigation Plan (2022).
106. California Department of Water Resources (DWR). Statewide Flood and Climate Vulnerability Assessment (2023).

New Occurrences of Landslides Since 2020

Since the adoption of the 2020 LHMP, a handful of new landslide or debris-flow events have been reported within or near TID's foothill zones, demonstrating that the hazard remains active. Key occurrences include:

- **Merrill Road, Tuolumne County (2025):** A slope failure / "mudslide" event necessitated clearing operations to restore access. Stanislaus National Forest and local crews collaborated in early 2025 to repair and clear the site.
- **Sawmill Flat, local route (May 2025):** A small landslide was reported to have blocked one lane of roadway. Crews using a plow were observed clearing the slide early in the morning.
- **Tuolumne County mudslides (2023):** During heavy winter precipitation, mudslides impacted communities in Tuolumne (along with Calaveras County), damaging home sites, blocking local roads, and stranding some residents.

These events are relatively localized and typically involved shallow debris flows or slope sloughing rather than large-scale mass movements. However, their occurrence underlines the ongoing susceptibility of foothill zones to slope failure, particularly in drainage corridors or along cut slopes.

In addition, remote sensing and statewide landslide reporting databases (e.g. the California Department of Conservation's Landslides Database) continue to record small, shallow failures across foothill areas, especially following storms though many of these do not rise to the level of media or county reports.

Because reporting is incomplete and many small slides do not make public records, it is plausible that additional, unreported shallow landslides or debris sloughs have occurred in hillside areas within TID's service area.

Probability of Future Landslide Events

The probability of future landslides within the TID service area varies depending upon the location. While the majority of TID's service area lies within the relatively flat Central Valley floor—where the probability of slope movement is negligible—foothill areas along the western Diablo Range and the eastern Sierra Nevada foothills remain susceptible to periodic landslide and debris-flow activity.

Historical patterns indicate that most slope failures in the region are triggered by intense or prolonged winter storms, often occurring in successive years when seasonal rainfall saturates steep, weathered soils. These conditions typically develop during years where strong atmospheric river systems develop which can deliver extreme precipitation totals to central California. Landslides of this nature are generally small to moderate in scale but can cause localized disruptions to roads, canals, and access routes that support TID operations.

The probability of future slope movement in the Tuolumne River watershed remains elevated due to ongoing post-fire recovery conditions from the 2013 Rim Fire. Burned slopes in that area remain susceptible to surface erosion, soil loss, and debris flows during high-intensity rainfall events.109 These hazards may persist for decades as vegetation and root systems continue to regenerate and stabilize steep terrain.

In addition, climate projections indicate increasing frequency and intensity of extreme rainfall events across the Central Valley and surrounding foothills. The California Fourth Climate Change Assessment (2023) notes that more frequent high-intensity storm events are likely to raise the probability of shallow landslides and debris flows, especially in areas affected by wildfire or grading disturbance [(107)].

Based on these factors, the probability of future landslides and debris flows within the TID service area is categorized as: **Highly Likely.**

107. California Office of Planning and Research (OPR). California's Fourth Climate Change Assessment: Statewide Summary Report. (2023).

Identifying Structures and Estimating Potential Losses from Landslides

Landslides and debris flows present a localized but significant hazard to District infrastructure situated in or near steep terrain. Although most TID facilities are located on the relatively flat Central Valley floor—where the likelihood of slope failure is minimal—some facilities and access routes extend into foothill areas along the western Diablo Range and the eastern Sierra Nevada, where the potential for slope instability increases. Landslides in these areas can result from prolonged or intense rainfall, earthquake-induced ground motion, or post-fire soil conditions and have the potential to cause structural damage, blockage of canals or roads, and operational disruptions.

This section evaluates TID facilities and infrastructure that could be affected by a major slope failure or debris-flow event and estimates potential replacement costs based on exposure within areas identified by the California Geological Survey (CGS) and the U.S. Geological Survey (USGS) as having elevated landslide susceptibility.

Because of the unique nature of District-owned assets, TID categorizes its facilities into the following functional groups:

- Water Storage
- Water Delivery
- Pumping and Drainage
- Transmission Lines
- Distribution Lines
- Other Buildings and Real Property
- Vehicles and Equipment

These categories are consistent with TID's internal accounting and asset management structure and allow for the assessment of facilities that cross multiple hazard boundaries. Within each grouping, the value of individual assets has been estimated using standard replacement cost methodologies consistent with FEMA and Cal OES guidance.

For landslide hazard analysis, TID's asset inventory was compared against CGS Landslide Susceptibility Maps, USGS Slope Stability Models, and topographic overlays identifying steep or burned slopes with a history of instability. Facilities located within or immediately downslope of these mapped hazard areas were considered at risk of direct slope failure or secondary impacts such as debris inundation, erosion, or loss of access.

TID's water delivery and drainage systems are susceptible to landslide impacts due to their alignment along natural channels, canals, and steep embankments in foothill terrain. Culverts and siphons located in drainages or canyon crossings may be obstructed or damaged by falling debris, increasing maintenance and operational costs. Access roads and rights-of-way that traverse hillside areas also face risk of slope movement, particularly following intense rainfall or wildfire.

Electrical transmission and distribution assets are generally located in low-slope areas, though towers or poles sited near unstable slopes could experience foundation displacement or line tension caused by ground movement. Landslides or debris flows can also sever access routes to remote substations or hydroelectric facilities, delaying response and repair efforts.

Potential losses were estimated based on the replacement cost of District assets located within or immediately adjacent to mapped landslide hazard areas. Because landslides tend to occur in limited geographic areas and affect infrastructure rather than occupied buildings, estimated losses primarily reflect physical damage to water conveyance structures, roadways, drainage facilities, and electrical infrastructure rather than structural losses or personnel displacement.

Overall, the estimated replacement cost exposure for District assets in landslide-susceptible areas is low in total dollar value but moderate in operational consequence, given the potential for even small slope failures to disrupt access, block drainage systems, or impact facilities essential to water and power delivery.

Table 34. Landslide Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 125,363,273
Pumping & Drainage	$ 0
Generation	$ 256,358,622
Substations	$ 2,231,442
Transmission	$ 26,750,000
Distribution	$ 89,309,269
Other Buildings and Real Property	$ 10,167,977
Vehicles & Equipment	$ 5,123,793

Methodology for Exposure, Vulnerability, and Loss Estimation

To evaluate the potential impacts of landslides on District facilities, TID applied a consistent, FEMA-aligned methodology adapted to the characteristics of geologic and slope stability hazards.

I. Inventory of Assets

- Used a comprehensive inventory of TID-owned infrastructure, facilities, and equipment.
- Assets were grouped by operational function consistent with TID's accounting categories.
- Asset valuation was based on current replacement costs derived from TID financial records, engineering cost estimates, and comparable industry benchmarks.

II. Hazard Definition and Exposure Mapping

- Defined the landslide hazard using available slope stability data, and regional post-fire debris-flow modeling.
- Overlaid mapped hazard zones with District asset locations using GIS-based exposure mapping.

III. Vulnerability Assessment

- Evaluated each asset's sensitivity to slope failure based on construction type, location, and potential exposure to landslides.
- Identified facilities most vulnerable to direct damage, operational interruption, or loss of access.
- Considered secondary impacts to each identified asset.
- Integrated maintenance and inspection data from TID field operations to verify locations where slope conditions have previously caused instability or access issues.

IV. Loss Estimation

- Estimated potential replacement costs for assets located within or immediately adjacent to mapped landslide hazard areas.
- Where detailed replacement values were available, site-specific cost estimates were applied; otherwise, proportional exposure estimates were derived from comparable facility types.
- Loss estimates by facility group, summarized in the Landslide Replacement Cost Summary Table, reflect physical damage, service interruption, and post-event maintenance requirements rather than structural losses to occupied buildings.
- Recognized that losses from landslides are typically limited in geographic extent but can have disproportionate operational impacts on water delivery, drainage, and access systems.

This approach enables TID to consistently estimate potential losses associated with landslides and debris flows across its infrastructure portfolio, ensuring comparability with other hazard types and supporting data-driven prioritization of slope stabilization and mitigation investments throughout TID.

Public Health Emergency

Vulnerability Overview

Public health emergencies include a wide range of biological threats that can disrupt community health, essential services, and critical infrastructure operations. These events may result from naturally occurring disease outbreaks, pandemics, or accidental or intentional biological releases. Pathogens such as viruses, bacteria, and toxins continue to pose persistent risks to human health, and the frequency of emerging infectious diseases has increased significantly over the past several decades. Global travel, population growth, climate change, and the expansion of animal-to-human interaction have all contributed to the spread and evolution of disease vectors capable of affecting both humans and ecosystems.

Infectious diseases remain a leading cause of illness, disability, and death worldwide. The number of novel pathogens identified each decade continues to increase. The resurgence of diseases once considered controlled, such as measles and pertussis, alongside the emergence of new viruses, highlights the continuing vulnerability of public health systems. The World Health Organization (WHO) defines a pandemic as the worldwide spread of a new disease that results in widespread human infection and significant social and economic disruption. Public health readiness can be affected by misinformation, inconsistent coordination among health agencies, and varying levels of public confidence in vaccination and disease prevention programs, all of which can challenge prevention and response efforts.

TID recognizes that both naturally occurring outbreaks and intentional biological incidents are credible hazards that could affect its workforce, customers, and operational continuity. Naturally occurring biological hazards of concern include avian influenza (H5N1), H1N1 and other influenza strains, Ebola virus, measles, Middle East Respiratory Syndrome (MERS), Severe Acute Respiratory Syndrome (SARS), West Nile virus, Zika virus, and COVID-19.

The emergence of COVID-19 (SARS-CoV-2) in late 2019 marked a defining global public health emergency. Originating in Wuhan, China, the virus spread rapidly across continents and reached California by early 2020. In March 2020, the Governor of California declared a state of emergency and issued a statewide Stay-at-Home Order that required the closure of non-essential businesses and directed employees to telework where possible. The COVID-19 pandemic had widespread effects on workforce availability, supply chains, and essential service delivery, including utility operations. It demonstrated the far-reaching impacts a public health emergency can have on community health, economic stability, and continuity of critical services.

The experience of COVID-19 reinforced the importance of sustained public health preparedness, interagency coordination, and continuity planning to mitigate future biological hazards. TID continues to coordinate closely with Stanislaus County Public Health as part of regional preparedness efforts and *in coordination with the county, developed a* Closed Point of Distribution (POD) *Plan* to support the distribution of medical countermeasures and protective supplies *to employees and staff* in the event of a biological incident or public health emergency. While the probability of specific disease outbreaks cannot be predicted with certainty, the recurrence of infectious disease events and the high level of global connectivity confirm that public health emergencies remain a continuing and evolving hazard of concern for the Turlock Irrigation District.

Table 35. Basis for Hazard Identification and Inclusion – Public Health Emergency

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Public Health Emergency	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized in the Multi-Jurisdictional LHMPs for Stanislaus County (identified as Public Health Hazards, Pandemics/Epidemics) and Merced County (identified as Pandemics/Epidemics). • Supported by input and consensus from the TID Planning Team. • Informed by state and federal public health risk assessments from the California Department of Public Health (CDPH), Centers for Disease Control and Prevention (CDC), and the World Health Organization (WHO). • Validated through operational experience during the COVID-19 pandemic and TID's coordination with Stanislaus County Public Health as a Closed Point of Distribution (POD).	• Documented impacts to workforce availability, supply chains, and essential service continuity during the COVID-19 pandemic. • Continued potential for future outbreaks or biological incidents to disrupt District operations, regional energy and water services, and local economic stability. • Included due to the potential for significant public health and operational consequences resulting from naturally occurring outbreaks, accidental releases, or intentional biological events. • Recognized by FEMA, Cal OES, and CDPH as a recurring statewide hazard requiring coordinated emergency planning and continuity of operations measures. • Supports alignment with local and state health preparedness programs and reinforces TID's role as a Closed POD partner in regional biological response operations. • Serves to ensure that future mitigation and continuity strategies account for long-term recovery, staff protection, and maintenance of essential services during public health emergencies.

Location

A public health emergency could affect the entire Turlock Irrigation District service area, as disease transmission is not limited by jurisdictional boundaries. Cities such as Turlock, Ceres, Modesto, Hughson, and Patterson represent areas of highest potential impact due to their higher population densities, concentration of commercial activity, and greater daily interaction among residents, workers, and visitors. These cities also serve as transportation and employment hubs, increasing the likelihood of rapid disease spread during a regional outbreak or pandemic.

The agricultural workforce in the region served by TID could also be significantly affected, as many employees work in close proximity during planting, harvest, and processing seasons. Seasonal labor and shared housing arrangements increase the potential for communicable diseases to spread quickly among workers, with secondary effects on agricultural production and local supply chains.

TID's service area covers both urban and rural communities across Stanislaus and Merced Counties, where access to healthcare facilities varies. Urban centers within the service territory are served by regional hospitals and clinics, but outlying rural areas may experience longer travel times and limited availability of healthcare services during a large-scale health emergency. These disparities could delay diagnosis and treatment, complicating containment and recovery efforts.

Critical infrastructure within TID, including power generation facilities, transmission and distribution systems, and water conveyance infrastructure could experience operational strain during a widespread outbreak. Workforce absenteeism, supply chain disruptions, and public health restrictions could reduce staffing levels and delay essential maintenance or emergency response activities.

As demonstrated during the COVID-19 pandemic, public health emergencies have the potential to affect every aspect of District operations and the surrounding community. TID's location in a region with interconnected urban centers, essential agricultural activity, and major transportation corridors such as State Route 99 and Interstate 5, increases both the likelihood and potential impact of a communicable disease event.

Continued coordination with Stanislaus County Public Health, Merced County Public Health, and other regional partners remains critical to protecting employee health, maintaining continuity of operations, and supporting community response and recovery.

Extent

Public health emergencies vary widely in scope, duration, and severity. A disease outbreak can range from a localized incident affecting a small population to a global pandemic causing extensive illness, loss of life, and widespread social and economic disruption. Since 1900, multiple major pandemics have affected the United States, including the 1918 “Spanish Flu,” which caused an estimated 675,000 deaths nationwide, as well as the influenza pandemics of 1957, 1968, and 2009 [108].

The 2009 H1N1 influenza pandemic was first identified in Imperial and San Diego Counties before spreading globally. In California, H1N1 resulted in more than 550 deaths and thousands of hospitalizations, straining the state’s healthcare system and prompting the declaration of a public health emergency [109]. The virus demonstrated how a novel strain of influenza could spread rapidly through the population, disproportionately affecting younger and otherwise healthy individuals who are not typically at high risk for severe influenza complications.

The COVID-19 pandemic (2019–2023) further illustrated the potential scale and disruption of a highly transmissible infectious disease. Originating in late 2019, COVID-19 spread quickly across the United States, causing unprecedented impacts to public health, the economy, and essential service delivery. Within the TID service area, the counties of Stanislaus, Merced, and Tuolumne reported tens of thousands of confirmed cases and hundreds of deaths by the end of 2020, with significant surges continuing through 2021 [110]. The pandemic tested the resilience of public health systems and essential service providers, including utilities, which faced operational challenges due to workforce illness, supply chain disruptions, and the need to modify workplace practices to prevent disease transmission.

The pandemic also highlighted the interdependence of critical infrastructure sectors. Utilities such as TID depend on healthy, available staff to maintain operations, as well as reliable supply chains for replacement parts, fuel, and treatment chemicals. Interruptions in these systems can have cascading effects, amplifying the consequences of a prolonged public health emergency.

In addition to human diseases, TID’s service area faces an ongoing threat from zoonotic diseases; pathogens transmitted between animals and humans. One of the most significant local concerns is avian influenza (H5N1) due to the large number of poultry and other birds raised and processed in the region. Although avian influenza has not demonstrated sustained human-to-human transmission, certain strains are highly virulent in birds and can occasionally infect humans who have direct contact with infected animals [111]. Were such a strain to mutate to allow efficient human transmission, the resulting pandemic could have severe implications for both public health and the regional agricultural economy.

Public health emergencies can therefore range in extent from isolated outbreaks that disrupt limited sectors to full-scale pandemics that affect all aspects of society. The scale of impact depends on multiple factors, including the transmissibility and severity of the pathogen, population density, public health capacity, and effectiveness of mitigation measures.

Within the TID service area, the effects of a large-scale event would likely include workforce shortages, reduced customer demand in commercial and industrial sectors, supply chain delays, and increased coordination requirements with local health authorities.

108. Centers for Disease Control and Prevention (CDC). 1918 Pandemic (H1N1 Virus) Overview. (2022).
109. California Department of Public Health (CDPH). 2009 H1N1 Influenza Pandemic Summary Report. (2010).
110. California Department of Public Health (CDPH). COVID-19 Case Data by County. (2023).
111. World Health Organization (WHO). Avian Influenza Weekly Update Number 983. (2024).

Development Since 2020 and the Impact on a Public Health Emergency

Since 2020, development within TID's service area has continued at a moderate pace, largely concentrated in established population centers such as Turlock, Ceres, Modesto, Hughson and Patterson, as well as surrounding agricultural communities. While these development patterns do not directly create new biological hazards, they influence population density, mobility, and infrastructure systems that affect the potential spread, management, and impact of future public health emergencies.

Population Growth and Urban Expansion:
Continued residential and commercial development in the region contributes to higher population densities and increased daily movement among workers, students, and customers. Denser population clusters and shared work environments can accelerate the spread of infectious diseases once introduced, particularly in schools, food processing facilities, and other indoor workplaces [112].

Workforce Mobility and Agricultural Employment:
TID's service area includes a large agricultural workforce that operates across multiple sites and often in close proximity to others during harvest and processing periods. The use of seasonal labor, shared transportation, and group housing can contribute to higher exposure potential in the event of a communicable disease outbreak. Development of new agricultural facilities and food processing operations may also increase worker concentration in specific locations, requiring additional public health coordination to ensure continuity of operations during emergencies [113].

Critical Infrastructure and Essential Workforce:
TID's infrastructure expansions and modernization projects since 2020 have improved system reliability but have also increased the number of specialized staff needed to operate and maintain essential services. In a widespread outbreak or pandemic, workforce absenteeism or quarantine requirements could temporarily reduce TID's ability to perform maintenance, field inspections, and emergency response activities. The experience of COVID-19 demonstrated that essential service continuity depends on strong infection control measures, flexible telework policies, and pre-established response plans [114].

Health and Emergency Coordination Improvements:
Since 2020, TID has strengthened its coordination with Stanislaus County Public Health and other regional partners to improve preparedness for future biological incidents. TID developed a plan in coordination with Stanislaus County to serve as a Closed Point of Distribution to distribute medical countermeasures and protective supplies to employees and staff in the event of a biological incident or public health emergency. This partnership enhances TID's ability to sustain essential operations and protect critical infrastructure personnel during a regional or statewide health crisis.

Technology and Remote Work Capacity:
The expansion of remote work and digital operations across administrative and support functions since the COVID-19 pandemic has improved organizational resilience. Investments in secure communications, remote monitoring, and Supervisory Control and Data Acquisition (SCADA) systems allow for continued operations even when in-person staffing is limited. Remote work is not feasible for all operational roles, such as field crews, power plant, and power control personnel, so contingency planning remains essential.

Overall, development trends since 2020 have modestly increased population and workforce exposure to communicable disease risks due to denser development and continued agricultural activity. At the same time, institutional learning from the COVID-19 pandemic and new interagency coordination mechanisms have significantly improved TID's readiness to manage future public health emergencies impacting TID and its staff.

112. California Department of Finance. Demographic Research Unit: Population Estimates for Cities and Counties, 2020–2024.
113. U.S. Department of Agriculture (USDA). Agricultural Workforce in California Report. (2023).
114. Federal Emergency Management Agency (FEMA). COVID-19 Pandemic Operational Guidance for the 2021 Hurricane Season.

The Impact of Future Development Trends on a Public Health Emergency

Future development within the TID service area is expected to continue primarily in established urban centers. While these growth patterns support economic expansion and housing demand, they also have the potential to influence how public health emergencies affect the community and District operations.

Increased population density, expanded commercial activity, and higher mobility associated with urban growth can create conditions that facilitate the spread of infectious diseases. Workplaces, schools, transportation corridors, and shared public spaces may experience higher levels of interpersonal contact, which can accelerate disease transmission once a contagious pathogen is introduced [115].

As demonstrated during recent global outbreaks, diseases such as influenza and other respiratory viruses are primarily transmitted through droplets produced when an infected person coughs, sneezes, or speaks near others. Transmission can also occur when individuals touch contaminated surfaces and then touch their eyes, nose, or mouth [116]. In areas experiencing population growth, these risks may be amplified if cleaning, ventilation, and sanitation practices do not keep pace with increased facility use or occupancy levels.

The expansion of commercial and industrial development, including food processing, manufacturing, and logistics facilities, may also increase the number of employees working in enclosed environments. Without appropriate workplace controls or health protocols, these settings could become focal points for disease transmission that affect workforce availability and supply chain continuity.

However, future development can also improve resilience. New construction typically incorporates modern ventilation systems, greater space flexibility, and updated building codes that promote health and safety. The ongoing use of remote work technologies and automation in administrative and field operations can further reduce exposure risks and help maintain essential services during future health emergencies.

Overall, while future development may modestly increase the potential for disease transmission through higher population interaction, proactive planning, improved building standards, and strong public health coordination can significantly reduce vulnerability. Continued collaboration with Stanislaus County and Merced County Public Health Departments will remain critical to ensuring that regional growth does not outpace preparedness and that TID operations remain protected during any future public health emergency.

115. California Department of Finance. Demographic Research Unit: Population and Housing Estimates, 2020–2024.
116. Centers for Disease Control and Prevention (CDC). How Respiratory Viruses Spread. (2023).

New Occurrences of Public Health Emergencies Since 2020

Since the adoption of the 2020 TID Local Hazard Mitigation Plan, several notable public health events have occurred within the region, reaffirming that infectious diseases remain an ongoing hazard of concern.

The COVID-19 pandemic (2019–2023) was the most significant public health emergency to affect the Turlock Irrigation District service area in recent history. The first confirmed cases were reported in California in early 2020, with widespread community transmission occurring by spring of that year. The counties of Stanislaus, Merced, and Tuolumne collectively reported tens of thousands of confirmed infections and hundreds of fatalities during the height of the pandemic [117].

Local governments declared public health emergencies, implemented stay-at-home orders, and activated emergency operations centers. TID maintained essential services throughout the pandemic by implementing workforce protection measures, modified work schedules, and telework policies. The event demonstrated the far-reaching impacts of a global pandemic on workforce availability, supply chains, community health, and operational continuity.

Since 2021, several smaller but regionally significant outbreaks have been reported in California, though none have reached the magnitude of COVID-19. Annual influenza (flu) seasons continue to result in widespread illness, with elevated activity during 2022 and 2023, including strains that placed additional demand on hospitals and healthcare providers [118].

Other communicable disease activity has also affected the region:

- West Nile virus remains endemic in the Central Valley, with confirmed human and animal cases reported each year in Stanislaus and Merced Counties [119].
- Hepatitis A cases increased across several California counties between 2022 and 2024, prompting targeted vaccination and sanitation efforts among vulnerable populations [120].
- In 2022, limited cases of monkeypox (Mpox) were reported in California, though containment measures prevented widespread community transmission [121].
- Measles and pertussis (whooping cough) remain monitored diseases of concern due to occasional travel-related cases and declining vaccination coverage in some areas.

While none of these recent outbreaks reached pandemic scale, they underscore the region's ongoing vulnerability to biological hazards and the importance of sustained coordination between TID, local public health departments, and emergency management partners. Future biological events whether emerging naturally, accidentally released, or intentionally introduced could again affect TID operations, employee health, and the continuity of essential services.

117. California Department of Public Health (CDPH). COVID-19 Case Data and County Summaries.
118. Centers for Disease Control and Prevention (CDC). Weekly U.S. Influenza Surveillance Report. (2024).
119. California Department of Public Health (CDPH). West Nile Virus Annual Report: California Summary. (2024).
120. California Department of Public Health (CDPH). Hepatitis A Outbreak Data and Response. (2024).
121. Centers for Disease Control and Prevention (CDC). 2022–2023 U.S. Monkeypox (Mpox) Outbreak Response Summary.

Probability of Future Public Health Emergency Events

Public health emergencies are expected to remain a highly likely occurrence within the Turlock Irrigation District service area. Seasonal outbreaks of influenza, periodic spikes in respiratory illness, and the continuing presence of COVID-19 and its variants confirm that communicable diseases will continue to circulate within the community. Emerging pathogens and re-emerging diseases have become more common due to increased global travel, regional mobility, and interactions between human and animal populations [122].

TID's service area includes a mix of densely populated cities such as Turlock, Ceres, and Modesto, along with agricultural and rural communities that employ a large, mobile workforce. These conditions increase opportunities for disease transmission, particularly in workplaces, schools, and shared housing environments [123].

Environmental factors, including higher average temperatures, variable air quality, and the indirect effects of climate change, may further increase vulnerability to respiratory and vector-borne illnesses. As seen in recent years, even moderate disease outbreaks can strain healthcare systems, affect workforce availability, and disrupt essential service operations.

Based on these factors and the recurring nature of communicable disease outbreaks, the probability of future public health emergencies in the TID service area is classified as: **HIGHLY LIKELY.**

122. Centers for Disease Control and Prevention (CDC). Emerging Infectious Diseases Report. (2024).
123. California Department of Public Health (CDPH). Regional Communicable Disease Summary for Stanislaus and Merced Counties. (2024).

Identifying Structures and Estimating Potential Losses from a Public Health Emergency

The direct physical impact of a public health emergency on District infrastructure and facilities is minimal. However, the indirect impacts on operations, maintenance, and service continuity can be substantial. During a widespread illness or pandemic, the ability to sustain daily operations may be compromised if a significant portion of the workforce is unavailable due to illness, quarantine, or caregiving responsibilities. Maintaining critical staff during such an event is essential to ensure the reliability of TID's power generation, water delivery, and drainage systems.

Operational challenges during a public health emergency typically arise from workforce shortages, increased demand for sanitation, and the need for protective measures to safeguard employees, customers, and visitors. Direct costs to infrastructure and facilities are primarily associated with protective measures such as the installation of protective barriers, use of personal protective equipment (PPE), conversion to touchless fixtures, and enhanced cleaning and disinfection protocols. These measures often require additional expenditures for materials, contracted labor, and cleaning supplies, as well as adjustments to staffing schedules and facility access procedures.

The human impacts of a public health emergency can be severe, resulting in widespread illness, hospitalization, and fatalities. The Centers for Disease Control and Prevention (CDC) estimates that between 40 and 50 percent of a workforce may be affected during a significant outbreak or pandemic [124]. This level of absenteeism can lead to reduced productivity, operational delays, and potential service interruptions for utilities such as TID that rely on specialized personnel to operate complex systems.

While TID's primary responsibilities focus on energy and water infrastructure, the broader community impacts of a public health emergency also affect local agriculture, commerce, and supply chains. The TID service area is home to major agricultural operations that depend on a stable labor force, reliable water deliveries, and continuous power service. Disease outbreaks among agricultural workers or food processing employees can disrupt production, strain logistics networks, and indirectly affect TID operations and customer demand.

According to the CDC, the annual cost of seasonal influenza to U.S. businesses is approximately $10.4 billion, including medical costs, hospitalizations, and lost productivity [125]. This figure underscores the economic burden that even routine health events can impose and highlights the need for proactive planning to maintain essential services and protect the workforce.

Proactively addressing these risks through comprehensive preparedness, coordination with local public health agencies, and internal continuity planning enables TID to reduce potential impacts on operations and support community resilience during future public health emergencies.

124. Centers for Disease Control and Prevention (CDC). Pandemic Influenza Preparedness Framework (2023).
125. Centers for Disease Control and Prevention (CDC). Seasonal Influenza Economic Burden Report (2024).

Table 36. Public Health Emergency Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 0
Pumping & Drainage	$ 0
Generation	$ 0
Substations	$ 0
Transmission	$ 0
Distribution	$ 0
Other Buildings and Real Property	$ 0
Vehicles & Equipment	$ 0

Methodology for Exposure, Vulnerability, and Loss Estimation

To evaluate the potential impacts from a public health emergency flooding on District facilities, TID applied a consistent, FEMA-aligned methodology adapted to the unique conditions this risk poses. Damage results from workforce impacts, supply chain disruptions, and the need for operational adaptations

I. Inventory of Assets

- Assets were grouped by operational function consistent with TID's accounting categories.
- While direct structural replacement is unlikely, cost exposure relates to operational continuity and workforce capacity needed to sustain critical systems.

II. Hazard Definition and Exposure Mapping

- Defined the public health hazard based on Centers for Disease Control and Prevention (CDC) guidance and state and local public health frameworks.
- Exposure is system-wide, as disease transmission and workforce illness can simultaneously affect all District operations.
- Considered the potential for workforce absenteeism ranging from 40–50% during a severe outbreak or pandemic as well as dependencies on vendors, contractors, and essential service providers.
- Evaluated exposure pathways such as employee interaction density, shared facilities, and operational interdependencies across TID service areas.

III. Vulnerability Assessment

- Assessed each operational area's sensitivity to workforce shortages, identifying functions requiring specialized or licensed personnel essential to maintaining system reliability.
- Evaluated vulnerabilities associated with limited redundancy in key operational roles and the potential impacts of delayed maintenance or outage restoration.
- Considered the need for increased sanitation, protective measures, and changes to workplace configurations.
- Integrated TID's operational experience from prior public health events, including enhanced cleaning protocols, PPE distribution, and modified work schedules.

IV. Loss Estimation

- Estimated potential costs based on indirect operational impacts.
- Applied national CDC data indicating that routine seasonal influenza costs U.S. businesses approximately $10.4 billion annually to contextualize potential economic burdens from widespread illness.
- Recognized that losses are primarily associated with productivity decline, service delays, and the costs of workforce protection and continuity measures rather than infrastructure repair.
- Loss estimates also account for community-level ripple effects on agricultural production, energy demand, and water delivery arising from labor shortages and supply disruptions.

While the likelihood of direct physical damage is low, prolonged workforce disruption can lead to significant operational and financial impacts across TID systems.

Wildland Fire

Vulnerability Overview

While much of the Turlock Irrigation District (TID) service area comprises irrigated farmland, towns, and cities, these landscapes are not shielded from wildfire risk. In recent years, wildland fires have devastated neighborhoods and infrastructure in even the most developed areas—fire is no longer strictly a rural or forested hazard. For example:

- In January 2025, a series of intense wildfires, including the Palisades Fire and Eaton Fire in the Los Angeles metropolitan region, destroyed thousands of structures, claimed multiple lives, and forced large-scale evacuations in heavily populated areas.
- In 2024, the Line Fire burned approximately 43,978 acres in San Bernardino County, prompting evacuations in adjacent communities and highlighting that fires in the wildland–urban interface can spread into foothill and valley areas near development.
- Even in 2025, the Pickett Fire in Napa County, though less catastrophic in terms of structures, burned nearly 6,819 acres and encroached on vineyard and rural-residential lands—emphasizing that fire exposure continues across diverse land uses.

These events reflect broader trends: wildfires are becoming more frequent, more intense, and more capable of crossing into irrigated and urban areas. Wildfires in California's wildland–urban interface (WUI) have become increasingly destructive in recent years, burning tens of thousands of acres and destroying more than 16,000 homes and other structures across the state. These events underscore how fire behavior that once remained largely in undeveloped areas now routinely affects populated communities and critical infrastructure.

In response to this shifting risk landscape, TID has explicitly included the threat of wildland fire damaging or destroying District property, infrastructure, and facilities in this plan. The District's hundreds of miles of overhead electric lines mounted on wooden poles span rural, agricultural, and wildland urban interface zones, where ignition sources, wind-driven fire behavior, and vegetation fuel loads raise the probability of loss.

The asset evaluation highlights that TID holds a significant portion of its infrastructure within or adjacent to State-designated high fire-threat zones. A severe wildfire event could lead to widespread damage, costly repairs, service disruptions, and loss of customer confidence. By recognizing wildland fire as a credible hazard, TID positions itself to better assess vulnerability, fund mitigation, and plan resilient operations.

Table 37. Basis for Hazard Identification and Inclusion – Wildland Fire

Hazard	How Hazard was Identified	Why this Hazard is Included in the LHMP
Wildland Fire	• Identified as a hazard of concern in the TID 2020 LHMP. • Recognized as a significant hazard in the Multi-Jurisdictional Local Hazard Mitigation Plans (MJLHMPs) for Stanislaus, Merced, and Tuolumne Counties. • Identified in CAL FIRE's Fire Hazard Severity Zone maps and Fire Threat Areas within and adjacent to the TID service area. • Supported by historical fire occurrence data from CAL FIRE's Fire and Resource Assessment Program (FRAP). • Corroborated through stakeholder input and staff knowledge of local fire risks affecting utility corridors, substations, and rural service areas.	• Plans (MJLHMPs) for Stanislaus, Merced, and Tuolumne Counties. • Identified in CAL FIRE's Fire Hazard Severity Zone maps and Fire Threat Areas within and adjacent to the TID service area. • Supported by historical fire occurrence data from CAL FIRE's Fire and Resource Assessment Program (FRAP). • Corroborated through stakeholder input and staff knowledge of local fire risks affecting utility corridors, substations, and rural service areas. • TID maintains extensive infrastructure—particularly overhead electric lines—within and adjacent to designated fire-threat areas. • Increased statewide frequency and severity of wildland–urban interface fires has expanded exposure beyond traditional forested regions. • Potential for wildfire to damage or destroy District-owned assets, disrupt electric and water

	operations, and endanger employee and public safety. • Recognized as a major hazard by regional partners and regulatory agencies, including CAL FIRE and the California Public Utilities Commission (CPUC). • Retained due to its potential to cause extensive economic losses, operational disruptions, and long-term recovery challenges for TID.

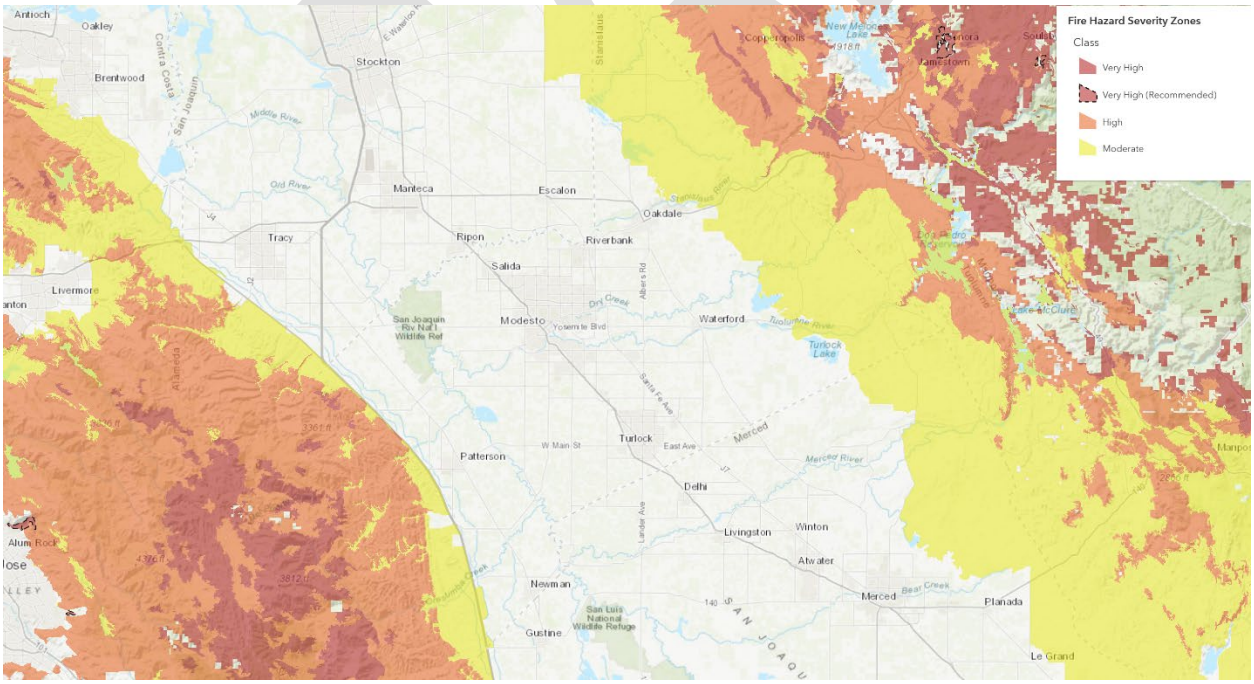
Location

The Turlock Irrigation District (TID) service territory extends from the foothills of the Sierra Nevada near Don Pedro Reservoir to the crest of the Coast Range, encompassing a large portion of California's Central Valley. Most of this area consists of irrigated farmland and grasslands with relatively low fire threat, but the far western and far eastern edges of the District include topography and vegetation that elevate wildfire potential [82].

TID has formally established two designated Fire Zones, the East Side Fire Zone near La Grange and the West Side Fire Zone near Diablo Grande. Both zones fall within State Responsibility Areas (SRAs) where CAL FIRE standards apply to vegetation management and electrical equipment operations. Portions of these SRAs also overlap with California Public Utilities Commission (CPUC) Tier 2 High Fire-Threat Districts. TID applies whichever standards, CAL FIRE or CPUC are more stringent when overlaps occur [82].

EXAMPLE FIRE THREAT MAP REPLACE WITH ONE FROM TID GIS MAPPING SHOWING DISTRICT ELECTRICAL SERVICE BOUNDARY

Map 6. Fire Threat Map for the TID Region



East Side Fire Zone

Located in the Sierra Nevada foothills, this zone includes riparian corridors along the Tuolumne River and portions of Highway 132. It contains approximately 41 miles of distribution line and 68.6 miles of transmission line within areas designated as either SRA or CPUC Tier 2. About 259 customer meters are within this zone, including 94 within La Grange itself [83].

West Side Fire Zone

This area extends from the Central Valley floor into the Coast Range, encompassing steep canyon terrain and grassland fuels near Del Puerto Canyon Road. It includes 42 miles of distribution and 8 miles of transmission line across SRA and CPUC Tier 2 lands, with 716 total customer meters, of which 670 are in Tier 2 areas [83].

Fire Hazard Classification

The 2024 CAL FIRE Fire Hazard Severity Zone (FHSZ) maps classify statewide lands within Moderate, High, and Very High categories based on fuels, slope, and fire behavior. These updated maps were adopted January 31, 2024, and became effective April 1, 2024, replacing the prior 2007 version. For Local Responsibility Areas, new LRA FHSZ maps were released in March 2025 [79, 80, 81].

TID's 2025 Wildfire Mitigation Plan reports that approximately 29 percent of the District's total service area lies within CPUC High Fire Threat Districts (Tier 2), while no areas fall into Tier 3 (Extreme Risk) designations. The majority of Tier 2 lands are concentrated in the La Grange and Diablo Grande corridors [85].

Vegetation and Topography

Vegetation within TID's Fire Zones varies from grasslands and agricultural fields across the valley floor to chaparral and oak woodland in the foothill zones. The West Side Fire Zone includes slopes exceeding 20 percent, and the East Side Fire Zone averages under 10 percent, resulting in faster fire spread and higher intensity in western areas [84].

Location Summary

Wildfire hazard in TID's territory is concentrated primarily at the eastern and western boundaries, where a combination of slope, vegetation, and weather patterns creates conditions for more severe fire behavior. TID's 2025 Wildfire Mitigation Plan applies the most stringent requirements from both CAL FIRE and CPUC standards in these zones to reduce ignition potential and strengthen system resilience [82, 83].

79. CAL FIRE – Office of the State Fire Marshal. Fire Hazard Severity Zones in State Responsibility Areas, 2024 Update. Adopted Jan 31 2024; effective Apr 1 2024.
80. CAL FIRE – Fire and Resource Assessment Program (FRAP). Final 2024 State Responsibility Area FHSZ Maps.
81. CAL FIRE – Office of the State Fire Marshal. Local Responsibility Area (LRA) Fire Hazard Severity Zone Maps. Released March 24, 2025.
82. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 5.2 "Locations of Fire Zones." pp. 30–32.
83. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 4.0 "Wildfire Risks and Drivers." pp. 19–21.
84. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 4.5 "Topography and Slope." p. 27.
85. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Table 12 and Appendix A: Fire Zone Asset Summary Data.

Extent

Wildland fire potential within TID varies by location and topography. While much of the District consists of irrigated farmland with low fire potential, the eastern and western boundaries include foothill and canyon terrain where vegetation, slope, and wind conditions contribute to elevated wildfire behavior.

Wildfires within or near the TID service area typically range between 100 and 500 acres, burning primarily in grasslands and oak woodland habitats [86]. These incidents occur most often during late summer and early autumn when prolonged heat and dry vegetation combine with gusty winds to create receptive fire conditions. Fires in these zones generally exhibit low- to moderate-intensity surface fire behavior, though localized areas with dense chaparral or steep terrain can produce short-duration flame lengths exceeding 20 feet, posing risks to distribution infrastructure and personnel safety [87].

Although large-scale wildfires are less frequent within the District's boundaries, significant fires exceeding 1,000 acres have periodically affected areas adjacent to TID facilities and service corridors. Since 2020,

the region has experienced several major incidents within or near CAL FIRE-designated State Responsibility Areas (SRAs) overlapping TID's East Side and West Side Fire Zones:

- The Del Puerto Canyon Fire (2020) burned more than 5,400 acres west of Interstate 5 in rugged grass and brush terrain within the western portion of the District's service boundary, threatening power infrastructure and prompting multi-agency suppression efforts [88].
- The SCU Lightning Complex Fire (2020)—a massive event that burned more than 390,000 acres across multiple counties including parts of Stanislaus County—produced long-range ember cast, damaged utility infrastructure, and led to extended power-safety shutoffs in surrounding jurisdictions. This event demonstrated how lightning-driven wildfires could threaten TID's western transmission corridor and nearby service areas under extreme conditions [89].
- The Electra Fire (2022) in Amador and Calaveras Counties—while outside TID's service area—illustrated how extreme fire weather and low fuel moisture in the Sierra foothills could threaten electric infrastructure similar to that found in TID's East Side Fire Zone [90].

Smaller but impactful events, including the Diablo Grande Grass Fire (2023) and the Lake Road Fire (2024) near La Grange, each burned several hundred acres and temporarily restricted access to TID facilities for maintenance and inspection crews [91].

According to TID's 2025 Wildfire Mitigation Plan, approximately 4.6 percent of TID's overhead distribution system and 17 percent of its transmission system are located within either SRA or CPUC Tier 2 High Fire-Threat Districts, representing more than 100 line miles of elevated exposure [92]. These areas correspond with zones that CAL FIRE's 2024 Fire Hazard Severity Zone (FHSZ) maps classify as High or Very High hazard, indicating that wildfire behavior could involve rapid rates of spread, long-range ember production, and limited suppression access during red-flag weather conditions [93].

Wildland–Urban Interface Conditions

The Wildland–Urban Interface (WUI), defined by the National Fire Protection Association (NFPA) as areas where human development meets or intermixes with wildland vegetation, has expanded across Stanislaus County as residents seek privacy, natural beauty, and affordable housing near open space [94]. These trends increase the likelihood of fire ignition and complicate suppression efforts where homes, infrastructure, and combustible vegetation coexist.

Within TID's service area, the most notable WUI development is Diablo Grande, located west of Patterson in the West Side Fire Zone. This community lies within a moderately steep canyon surrounded by grass and scattered oak woodland, with a single paved access road that TID's distribution lines cross multiple times. The combination of topographic confinement, limited egress, and adjacent flammable fuels presents evacuation and firefighter-access challenges during wildland fire incidents [95].

Other smaller WUI pockets exist near La Grange and along Lake Road, where rural residential structures intermingle with riparian and grassland fuels. The 2025 Wildfire Mitigation Plan identifies these areas for enhanced vegetation management, pole-hardening projects, and improved situational awareness through weather monitoring and patrols [96].

86. CAL FIRE. Fire and Resource Assessment Program (FRAP) Fire Perimeters 2020–2024.
87. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 4.5 "Topography and Slope." pp. 27–28.
88. CAL FIRE Incident Report. Del Puerto Canyon Fire (Stanislaus County), 2020.
89. CAL FIRE Incident Report. SCU Lightning Complex Fire (Alameda, Contra Costa, Santa Clara, San Joaquin, Merced, and Stanislaus Counties), 2020.
90. CAL FIRE Incident Report. Electra Fire (Amador/Calaveras Counties), 2022.
91. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 5.2 "Locations of Fire Zones." pp. 30–32.
92. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Appendix A: Fire Zone Asset Summary Data.
93. CAL FIRE – Office of the State Fire Marshal. Fire Hazard Severity Zones in State Responsibility Areas, 2024 Update. Adopted Jan 31 2024; Effective Apr 1 2024.

94. National Fire Protection Association (NFPA). Wildland-Urban Interface (WUI): Definition and Conditions. NFPA 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fire, 2023 Edition.
95. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 4.0 “Wildfire Risks and Drivers.” pp. 19–21.
96. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 6.2 “Vegetation Management and System Hardening Priorities.” pp. 38–40.

Development Since 2020 and the Impact on Wildland Fire Risk

Since 2020, development within the TID service area has continued primarily within incorporated cities such as Turlock, Ceres, Hughson, Patterson, and Newman, where new housing and commercial projects are concentrated near existing infrastructure. These urban expansions occur mostly on formerly irrigated agricultural land with low wildfire potential. However, incremental growth at the urban–rural interface, particularly in western Stanislaus County near Diablo Grande and eastern areas near La Grange and Lake Road—has increased exposure to wildland fire conditions and expanded the WUI footprint across portions of TID’s service area [97].

According to the Stanislaus Council of Governments 2024 Regional Housing Needs Assessment, jurisdictions within TID’s boundaries are expected to add approximately 23,000 new housing units between 2023 and 2031, with much of this growth occurring along the periphery of existing communities [98].

While most projects are infill or adjacent to developed areas, several new residential subdivisions west of Patterson and east of Waterford and La Grange are located near or within CAL FIRE-designated High or Very High Fire Hazard Severity Zones (FHSZs) [99].

The City of Patterson’s West Patterson Master Plan area and adjacent Diablo Grande development continue to represent the most significant concentration of WUI housing within TID’s service area. The steep terrain, single access routes, and proximity to flammable vegetation create persistent evacuation and fire-protection challenges that could be exacerbated by additional housing or infrastructure expansion [100].

Although most new construction in California is subject to Chapter 7A of the California Building Code, which requires ignition-resistant materials and defensible space standards in mapped fire hazard zones, new residential expansion near the wildland edge still increases ignition probability, complicates evacuation logistics, and places additional strain on electrical infrastructure.

New developments also expand the distribution footprint required to serve customers, resulting in additional line miles extending into grassland and foothill environments.

TID’s 2025 Wildfire Mitigation Plan anticipates that continued edge development may incrementally expand the District’s exposure to CPUC Tier 2 High Fire-Threat Districts by up to 3 percent over the next decade unless mitigated through vegetation management, system hardening, and undergrounding projects [101].

While overall population growth in the service area remains moderate, the distribution of that growth toward the wildland interface underscores the need for continued planning coordination, system resilience investments, and public education in high-risk corridors.

97. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 4.0 “Wildfire Risks and Drivers.” pp. 19–21.
98. Stanislaus Council of Governments. 2024 Regional Housing Needs Assessment (RHNA) and Growth Forecasts.
99. CAL FIRE – Office of the State Fire Marshal. Fire Hazard Severity Zones in State Responsibility Areas, 2024 Update. Adopted Jan 31 2024; Effective Apr 1 2024.
100. City of Patterson. West Patterson Master Plan and Diablo Grande Specific Plan Updates, 2023.
101. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 6.2 “Vegetation Management and System Hardening Priorities.” pp. 38–40.

Impact of Future Development on Wildland Fire Risk

Future development within the TID service area will continue to influence wildfire exposure patterns over the next decade. While the majority of planned growth remains concentrated in incorporated cities with limited fire potential, incremental expansion at the wildland–urban interface, especially west of Patterson and east of La Grange, will modestly increase wildfire risk for both new residents and critical TID infrastructure.

The Stanislaus County General Plan Update (2023) and StanCOG 2024 Regional Housing Needs Assessment project continued suburban growth extending into foothill and rangeland areas previously dominated by agriculture or open space. This gradual expansion of the WUI increases the likelihood of human-caused ignitions, introduces new evacuation constraints, and requires additional electrical distribution infrastructure in high-fuel environments [102, 103].

As communities such as Diablo Grande, La Grange, and Lake Road attract new housing and recreational development, wildfire exposure will rise through:

- Increased ignition sources (vehicles, equipment, electrical faults, and landscaping).
- Greater structural density within grass and oak woodland fuels.
- More residents and visitors dependent on single-access routes for evacuation.
- Expansion of overhead distribution lines to serve new developments.

TID's 2025 Wildfire Mitigation Plan identifies that projected residential and commercial buildout could increase the District's exposure within CPUC Tier 2 High Fire-Threat Districts by as much as 5 percent by 2035, assuming current growth trends continue [104]. This additional exposure is primarily associated with new line-miles required to support housing expansion in western Stanislaus County and eastern foothill corridors.

Although future development within TID's service territory is not expected to substantially alter regional wildfire behavior, the spatial distribution of growth will continue to shape local vulnerability. Even limited new construction in the West Side canyons or East Side foothills could amplify ignition probability, increase exposure of overhead electrical infrastructure, and complicate emergency response operations. Effective land-use coordination and early integration of mitigation standards will be essential to prevent incremental growth from producing disproportionate wildfire risk.

102. Stanislaus County. General Plan Update and Safety Element, 2023.
103. Stanislaus Council of Governments (StanCOG). 2024 Regional Housing Needs Assessment (RHNA) and Growth Forecasts. Modesto, CA.
104. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 6.2 "Vegetation Management and System Hardening Priorities." pp. 38–40.

New Occurrences of Wildland Fire

Since completion of the previous TID LHMP in 2020, several major wildfires have occurred within or near the District's electric service territory and across the greater Northern California region. These incidents underscore the ongoing vulnerability of foothill and canyon areas particularly those in TID's West Side and East Side Fire Zones, to large, fast-moving grass and brush fires intensified by prolonged drought, record heat, and increased lightning activity.

2020 SCU Lightning Complex Fire:

In August 2020, an unprecedented series of dry lightning storms ignited hundreds of fires across Northern California, leading to the formation of several large fire complexes. The SCU Lightning Complex, which burned more than 390,000 acres across Alameda, Contra Costa, Santa Clara, San Joaquin, Merced, and Stanislaus Counties, became one of the largest wildfires in California history [105].

Within Stanislaus County, the fire impacted grasslands and rangelands west of Interstate 5, resulting in extensive smoke, long-range ember cast, and precautionary power-safety shutoffs affecting TID customers in the West Side Fire Zone.

2020 Del Puerto Canyon Fire:

Just weeks later, in September 2020, the Del Puerto Canyon Fire ignited near Patterson and burned approximately 5,400 acres of steep grass and brush terrain within the western boundary of TID's service territory [106]. The fire required multi-agency suppression and temporarily closed Del Puerto Canyon Road. TID power facilities were not damaged, though the incident validated system-hardening priorities later incorporated into the 2025 Wildfire Mitigation Plan.

2021–2022 Statewide Fire Seasons:

While no major fires directly affected TID facilities during 2021, regional events such as the Dixie Fire (2021) and Electra Fire (2022) reinforced operational lessons regarding vegetation management, PSPS coordination, and situational awareness during extreme fire-weather conditions [107].

2023 Diablo Grande Grass Fire:

In July 2023, a grass fire near Diablo Grande burned roughly 250 acres of rangeland within TID's West Side Fire Zone, producing flame lengths of 15–20 feet and briefly threatening homes and distribution poles near Diablo Grande Parkway [108]. Quick suppression and favorable wind shifts prevented infrastructure loss, but the event highlighted evacuation and access limitations associated with single-road WUI developments.

2024 Lake Road Fire:

In June 2024, the Lake Road Fire east of La Grange burned approximately 320 acres of mixed grass and oak woodland adjacent to TID's East Side Fire Zone [109]. The fire prompted short-term power shutoffs to ensure firefighter safety and underscored the importance of vegetation clearance and inspection patrols in riparian areas along the Tuolumne River.

Summary

Between 2020 and 2024, the combination of extreme heat events, periodic drought, and lightning-caused ignitions has increased the frequency of wildland fires within and adjacent to TID's service territory. While most incidents have remained under 1,000 acres, the 2020 SCU Lightning Complex and Del Puerto Canyon Fire demonstrated that large-scale fires in the region can quickly threaten transmission corridors and WUI communities under red-flag conditions.

105. CAL FIRE Incident Report. SCU Lightning Complex Fire (Alameda, Contra Costa, Santa Clara, San Joaquin, Merced, and Stanislaus Counties), 2020.
106. CAL FIRE Incident Report. Del Puerto Canyon Fire (Stanislaus County), 2020.
107. CAL FIRE Incident Reports. Dixie Fire (2021) and Electra Fire (2022).
108. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 5.2 "Locations of Fire Zones." pp. 30–32.
109. Turlock Irrigation District. 2025 Wildfire Mitigation Plan, Section 6.2 "Vegetation Management and System Hardening Priorities." pp. 38–40.

Probability of Future Wildland Fire Events

Wildland fire will remain a recurring and significant hazard within the TID service area due to its location between two fire-prone regions; the Coast Range foothills to the west and the Sierra Nevada foothills to the east. Although irrigated agricultural lands across the central valley floor limit widespread fire spread, grass, brush, and oak woodland fuels along the District's perimeters sustain periodic wildland fire activity.

Review of CAL FIRE fire-perimeter data and TID incident records indicate that moderate to large wildfires (>100 acres) have affected the East Side or West Side Fire Zones approximately every four to six years since the early 2000s [110]. Notable recent events include the Del Puerto Canyon Fire (2020), SCU

Lightning Complex (2020), and smaller fires near Diablo Grande (2023) and La Grange (2024). The pattern shows consistent recurrence under drought and high-wind conditions rather than isolated, anomalous events.

The California Fourth Climate Change Assessment projects a 35–55 percent increase in extreme fire-weather days in the San Joaquin Valley and adjacent foothills by mid-century [111]. Longer dry seasons, more frequent heat waves, and invasive annual grasses contribute to faster ignition and spread even in non-forested landscapes. Lightning activity, historically rare in the southern Central Valley, has increased in both frequency and geographic reach since 2020, producing events like the SCU Lightning Complex.

Together, these factors indicate that wildland fire frequency and intensity are trending upward statewide and regionally, with implications for TID's transmission and distribution corridors traversing Tier 2 High Fire-Threat Districts.

For these reasons, the probability of a future wildland fire event impacting TID is: **HIGHLY LIKELY.**

110. CAL FIRE FRAP. Fire Perimeters (2000–2024) – Stanislaus, Merced, and Tuolumne Counties Dataset. Sacramento, CA.
111. California Energy Commission. Fourth Climate Change Assessment: San Joaquin Valley Region Report. 2022.

Identifying Structures and Estimating Potential Losses from a Wildland Fire

Wildland fire presents a persistent and evolving threat to Turlock Irrigation District (TID) infrastructure, particularly within the East Side and West Side Fire Zones, where electric transmission and distribution systems traverse grassland, oak woodland, and canyon terrain designated as High or Very High Fire Hazard Severity Zones (FHSZs).

Although wildfire events are less frequent than flood or storm incidents, the potential for rapid-onset, high-intensity damage to aboveground electrical and communication infrastructure makes fire one of the District's costliest natural hazards in terms of recovery time and asset replacement.

This section evaluates District facilities and infrastructure that could be affected by a major wildfire event and estimates potential replacement costs based on exposure within mapped CAL FIRE FHSZs and CPUC Tier 2 High Fire-Threat Districts.

Because of the unique nature of District-owned assets, TID's TID categorizes its facilities into the following functional groups:

- Water Storage
- Water Delivery
- Pumping and Drainage
- Transmission Lines
- Distribution Lines
- Other Buildings and Real Property
- Vehicles and Equipment

These groupings are consistent with TID's internal accounting and asset management structure and allow for the assessment of facilities that cross multiple hazard boundaries. Within each grouping, the value of individual assets has been estimated using standard replacement cost methodologies consistent with FEMA and CalOES guidance.

For wildfire exposure, TID's asset inventory was compared to the most recent CAL FIRE 2024 Fire Hazard Severity Zone maps and CPUC Fire-Threat Maps. Assets located within or immediately adjacent to Tier 2 High Fire-Threat Districts were classified as at-risk.

Exposure is concentrated in two geographic clusters: the Diablo Grande/Del Puerto Canyon corridor on the west side, and the La Grange/Lake Road corridor on the east side.

TID's water delivery and pumping facilities generally face lower direct fire risk but may experience indirect impacts such as power interruption, reduced access, or smoke-related operational limits during major incidents.

Administrative and operational buildings, including headquarters and service yards, are located on the valley floor and are considered low exposure for direct wildfire loss.

Wildfire-related losses can occur through multiple pathways, including:

- Direct damage to wooden poles, insulators, transformers, and conductors exposed to radiant heat or flame.
- Indirect impacts from loss of vegetation control, restricted access, and secondary ignition hazards following equipment failure or wind-driven embers.
- Smoke and heat damage to mechanical and electrical components at substations and pumping plants.

Because wildfire primarily affects aboveground electrical and communication systems, the most significant losses would occur to distribution and transmission assets, which are also among the most expensive and time-consuming to replace.

- **Transmission Lines:** Potential damage could result in widespread power outages, requiring extensive reconstruction and mutual aid support.
- **Distribution Lines:** Damage to poles or conductors in Tier 2 areas could cause localized outages and customer service disruption.
- **Water Delivery and Pumping Systems:** Risk of operational interruption or minor damage from adjacent fire activity, though facilities are typically fire-resistant.

Methodology for Exposure, Vulnerability, and Loss Estimation

Wildfire presents a distinct hazard to TID operations because of its potential to cause direct physical damage to District assets and widespread service disruptions. The following methodology was applied to identify exposure, assess vulnerabilities, and estimate potential wildfire-related losses.

I. Inventory of Assets

- Used a comprehensive inventory of TID-owned infrastructure, facilities, and equipment.
- Assets were grouped by operational function consistent with TID's accounting categories
- Asset valuation was based on current replacement costs derived from TID financial records, engineering cost estimates, and comparable utility benchmarks.

II. Hazard Definition and Exposure Mapping

- Defined the wildfire hazard using CAL FIRE Fire Hazard Severity Zone (FHSZ) data, historical fire perimeters, and regional wildfire behavior models.
- Characterized hazard exposure based on vegetation type, topography, and proximity to the wildland–urban interface (WUI).
- Overlaid mapped hazard zones with District asset locations using GIS-based exposure mapping to identify facilities within or adjacent to Very High, High, and Moderate hazard areas.

III. Vulnerability Assessment

- Evaluated each asset's sensitivity to wildfire based on construction materials, site defensibility, and accessibility for fire suppression or repair.
- Identified facilities most vulnerable to direct flame contact, radiant heat damage, smoke intrusion, or loss of operational access.
- Considered secondary effects such as power interruption, damage to communication systems, or degradation of air quality affecting personnel safety.
- Integrated TID inspection and maintenance data to validate facilities historically affected by nearby wildfires or vegetation encroachment.

IV. Loss Estimation

- Estimated potential replacement costs for assets located within or immediately adjacent to mapped wildfire hazard areas.
- Applied site-specific cost data where available; otherwise, estimates were derived from comparable facility types.
- Loss estimates by facility group reflect physical damage, service interruption, and post-event restoration needs.
- Recognized that while wildfire damage may be limited, resulting outages or access restrictions can have wide-ranging operational and financial impacts.

This methodology provides a consistent, repeatable process for evaluating the potential impacts of drought on TID's infrastructure and supports prioritization of mitigation actions.

Table 38. Flooding Summary of At-Risk Assets and Replacement Values

Water Delivery	$ 250,726,547
Pumping & Drainage	$ 0
Generation	$ 256,358,622
Substations	$ 2,231,442
Transmission	$ 26,750,000
Distribution	$ 89,309,269
Other Buildings and Real Property	$ 10,167,977
Vehicles & Equipment	$ 5,123,793

Aquatic Invasive Species

Vulnerability Overview

Aquatic Invasive Species (AIS) are non-native plants, animals, and pathogens that invade aquatic ecosystems beyond their natural range. Once introduced, they can rapidly establish, outcompete native species, and disrupt ecological and operational systems. AIS spread through both intentional and unintentional human activity, such as dumping aquarium contents into waterways or through boating, fishing, and shipping activities that transfer larvae, seeds, or fragments between water bodies [112].

In California, AIS have become a persistent problem due to global trade, regional water transfers, recreational boating, and warming water conditions. Common pathways include ballast-water discharge, boat-hull fouling, and contaminated equipment. Once established, eradication is rarely possible; even small plant fragments or microscopic larvae can create new populations [113].

AIS of primary concern to the Central Valley and the TID service area include invasive animals such as the Quagga Mussel *(Dreissena Bugensis),* Zebra Mussel *(Dreissena Polymorpha),* and Nutria (Myocastor coypus), as well as aquatic plants such as Brazilian Waterweed *(Egeria Densa)* and Water Hyacinth (Eichhornia Crassipes). These species pose significant threats to water conveyance systems, irrigation infrastructure, and natural habitats, and their spread is likely to intensify as water temperatures rise, and hydrologic patterns shift under a changing climate [114].

Key Species Affecting the TID Region

Nutria: Nutria, are large, semi-aquatic rodent first detected in California in 2017, now present in Stanislaus, Merced, and neighboring counties [115]. Nutria can consume up to 25 percent of their body weight in vegetation daily and cause severe damage to levees, canal banks, and wetlands through burrowing and destroying the protective vegetation. Their burrow systems can undermine earthen embankments, increasing maintenance demands and the potential for structural failures along canals and drains. Periods of prolonged drought, which drive vegetation die-off, can push nutria to migrate and expand their range in search of suitable wetland habitat.

Quagga and Zebra Mussels: These tiny, freshwater mussels attach to hard surfaces and multiply rapidly, clogging pipes, pumps, and intakes [116]. They reduce water-conveyance efficiency, damage power-generation facilities, and alter aquatic food webs by filtering vast quantities of plankton. Even small infestations can significantly increase maintenance requirements for irrigation and generation infrastructure. Higher water temperatures and reduced mixing in reservoirs can create favorable conditions for larvae to survive and spread into areas that were previously unsuitable.

Brazilian Waterweed: Brazilian Waterweed *(Egeria Densa)* is a submerged, rooted aquatic plant that forms thick underwater stands capable of spreading rapidly through stem fragments. Native to South America, it was introduced to California as an aquarium plant and is now widespread throughout the Sacramento–San Joaquin Delta and connected waterways. Dense growth of Brazilian Waterweed can restrict water circulation, clog canal intakes, and interfere with pumping and flow operations. Heavy infestations reduce dissolved oxygen levels, trap sediment, and displace native aquatic vegetation, degrading habitat quality. For TID, this species poses an operational challenge by reducing conveyance efficiency in reservoirs and canals. Its growth is strongly influenced by temperature, light, and nutrient availability—factors expected to become increasingly favorable during prolonged warm, low-flow conditions.

Water Hyacinth: Water Hyacinth is a fast-growing, free-floating aquatic plant capable of doubling its mass in as little as two weeks under favorable conditions [117]. Native to South America, it has spread throughout the Sacramento–San Joaquin Delta and Central Valley waterways. Dense mats block sunlight, deplete dissolved oxygen, and impede navigation and flow. For agencies such as TID, these infestations

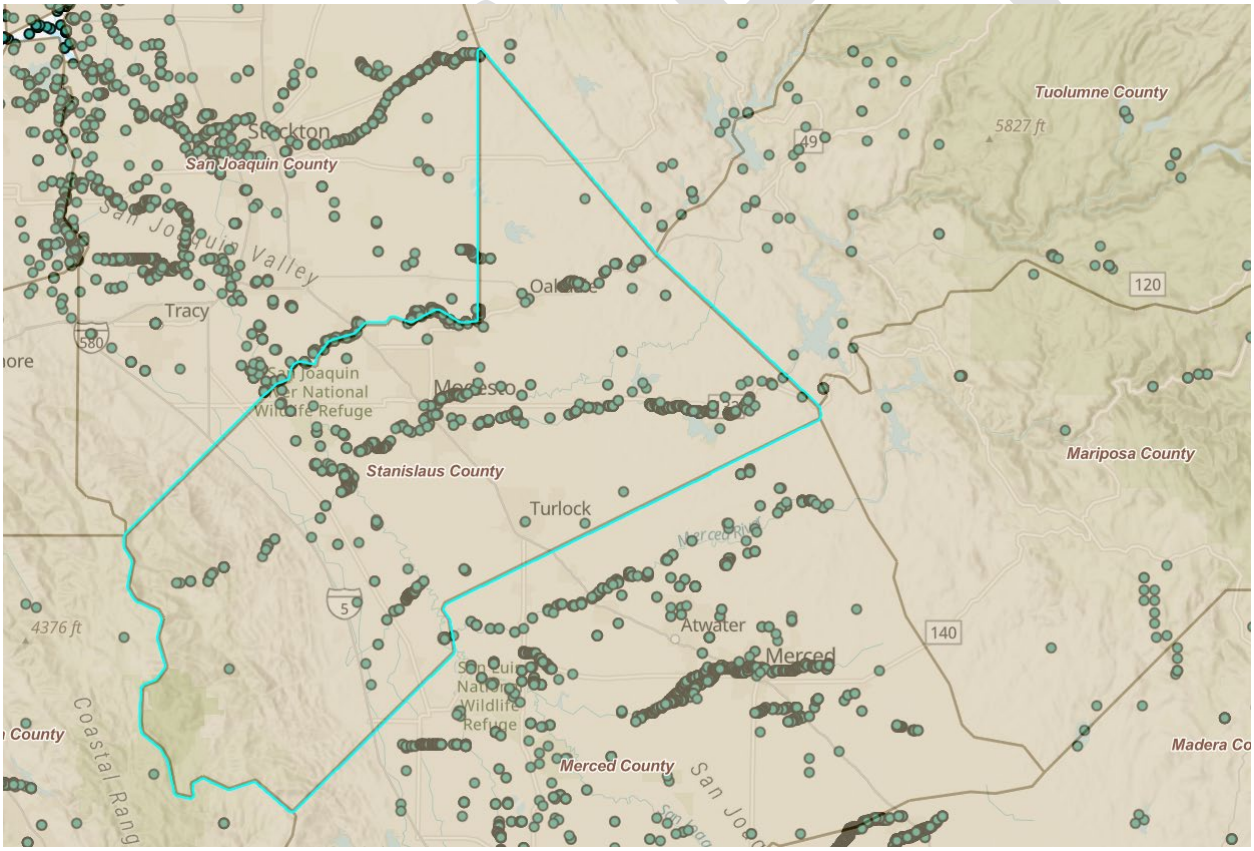
can obstruct canal intakes and conveyance structures, restrict reservoir operations, and increase the need for mechanical and chemical control measures. The plant's rapid growth is strongly influenced by temperature and nutrient levels, conditions expected to become more favorable under future warm, dry periods.

Location

AIS occurrences in the TID service area are primarily associated with major waterways and surface-water conveyance infrastructure connected to the Tuolumne River and Don Pedro Reservoir. According to the University of California Agriculture and Natural Resources (UCANR) mapping portal, infestations have been documented throughout the Sacramento–San Joaquin Delta and within regional canals and drainage systems linked to TID operations [118].

Figure 18 below illustrates the distribution of AIS in Stanislaus County, as documented by the UCANR. Each colored symbol on the map represents a different type of AIS observed within the region, including snails, mussels, and clams; aquatic plants and algae; mammals such as nutria; reptiles and amphibians; flatworms and flukes; fishes; crustaceans; and colonial invertebrates. The map highlights the presence and diversity of invasive species along major waterways, including the Tuolumne and San Joaquin Rivers, which connect directly to the Turlock Irrigation District's service area.

Map 7. Distribution of Aquatic Invasive Species in California and the Central Valley Region (Source: University of California Agriculture and Natural Resources, 2024)



Within Stanislaus County, known AIS have been reported along the Tuolumne and San Joaquin Rivers and in local tributaries. Given the hydrologic connectivity between regional systems, AIS could easily spread into TID-managed facilities through water movement or contaminated equipment. Longer growing seasons and reduced streamflow during droughts further expand their potential range.

112. Izaak Walton League of America. Aquatic Invasive Species: Stop Aquatic Hitchhikers. 2021.

113. California State Parks, Division of Boating and Waterways. Aquatic Invasive Species Program Annual Report. 2021.
114. Invasive Species Centre (Canada). Climate Change and Invasive Species Fact Sheet. 2021.
115. California Department of Fish and Wildlife. Nutria Eradication Program Summary. 2018.
116. U.S. Geological Survey (USGS). Nonindigenous Aquatic Species Database. 2022.
117. University of California, Riverside – Center for Invasive Species Research. Water Hyacinth Profile. 2022.
118. University of California Agriculture and Natural Resources (UCANR). California Aquatic Invasive Species Map Portal. 2024.

Extent

The impacts of AIS on District operations are considered minor to moderate, depending on species type, infestation scale, and hydrologic conditions [119]. While AIS rarely threatens life safety, they can cause ecological degradation and operational disruption.

Water Hyacinth form dense mats that block intakes, restrict flow, and reduce pumping efficiency. These infestations intensify during prolonged warm periods and low-flow conditions, which favor rapid vegetative growth and reduced flushing. Quagga and zebra mussels clog submerged infrastructure, increasing energy consumption, and requiring frequent cleaning. Nutria burrowing weakens levees, embankments, and drain structures, increasing erosion and maintenance costs, particularly after high-water events.

Typical consequences include:

- Clogging of irrigation and drainage infrastructure, reducing conveyance efficiency
- Damage to pumps, screens, gates, and control structures
- Degradation of aquatic habitats and loss of native species
- Increased maintenance and operational costs
- Reduced recreational and aesthetic value of reservoirs

AIS infestations are nearly impossible to eradicate once established and require ongoing management. The overall magnitude of the hazard to TID is considered localized but operationally significant.

AIS have been observed in Central Valley waterways for more than a decade. The California Department of Fish and Wildlife confirmed nutria infestations in Stanislaus and Merced Counties beginning in 2017 [120]. Quagga and zebra mussels were first detected in Southern California in 2007–2008 and continue to spread northward through connected systems.

Water Hyacinth has been a recurring problem in the Delta, periodically restricting navigation and requiring costly mechanical and chemical control programs. In warmer, drier years, hyacinth growth accelerates due to higher nutrient concentrations and reduced flow. Although TID has not reported a major infestation within its own conveyance network, its hydraulic connection to the Tuolumne River and Don Pedro Reservoir places the District at elevated risk.

119. California State Parks. AIS Program Impact Assessment. 2021.
120. California State Hazard Mitigation Plan (SHMP). 2018 Update.

Development Trends Since 2020 and the Impact on AIS Infestations

Since 2020, development within the Turlock Irrigation District (TID) service area has primarily involved infill residential projects, light industrial facilities, and agricultural support infrastructure. These activities have had minimal direct influence on the occurrence or spread of aquatic invasive species (AIS). However, new construction near waterways, increased recreational use of District reservoirs, and expanded maintenance or infrastructure work involving canal systems can create opportunities for AIS introduction through the movement of water, soil, or equipment.

TID continues to coordinate with local jurisdictions and regulatory agencies to promote inspection, cleaning, and best-management practices that prevent the transport of AIS during construction and recreational activities.

Impact of Future Development on AIS Infestations

Future development and infrastructure expansion adjacent to waterways may inadvertently increase the risk of AIS introduction through water transfers, construction runoff, or equipment mobilization. Additionally, changing regional water demands and climate-driven conditions may heighten reliance on reservoirs and canals for multi-purpose storage, increasing exposure potential.

TID mitigates these risks through active participation in regional AIS prevention programs, including public outreach, vessel inspection partnerships, and operational monitoring. The District incorporates AIS prevention into its maintenance and operations practices through periodic inspections, cleaning protocols, and vegetation management. Public education remains a core prevention strategy, with awareness efforts implemented at boat launches, campgrounds, and other TID-managed recreational facilities.

Probability of Future Occurrences of AIS Infestations

The combination of regional hydrologic connections, recreational boating, imported equipment, and warmer water temperatures creates multiple introduction pathways. State and federal programs including the California Marine Invasive Species Act, CDFW's Dreissenid Mussel Prevention Program, and local boat-inspection initiatives help reduce risk but cannot eliminate it entirely [121]. Given ongoing detections of nutria and persistent hyacinth growth, AIS events are expected to continue annually, with more frequent outbreaks during extended droughts and warmer water cycles.

For these reasons, the probability of future AIS introduction or spread within TID's system is: **Likely.**

121. California Marine Invasive Species Program. Annual Compliance Summary. 2022.

Identifying Structures and Estimating Potential Losses from Aquatic Invasive Species Infestation

AIS can affect multiple components of the District's operational infrastructure. Water Hyacinth and Brazilian Waterweed can obstruct intakes and headworks, while quagga and zebra mussels colonize interior surfaces, reducing system efficiency and the lifespan of mechanical equipment. These infestations can displace native vegetation, alter flow patterns, and degrade water quality. Nutria burrowing weakens levees and canal banks, particularly where vegetation loss from drought leaves soils more susceptible to erosion and collapse.

Because of the unique nature of District-owned assets, TID's TID categorizes its facilities into the following functional groups:

- Water Storage
- Water Delivery
- Pumping and Drainage
- Transmission Lines
- Distribution Lines
- Other Buildings and Real Property
- Vehicles and Equipment

These groupings are consistent with TID's internal accounting and asset management structure and allow for the assessment of facilities that cross multiple hazard boundaries. Within each grouping, the value of individual assets has been estimated using standard replacement cost methodologies consistent with FEMA and CalOES guidance.

TID facilities most at risk from AIS include reservoirs, canals, pumping plants, and conveyance structures with submerged or wetted components. To evaluate exposure, TID compared its asset inventory against known and potential infestation areas identified through the UCANR California AIS Distribution Map and regional waterway data. Exposure is greatest for facilities with continuous or seasonal surface-water contact, including Don Pedro Reservoir, Turlock Lake, and the District's primary canal network.

The TID infrastructure at greatest risk to an AIS infestation includes:

- **Reservoirs and Water Storage Facilities:** AIS such as Water Hyacinth and Brazilian Waterweed can form dense mats on the water surface, obstructing intakes, restricting reservoir operations, and reducing usable storage capacity.
- **Pumping & Drainage Systems:** Pumps and discharge systems are susceptible to clogging and fouling from vegetation and mussel colonization. Reduced flow efficiency and increased friction losses can elevate energy demand, increase mechanical wear, and lead to overheating or equipment failure.
- **Generation Facilities:** Hydroelectric facilities and small generating units with water cooling or submerged infrastructure are at risk of reduced efficiency or damage from biofouling and sediment accumulation caused by AIS. Over time, infestations can diminish turbine performance and require costly decontamination or equipment replacement.
- **Vehicles & Equipment:** Boats, dredges, and portable pumps are potential vectors for AIS spread if not properly cleaned between use sites. Routine decontamination and inspection programs are required to prevent unintentional transport of vegetation or larvae between reservoirs, canals, and other water bodies.

While precise loss values are difficult to quantify, AIS infestations can impose moderate to high annual maintenance costs on affected facilities. Based on regional data from comparable California water agencies, mechanical and chemical control of aquatic vegetation and mussels can increase annual maintenance expenses by 10 to 25 percent for infested conveyance systems. In severe or prolonged infestations, these costs may be significantly higher, depending on system size and accessibility.

Secondary impacts may include reduced irrigation delivery reliability, temporary shutdowns of pumping facilities, or flow restrictions during removal operations. Extended infestations can also increase energy demand for pumping, reduce power-generation efficiency, and shorten equipment service life due to repeated cleaning or chemical exposure. TID may also face longer maintenance windows, higher vegetation-control costs, and greater potential for operational disruptions linked to invasive species proliferation.

Table 39. AIS At-Risk Assets and Replacement Values

Reservoirs and Water Storage Facilities	$ 0
Pumping & Drainage	$ 0
Generation	$ 0
Substations	$ 0
Transmission	$ 0
Distribution	$ 0
Other Buildings and Real Property	$ 0
Vehicles & Equipment	$ 0

IV. Mitigation Strategy

The Mitigation Strategy outlines the actions, projects, and policy measures TID will implement to reduce long-term risk to its electric, irrigation, water storage, and operational infrastructure from identified natural hazards. This strategy supports FEMA's requirements under 44 CFR §201.6(c)(3), CalOES Plan Review Tool (PRT) criteria, and TID's internal reliability and capital planning objectives.

Purpose of a Mitigation Strategy

The mitigation strategy serves several purposes:

- **Reduce vulnerability to hazards**: Support informed decisions that reduce hazard exposure and consequences.
- **Lower long-term costs**: Implement proactive measures that reduce future damage, service interruptions, and emergency repair costs.
- **Bridge funding gaps:** Position TID to compete for federal and state funding that supplement District investments.
- **Accelerate recovery:** Reduce the duration and severity of service disruptions following disaster events.
- **Resource stewardship:** Maintain reliable, cost-effective management of TID's electric and irrigation systems.
- **Support community resilience:** Contribute to a safer, more disaster-resistant region by improving the resilience of essential services relied upon by households, businesses, and agriculture.

WHY MITIGATION MATTERS TO TID

- ***Saves Lives & Protects Property***
- ***Shields Critical Infrastructure***
- ***Reduces Outage Duration & Recovery Costs***
- ***Improves System Reliability***
- ***Strengthens Regional Resilience***

"Every dollar invested in mitigation saves an estimated six to eight dollars in future disaster costs."
-National Institute of Building Sciences

Goals and Objectives

TID Strategic Plan Goals

Mitigation goals provide broad, long-term direction for reducing hazard impacts and strengthening the District's resilience. They reflect TID's commitment to protecting life, property, and essential services while reducing vulnerabilities across its service area. The goals in this LHMP are aligned with the priorities and themes in TID's Strategic Plan, including system reliability, operational excellence, customer and community safety, financial sustainability, and responsible stewardship of District resources.

- **Water and Electric Supply and Distribution Goals**
  - Optimize Water and Power Assets to Increase Reliability and/or Decrease Costs
  - Manage, Maintain, or Replace Water and Power Assets in the Most Cost Effective Manner
  - Implement Additional Water and Power Storage Projects to Increase Reliability, Improve Water Quality, and/or Decrease Costs
  - Proactively Leverage Regulatory, Legislative, and Technological Opportunities to Best Serve Our Community Through Intentional Collaboration
- **Finance and Rates Goals**
  - Enhance the Financial Health of the District
  - Enhance Financial Reporting
  - Maintain Competitive Rates with Peer Groups

- **Workforce Goals**
  - Attract, Develop, and Retain a Highly Skilled Workforce
  - Enhance Human Resources Processes, Procedures, and Systems
- **Customer Service and Community Relations Goals**
  - Achieve Recognition for Transparency in TID's Operations and Governance
  - Institute Assistance Programs that Address the Diverse Needs of TID Customers
  - Increase Public Awareness of the Core Services TID Provides as a Community-Owned Utility
  - Increase Outreach, Expand Collaboration and Enhance Partnerships with Customers, the Community and Associations
  - Increase Customer Participation in all TID Energy Programs
  - Expand TID's Customer Satisfaction Program
- **Safety Goals**
  - Promote a Safety First Culture
  - Maintain a Comprehensive Emergency Management Program
- **Technology Goals**
  - Enhance the Customer Experience using Emerging Technologies
  - Develop Data Analytics for Data Driven Decision Making
  - Develop a Technology Roadmap

These goals support TID's mission to deliver safe, reliable, and affordable water and power services, and ensure that mitigation strategies reflect the priorities outlined in the Strategic Plan. The mitigation actions identified in this LHMP emphasize resilient infrastructure, sound engineering practices, and safe operational processes that reduce risk, prevent injuries, and minimize hazard-related damage across the District's service area.

State of California Multi-Hazard Mitigation Plan Goals

TID supports the goals that it shares with the State of California Multi-Hazard Mitigation Plan, namely:

- **Goal 1-** Significantly reduce risk to life, community lifelines, the environment, property, and infrastructure by planning and implementing whole-community risk reduction and resilience strategies.
- **Goal 2-** Build capacity and capabilities to increase disaster resilience among historically underserved populations, individuals with access and functional needs, and communities disproportionately impacted by disasters and climate change.
- **Goal 3-** Incorporate equity metrics, tools, and strategies into all mitigation planning, policy, funding, outreach, and implementation efforts.
- **Goal 4-** Apply the best available science and authoritative data to design, implement, and prioritize projects that enhance resilience to natural hazards and climate change impacts.
- **Goal 5-** Integrate mitigation principles into laws, regulations, policies, and guidance to support equitable outcomes to benefit the whole community.
- **Goal 6-** Significantly reduce barriers to timely, efficient, and effective hazard mitigation planning and action.

TID Mitigation Goals

TID developed the following mitigation goals and priorities to guide long-term risk reduction efforts across its electric, irrigation, water storage, and administrative operations. These goals reflect the District's mission to provide reliable, safe, and cost-effective services while protecting life, property, and critical infrastructure from natural hazards.

1. **Protect Life and Safety**

Safeguard the public, TID staff, and first responders by reducing exposure to hazards and improving preparedness, response, and recovery capabilities.

2. **Protect TID Infrastructure and Operations**
   Reduce the risk of damage to electric, irrigation, and water storage infrastructure through engineered mitigation, system hardening, and redundancy.

3. **Enhance System Reliability and Continuity of Operations**
   Maintain essential services—including power delivery, water delivery, SCADA, communications, and emergency response—during and after hazard events.

4. **Reduce Future Losses Through Proactive Mitigation**
   Implement cost-effective, forward-looking strategies that reduce operational disruptions, disaster impacts, and long-term recovery costs.

5. **Integrate Mitigation Into District Planning and Decision-Making**
   Ensure hazard mitigation considerations are consistently incorporated into capital planning, budgeting, policy updates, and system asset management.

TID Mitigation Priorities

These priorities translate the goals into clear focus areas that guide project selection and investment decisions:

1. **Enhance Infrastructure Resilience and Asset Management**
   Upgrade, harden, and modernize TID's electrical, irrigation, and water storage systems to withstand earthquakes, extreme weather, flooding, wildfire, and climate-driven hazards.

2. **Promote Financial Resilience and Risk Reduction**
   Pursue cost-effective mitigation projects, leverage grants and external funding, and reduce long-term disaster-related financial exposure.

3. **Strengthen Water Resource Stewardship and Drought Resilience**
   Support programs, technologies, and operational practices that improve water conservation, sustain water availability, and mitigate drought impacts.

4. **Foster Regional Collaboration and Multi-Agency Coordination**
   Work with counties, cities, special districts, watershed groups, power utilities, and emergency response partners to align mitigation efforts and share resources.

5. **Enhance Community Safety and Public Awareness**
   Expand education, outreach, and customer engagement to promote safe behaviors, reduce risk, and support community preparedness.

6. **Adopt and Integrate Advanced Technologies**
   Use modern hazard monitoring, situational awareness tools, data analytics, and predictive modeling to identify vulnerabilities and improve emergency operations.

7. **Ensure Effective and Inclusive Strategic Planning**
   Incorporate mitigation into long-term planning, capital programming, budgeting, and asset management; update priorities as risks, regulations, and system conditions change.

Mitigation Objectives

To implement the goals and priorities above, TID will pursue the following specific objectives:

1. Reduce exposure of substations, transmission lines, hydropower assets, and critical irrigation facilities to hazards identified in this plan.

2. Harden electric and water infrastructure to minimize service interruptions and support rapid restoration.
3. Modernize monitoring, detection, communications, and situational awareness systems (e.g., sensors, SCADA upgrades, weather data, seismic monitoring).
4. Improve operational flexibility during emergencies through redundancy, remote operations, mobile assets, and cross-training.
5. Strengthen coordination protocols with local, state, and federal partners for mutual aid, emergency response, and joint mitigation opportunities.
6. Align TID mitigation efforts with countywide and regional resilience initiatives.
7. Support water conservation, watershed management, and drought-resilience programs.
8. Integrate hazard mitigation considerations into capital improvement planning, annual budgeting, and long-range infrastructure strategy.
9. Expand community education programs to reduce risk, promote safe behaviors, and improve preparedness.
10. Use after-action findings, data analytics, and performance metrics to refine and improve mitigation practices over time.

Implementing the Mitigation Action Plan

Tables 45-47 summarize TID's mitigation actions and document completion status, responsible departments, and implementation planning. Table 45 lists actions from the 2020 LHMP that are completed or discontinued. Table 46 lists actions carried forward into the 2026 LHMP update. Table 47 lists mitigation actions newly identified during the 2026 update.

Identifying Mitigation Actions

For the 2026 update, the Planning Team evaluated potential mitigation actions in alignment with TID's Strategic Plan, operational priorities, and lessons learned since adoption of the 2020 LHMP. The team identified new mitigation actions for each hazard, assessed vulnerabilities across electric and irrigation systems, and reviewed the status of actions carried forward from the 2020 plan, categorizing them as completed/institutionalized, ongoing/in progress, planned, or discontinued.

Mitigation actions in this plan include both pre-disaster and post-disaster strategies focused on reducing hazard impacts within TID's service area and strengthening system reliability. These efforts include:

- Integrating mitigation considerations into capital improvement planning, asset management, and operational policies.
- Assessing vulnerabilities of substations, transmission and distribution facilities, irrigation infrastructure, and critical facilities.
- Addressing high-risk areas with engineered safety measures and system hardening.
- Enhancing communication, situational awareness, and coordination with county agencies, emergency responders, and regional partners.
- Strengthening cross-departmental planning and operational coordination.
- Building trust and awareness within the community through public education and outreach programs.

This LHMP builds upon the 2020 plan and reflects TID's evolving priorities for reducing risk, protecting critical assets, and ensuring continued delivery of electric power and irrigation water. The updated mitigation strategy incorporates new hazards, refined risk assessments, and District-specific needs identified since 2020, while reaffirming TID's commitment to safety, reliability, and long-term resilience.

After identifying new and continued mitigation actions, the Planning Team evaluated each project using a structured, FEMA-aligned prioritization process. This approach ensures that actions are feasible, cost-

effective, and aligned with TID's operational needs, regulatory requirements, and Strategic Plan priorities. The criteria used to score and prioritize mitigation actions guide decision-making and help direct resources toward the most beneficial risk-reduction strategies.

Evaluating and Prioritizing Mitigation Activities

TID develops, evaluates, and prioritizes mitigation actions through a structured process that aligns with FEMA guidance, the Disaster Mitigation Act of 2000, and TID's strategic and operational priorities. Mitigation is treated as an ongoing, District-wide effort integrated into daily operations, capital planning, maintenance programs, and long-range infrastructure investments.

Mitigation Action Development Framework

TID uses a multi-step approach to develop risk-reduction actions:

Step 1- Hazard Analysis & Vulnerability Assessment
Mitigation actions are informed by the risk assessment in Section 3, including exposure, damage potential, and system criticality.

Step 2- SME Workshops & Cross-Department Coordination
SMEs from Water Operations, Power Operations, Engineering, IT, Finance, and Emergency Management collaboratively identify vulnerabilities and feasible mitigation measures.

Step 3- Drafting of Mitigation Actions
Each action is documented using FEMA standards, including:

- Addressing each Hazard
- Determining affected assets and systems
- Determining the appropriate mitigation approach
- Identifying the TID department(s) responsible for the mitigation project
- Estimating the cost
- Identifying potential funding sources
- Timeline for implementation

Step 4- Prioritization and Cost-Benefit Evaluation
Actions are evaluated using TID's mitigation action prioritization methodology (see following section), incorporating FEMA's principles and District-specific considerations.

Step 5- Board Adoption & Implementation
Upon LHMP adoption, mitigation actions become formally recognized initiatives considered in capital planning, budgeting, and operational decision-making.

TID acknowledges that not all future mitigation needs can be predicted. This LHMP provides a framework allowing the District to identify and carry out additional mitigation measures as hazards evolve, infrastructure ages, or emergencies reveal new vulnerabilities even when the LHMP has not yet been updated.

Criteria for Evaluating and Prioritizing Mitigation Actions

TID evaluates mitigation actions using FEMA's guidance and District-specific operational priorities.

Actions are scored on the following factors:

Each action is evaluated across the criteria below to support consistent prioritization and selection.

- **Risk Reduction Impact (High–Medium–Low)**
  Priority is given to actions that protect:
  - Large numbers of customers

    - High-criticality assets
    - Infrastructure essential to water delivery, power delivery, SCADA, communications, and emergency operations
- **Benefit-Cost Effectiveness**
  TID applies FEMA's Benefit-Cost Analysis concepts and internal financial evaluation:
    - Expected reduction in damages
    - Avoided outage repair and operational costs
    - Grant eligibility and cost-share opportunities
- **Technical and Administrative Feasibility**
  Considers whether TID has:
    - Engineering, construction, and technical capacity
    - Staff availability
    - Ability to implement the project within a reasonable timeframe
- **Funding Availability**
  Evaluates whether funding can be secured through:
    - TID capital and maintenance budgets
    - FEMA Hazard Mitigation Grant Program, Flood Mitigation Assistance, or other grant programs
    - State funding (DSOD, CEC, CA Resilience initiatives)
- **Environmental and Community Impact**
  Assesses environmental compliance, permitting requirements, and community interface considerations.
- **Alignment with TID Strategic Priorities**
  Projects that improve system reliability, enhance wildfire and drought resilience, protect critical infrastructure, modernize assets, or meet regulatory requirements receive higher priority.

Use of FEMA's STAPLEE Considerations

Where appropriate, TID also incorporates FEMA's STAPLEE framework to further evaluate feasibility:

- **Social:** Equitable benefits and community acceptance
- **Technical:** Proven effectiveness and engineering viability
- **Administrative:** Staffing and resources required
- **Political:** Leadership, stakeholder, and community support
- **Legal:** Authority and compliance
- **Economic:** Cost-effectiveness and funding availability
- **Environmental:** Regulatory compliance and environmental impacts

Ongoing Commitment to Mitigation

Mitigation is incorporated into TID's capital improvement planning, operational budgets, inspection programs, and maintenance cycles. Many mitigation measures are continually implemented as part of asset upgrades, vegetation management, dam and canal maintenance, substation improvements, wildfire mitigation, and modernization projects.

Projects identified in this LHMP that receive funding, whether through District resources or grant programs, must be cost-effective, technically feasible, and contribute to TID's long-term resilience. The District may also implement additional mitigation projects that emerge from new hazards, evolving climate conditions, post-incident lessons learned, or stakeholder and community input.

TID remains committed to protecting life safety, safeguarding critical water and power infrastructure, and maintaining reliable, resilient service across its service area.

Mitigation Funding Strategy

TID is committed to funding feasible mitigation activities through a combination of District budget allocations and federal and state grant programs when available. Potential funding sources are shown in the following table.

Table 40. Potential Mitigation Project Funding Sources

Grant Name	Agency	Purpose
FEMA Hazard Mitigation Grant Program (HMGP)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To prevent future losses of life and property due to disasters; to implement state and local hazard mitigation plans; to enable mitigation measures to be implemented during immediate recovery from a disaster; and to provide funding for previously identified mitigation measures to benefit the disaster area.
Emergency Management Performance Grants (EMPG)	U.S.Department of Homeland Security; Federal Emergency Management Agency	To encourage development of comprehensive emergency management at State and local levels and to improve emergency management planning, preparedness, mitigation, response and recovery capabilities.
Public Assistance Program (PA) HMGP Post-Disaster Grants (when applicable)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To provide supplemental assistance to States, local governments, and certain private nonprofit organizations to alleviate suffering or hardship resulting from major disasters or emergencies declared by the President. Under Section 406, Public Assistance funds may be used to mitigate the impact of future disasters.
Emergency Watershed Protection	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide emergency technical or financial assistance to install or repair structures that reduce runoff and prevent soil erosion to safeguard life and property.
Disaster Mitigation and Technical Assistance Grants	U.S. Department of Commerce, Economic Development Administration	To help States and localities to develop and /or implement a variety of disaster mitigation strategies.
Watershed Surveys and Planning	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide planning assistance to Federal, State, and local agencies for the development of coordination water and related land resources programs in watersheds and river basins.
National Earthquake Hazards Reduction Program (NEHRP)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To mitigate earthquake losses that can occur in many parts of the nation, providing earth science data and assessments essential for warning of imminent damaging earthquakes, land-use planning, engineering design, and emergency preparedness decisions.

Grant Name	Agency	Purpose
Engineering for Natural Hazards	National Science Foundation	Supports fundamental research that advances knowledge for understanding and mitigating the impact of natural hazards on constructed civil infrastructure.
The WaterSMART Program's Water and Energy Efficiency Grants	US Bureau of Reclamations	Encourage water conservation and improve water management by reducing water use and energy consumption by implementing more efficient practices and infrastructure. Helps mitigate climate change impacts on water resources.
Large-Scale Water Efficiency Projects and the Drought Program	US Bureau of Reclamations	Grant programs, typically administered under the umbrella of the WaterSMART Program, this program supports largescale, complex water efficiency projects that generate significant water savings or modernize water delivery systems.
CAL FIRE Fire Prevention Grants	CAL FIRE	Program to fund activities like fuel reduction, community fire planning, evacuation planning, and public education. Portions administered through the Fire Safe Council.
California Department of Water Resources (DWR) Flood Management Grants	California Department of Water Resources	Provides funding for projects that improve flood management and reduce flood risk by enhancing flood protection infrastructure and implementing integrated flood management.
California Hazard Mitigation Grant Program (HMGP)	Cal OES	Mirroring the federal program, this grant program enhances state and local hazard mitigation planning and implementation of mitigation projects during the immediate recovery from a disaster.
Cal OES Earthquake and Tsunami Program Grants	Cal OES	This program aims to reduce vulnerability to seismic and tsunami hazards through planning and public outreach. Funds projects related to earthquake and tsunami preparedness, including public education and warning systems.

The District will actively explore these grant opportunities and apply for funding once a project is identified as viable or, when applicable, during the investigative phase to assist with associated costs. TID's Emergency Management Planning Team (EMPT) will facilitate and monitor grant funding opportunities and will provide updates on the outcome of grant applications as part of the annual progress reporting process outlined in this LHMP.

Mitigation Capabilities

TID's mitigation capabilities encompass existing authorities, policies, programs, and resources. These are categorized into four types:

1. Planning and Regulatory
2. Administrative and Technical
3. Financial

4. Education and Outreach

The following tables outline TID's mitigation capabilities.

Table 41. Planning and Regulatory Capabilities

Planning or Regulatory Tool	Yes/No Year	• Does the plan address hazards? • Does the plan identify projects to include in the mitigation strategy? • Can the plan be used to implement mitigation actions?
Ag Water Management Plan	Yes 2021	The Agricultural Water Management Plan describes TID's water supplies and irrigation demand, local conditions, facilities and operations, rules and policies, and a variety of water management activities, including a series of efficient water management practices (EWMPs) designed to improve water use efficiency. This documents how TID is complying with current law, and opportunities for continued improvement.
Capital Improvements Plan	Yes Annually	• No • No Yes, can be used to implement mitigation actions
Comprehensive/Master Plan	Yes 2020	TID has a Strategic Plan updated in 2020. This plan does not identify hazards specifically but can be used as authority to conduct mitigation activities that align with the strategic goals of the plan. Safety, Security, and Emergency Preparedness are identified in the plan as important goals for TID.
Continuity of District/ Continuity of Operations Plan	Yes 2024	• Yes, the COD/COOP addresses the effect on operations at TID when either a facility or facilities are damaged rendering them unusable or staff cannot report for work due to damaged facilities, widespread health emergency, or other reasons. The COD/COOP contains alternate work facilities and staffing plans, outlines for recovery operations, orders of succession, delegation of authority, devolution of authority, identifies Continuity Records and Mission Essential Functions of the District. • This plan does not identify specific projects to include in the mitigation strategy but does give some direction that helps in developing mitigation measures, such as the need for a mobile command post and alternate communication methods and equipment. • Since it has already been approved by the TID Management Team, it could be used internally as justification for implementing mitigation measures that improve the District's ability to function when facilities or personnel are unavailable.
Don Pedro Emergency Action Plan	Yes 2022	• Yes, this plan addresses specific hazards relating to emergency conditions at the Don Pedro Dam and Spillway. • No, this is an emergency response plan and not a mitigation plan. • No, this is an emergency response plan and not a mitigation plan.
Don Pedro Woody Debris Management Plan	Yes 2017	• The Don Pedro Woody Debris Management Plan is a requirement under Article 52 of the project's Federal Energy Regulatory Commission hydropower license. • This plan describes the requirements and process that the District must undertake to manage the woody debris in the reservoir that pose a public safety risk to recreational users of Don Pedro. • Yes, appropriate mitigation actions involving floatable debris at Don Pedro can be implemented under this plan.

Planning or Regulatory Tool	Yes/No Year	• Does the plan address hazards? • Does the plan identify projects to include in the mitigation strategy? • Can the plan be used to implement mitigation actions?
Don Pedro Vulnerability-Risk Assessment	Yes 2019	• Yes, this plan addresses specific hazards relating to security related issues at the Don Pedro Dam. • Yes, this plan details projects that could help to mitigate risks identified in the LHMP involving the dam or appurtenant structures. • Yes, appropriate mitigation actions could be implemented under the LHMP as described in this plan.
Economic Development Plan	No	This is not applicable to TID.
Emergency Operations Plan	Yes 2021	• Yes, the plan addresses both natural and man-made hazards for both the electric and irrigation water provided to customers by TID. • The Emergency Operations plan does not address specific projects to include in the mitigation strategy. • No, the EOP is the overarching plan addressing emergency responses in the District, not mitigation.
Integrated Resource Plan	Yes 2023	• The Integrated Resource Plan serves as the foundational planning strategy to deliver safe, reliable electricity service to the District's customers while maintaining stable reasonable and affordable rates. • No, this is a strategy document describing in concept, how TID will provide reliable and affordable power. • No, this document does not identify specific projects.
Stormwater Management Plan	No	• This is not applicable to TID.
Transportation Plan	No	This is not applicable to TID.
Turlock Sub-basin Groundwater Management Plan	Yes 2020	• A joint plan of MID and TID outlining the District's comprehensive management plan for the Tuolumne River. • Yes, there are projects in this plan that could be included in an appropriate mitigation strategy. • The projects could be implemented under this plan if appropriate.
Turlock Lake Emergency Action Plan	Yes 2022	• Yes, this plan addresses specific hazards relating to emergency conditions at the dams at Turlock Lake. • No, this is an emergency response plan and not a mitigation plan. • No, this is an emergency response plan and not a mitigation plan.
La Grange Dam Emergency Action Plan	Yes 2022	• Yes, this plan addresses specific hazards relating to emergency conditions at La Grange Dam. • No, this is an emergency response plan and not a mitigation plan. • No, this is an emergency response plan and not a mitigation plan.
Wildfire Mitigation Plan	Yes 2023	• Yes, this plan specifically addresses steps the District is taking to reduce the likelihood that its facilities will start or contribute to the growth of a wildfire inside its boundaries. • Yes, in addition to hardening its equipment in elevated fire zone areas, the plan calls for implementing new technologies when they become available. • Yes, mitigation actions can be implemented as described in the Wildfire Mitigation Plan as required under its adoption required under the Public Utilities Code section 8387 (b).
Building Code, Permitting, and Inspections		
Building Code	No	This is not applicable to TID.
Building Code Effectiveness Grading Schedule (BCEGS) Score	No	This is not applicable to TID.
Fire department ISO rating	No	This is not applicable to TID.

Planning or Regulatory Tool	Yes/No Year	• Does the plan address hazards? • Does the plan identify projects to include in the mitigation strategy? • Can the plan be used to implement mitigation actions?
Site Plan Review Requirements	No	This is not applicable to TID.
Electrical Facilities Inspection	Yes	Yes, inspection from TID is required prior to energizing new services or any time a generator is installed by the customer.
Land Use Planning and Ordinances		
Zoning ordinance	No	This is not applicable to TID.
Subdivision ordinance	No	This is not applicable to TID.
Floodplain ordinance	No	This is not applicable to TID.
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	No	This is not applicable to TID.
Flood insurance rate maps	No	This is not applicable to TID.
Acquisition of land for open space and public recreation uses	No	This is not applicable to TID.
How can these capabilities be expanded and improved to reduce risk?		
These plans can support hazard mitigation as part of their routine implementation. Whenever mitigation efforts are carried out under one of these plans, it is important to evaluate how the work could align with or complement projects identified in the LHMP.		

Table 42. Administrative or Technical Capabilities

Administrative or Technical Capability	Yes/No	Department/Position
Engineer/Professional Trained in Construction Practices Related to Buildings or Infrastructure	Yes	Civil Engineering, Line Engineering, and Construction and Maintenance Departments.
Engineer with an Understanding of Natural Hazards	Yes	Civil Engineering and Line Engineering Departments
Personnel Skilled In GIS	Yes	Civil Engineering, Line Engineering, and Information Technology Departments
GIS Data- Land Use	Yes	Civil Engineering and Line Engineering Departments
Emergency Manager	Yes	Security and Emergency Preparedness Department
Maintenance programs to reduce risk (vegetation management, canal clearing, facility inspections, and infrastructure upkeep)	Yes	TID implements ongoing maintenance programs designed to reduce operational and hazard-related risks across its electric and irrigation systems. The TID Wildfire Mitigation Plan outlines vegetation management, inspection, and operational practices that lower the likelihood of power line–caused wildfires. In addition, the District conducts regular maintenance on canals, power plants, dams, and other critical infrastructure to prevent system failures, improve reliability, and minimize vulnerability to natural hazards.
Mutual Aid Agreements	Yes	TID has mutual aid agreements with neighboring utilities and the California Municipal Utilities Association (CMUA) to provide and receive assistance during emergencies. Coordination between TID, neighboring utilities, and the CMUA has proven effective in past instances where mutual aid was requested.
How can these capabilities be expanded and improved to reduce risk?		
The Emergency Management Planning Team and Subject Matter Experts should integrate actions from the LHMP when creating After Action Reports and Improvement Plans following the activation or exercise of an Incident Action Plan (IAP), Emergency Response Plan (ERP), or Emergency Action Plan (EAP). This approach ensures that improvements and lessons learned from these activities are incorporated into the LHMP.		

Table 43. Financial Capabilities

Financial Capability	Yes/No	Comments
Capital Improvements Project Funding	Yes	Both the Water Resources and Electrical Engineering & Operations Divisions maintain capital budgets that can fund mitigation-related improvement projects.
Authority to Levy Taxes for Specific Purposes	Yes	The District can assess taxes as long as it follows Prop 218.
Fees for Water Delivery or Electric Services	Yes	TID is authorized to set and collect rates and charges for the delivery of water and electrical services it provides to its customers. These rates are structured to cover the costs of service delivery, operation and maintenance, and infrastructure improvements.
Impact Fees for New Development	Yes	Under GC 66000, et seq., special districts are allowed to charge and collect impact fees.
Incur Debt Through General Obligation Bonds	Yes	TID generally can raise funds through the issuance of general obligation (GO) bonds. GO bonds are a common financing mechanism used by special districts to fund large infrastructure projects or capital improvements, such as water delivery systems, energy infrastructure, or other essential services within the district's scope.
Incur Debt Through Special Tax Bonds	No	Not Applicable to TID
Incur Debt Through Private Activities	No	Not Applicable to TID
Withhold Spending in Hazard Prone Areas	No	As a Special District, TID does not have the authority to withhold spending in hazard prone areas.
CAL FIRE Fire Prevention Grants	Yes	Program to fund activities like fuel reduction, community fire planning, evacuation planning, and public education. Portions administered through the Fire Safe Council.
California Department of Water Resources (DWR) Flood Management Grants	Yes	Provides funding for projects that improve flood management and reduce flood risk by enhancing flood protection infrastructure and implementing integrated flood management.
California Hazard Mitigation Grant Program (HMGP)	Yes	Mirroring the federal program, this grant program enhances state and local hazard mitigation planning and implementation of mitigation projects during the immediate recovery from a disaster.
Cal OES Earthquake and Tsunami Program Grants	Yes	This program aims to reduce vulnerability to seismic and tsunami hazards through planning and public outreach. Funds projects related to earthquake and tsunami preparedness, including public education and warning systems.
FEMA Hazard Mitigation Grant Program (HMGP)	Yes	Administered by FEMA, HMGP provides funding to state, local, tribal, and territorial governments to implement long-term hazard mitigation measures following a major disaster declaration. Eligible projects aim to reduce the loss of life and property from future disasters. Utilities like TID can apply for HMGP funds to support projects that align with their LHMP objectives.

Financial Capability	Yes/No	Comments
Grid Resilience and Innovation Partnerships (GRIP) Program	Yes	Funded by the U.S. Department of Energy, the GRIP program allocates grants to enhance grid flexibility and resilience against extreme weather and climate change. TID can apply for GRIP funds to upgrade its power grid infrastructure, thereby mitigating risks associated with natural disasters. The GRIP Program encompasses three key components: • **Grid Resilience Utility and Industry Grants:** These grants support projects that prevent outages and enhance the resilience of the electric grid. • **Smart Grid Grants:** This component funds the deployment of technologies that enhance grid flexibility, situational awareness, and operational efficiency. • **Grid Innovation Program:** This program supports projects that use innovative approaches to transmission, storage, and distribution infrastructure to enhance grid resilience and reliability.
FEMA Flood Mitigation Assistance	No	This FEMA program offers grants to states, local communities, tribes, and territories to reduce or eliminate the risk of repetitive flood damage to buildings insured under the National Flood Insurance Program (NFIP). TID does not have any repetitive loss properties and is self-insured. The District does not participate in the NFIP.
Community Development Block Grant	No	As a special district, TID itself is not directly eligible to receive Community Development Block Grants (CDBG), as these federal funds are typically allocated to cities, counties, and states to support community development and infrastructure projects. However, TID can collaborate with eligible entities, such as local municipalities or county governments, to participate in projects funded by CDBGs that align with their mission and services.
FEMA Emergency Management Performance Grant	Yes	Administered by FEMA, the EMPG provides funding to state, local, tribal, and territorial emergency management agencies to support the implementation of the National Preparedness System and to work toward the National Preparedness Goal of a secure and resilient nation.
US Bureau of Reclamation (USBR)	Yes	TID could seek funding opportunities to partner with USBR on mutually beneficial projects.
How can these capabilities be expanded and improved to reduce risk?		
TID plans to seek grant funding to implement mitigation projects identified in this LHMP that are determined to be viable and cost-effective. Additionally, high-priority projects, as identified through a cost-benefit analysis, and/or that directly support Community Lifelines, may be funded through the District's capital improvement plan or other internal financing mechanism. Additionally, the District may consider engaging a grant writer, either on a contract or other basis, to secure funding for projects identified in the LHMP.		

Table 44. Education and Outreach Capabilities

Type of Resource	Resource Name	Ability to Support Mitigation
Personnel Resource	TID External Affairs, Security and Emergency Preparedness, Customer Service, Line, and Irrigation Services Departments	The District provides ongoing public education and outreach to increase community awareness of hazards, preparedness actions, and mitigation programs. TID regularly shares safety information through its website, social media, customer newsletters, and targeted campaigns on topics such as wildfire prevention, electrical safety, drought awareness, canal safety, and emergency preparedness. The District also conducts outreach at community events, partners with local agencies on preparedness messaging, and provides timely alerts and public information during emergencies. These efforts help customers understand risks, reduce unsafe behaviors, and support District mitigation goals.

Type of Resource	Resource Name	Ability to Support Mitigation
Financial Resource	TID Finance Department	The Finance Department works closely with all District departments, the Board of Directors, and the public to support budget compliance, cost controls, risk assessment, and financially sound operations. The department manages accounting, develops and oversees budgets, and ensures access to cost-effective financing. Mitigation-related responsibilities include identifying funding opportunities, managing grant and capital budgets, and supporting the financial planning required to implement mitigation projects.
Personnel Resource	TID Security and Emergency Preparedness Department	Leads and coordinates TID's comprehensive emergency management and security program, including hazard mitigation planning, NIMS/ICS training, section-specific EOC training, and multi-department exercises. The department develops and maintains the District's emergency, continuity, and mitigation plans; supports operational readiness through drills and evaluations; and coordinates response activities during emergencies. It also facilitates damage assessments, documentation, and initial recovery operations, and works closely with internal departments and external partners to reduce risk, strengthen response capabilities, and support efficient recovery and restoration of services.
Personnel Resource	TID External Affairs, TID Aquatic Biologist	TID conducts extensive education and outreach activities through its External Affairs Department and technical staff. External Affairs provides school and community presentations on electrical safety, water safety, conservation, and emergency preparedness, helping students and residents understand local hazards and safe behaviors. The District's Aquatic Biologist also delivers educational programs on fisheries, and the salmon habitat and lifecycle supporting awareness of environmental stewardship and watershed conditions. These outreach efforts increase public understanding of risk, promote mitigation behaviors, and strengthen community preparedness.
Safety related school and community programs	TID External Affairs	Dexter the Duck, TID's safety mascot, plays a key role in teaching local children about irrigation canal safety and the dangers of swimming in unsafe waterways. Building on this long-standing outreach effort, Dexter now also helps promote water awareness, conservation, and electrical safety through school visits, community events, and TID's summer "Swim for Free with TID" program. These educational efforts reinforce safe behaviors, encourage children to choose supervised swimming locations, and support the District's broader public safety mission.
Storm Ready Certification		This is not applicable to TID.
Firewise Communities Certification		This is not applicable to TID

How can these capabilities be expanded and improved to reduce risk?
TID can strengthen and expand these capabilities by increasing the frequency and reach of public education campaigns, enhancing multilingual communication resources, and partnering more widely with schools, community organizations, and local governments to deliver consistent hazard-specific messaging. Continued investment in staff training, cross-department exercises, and updated emergency plans will further improve preparedness and response capabilities. Expanding grant-seeking efforts and integrating mitigation considerations into capital planning will improve the District's ability to implement risk-reduction projects. Enhancing data collection, outreach metrics, and after-action evaluations will also help refine programs and ensure mitigation activities effectively reduce risk across the service area.

National Flood Insurance Program Compliance

The National Flood Insurance Program (NFIP) and Community Rating System (CRS) apply to local jurisdictions that regulate floodplain development and participate in FEMA's flood insurance program. TID is a self-insured public utility and does not participate in the NFIP or CRS. TID does not identify repetitive loss properties under NFIP definitions. Flood risk reduction is addressed through District infrastructure investments, operations, and the mitigation actions identified in this LHMP.

Mitigation Actions

Review of 2020 Mitigation Actions

TID's 2020 Local Hazard Mitigation Plan (LHMP) identified a range of mitigation projects and initiatives intended to reduce risk across the District's electric and irrigation systems. As part of the 2026 LHMP update, all mitigation actions from the 2020 plan were systematically reviewed to evaluate their current status, continued relevance, and alignment with updated hazard data, operational priorities, and input received through the Subject Matter Expert review process.

Mitigation actions that were completed, institutionalized as standard operating practices, or determined to be non-viable or outside the District's authority are documented in the table below. Mitigation actions that remain valid but were not completed have been carried forward and incorporated into the updated mitigation strategy to ensure continuity, accountability, and sustained progress in reducing risk.

Table 45. Completed and Discontinued Mitigation Actions from the 2020 LHMP

2020 Mitigation Activity	Responsible Department	Project Status
Continue to review, update and exercise all dam related EAPs per the requirements of each plan. Continue to include outside agencies with a role in an activation of the plan to participate in the plan review and exercise.	Chief Dam Safety Engineer	**Completed - Institutionalized.** This mitigation action has been completed and integrated into standard District operations to ensure continued risk reduction.
Continue to participate in Emergency Action Plan training and exercises by attending presentations of other local jurisdiction's plans.	Various TID Departments	**Completed - Institutionalized.** This mitigation action has been completed and integrated into standard District operations to ensure continued risk reduction.
Continue to work with Stanislaus County on the Tuolumne River /TID Flood Working Group to develop and approve plans specific to public notification and evacuation.	Security and Emergency Preparedness, Chief Dam Safety Engineer	**Completed - Institutionalized.** Stanislaus County conducts a "growl test" of the La Grange siren regularly to ensure its continued operation. The county has the sole authority to activate the siren. This project has transitioned to an ongoing maintenance item for the District.
Route power to critical facilities during power outages.	Security and Emergency Preparedness, Engineering and Operations Administration, Line Department	**Completed.** This project was completed in 2025.
Participate in the Great California Shakeout exercise conducted annually by CAL OES.	Security and Emergency Preparedness, Communications Division	**Completed - Now Standard Operating Procedure.**
Provide training to first responders about the hazards of electrical equipment during earthquake events.	Line Division	**Completed - Now Standard Operating Procedure.**

2020 Mitigation Activity	Responsible Department	Project Status
Provide education to local First Responders on the dangers posed by electrical equipment during flood events.	Line Division	**Completed - Now Standard Operating Procedure.**
Notification system to primary personnel activated to the DOC	Security and Emergency Preparedness	**Completed - Now Standard Operating Procedure.**
Increase the ability of TID to monitor local weather and streamflow conditions in order to more accurately forecast impacts of hyper-local weather events.	Hydrology Department	**Completed - Now Standard Operating Procedure.**
Mitigate the effects of extreme heat on employees working in older, existing buildings at the District which currently do not have air conditioning.	Environmental Health Division, Facilities, Construction & Maintenance, Civil Engineering	**Completed - Now Standard Operating Procedure.** This is now part of Cal/OSHA's standard for Heat Illness Prevention in Indoor Places of Employment that became effective in July of 2024.
Investigate the feasibility and effectiveness of reducing evaporation in the canal system.	Water Resources Administration, Power Supply Administration	**Completed – Monitoring and Evaluation Ongoing.** TID partnered with UC Merced, the State of California and private companies on project NEXUS to install solar panels over a portion of its canal system to evaluate the concept's effectiveness in reducing evaporation and the growth of aquatic weeds. This project is complete and is currently undergoing testing to determine its effectiveness. The results of the studies will be complete at the end of 2028.
Reduce the occurrence of tree limbs falling or being blown into power lines during storm events.	Electrical Engineering and Operations Administration	**Completed - Now Standard Operating Procedure.** This work has been completed in high fire-threat areas as part of the District's Wildfire Mitigation Plan. This is now part of the District's ongoing maintenance program.
Modernize water control structures on the lower canal system.	Water Resources Administration	**Incorporated into the project to "Prepare for Changes in Water Availability in the Canal System Due to the Impacts of Climate Change."** This project is part of the Total Channel Control Project.
Prepare for changes in water availability in the canal system due to the impacts of extreme weather by augmenting surface water supplies.	Water Resources Administration	**Incorporated into the project to "Prepare for Changes in Water Availability in the Canal System Due to the Impacts of Climate Change."** This project is part of the Ceres and Lateral 5.5 Regulating Reservoir Projects.
Provide a video feed of spillway operations to the DOC and Power Control Center.	Security and Emergency Preparedness	**Completed - Now Standard Operating Procedure.**
Mitigate landslide risk on all new access roads to TID infrastructure.	Civil Engineering	**Completed - Now Standard Operating Procedure.**
Evaluate areas of the District for landslide risk and correct issues prior to the winter storm season.	Water Distribution, Civil Engineering, Construction and Maintenance, Line Department	**Completed - Now Standard Operating Procedure.**
Where possible, underground electric distribution facilities and equipment.	Electrical Engineering and Operations, Line Department	**Completed - Now Standard Operating Procedure.**

2020 Mitigation Activity	Responsible Department	Project Status
Install falling wire sensors to alert TID Power Control Center to downed lines.	Electrical Engineering and Operations, Line Department	**Completed - Now Standard Operating Procedure.**
Continue to review, update and exercise all dam related EAPs per the requirements of each plan. Continue to include outside agencies with a role in an activation of the plan to participate in the plan review and exercise.	Dam Safety, Security and Emergency Preparedness.	**Completed - Institutionalized.**
Enhance TID's ability to selectively de-energize lines or portions of lines in the high fire-threat zones to reduce the chance of its equipment starting a fire.	Electrical Engineering and Operations	**Completed - Now Standard Operating Procedure.**
Limit electricity availability during periods of prolonged fuel unavailability.	Power Supply	**Completed - Now Standard Operating Procedure.**
Update maps of river elevations and facilities inundated to reflect correct information after 2017 Increased Flows Event.	Hydrology	**Completed - Now Standard Operating Procedure.**
Provide appropriate breathing protection for employees working outside during elevated levels of wildfire smoke which result in an AQI for PM2.5 forecast to be at a level determined by the Department of Industrial Relations (DIR) as a health risk to those working outside.	Environmental Health and Safety	**Completed - Now Standard Operating Procedure.**
Security fencing around dam and spillway to keep onlookers away from spill operations.	Security and Emergency Preparedness	**Completed - Now Standard Operating Procedure.**
Prevent rocks or debris from falling onto the Don Pedro Power Plant and infrastructure.	Dam Safety, Power Plan Engineering	**Completed.**
Maintain equipment necessary to clear slides from District-owned access roads or rights-of-way in the event a slide occurs.	Construction and Maintenance	**Completed - Now Standard Operating Procedure.**
To the extent possible, provide alternate work schedules and/or telecommuting options for healthy staff unable to report for work because they are home caring for ill family members.	Human Resources	**Completed - Now Standard Operating Procedure.**
Provide personal protective equipment (PPE) to employees interacting with members of the public during a health emergency.	Environmental Health and Safety	**Completed - Now Standard Operating Procedure.**
Segment the air handling equipment to isolate zones where the public has access in order to minimize the exposure of healthy employees.	Facilities	**Completed - Now Standard Operating Procedure.**
Provide alternate remote customer service locations in place of the Canal Office.	Customer Service	**Completed - Now Standard Operating Procedure.**

2020 Mitigation Activity	Responsible Department	Project Status
Provide for proper PPE and sanitizing of facilities and machinery used to count money.	Environmental Health and Safety	**Completed - Now Standard Operating Procedure.**
Improve access to equipment necessary for proper hand sanitizing throughout the District.	Facilities	**Completed - Now Standard Operating Procedure.**
Replace wood poles that failed the intrusive test in high fire-threat areas with more resilient types of poles.	Electrical Engineering and Operations	**Completed - Now Standard Operating Procedure.**
Replace existing conductors prone to failure and falling to the ground in the East and West side fire zones.	Electrical Engineering and Operations	**Completed.**
Where possible, use tree wire in high fire-threat areas.	Electrical Engineering and Operations	**Completed - Now Standard Operating Procedure.**
Improve access to electrical facilities and exit routes in remote areas.	Civil Engineering, Construction and Maintenance	**Completed.**
Incorporate the Everbridge Alert System (TIDAlert) into the procedures for making notifications to entities identified on the Notification Flowcharts for all dam EAPs and other EAP/IAP activations.	Security and Emergency Preparedness	**Completed - Now Standard Operating Procedure.**
Reduce outages during high wind events by improving the ability of transmission and distribution lines to withstand high winds.	Electrical Engineering and Operations	**Completed.**
Upgrade the building heaters in the water treatment facilities at DPRA in order to protect equipment in the event of extreme cold temperatures.	DPRA	**Completed.**
Purchase and implement an outage management system.	Electrical Engineering and Operations	**Completed.**
Dispose of floatable debris in the upper reaches of the reservoir that has washed downstream from the Tuolumne River.	DPRA	**Completed.**
Mobile command post for locating District response personnel in close proximity to damaged facilities during recovery.	Security and Emergency Preparedness	**Discontinued - Determined Non-Viable.** Investigations into acquiring and outfitting a mobile command post have been completed and it was determined that this project is non-viable.
Provide a second method of egress from the Turlock Lake Campgrounds to be used in the event of an emergency at the facility necessitating the rapid evacuation of the campground.	Security and Emergency Preparedness, Chief Dam Safety Engineer, Civil Engineering	**Discontinued – Hazard No Longer Exists.** The campgrounds at Turlock Lake are being removed and the area is being returned to a more natural state with no services or recreational access.
Develop alternate fuel sources should natural gas delivery be disrupted due to a major earthquake damaging supply pipelines.	Security and Emergency Preparedness, Power Supply Administration	**Discontinued - Determined Non-Viable.** This project has been determined to be non-viable.
Construction of a bridge or other means of passing water from the spillway without removing Bonds Flat Rd at the spillway.	TID, DPRA and Tuolumne County	**Discontinued - Determined Non-Viable.** This project has been evaluated and has been determined to be non-viable.

2020 Mitigation Activity	Responsible Department	Project Status
Discourage further development in the historical river channel.	Civil Engineering, Water Resources, Engineering and Standards and Line Engineering Dept.	**Discontinued - Determined to be Outside the District's Authority.**
Prevent rocks or debris from falling onto the La Grange Power Plant and infrastructure.	Civil Engineering, Hydroelectric Department, CDSE	**Discontinued - Risk Low.** The risk from rockfall at the La Grange Powerplant has been determined to be low. This project may be undertaken at a future date.
Discourage development in landslide-prone areas.	Civil Engineering	**Discontinued - Determined to be Outside the District's Authority.**

Actions listed below were not completed at the time of this update and remain relevant; they are carried forward for continued implementation and annual progress tracking.

Ongoing and Carried Forward Mitigation Actions

Table 46. 2020 LHMP Mitigation Actions Continuing into the 2026 LHMP Update

2020 Mitigation Activity	Responsible Department	Project Status
Integrate the LHMP priorities into other TID plans including the Emergency Operations Plan, Continuity of District/Continuity of Operations Plan, Capital Improvement Plans and other District plans.	Security and Emergency Preparedness, TID Management Team	**In Progress.** The priorities and mitigation actions identified in the LHMP are being evaluated and, where feasible, integrated into other District plans, programs, and processes, including the District's Strategic Plan, Emergency Operations Plan, Continuity of District/Continuity of Operations Plan, and applicable Capital Improvement Plans. This integration supports institutionalization of hazard mitigation across District operations and capital planning and will reduce or eliminate long-term risk to people, property, critical facilities, and essential services from identified hazards. This project will continue through 2031.
Improve cell phone coverage at Don Pedro Reservoir for internal communications capabilities and to allow for alerting and warning of watercraft via cell phones if it is necessary to evacuate the lake due to spillway operations, potential failure scenarios or unsafe conditions.	Security and Emergency Preparedness, Station Engineering, Electronics	**In Progress.** The District is conducting a pilot evaluation of mobile cellular signal booster technology in field staff vehicles to assess effectiveness, operational reliability, and feasibility for broader deployment. The pilot includes installation of a booster unit in a field vehicle to evaluate performance in areas with limited cellular coverage. Findings from this pilot will inform a decision on potential expansion to additional vehicles and consideration of permanent installations in identified coverage-deficient areas. The pilot evaluation is anticipated to be completed in 2026.

2020 Mitigation Activity	Responsible Department	Project Status
Improve radio and cell phone coverage at locations where signal strength is weak or radio communication is difficult.	Security and Emergency Preparedness, Station Engineering, Electronics	**In Progress.** The District is conducting a pilot evaluation of mobile satellite communications equipment on crew trucks to assess system effectiveness, reliability, and operational value in remote and coverage-limited areas. Initial testing is scheduled to begin on one vehicle in 2025, with evaluation and documentation of performance extending through 2026. Results of this pilot will inform decisions regarding potential expansion and installation of satellite communication systems on additional vehicles, as operationally appropriate. This project is expected to continue through 2031.
Re-configure and expand TID's District Operations Center to include dedicated meeting space, JIC, and breakout rooms for Management/ Command and General Staff and a separate area for meals/ breaks.	Security and Emergency Preparedness, Facilities	**In Progress.** Facility improvements and limited remodeling have been completed to provide dedicated meeting space in support of emergency operations. Additional enhancements are required to strengthen physical security and upgrade audiovisual capabilities to ensure the existing District Operations Center can function effectively during emergencies. Planning for further improvements is underway, with additional work anticipated to begin in 2027.
Provide NIMS, SEMS and ICS training to TID employees with a role in an emergency response. The National Incident Management System (NIMS), Standardized Emergency Management System (SEMS), and the Incident Command System (ICS) were developed so that responders from different jurisdictions and disciplines can work together to provide a unified approach to incident management using a common set of operating principles, organizational structure, and terminology.	Security and Emergency Preparedness	**Ongoing.** The District is currently evaluating options for a Learning Management System to support training, credentialing, and exercise-related requirements. This effort enhances workforce readiness and sustains institutional knowledge. Project evaluation and implementation activities are scheduled for completion by 2031.
Provide portable power stations to communities without electricity for charging of cell phones.	Security and Emergency Preparedness	**Planned - Not Yet Started.** The District has identified the need to evaluate solutions for providing remote cell phone charging capability, including fixed charging stations and portable generators or power units, to support field operations, and support to those impacted during emergencies and extended outages. Investigation and evaluation of options and cost estimates will begin in 2027 and are scheduled for completion by 2031.

2020 Mitigation Activity	Responsible Department	Project Status
Provide a way to back-feed the DPRA warehouse and Don Pedro 2 Substation	Electrical Engineering and Operations, Line Department	**Planned - Not Yet Started.** Provide back-feed electrical capability to the DPRA Warehouse and Don Pedro 2 Substation to improve power system resilience and continuity of operations during outages. The project is currently under review by Electrical Engineering and Operations and the Line Department and may be evaluated for inclusion within the Don Pedro Life Extension Project, subject to engineering feasibility, funding availability, and capital planning priorities. This project is expected to continue through 2031.
Improve earthquake resistance at District facilities.	Security and Emergency Preparedness, Civil Engineering	**Ongoing.** Implement seismic mitigation measures to improve earthquake resistance at District facilities and reduce the risk of damage, service disruption, and safety impacts. Efforts are being led by Civil Engineering with support from Security and Emergency Preparedness and are ongoing, with work anticipated to continue through at least 2031.
Rehabilitate or rebuild the Upper Main Canal to make it more resilient and resistant to seismic events or other potential impacts.	Water Resources Administration	**In Progress.** The District is developing a more comprehensive hydraulic model to simulate operational performance and capacity conditions necessary to support the full range of the District's interests under both normal and hazard conditions. This model will be used to identify system vulnerabilities, evaluate replacement alternatives, and update cost estimates to inform decisions that reduce the risk of infrastructure failure, service disruption, and secondary impacts during hazard events. Based on the results, the District will proceed with design and construction of a replacement facility, as appropriate. This project will continue through 2031.
Rehabilitate and rebuild selected dams at Turlock Lake to make them more resilient and resistant to seismic events or other potential impacts.	Chief Dam Safety Engineer, TID Civil Engineering	**In Progress.** Rehabilitate and rebuild selected dams at Turlock Lake to improve structural resilience and resistance to seismic events and other hazard impacts, thereby reducing the risk of dam failure, downstream flooding, and service disruptions. The Mitigated Negative Declaration for the project has been completed, and the District is proceeding with a Section 10 consultation with the U.S. Fish and Wildlife Service. TID continues to advance project design in coordination with the California Department of Water Resources Division of Safety of Dams. Project implementation is ongoing and is expected to continue through 2031.

2020 Mitigation Activity	Responsible Department	Project Status
Provide alternative fuel source for District vehicles and equipment.	Security and Emergency Preparedness, Fleet, Materials Management	**Ongoing.** Provide alternative and redundant fuel sources for District vehicles and equipment to support continuity of operations during disasters, emergencies, and fuel supply disruptions. Security and Emergency Preparedness, Fleet, and Materials Management are evaluating the feasibility of using the existing 100,000-gallon diesel tank at the Walnut Power Plant as an emergency alternate fuel source in the event of supply interruptions. The District is also assessing the potential impacts of statewide refinery shutdowns and other market disruptions on its ability to secure sufficient fuel during shortages. In parallel, TID has incorporated electric vehicles and pickup trucks into its regular fleet replacement program to diversify energy sources and reduce reliance on traditional fuel supplies. This effort is ongoing and is expected to continue through 2031.
Provision for continuous operations at the DOC in the event of a power outage.	Security and Emergency Preparedness and Facilities	**Planned - Not Yet Started.** Provide redundant power capability to support continuous operations at the District Operations Center during power outages and other utility disruptions, ensuring sustained command, coordination, and communications during emergencies. Security and Emergency Preparedness, in coordination with Facilities, will evaluate options as part of the planned District Operations Center upgrades to reduce operational downtime and enhance overall emergency response resilience. An options analysis and cost estimate will be completed prior to final project scoping. This project is expected to continue through 2031.
Reduce the number of outages due to high overnight temperatures during a high heat event.	Electrical Engineering and Operations Department	**Ongoing.** Reduce the frequency and duration of electrical outages associated with high overnight temperatures during extreme heat events by improving monitoring and early detection of equipment stress. The Electrical Engineering and Operations Department is installing sensors on select underground transformers to monitor temperature, oil pressure, and voltage, enabling proactive maintenance and operational adjustments before failures occur. This effort enhances system reliability during extreme heat conditions and is ongoing, with work expected to continue through 2031.

2020 Mitigation Activity	Responsible Department	Project Status
Utilize mobile air quality monitors on job sites when the AQI for PM2.5 is forecasted to be at a level determined by the DIR as a health risk to those working outside.	Environmental Health Division, Security & Emergency Preparedness	**Planned - Not Yet Started.** Deploy mobile air quality monitoring equipment at job sites when forecasted PM2.5 Air Quality Index levels reach thresholds identified by Cal/OSHA as presenting a health risk to outdoor workers. Led by the Environmental Health Division in coordination with Security and Emergency Preparedness, this action reduces health impacts, supports compliance with occupational safety requirements, and informs operational decision-making during poor air quality events. Cost estimates and equipment specifications have not yet been developed. This effort is scheduled to continue through 2031.
Increase the ability of TID to monitor water temperature and quality in Don Pedro Reservoir negatively impacted by runoff and debris flows resulting from storm events occurring in the Tuolumne River watershed and adjust operations in order to mitigate them.	Hydrology Department	**Planned - Not Yet Started.** Increase the District's ability to monitor water temperature and water quality conditions in Don Pedro Reservoir that may be adversely affected by storm-related runoff, sediment, and debris flows originating in the Tuolumne River watershed. This action supports timely operational adjustments that mitigate water quality degradation, protect downstream resources, and maintain reliable water deliveries following storm events. The Hydrology Department is evaluating the use of fixed water quality monitoring stations, including floating buoy systems within the reservoir, to collect continuous data throughout the full water column. These buoy-based systems may also function as remote weather stations, providing real-time meteorological data to support operational decision-making during storm and post-storm conditions. In addition, the District is exploring the use of mobile monitoring sensors deployed in active work areas to measure turbidity and other water quality parameters during in-channel river operations. This project is expected to continue through 2031.

2020 Mitigation Activity	Responsible Department	Project Status
Prepare for changes in water availability in the canal system due to the impacts of climate change.	Water Distribution, Hydrology, Civil Engineering, Construction & Maintenance	**In Progress.** To address increasing variability in water supplies associated with climate change, the District is implementing system upgrades that enhance operational flexibility, improve flow control, and strengthen service reliability across the canal network. Ongoing efforts include expanded use of regulating reservoirs to provide operational buffering and the implementation of Total Channel Control systems to improve real-time flow management and reduce operational losses. Collectively, these actions reduce vulnerability to drought, extreme precipitation, and shifting runoff patterns while supporting efficient water delivery under changing climate conditions. These efforts will continue through 2031.
Improve TID's capability to forecast water content in the Tuolumne River Watershed.	Water Resources Administration	**In Progress.** Improve the District's ability to forecast water content and runoff potential within the Tuolumne River Watershed to support informed operational planning and drought and flood risk mitigation. The District is using advanced forecasting tools, including the Airborne Snow Observatory and the Hydrocomp Forecast and Analysis Model, to enhance analysis of snowpack conditions and anticipated runoff volumes. These capabilities support proactive water management decisions, reduce uncertainty during extreme hydrologic conditions, and strengthen long-term water supply resilience. This effort is ongoing and is expected to continue through 2031.
Acquire new technology including computer hardware, software, data management systems, and an expansion of the HFAM model to include Mustang, McDonald, and Sand Creek improving the ability to predict and respond to hyper-local weather events which are increasing in frequency and intensity due to the effects of climate change. Incorporate this new data into future modeling of watershed behavior.	Hydrology Department	**In Progress.** The Hydrology Department is currently advancing a potential monitoring project on McDonald Creek to improve measurement of flows in this seasonal stream and better manage storm runoff entering Turlock Lake. These efforts support improved situational awareness, reduced flood risk, and more informed operational decision-making and are expected to continue through 2031.

2020 Mitigation Activity	Responsible Department	Project Status
Improve communication with assisting and cooperating agencies during an emergency condition at Don Pedro or other District owned or operated dam. Establish a method for sharing real-time information, video feeds and data.	Hydrology Department, Security and Emergency Preparedness	**Ongoing.** Strengthen communication and information-sharing capabilities with assisting and cooperating agencies during emergency conditions at Don Pedro Dam or other District-owned or operated dams by establishing reliable methods for transmitting real-time situational information, including data, imagery, and video feeds. This action supports coordinated decision-making, timely protective actions, and effective interagency response during high-consequence incidents. In addition to pursuing grant funding to enhance communications infrastructure, the District is leveraging established relationships with the Stanislaus County Office of Emergency Services and the Amateur Radio Emergency Service, which can provide resilient, redundant capabilities for transmitting real-time information and multimedia when traditional communications systems are degraded or unavailable. These efforts are ongoing and are expected to continue through 2031.
Improve interoperability between TID and response agencies during a High Flow Condition or other emergency condition at any District owned or operated dam.	Hydrology Department, Security and Emergency Preparedness	**In Progress.** Improve communications interoperability between the District and responding agencies during High Flow Conditions or other emergency situations at District-owned or operated dams to support coordinated response, unified situational awareness, and timely decision-making. Interoperability enhancements implemented to date include installation of Amateur Radio Emergency Service antennas at the District Operations Center and procurement of an interoperability communications bridge. In addition, the Security and Emergency Preparedness Department maintains programmable radios capable of direct communication with public safety agencies during emergency operations. The District will further evaluate the establishment of a dedicated emergency sideband on its radio system to allow Reclamation Districts to communicate directly with operators at Gomes Lake during emergency conditions. These efforts strengthen redundant communications capability and will continue through 2031.

2020 Mitigation Activity	Responsible Department	Project Status
Add additional infiltration galleries in the Tuolumne River at Fox Grove.	Hydrology Department	**In Progress.** Add additional infiltration galleries in the Tuolumne River at Fox Grove to increase raw water supply reliability and system resilience during periods of variable flow and drought conditions. Phase 1 has been completed and currently supplies raw water to the Stanislaus Regional Water Authority drinking water treatment plant. Preliminary evaluation and planning for a potential second phase are underway to further enhance capacity and operational redundancy. This project supports long-term water supply resilience and is expected to continue through 2031.
Prevent debris flow or rockfall from impacting the canal system in areas prone to landslide.	Civil Engineering	**Ongoing.** Reduce the risk of debris flows and rockfall impacting the canal system in areas susceptible to landslides in order to maintain safe and reliable water conveyance. The Civil Engineering Department conducts ongoing monitoring and inspections of canal segments with elevated landslide or rockfall risk. Where risks are determined to be unacceptable, targeted mitigation measures are implemented to stabilize slopes, reduce hazard exposure, and protect canal infrastructure and water delivery operations. Landslide mitigation work was completed along the Upper Main Canal in 2021. These efforts enhance system resilience and are expected to continue through 2031.
Access Road improvements or alternate routes to critical facilities.	Civil Engineering	**Planned - Not Yet Started.** Improve access roads and identify alternate routes to critical District facilities to ensure safe and reliable access for operations, maintenance, and emergency response during adverse conditions. Civil Engineering is evaluating potential improvements to the access road serving the canal headgates at La Grange Dam, as well as the addition of road base in known problem areas along the canal system. The District is also assessing access options through the 20 Minute Falls area to enhance redundancy and reduce vulnerability to access disruptions. These efforts improve responder access, reduce delays during emergency operations, and support continuity of critical functions and are expected to continue through 2031.

2020 Mitigation Activity	Responsible Department	Project Status
Provide better access to flu vaccines for all employees and other vaccines for those working outside District offices.	Security and Emergency Preparedness, Human Resources	**In Progress.** Employees now can go to a local pharmacy to receive a flu or COVID vaccine at no charge to them. The COOP was updated in 2021 to align with current District continuity operations guidelines. TID drafted a Closed POD Plan with Stanislaus County. This plan needs to be reviewed and adopted by the County Public Health Department. These actions strengthen workforce resilience and are expected to continue through 2031.
Use FR3 overhead transformers in high fire-threat areas.	Electrical Engineering and Operations, Line Department	**In Progress.** Reduce wildfire ignition risk in high fire-threat areas by installing FR3 overhead transformers that use vegetable-based dielectric fluid with a higher fire point and lower flammability than conventional mineral oil. Electrical Engineering and Operations, in coordination with the Line Department, has continued installing FR3 transformers in areas with elevated wildfire risk to reduce the likelihood and severity of fire ignition associated with electrical equipment failures. This activity enhances system safety and resilience and is expected to continue through 2031.
Construct a communication system in order to facilitate the use of SCADA in high fire threat areas.	Electrical Engineering and Operations, Line Department	**In Progress.** Enhance system monitoring, control, and situational awareness in high fire-threat areas by constructing a resilient communications network capable of supporting SCADA operations during normal and emergency conditions. Electrical Engineering and Operations, in coordination with the Line Department, is deploying cellular and satellite communication equipment at strategic locations throughout the District to improve SCADA connectivity, particularly in remote and coverage-limited areas. These improvements support early detection of system abnormalities, faster operational response, and reduced wildfire risk associated with electrical infrastructure. This effort is ongoing and is expected to continue through 2031.

The mitigation actions listed in Table 46 were originally identified in the 2020 LHMP and remain valid and relevant. These actions are currently ongoing, in progress, or planned, and have been carried forward into the 2026 LHMP update to support continued implementation, monitoring, and risk reduction across the District's electric and irrigation systems.

Newly Identified Mitigation Actions

In addition to carried-forward mitigation actions, the Planning Team identified new mitigation actions during the 2026 LHMP update. These actions were developed through the Subject Matter Expert review process and reflect updated hazard conditions, operational experience, and emerging risks. The actions listed in Table 47 represent new strategies not previously included in the 2020 LHMP and are intended to further strengthen system resilience and risk reduction.

Mitigation Priority Categories

- **High Priority:** Immediate safety or operational risk reduction
- **Medium Priority:** Important but not urgent risk-reduction measures
- **Low Priority:** Long-term, opportunistic, or dependent on external factors

These priority categories help TID plan near-term investments, schedule longer-term projects, and identify the most appropriate actions for state or federal mitigation funding opportunities. The following section presents the full set of current mitigation actions for the 2026 LHMP update.

Cost Ranges

- Low (≤ $100,000)
- Moderate ($100,000 – $1 million)
- High (>$1 million)
- To Be Determined

Estimated cost ranges are preliminary and will be refined during project scoping, capital planning, or mitigation grant application development. Ranges are for planning purposes and do not replace project-level engineering estimates or FEMA benefit-cost analysis.

Table 47. Newly Identified Mitigation Actions for the 2026 LHMP

Mitigation Action	Hazard(s) Addressed	Responsible Department(s)	Mitigation Benefit or Objective	Priority	Implementation Timeframe	Estimated Cost Range
Improve ground clearance along the Tuolumne Transmission Line.	Wildland Fire; Extreme Weather; Flood	Electrical Engineering & Operations Administration, Construction & Maintenance	Reduce wildfire ignition risk, storm damage, and access constraints by improving vegetation and ground clearance along critical transmission infrastructure	High	Ongoing (2026-2031)	Moderate–High
Implement wildfire mitigation measures using fiber arms, fire-resistant poles, and Cal Fire–approved lightning arrestors in high fire-threat areas.	Wildland Fire	Electrical Engineering & Operations Administration, Line Department	Reduce ignition risk and infrastructure damage during wildfire events through use of fire-resistant materials and enhanced electrical protection.	High	Ongoing (2026-2031)	High
Upgrade the land mobile radio system to a digital platform and resurvey the District for coverage gaps.	Communications Failure (All Hazards)	Maintenance & Operations, Electronics	Improve reliability, coverage, and interoperability of District communications during routine operations and emergency conditions.	High	2026-2028	Moderate
Identify transformers containing PCBs and replace mineral oil transformers at substations.	Hazardous Materials release resulting from Wildland Fire; Earthquake; or Flood	Electrical Engineering & Operations Administration, Maintenance & Operations	Reduce environmental and health risks associated with legacy equipment and improve substation resilience to identified hazards, enhancing system reliability during emergencies and disasters.	Medium	Ongoing (2026-2031)	Moderate-High
Establish a boat inspection and motor-flushing program at Don Pedro Reservoir.	Aquatic Invasive Species	Water Resources Administration, Don Pedro Recreation Agency	Prevent introduction and spread of aquatic invasive species through early detection, inspection, and decontamination measures.	Medium	2026–2027	To Be Determined
Cap canal banks with road base to improve access during storms and reduce maintenance impacts.	Extreme Weather; Flood; Landslide	Civil Engineering, Construction and Maintenance	Improve emergency and maintenance access, reduce erosion, and enhance operational reliability during storm events.	Medium	Ongoing (2026-2031)	Moderate
Identify and formalize staging areas for emergency materials, equipment, and access during flood or other emergencies.	Dam Failure; Flood; Earthquake; Wildland Fire; Landslide; Extreme Weather	Security and Emergency Preparedness, Construction and Maintenance	Improve emergency response readiness by pre-identifying and securing staging areas outside dam inundation zones through formal agreements and MOUs.	High	2026-2029	Low

Project Review and Evaluation Process

Mitigation actions identified in this LHMP will undergo a structured internal review prior to implementation to ensure each project is feasible, cost-effective, and aligned with TID's operational and strategic priorities. This review process includes:

- Assessment of the project concept and mitigation approach, confirming the action addresses the relevant hazard and system vulnerabilities.
- Evaluation of scheduling, operational impacts, and funding requirements, including opportunities to pursue State or FEMA mitigation grants and alignment with TID's capital planning cycles.
- Review of project scope, design considerations, and cost estimates by the responsible TID departments, such as Engineering, Water Operations, Power Operations, Finance, and Security & Emergency Preparedness.
- Completion of required environmental reviews and permitting before work begins.

TID will rely on the expertise of these operational and administrative departments to advance mitigation actions from concept to implementation and to ensure projects are completed in a manner that strengthens system resilience and reduces risk.

V. Plan Maintenance

Monitoring, Evaluating, and Updating the LHMP

TID's LHMP was developed through a coordinated effort involving multiple District departments, subject matter experts, and partner agencies. To ensure the plan remains effective and actionable, TID will routinely monitor and evaluate the progress of mitigation actions and assess whether implemented projects are achieving their intended risk-reduction goals. Regular review of plan performance allows the District to identify successes, address challenges, and incorporate new information, emerging hazards, and changing operational needs into future updates.

Annual Review and Progress Monitoring

TID will conduct ongoing monitoring of mitigation activities and perform a formal annual review to evaluate implementation progress. The Security & Emergency Preparedness Department will coordinate this process and communicate with responsible departments throughout the year to track project status, challenges, and emerging needs.

The first annual review will occur one year after FEMA approval of the updated LHMP and will use TID's LHMP Progress Report Form to document progress and identify areas requiring adjustment. The Progress Report will assess the plan using the following criteria:

- Identification of new or emerging hazards
- Occurrence of disaster events during the reporting period
- Public comments or stakeholder feedback regarding the LHMP
- Continued relevance of goals and objectives
- Progress on existing mitigation actions and initiation of newly identified actions
- Obstacles, delays, or resource gaps affecting implementation
- Adequacy of staffing, funding, and technical resources
- Achievement of expected outcomes or measurable risk reduction
- Recommended corrective actions
- Changes in development trends or system conditions that alter risk

Findings from the annual review will be presented to the LHMP Steering Committee for evaluation. Recommendations will then be forwarded to TID Senior Management for consideration and direction.

Five-Year Plan Update

To maintain eligibility for FEMA hazard mitigation funding, TID will update its LHMP every five years. The next formal update cycle will begin in 2029, led by the Security & Emergency Preparedness Department with support from relevant operational and administrative departments.

The five-year update will include:

- Reviewing FEMA's current LHMP update requirements and guidance
- Conducting a comprehensive reassessment of regional hazards, vulnerabilities, and climate-related trends
- Updating inventory data for critical facilities, infrastructure, and assets
- Coordinating with local, regional, and State partners to ensure consistency across plans
- Reviewing, evaluating, and revising the mitigation strategy based on updated conditions
- Updating the Mitigation Action Plan to reflect completed, ongoing, deferred, or newly identified actions
- Submitting the updated plan to Cal OES and FEMA for review

- Presenting the LHMP to the TID Board of Directors for formal adoption upon receiving FEMA's "Approval Pending Adoption" letter
- Returning the adopted plan and resolution to FEMA for final approval

Maintaining this cycle ensures the LHMP remains a current, effective tool for guiding investments in hazard mitigation and strengthening resilience across TID's service area.

Criteria for Revisions to the LHMP

The LHMP may require revision outside the five-year cycle when significant changes occur. TID will consider plan revisions when:

- New technologies or mitigation approaches become available
- Changing conditions modify goals, objectives, actions, or hazard profiles
- Updated data or analysis improves understanding of vulnerabilities
- Significant development or system changes alter exposure to hazards
- Resource availability changes substantially
- Major disaster events affect TID's service area or operations
- Federal, State, or local regulations, codes, policies, or funding requirements change

Continued Public Involvement

TID remains committed to providing ongoing opportunities for public engagement throughout the life of the LHMP. A dedicated webpage will host the most current version of the plan, provide a summary of recent updates, and include a mechanism for submitting public comments at any time. Contact information, email, and phone will be available for stakeholders seeking additional information or wishing to provide feedback.

TID will also promote awareness of the LHMP and mitigation initiatives by participating in community meetings, Operational Area Council meetings, Disaster Council meetings, and other public forums routinely attended by District representatives.

All public comments received will be documented, included in the annual progress report, and considered in future plan updates to ensure the LHMP remains responsive to community needs and priorities.

LHMP Progress Report Form

As part of the annual maintenance process, the Security & Emergency Preparedness Department will convene the LHMP Planning Team to complete the LHMP Progress Report Form, which serves as the official tool for tracking mitigation project progress, documenting changes, and identifying emerging issues. This process enables departments to adjust resource allocations, address implementation challenges, and request additional support when needed.

The completed Progress Report will be stored as part of TID's LHMP maintenance record and used to inform the next update cycle, ensuring the plan remains effective, actionable, and aligned with evolving risks and operational priorities.

For an example of the LHMP Progress Report Form, see "Appendix #" on page ##.