CLIMATE CHANGE

Climate change contributes to ongoing, escalating impacts on people, the economy, and the environment on both the local and global level. Addressing and preparing for these impacts requires collaboration and transformative action among economic, governmental, social, environmental, and other elements. In recent years, California has been at the forefront of developing approaches to promote resiliency to the effects of climate change and reduce greenhouse gas (GHG) emissions while continuing to foster economic growth, social equity, and environmental protection. This report addresses the federal, state, and regulatory framework related to climate change and greenhouse gas emissions, the status of local climate action efforts, conditions related to climate change, including primary GHG emissions sources, and potential impacts associated with climate change, including sea-level rise, extreme heat, changes in precipitation and drought, increased risk of wildfire and flooding, and other impacts.

Topics:

1 Background and Regulatory Framework

2 Existing Conditions and Climate Change Scnearios

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1 BACKGROUND AND REGULATORY FRAMEWORK

This section identifies terminology associated with climate change and GHG issues and the associated regulatory framework at the federal, state, regional, and local levels.

KEY TERMS

Acre-feet (AF). A unit of volume equal to the volume of a sheet of water one acre in area and one foot in depth; equivalent to 43,560 cubic feet.

Bay Area Regional Reliability (BARR). A partnership made up of several large water suppliers serving six counties in the San Francisco Bay Area. Partners include Alameda County Water District, Bay Area Water Supply and Conservation Agency, Contra Costa Water District, East Bay Municipal Utility District, Marin Municipal Water District, San Francisco Public Utilities Commission, Santa Clara Valley Water District, and Zone 7 Water Agency.

CALGreen. The State of California mandatory green building code.

Carbon Dioxide-equivalent (CO_2e). A standard unit for measuring greenhouse gas emissions, expressed in terms of the amount of carbon dioxide that would create the same amount of global warming.

Cap-and-Trade Program. A Cap-and-Trade Program is a common term for a government regulatory program designed to limit, or cap, the total level of emissions of carbon dioxide as a result of industrial activity. The California Cap-and-Trade Program sets a statewide limit on sources responsible for 85% of California's greenhouse gas emissions and establishes a price signal designed to drive long-term investment in cleaner fuels and more efficient use of energy.

Marin Municipal Water District (MMWD). The water district covers approximately 147 square miles and provides potable water service to the Town of Tiburon.

Coastal Storm Monitoring System (CoSMoS). A tool developed by the United States Geologic Survey that can simulate sea-level rise in combination with storm events and other coastal dynamics.

Federal Clean Air Act (FCAA). A federal law designed to control air pollution on the nation level.

Greenhouse Gas (GHG). A gas that contributes to the global greenhouse effect by absorbing infrared radiation, which includes carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons.

Intergovernmental Panel on Climate Change (IPCC). The United Nations body for assessing the science related to climate change.

State Water Project (SWP). The state water management project providing drinking water to more than 23 million people in California.

United States Environmental Protection Agency (EPA). An independent agency of the United States federal government for environmental protection.

Urban Water Management Plan (UWMP). Urban Water Management Plans are prepared by urban water suppliers every 5 year to support long-term resource planning and water supply sustainability.

Vector-borne Disease (VBD). Illnesses caused by parasites, viruses and bacteria that are transmitted by mosquitoes, sandflies, triatomine bugs, blackflies, ticks, tsetse flies, mites, snails, and lice.

Regulatory Framework

Federal

Clean Air Act

The Federal Clean Air Act (FCAA) was first signed into law in 1970. In 1977, and again in 1990, the law was substantially amended. The FCAA is the foundation for a national air pollution control effort, and it is composed of the following basic elements: NAAQS for criteria air pollutants, hazardous air pollutant standards, state attainment plans, motor National Ambient Air Quality Standards (NAAQS) vehicle emissions standards, stationary source emissions standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

The EPA is responsible for administering the FCAA. The FCAA requires the EPA to set NAAQS for several problem air pollutants based on human health and welfare criteria and recognizes the importance for each state to locally carry out the requirements of the FCAA, as consideration of local industries, geography, housing patterns, etc. are needed to address pollution control at the local level.

Energy Policy and Conservation Act

The Energy Policy and Conservation Act of 1975 required that all vehicles sold in the United States meet certain fuel economy goals. Through this Act, Congress established the first fuel economy standards for on-road motor vehicles in the U.S. Pursuant to the Act, the National Highway Traffic and Safety Administration, which is part of the U.S. Department of Transportation (USDOT), is responsible for establishing additional vehicle standards and for revising existing standards.

Since 1990, the fuel economy standard for new passenger cars has been 27.5 mpg. Since 1996, the fuel economy standard for new light trucks (gross vehicle weight of 8,500 pounds or less) has been 20.7 mpg. Heavy-duty vehicles (i.e., vehicles and trucks over 8,500 pounds gross vehicle weight) are not currently subject to fuel economy standards. Compliance with federal fuel economy standards is determined on the basis of each manufacturer's average fuel economy for the portion of its vehicles produced for sale in the U.S. The Corporate Average Fuel Economy (CAFE) program, which is administered by the EPA, was created to determine vehicle manufacturers' compliance with the fuel economy standards. The EPA calculates a CAFE value for each manufacturer based on city and highway fuel economy test results and vehicle sales. Based on the information generated under the CAFE program, the USDOT is authorized to assess penalties for noncompliance. In March 2020, the USDOT's National Highway Traffic Safety Administration (NHTSA) and the EPA released the final Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years (MY) 2021-2026 Passenger Cars and Light Trucks, which sets CAFE and CO2 emissions standards that increase 1.5% in stringency each year from MY 2021 through 2026. These standards apply to both passenger cars and light trucks, and are intended to continue the United States' progress towards energy independence and carbon dioxide reduction, while recognizing the realities of the marketplace and consumers' interest in buying vehicles that meet all of their diverse needs. In MY 2026, it is projected that 40.4 mpg will be the overall industry average required fuel economy.

Energy Policy Act of 1992 (EPAct)

The Energy Policy Act of 1992 (EPAct) was passed to reduce the country's dependence on foreign petroleum and improve air quality. EPAct includes several parts intended to build an inventory of alternative fuel vehicles (AFVs) in large, centrally fueled fleets in metropolitan areas. EPAct requires certain federal, state, and local government and private fleets to purchase

a percentage of light duty AFVs capable of running on alternative fuels each year. In addition, financial incentives are included in EPAct. Federal tax deductions are allowed for businesses and individuals to cover the incremental cost of AFVs. States are also required by the act to consider a variety of incentive programs to help promote AFVs.

Energy Policy Act of 2005

The Energy Policy Act of 2005 was signed into law on August 8, 2005. Generally, the Act provides for renewed and expanded tax credits for electricity generated by qualified energy sources, such as landfill gas; provides bond financing, tax incentives, grants, and loan guarantees for a clean renewable energy and rural community electrification; and establishes a federal purchase requirement for renewable energy.

Energy Independence and Security Act (EISA) of 2007

The Energy Independence and Security Act (EISA) of 2007 aimed to improve vehicle fuel economy and reduce U.S. dependence on petroleum. EISA included provisions to increase the supply of renewable alternative fuel sources by setting a mandatory Renewable Fuel Standard, which requires transportation fuel sold in the United States to contain a minimum of 36 billion gallons of renewable fuels annually by 2022. The law set the Corporate Average Fuel Economy standard at 35 miles per gallon for passenger cars and light trucks by 2020. EISA also includes grant programs to encourage the development of cellulosic biofuels, plug-in hybrid electric vehicles, and other emerging electric technologies. The law is projected to reduce greenhouse gas emissions by 9% by 2030.

Further Consolidated Appropriations Act of 2020

The Further Consolidated Appropriations Act of 2020 (Public Law 116-94) retroactively reinstated and extended several alternative fuel tax incentives. The law reinstated, through December 31, 2020, a variety of alternative fuel tax credits and a special depreciation for eligible biofuel plants. It also reinstates the income and excise tax credit for biodiesel and renewable diesel fuel mixtures, through December 31, 2022.

Surface Transportation Efficiency Acts

The national surface transportation acts authorize funds for highway construction, highway safety, and public transportation programs. The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 established the Congestion Mitigation and Air Quality (CMAQ) Improvement Program, which provides funding for projects and programs in air quality non-attainment and maintenance areas to reduce transportation-related emissions. The Transportation Equity Act for the 21st Century (TEA-21) of 199) continued the CMAQ program and established the Clean Fuels Grant Program, which allows transit systems to apply for and receive grants to purchase or lease clean fuel buses, related equipment or facilities, and use biodiesel. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), enacted in 2005, continued and amended several programs established under ISTEA and TEA-21, including CMAQ and the Clean Fuels Grant Program. SAFETEA-LU also established additional programs and incentives related to alternative fuels, advanced vehicles, and fuel efficiency, including the alternative fuel excise tax credit. The Moving Ahead for Progress in the 21st Century (MAP-21) Act, enacted in 2012, continued and amended existing programs, including CMAQ, and established additional funding opportunities for alternative fuel infrastructure and research. The Fixing America's Surface Transportation (FAST) Act, enacted in 2015, continued CMAQ while adding new provisions related to alternative fuels, including the establishment of national alternative fuel station corridors and authorization for federal agencies to install electric vehicle supply equipment for employee use, subject to certain conditions.

Federal Climate Change Policy

According to the EPA, "the United States government has established a comprehensive policy to address climate change" that includes slowing the growth of emissions; strengthening science, technology, and institutions; and enhancing international cooperation. To implement this policy, "the Federal government is using voluntary and incentive-based programs to reduce emissions and has established programs to promote climate technology and science." The federal government's goal is to reduce the greenhouse gas (GHG) intensity (a measurement of GHG emissions per unit of economic activity) of the American economy by 18% over the 10-year period from 2002 to 2012. In addition, the EPA administers multiple programs that encourage voluntary GHG reductions, including "ENERGY STAR", "Climate Leaders", and Methane Voluntary Programs. However, as of this writing, there are no adopted federal plans, policies, regulations, or laws directly regulating GHG emissions.

In 2019, total gross United States greenhouse gas emissions were 6,577.2 million metric tons of carbon dioxide equivalent (MMT CO2 Eq). Total United States emissions have increased by 2.0% from 1990 to 2019, down from a high of 15.7% above 1990 levels in 2007. In 2019, the primary sources of greenhouse gas emissions in the United States are the Transportation Sector (28.9%), Electricity Production Industry Sector (25.2%), Industry Sector (22.8%), Commercial and Residential Sector (12.5%), and Agriculture Sector (10.2%)[1].

Mandatory Greenhouse Gas Reporting Rule

On September 22, 2009, the EPA issued a final rule for mandatory reporting of GHGs from large GHG emissions sources in the United States. In general, this national reporting requirement will provide the EPA with accurate and timely GHG emissions data from facilities that emit 25,000 metric tons or more of CO_2 per year. This publicly available data will allow the reporters to track their own emissions, compare them to similar facilities, and aid in identifying cost effective opportunities to reduce emissions in the future. Reporting is at the facility level, except that certain suppliers of fossil fuels and industrial greenhouse gases along with vehicle and engine manufacturers will report at the corporate level. An estimated 85% of the total U.S. GHG emissions, from approximately 10,000 facilities, are covered by this final rule.

STATE

California Executive Orders S-3-05, S-20-06, and B-30-15, Assembly Bill 32, and Senate Bill 32

On June 1, 2005, then Governor Arnold Schwarzenegger signed Executive Order S-3-05. The goal of this Executive Order is to reduce California's GHG emissions to: 1) 2000 levels by 2010, 2) 1990 levels by the 2020 and 3) 80% below the 1990 levels by the year 2050.

In 2006, this goal was further reinforced with the passage of Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006. AB 32 sets the same overall GHG emissions reduction goals while further mandating that the CARB create a plan, which includes market mechanisms, and implement rules to achieve "real, quantifiable, cost-effective reductions of greenhouse gases." Executive Order S-20-06 further directs state agencies to begin implementing AB 32, including the recommendations made by the state's Climate Action Team.

[1] EPA. 2021. Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990—2019. Available at: https://www.epa.gov/sites/production/files/2021-02/documents/us-ghg-inventory-2021-main-text.pdf

In April 2015, Governor Jerry Brown signed Executive Order B-30-15, which requires that there be a reduction in GHG emissions to 40% below 1990 levels by 2030. This intermediate target was codified into law by Senate Bill 32 (SB 32), which was signed into law on September 8, 2016.

Climate Change Scoping Plan

On December 11, 2008, the CARB adopted its *Climate Change Scoping Plan* (Scoping Plan), which functions as a roadmap of the CARB's plans to achieve GHG reductions in California required by AB 32 through subsequently enacted regulations. The CARB updated the Scoping Plan in 2013 (*First Update to the Climate Change Scoping Plan*) (2013 Update) and again in 2017 (the *Final 2017 Scoping Plan Update*) (2017 Update). The 2013 Update built upon the initial Scoping Plan with new strategies and recommendations, and also set the groundwork to reach the long-term goals set forth by the state. The 2017 Update expanded the scope of the plan further by focusing on the strategy for achieving the state's 2030 GHG target of 40% emissions reductions below 1990 levels (to achieve the target codified into law by SB 32), and substantially advances toward the state's 2050 climate goal to reduce GHG emissions by 80% below 1990 levels. The 2017 Update is helping the State of California to:

- Lower GHG emissions on a trajectory to avoid the worst impacts of climate change;
- Support a clean energy economy which provides more opportunities for all Californians;
- Provide a more equitable future with good jobs and less pollution for all communities; and
- Improve the health of all Californians by reducing air and water pollution and making it easier to bike and walk.

The California 2030 GHG reduction target of 40% emissions reductions below 1990 levels guides the 2017 Update. The 2017 Update includes a suite of specific actions to meet the State's 2030 GHG reduction target, including additional measures developed or required by legislation since the 2015 Update, such as extending the LCFS to an 18% reduction in carbon intensity beyond 2020, and the requirements of SB 350 to increase renewables to 50% and to double energy efficiency savings. The 2017 Update also included the Mobile Source Strategy targets for more zero emission vehicles and much cleaner trucks and transit, the Sustainable Freight Action Plan to improve freight efficiency and transition to zero emission freight handling technologies, and the requirements under SB 1383 to reduce anthropogenic black carbon by 50% and hydrofluorocarbon and methane emissions by 40% below 2013 levels by 2030. The adoption of AB 398 into State law on July 25, 2017, clarifies the role of the Cap-and-Trade Program through December 31, 2030.

Assembly Bill 1493 - Vehicular Emissions: Greenhouse Gases

In response to Assembly Bill (AB) 1493, the CARB approved amendments to the California Code of Regulations (CCR) adding GHG emission standards to California's existing motor vehicle emission standards. Amendments to CCR Title 13 Sections 1900 (CCR 13 1900) and 1961 (CCR 13 1961), and adoption of Section 1961.1 (CCR 13 1961.1) require automobile manufacturers to meet fleet average GHG emission limits for all passenger cars, light-duty trucks within various weight criteria, and medium-duty passenger vehicle weight classes beginning with the 2009 model year. For passenger cars and light-duty trucks 3,750 pounds or less loaded vehicle weight (LVW), the 2016 GHG emission limits are approximately 37% lower than during the first year of the regulations in 2009. For medium-duty passenger vehicles and light-duty trucks 3,751 LVW to 8,500 pounds gross vehicle weight (GVW), GHG emissions are reduced approximately 24% between 2009 and 2016.

The CARB requested a waiver of federal preemption of California's Greenhouse Gas Emissions Standards. The intent of the waiver is to allow California to enact emissions standards to reduce carbon dioxide and other greenhouse gas emissions

from automobiles in accordance with the regulation amendments to the CCRs that fulfill the requirements of AB 1493. The EPA granted a waiver to California to implement its greenhouse gas emissions standards for cars.

Assembly Bill 1007 - Air Quality: Alternative Fuels

AB 1007 (Pavley, Chapter 371, Statutes of 2005) directed the CEC to prepare a plan to increase the use of alternative fuels in California. As a result, the CEC prepared the State Alternative Fuels Plan in consultation with the state, federal, and local agencies. The plan presents strategies and actions California must take to increase the use of alternative non-petroleum fuels in a manner that minimizes costs to California and maximizes the economic benefits of in-state production. The Plan assessed various alternative fuels and developed fuel portfolios to meet California's goals to reduce petroleum consumption, increase alternative fuels use, reduce greenhouse gas emissions, and increase in-state production of biofuels without causing a significant degradation of public health and environmental quality.

Bioenergy Action Plan – Executive Order #S-06-06

Executive Order #S-06-06 establishes targets for the use and production of biofuels and biopower and directs state agencies to work together to advance biomass programs in California while providing environmental protection and mitigation. The executive order establishes the following target to increase the production and use of bioenergy, including ethanol and biodiesel fuels made from renewable resources: produce a minimum of 20% of its biofuels within California by 2010, 40% by 2020, and 75% by 2050. The executive order also calls for the state to meet a target for use of biomass electricity.

Senate Bill 743 - Environmental Quality: Transit Oriented Infill Projects, Judicial Review Streamlining For Environmental Leadership Development Projects

SB 743, passed into law in 2013, changes the way that public agencies evaluate the transportation impacts of projects under CEQA through balancing the needs of congestion management with statewide goals related to infill development, promotion of public health through active transportation, and reduction of GHGs. The 2017 Update to the Scoping Plan identified that slower VMT growth from more efficient land use development patterns would promote achievement of the state's climate goals.

As detailed in SB 743, the Governor's Office of Planning and Research (OPR) was tasked with developing potential metrics to measure transportation impacts and replace the use of vehicle delay and level of service (LOS). More detail about SB 743 is provided in the Circulation Existing Conditions Report.

In December 2018, OPR released its final changes to the CEQA Guidelines, including the addition of Section 15064.3 that implements SB 743. In support of these changes, OPR published its Technical Advisory on Evaluating Transportation Impacts in CEQA, which recommends that the transportation impact of a project be based on whether it would generate a level of VMT per capita (or VMT per employee) that is 15% lower than existing development in the region. OPR's technical advisory explains that this criterion is consistent with Section 21099 of the California Public Resources Code, which states that the criteria for determining significance must "promote the reduction in greenhouse gas emissions". It is also consistent with the statewide per capita VMT reduction target developed by Caltrans in its Strategic Management Plan, which calls for a 15% reduction in per capita VMT, compared to 2010 levels, by 2020. Additionally, the California Air Pollution Control Officers Association (CAPCOA) determined that a 15% reduction in VMT is typically achievable for projects. CARB's First Update to the Climate Change Scoping Plan also called for local governments to set communitywide GHG reduction targets of 15% below then-current levels by 2020. Although not required, a lead agency may elect to be governed by the provisions of Section 15064.3 immediately. However, the provisions of Section 15064.3 do not apply statewide until July 1, 2020.

Executive Order B-48-18: Zero-Emission Vehicles

In January 2018, EO B-48-18 was signed into law and requires all State entities to work with the private sector to have at least 5 million zero-emission vehicles (ZEVs) on the road by 2030, as well as install 200 hydrogen fueling stations and 250,000 electric vehicle charging stations (EVCSs) by 2025. It specifies that 10,000 of the EVCSs should be direct current fast chargers. This Executive Order also requires all State entities to continue to partner with local and regional governments to streamline the installation of ZEV infrastructure. The Governor's Office of Business and Economic Development is required to publish a Plug-in Charging Station Design Guidebook and update the 2015 Hydrogen Station Permitting Guidebook to aid in these efforts. All State entities are required to participate in updating the 2016 Zero-Emissions Vehicle Action Plan (Governor's Interagency Working Group on Zero-Emission Vehicles 2016) to help expand private investment in ZEV infrastructure with a focus on serving low-income and disadvantaged communities. Additionally, all State entities are to support and recommend policies and actions to expand ZEV infrastructure at residential uses through the Low Carbon Fuel Standard Program, and recommend how to ensure affordability and accessibility for all drivers.

California Strategy to Reduce Petroleum Dependence (AB 2076)

In response to the requirements of AB 2076, the CEC and the CARB developed a strategy to reduce petroleum dependence in California. The strategy, *Reducing California's Petroleum Dependence*, was adopted by the CEC and CARB in 2003. The strategy recommends that California reduce on-road gasoline and diesel fuel demand to 15% below 2003 demand levels by 2020 and maintain that level for the foreseeable future. At the time of this writing, the Governor and Legislature are working to establish national fuel economy standards that double the fuel efficiency of new cars, light trucks, and sport utility vehicles (SUVs) and increase the use of non- petroleum fuels to 20% of on-road fuel consumption by 2020 and 30% by 2030.

Assembly Bill 2188 - Solar Permitting Efficiency Act

Assembly Bill (AB) 2188, enacted in California in 2015, required local governments to adopt a solar ordinance by September 30, 2015 that creates a streamlined permitting process that conforms to the bests practices for expeditious and efficient permitting of small residential rooftop solar systems. The act is designed to lower the cost of solar installations in California and further expand the accessibility of solar to more California homeowners. The bulk of the time and cost savings associated with a streamlined permitting process comes from the use of a standardized eligibility checklist and a simplified plan. This bill also shortens the number of days for those seeking Homeowner's Association (HOA) approval for a written denial of a proposed solar installation.

Governor's Low Carbon Fuel Standard (Executive Order #S-01-07)

Executive Order #S-01-07 establishes a statewide goal to reduce the carbon intensity of California's transportation fuels by at least 10% by 2020 through establishment of a Low Carbon Fuel Standard. The Low Carbon Fuel Standard is incorporated into the State Alternative Fuels Plan and is one of the proposed discrete early action GHG reduction measures identified by the CARB pursuant to AB 32.

Senate Bill 375 - Sustainable Communities and Climate Protection Act of 2008

Senate Bill (SB) 375 (SB 375) was built on AB 32 (California's 2006 climate change law). SB 375's core provision is a requirement for regional transportation agencies to develop a Sustainable Communities Strategy (SCS) in order to reduce GHG emissions from passenger vehicles. The SCS is one component of the existing Regional Transportation Plan (RTP). The SCS outlines the region's plan for combining transportation resources, such as roads and mass transit, with a realistic land use pattern, in order to meet a state target for reducing GHG emissions. The strategy must take into account the region's housing needs, transportation demands, and protection of resource and farmlands. The current RTP/SCS for the San

Francisco Bay Area is Plan Bay Area 2040. Plan Bay Area 2040 is the San Francisco Bay Area's roadmap for forecasting transportation needs through the year 2040, preserving the character of diverse communities, and adapting to the challenges of future population growth.

Additionally, SB 375 modified the state's Housing Element Law to achieve consistency between the land use pattern outlined in the SCS and the Regional Housing Needs Assessment allocation. The legislation also substantially improved cities' and counties' accountability for carrying out their housing element plans. Finally, SB 375 amended the California Environmental Quality Act (Pub. Resources Code, § 21000 et seq.) to ease the environmental review of developments that help reduce the growth of GHG emissions.

Climate Action Program at Caltrans

The California Department of Transportation, Business, Transportation, and Housing Agency, prepared a Climate Action Program in response to new regulatory directives. The goal of the Climate Action Program is to promote clean and energy efficient transportation and provide guidance for mainstreaming energy and climate change issues into business operations. The overall approach to lower fuel consumption and CO_2 from transportation is twofold: (1) reduce congestion and improve efficiency of transportation systems through mixed-use, higher-density, and transit-oriented development, operational improvements, and Intelligent Transportation Systems; and (2) institutionalize energy efficiency and GHG emission reduction measures and technology into planning, project development, operations, and maintenance of transportation facilities, fleets, buildings, and equipment.

The reasoning underlying the Climate Action Program is the conclusion that "the most effective approach to addressing GHG reduction, in the short-to-medium term, is strong technology policy and market mechanisms to encourage innovations. Rapid development and availability of alternative fuels and vehicles, increased efficiency in new cars and trucks (light and heavy duty), and super clean fuels are the most direct approach to reducing GHG emissions from motor vehicles (emission performance standards and fuel or carbon performance standards)."

Advanced Clean Cars Program

In January 2012, the CARB approved the Advanced Clean Cars program which combines the control of GHG emissions and criteria air pollutants, as well as requirements for greater numbers of zero-emission vehicles, into a single package of standards for vehicle model years 2017 through 2025. The new rules strengthen the GHG standard for 2017 models and beyond. This will be achieved through existing technologies, the use of stronger and lighter materials, and more efficient drivetrains and engines. The program's zero-emission vehicle regulation requires battery, fuel cell, and/or plug-in hybrid electric vehicles to account for up to 15% of California's new vehicle sales by 2025. The program also includes a clean fuels outlet regulation designed to support the commercialization of zero-emission hydrogen fuel cell vehicles by 2015 by requiring increased numbers of hydrogen fueling stations throughout the state. The program will have significant energy demand implications as battery, fuel cell, and/or plug-in hybrid electric vehicle sales increase overtime, creating new demand for electricity services both in residential and commercial buildings (e.g., charging stations) as well as demand for new EV and hydrogen fuel cell charging stations. The number of stations will grow as vehicle manufacturers sell more fuel cell vehicles. According to the CARB, by 2025, when the rules will be fully implemented, the statewide fleet of new cars and light trucks will emit 34% fewer global warming gases and 75% fewer smog-forming emissions than the statewide fleet in 2016.

California Building Energy Efficiency Standards

Title 24, Part 6 of the California Code of Regulations, known as the Building Energy Efficiency Standards, was established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically

to allow consideration and possible incorporation of new energy efficiency technologies and methods. On January 1, 2010, the California Building Standards Commission adopted CALGreen and became the first state in the United States to adopt a statewide green building standards code. The 2019 Energy Efficiency Standards were effective on January 1, 2020. Included as part of the 2019 Building Energy Efficiency Standards are rooftop solar power requirements. These requirements mandate that all new homes under three stories high install solar panels, and that solar systems must be sized to net out the annual kilowatt-hour energy usage of the dwelling. The updated Standards also incentivize "demand-responsive technologies," including battery storage and heat pump water heaters.

Title 24, Part 11, of the California Code of Regulations establishes CalGreen, which became mandatory in 2011. CalGreen addresses five areas of green building: 1) planning and design, 2) energy efficiency, 3) water efficiency and conservation, 4) material conservation and resources efficiency, and 5) environmental quality. The mandatory requirements are separated into non-residential and residential projects. Additionally, CalGreen also includes two optional tiers: Tier 1 and Tier 2. The tiers of the California Green Building Standards Code allow local building departments to set higher standards for certain sustainable goals. The Tier 1 optional requirements are more restrictive than the basic code requirements and include requirements such as higher energy efficiency goals and reduced water consumption targets. Tier 2 requirements up the ante with even higher, or more stringent, sustainable goals than Tier 1. The Town of Tiburon has adopted Tier 1 for all areas of the green building code, except for energy efficiency which is Tier 2.

CEQA Guidelines

In late 2018, amendments to the CEQA Guidelines were finalized, including changes to CEQA Guidelines Section 15064.4, which addresses the analysis of greenhouse gas emissions. The amendments were approved by the Office of Administrative Law and filed with the Secretary of State. The amendments became effective on December 28, 2018.

The revision of CEQA Guidelines Section 15064.4 clarified several points, including the following:

- Lead agencies must analyze the greenhouse gas emissions of proposed projects.
- The focus of the lead agency's analysis should be on the project's effect on climate change, rather than simply focusing on the quantity of emissions and how that quantity of emissions compares to statewide or global emissions.
- The impacts analysis of greenhouse gas emissions is global in nature and thus should be considered in a broader context. A project's incremental contribution may be cumulatively considerable even if it appears relatively small compared to statewide, national or global emissions.
- Lead agencies should consider a timeframe for the analysis that is appropriate for the project.
- A lead agency's analysis must reasonably reflect evolving scientific knowledge and state regulatory schemes.
- Lead agencies may rely on plans prepared pursuant to Section 15183.5 (Plans for the Reduction of Greenhouse Gases) in evaluating a project's greenhouse gas emissions.
- In determining the significance of a project's impacts, the lead agency may consider a project's consistency with the State's long-term climate goals or strategies, provided that substantial evidence supports the agency's analysis of how those goals or strategies address the project's incremental contribution to climate change and its conclusion that the project's incremental contribution is consistent with those plans, goals, or strategies.
- The lead agency has discretion to select the model or methodology it considers most appropriate to enable decision makers to intelligently take into account the project's incremental contribution to climate change.

In addition, in order to assure that energy implications are considered in project decisions, CEQA requires that EIRs include a discussion of the potential energy impacts of proposed projects, with particular emphasis on avoiding or reducing inefficient, wasteful and unnecessary consumption of energy. The goal of conserving energy implies the wise and efficient use of energy.

LOCAL

Bay Area Air Quality Management District 2017 Clean Air Plan

The Bay Area Air Quality Management District (BAAQMD) 2017 Clean Air Plan is a roadmap for regional efforts to reduce air pollution and protect public health and the global climate. The 2017 Plan identifies potential rules, programs, and strategies to reduce GHG emissions and other harmful air pollutants in the Bay Area. The 2017 Plan complements and supports other important regional and state planning efforts, including Plan Bay Area and the State of California's 2030 Scoping Plan.

This Plan lays out 85 distinct control measures to decrease fossil fuel combustion, improve energy efficiency, and decrease emissions of potent GHGs and other pollutants. Numerous measures reduce multiple pollutants simultaneously, while others focus on a single type of pollutant - for example, "super-GHGs" like methane and black carbon.

San Francisco Bay Conservation and Development Commission

The San Francisco Bay Conservation and Development Commission (BCDC) was created in 1965 to address a shrinking San Francisco Bay due to haphazard filling, to increase shoreline public access, and to regulate development along the waters of the Bay. Altogether, the Commission is charged with:

- Regulating all filling and dredging in San Francisco Bay (which includes San Pablo and Suisun Bays, sloughs and certain creeks and tributaries that are part of the Bay system, salt ponds and certain other areas that have been diked-off from the Bay);
- Protecting the Suisun Marsh, the largest remaining wetland in California, by administering the Suisun Marsh Preservation Act in cooperation with local governments;
- Regulating new development within the first 100 feet inland from the Bay to ensure that maximum feasible public access to the Bay is provided;
- Minimizing pressure to fill the Bay by ensuring that the limited amount of shoreline area suitable for high priority water-oriented uses is reserved for ports, water-related industries, water-oriented recreation, airports, and wildlife areas.
- Pursuing an active planning program to study Bay issues to ensure that Commission plans and policies are based upon the best available current information.
- Leading regionwide adaptation planning in light of rising sea level;
- Administering the federal Coastal Zone Management Act within the San Francisco Bay segment of the California coastal zone to ensure that federal activities reflect Commission policies.
- Participating in the regionwide program to administer a Long Term Management Strategy (LTMS) to ensure appropriate dredging and dredged materials disposal in San Francisco Bay; and,
- Participating in California's oil spill prevention and response planning program.

Under the McAteer-Petris Act, BCDC has jurisdiction over five areas: the San Francisco Bay, a 100-foot shoreline band, salt ponds, managed wetlands, and certain waterways. In the Tiburon Planning Area, the BCDC has jurisdiction over activities within San Francisco Bay and activities along the 100-foot shoreline band; therefore, any BCDC policies and regulations

pertaining to areas outside of the 100-foot shoreline band are advisory. Additionally, there are no salt ponds, managed wetlands, or waterways under BCDC's jurisdiction in the Tiburon Planning Area.

Since the San Francisco Bay is getting larger due to sea level rise, some flood protection strategies are expected to require larger amounts of fill than BCDC has ever previously permitted. In that vein, the BCDC has developed programs and tools to help prepare for and adapt to rising sea levels in the San Francisco Bay Area. The Policies for a Rising Bay project is part of the BCDC's climate change program, which involves building the region's capacity to plan for sea level rise and ensuring that the Commission's laws and policies support and encourage appropriate resilience and adaptation. Separately, the BCDC unanimously approved an amendment to the San Francisco Bay Plan to address climate change, which is included in the current version of the San Francisco Bay Plan. The BCDC also developed the Adapting to Rising Tides program, which provides guidance, tools, and information to address the specific challenges of climate change on the San Francisco Bay. The Adapting to Rising Tides program includes a Bay Shoreline Flood Explorer tool, which provides interactive mapping that illustrates sea level rise at the local level along the San Francisco Bay.

Town of Tiburon Climate Action Plan

In April 2011, the Town of Tiburon adopted a Climate Action Plan (CAP) to compile existing and potential strategies (i.e., actions, projects, and programs) that the Town's government operations and the community can take to address climate change. The CAP provides a brief background on what climate change is and its potential impacts, but focuses on the efforts Tiburon can take to reduce its greenhouse gas emissions and mitigate, to the extent feasible at the local level, the potential impacts of climate change. Specifically, this CAP:

- Summarizes the various regulations at the federal, state, and regional levels;
- Incorporates the Town's 2005 Greenhouse Gas Emission Inventory, which identified sources of greenhouse gas emissions generated by both the community and Town's government operations;
- Estimates how these emissions may change over time and establishes a target to reduce greenhouse gas emissions to 15% below 2005 levels by 2020; and
- Provides natural system, energy use, transportation, land use, green purchasing, waste and water use strategies necessary to minimize Tiburon's impacts on climate change and meet the established greenhouse gas emissions reduction target.

Town of Tiburon Greenhouse Gas Inventory for Community & Government Operations Emissions

In May 2009, Tiburon completed a *Greenhouse Gas Inventory* report for the baseline year of 2005, which was used in the preparation of the Town's CAP in 2011. In December 2012, Tiburon (in collaboration with the Marin Climate & Energy Partnership) completed a *2010 Greenhouse Gas Inventory*, which measures the progress the Town has made on reducing greenhouse gas emissions between 2005 and 2010. The inventory quantifies greenhouse gas emissions from a wide variety of sources, from the energy used to power, heat and cool buildings, to the fuel used to move vehicles and power off-road equipment, to the decomposition of solid waste and treatment of wastewater.

Since 2014, the Town of Tiburon (in collaboration with the Marin Climate & Energy Partnership) has prepared annual community greenhouse gas emissions inventories to measure progress in meeting the Town's GHG reduction goals. The most recent GHG inventory, the *Greenhouse Gas Inventory for Community Emissions for Year 2018* was prepared in April 2020. The inventory reports that community emissions dropped 26% between 2005 and 2018. The largest reductions were due to decreases in electricity and natural gas use emissions as well as transportation emissions. Although Tiburon has met

the local and statewide target to reduce emissions 15% by 2020, the State has enacted a longer-term goal to reduce emissions another 40% by 2030 (i.e., SB 32).

In December 2018, the Town of Tiburon (in collaboration with the Marin Climate & Energy Partnership) prepared a GHG emissions inventory that included an inventory government operations emissions. The *Greenhouse Gas inventory for Community Emissions (2016) and Government Operations Emissions (2015)* found that government emissions had dropped 35% between 2005 and 2015.

Marin Shoreline Sea Level Rise Vulnerability Assessment

The Marin County Department of Public Works and Community Development Agency are the project leads for the Bay Waterfront Adaptation & Vulnerability Evaluation (BayWAVE) program. The program began in September 2015 with funding from the County and additional financial support from the California Coastal Conservancy. In June 2017, the Marin County Department of Public Works prepared the *Marin Shoreline Level Rise Vulnerability Assessment* as part of the BayWAVE program to understand and prepare for sea level rise along the shoreline. This Vulnerability Assessment seeks to provide context and estimates of the physical and fiscal impacts across the County's bayside shoreline over the coming decades. The Vulnerability Assessment is also presented by jurisdiction in community profiles to enable local professionals, officials, and residents to engage is local discussions and relate to their neighbors. Each community profile details key issues and geographic locations, as well as includes economic, environmental, equity, and management considerations related to sea level rise vulnerability. The BayWAVE program's vulnerability process was guided by CalAdapt through the following phases of analysis:

Phase 1. Exposure: Assess potential changes in water level from sea level rise, storm events, and geomorphic change to determine the built and natural assets that could be exposed to saltwater;
Phase 2. Sensitivity: Assess the degree of damage or disruption tidal and storm surge flooding could cause on the exposed assets;
Phase 3. Adaptive Capacity: Assess each asset's adaptive capacity, or ability to respond successfully, to flooding, without human intervention.
Phase 4. Potential Impacts: Evaluate the potential consequences to the assets and larger context, assuming no intervention actions.
Phase 5. Risk & Onset: Describe the certainty and timing of impacts.

A community profile for the Town of Tiburon is included in this Vulnerability Assessment. The results of the assessment are summarized in Section 2, *Existing Conditions and Climate Change*, of this report.

2019-2020 Marin County Civil Grand Jury Report

The Civil Grand Jury is the only independent "watchdog" investigative body in Marin County. The Civil Grand Jury monitors the performance of the local government and makes recommendations. In September 2020, the 2019-2020 Marin County Civil Grand Jury published *Climate Change: How Will Marin [County] Adapt?* which investigated the actions taken by Marin's county, city, and town governments to prepare for the potential consequences of climate change and assessed the adequacy of those efforts. The Civil Grand Jury found that climate change mitigation efforts by Marin governments have been notably effective in meeting their goals to reduce greenhouse gas emissions; however, the Civil Grand Jury also found that the existing adaption efforts across the County pay insufficient attention to other potential effects of climate change, including impacts on public health, ecosystems, and social inequity. Additionally, it was found that there are insufficient staff and financial resources devoted to climate change adaption efforts across county government as well as in the cities, towns, and

other agencies, and may of the existing efforts are highly dependent on grant funding. Based on the results of the analysis, the Civil Grand Jury made the following 6 recommendations to enhance the County's ability to meet the climate challenge. Of the six recommendations, the following three are relevant to the Town of Tiburon:

- The Board of Supervisors, in collaboration with municipalities and other agencies affect by climate change, should convene a multi-jurisdictional task force (referred to in this report as the Marin Climate Adaptation Task Force) charged with developing a single, comprehensive, multi-jurisdictional adaptation strategy for all of Marin;
- Each member of the Marin Climate & Energy Partnership, should declare its support for broadening the partnership's missions and increasing its funding as necessary to enable it to support overall climate change planning efforts, including both mitigation and adaptation in cities, towns, and other member agencies throughout the County; and
- Each city and town, if it does not have a full-time sustainability coordinator (or similar position), should appoint a committee or commission charged with monitoring and reporting on its climate change mitigation and adaptation efforts.

The Civil Grand Jury requested a response from the Town to explain whether they agree or disagree with the three recommendations above. In December 2020, the Town of Tiburon approved and submitted a response to the Civil Grand Jury, which noted that the Town believed the first two recommendations required further analysis and that the third recommendation has already been implemented. For the first recommendation, the Town noted that the Civil Grand Jury recommendation specifically asks the County to take the lead in forming a new task force to develop a "single, comprehensive, multi-jurisdictional adaptation strategy for all of Marin". As one of many entities that could potentially be involved, Tiburon did not believe they are in a position to assess the capacity or willingness of the County to effectively implement this recommendation. Additionally, for the second recommendation, Tiburon agreed that expanding organizations like the Marin Climate & Energy Partnership could make an appreciable difference in helping cities, towns, and the county in addressing climate change challenges; however, the Town is not in support of increasing funding at this time as the COVID-19 pandemic has put a significant, and unprecedented strain on the financial condition of all Marin entities.

2 EXISTING CONDITIONS AND CLIMATE CHANGE SCENARIOS

Tiburon is a small incorporated town located on the Tiburon Peninsula in Marin County approximately seven miles north of the Golden Gate Bridge. Tiburon has a land area of 4.5 square miles and an estimated current population of 9,540[2]. Primarily a residential community of single-family homes, Tiburon has a relatively small percentage of land devoted to multi-family development and commercial uses. There are three commercial areas (i.e., Downtown Tiburon, the Cove Shopping Center, and the U.S. Highway 101/Tiburon Boulevard interchange) that provide necessary goods and services for residents, as well as public and private schools for grades K-8, a post office, a library, police and fire stations, and a Town Hall. With abundant parks and open space, there are many recreational opportunities within Tiburon Planning Area, including 736 acres of the 740-acre Angel Island State Park (Town of Tiburon, September 2005).

Climate change has the potential to significantly affect Tiburon's residents and businesses, as well as other communities in the San Francisco Bay around the world. For example, in Marin County, a modest 10- inch sea level rise could reach 700 buildings and 8 miles of roads along the bay, and a 60-inch rise, combined with a 100-year storm surge, could inundate

[2] California Department of Finance (DOF). May 2020. DOF E-5 Report.

12,000 buildings and 130 miles of roads[3]. To better analyze and understand the potential effects global climate change could have on this seaside community, the following section will provide an overview of the linkages between greenhouse gases and climate change and identify the existing conditions within Tiburon and the greater San Francisco Bay.

Greenhouse Gases and Climate Change Linkages

Various gases in the Earth's atmosphere, classified as atmospheric GHGs, play a critical role in determining the Earth's surface temperature. Solar radiation enters Earth's atmosphere from space, and a portion of the radiation is absorbed by the Earth's surface. The Earth emits this radiation back toward space, but the properties of the radiation change from high-frequency solar radiation to lower-frequency infrared radiation.

Naturally occurring greenhouse gases include water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also greenhouse gases, but they are, for the most part, solely a product of industrial activities. Although the direct greenhouse gases CO_2, CH_4, and N_2O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2011, concentrations of these three greenhouse gases have increased globally by 40, 150, and 20%, respectively (IPCC, 2013).

Greenhouse gases, which are transparent to solar radiation, are effective in absorbing infrared radiation. As a result, this radiation that otherwise would have escaped back into space is now retained, resulting in a warming of the atmosphere. This phenomenon is known as the greenhouse effect. Among the prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO_2), methane (CH_4), ozone (O_3), water vapor, nitrous oxide (N_2O), and chlorofluorocarbons (CFCs).

Emissions of GHGs contributing to global climate change are attributable in large part to human activities associated with the industrial/manufacturing, utility, transportation, residential, and agricultural sectors. In California, the transportation sector is the largest emitter of GHGs, followed by the industrial and electricity generation sectors (California Energy Commission, 2020).

As the name implies, global climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern, respectively. California produced 425 million gross metric tons of carbon dioxide equivalents ($MMTCO_2e$) in 2018 (California Air Resources Board, 2020a).).

Carbon dioxide equivalents are a measurement used to account for the fact that different GHGs have different potential to retain infrared radiation in the atmosphere and contribute to the greenhouse effect. This potential, known as the global warming potential of a GHG, is also dependent on the lifetime, or persistence, of the gas molecule in the atmosphere. Expressing GHG emissions in carbon dioxide equivalents takes the contribution of all GHG emissions to the greenhouse effect and converts them to a single unit equivalent to the effect that would occur if only CO_2 were being emitted.

Consumption of fossil fuels in the transportation sector was the single largest source of California's GHG emissions in 2018, accounting for 41% of total GHG emissions in the state. This category was followed by the industrial sector (24%), the electricity generation sector (including both in-state and out of-state sources) (15%), the agriculture and forestry sector (8%), the residential energy consumption sector (7%), and the commercial energy consumption sector (5%) (California Air Resources Board, 2020c).

[3] Marin County Department of Public Works. June 2017. *Marin Shoreline Sea Level Rise Vulnerability Assessment* (pp. 25, 43, 63).

Effects of Global Climate Change

The effects of increasing global temperature are far-reaching and extremely difficult to quantify. The scientific community continues to study the effects of global climate change. In general, increases in the ambient global temperature as a result of increased GHGs are anticipated to result in rising sea levels, which could threaten coastal areas through accelerated coastal erosion, threats to levees and inland water systems and disruption to coastal wetlands and habitat.

The impacts of climate change are already being felt in the San Francisco Bay Area and Northern California. Besides containing secular changes over several decades, the annual temperature record at San Francisco and surrounding San Francisco Bay locations (such as Tiburon) also exhibit shorter period variability from time scales of a few years to a few decades. From the observed and from the model historical simulations, it is seen that the model simulations begin to warm more substantially in the 1970s; this is likely a response to effects of GHG increases which began to increase significantly during this time period (California Energy Commission, 2012). According to California's latest Climate Change Assessment, annual average temperatures in the Bay Area will likely increase by approximately 4.4°F by the middle of this century and 7.2°F by the end of the century—unless there are significant efforts throughout the world to limit or reduce greenhouse gas emissions. Even with significant reduction efforts, the temperature increase is projected to be approximately 3.3°F by mid-century and 4.2°F by century's end[4].

Over the next century, increasing atmospheric GHG concentrations are expected to cause a variety of changes to global climate conditions, including sea level rise and storm surge in coastal areas, increased riverine flooding, and higher temperatures more frequently (leading to extreme heat events and wildfires), particularly in inland areas. Local impacts stemming from climate related conditions range from impacts to extreme temperatures, flooding, public health, wildfires and infrastructure.

For example, if the temperature of the ocean warms, it is anticipated that the winter snow season would be shortened. Snowpack in the Sierra Nevada provides both water supply (runoff) and storage (within the snowpack before melting), which is a major source of supply for the state. The snowpack portion of the supply could potentially decline by 50% to 75% by the end of the 21st century (National Resources Defense Council, 2014). This phenomenon could lead to significant challenges securing an adequate water supply for a growing state population. Further, the increased ocean temperature could result in increased moisture flux into the state; however, since this would likely increasingly come in the form of rain rather than snow in the high elevations, increased precipitation could lead to increased potential and severity of flood events, placing more pressure on California's levee/flood control system.

According to the most recent California Climate Change Assessment (*California's Fourth Climate Change Assessment*) (2018), and the Marin County Civil Grand Jury *Climate Change: How Will Marin Adapt (2020)*, the impacts of global warming in California are anticipated to include, but are not limited to, the following:

- Ocean Warming
- Extreme Heat
- Precipitation
- Wildfires
- Flooding & Sea Level Rise
- Water Resources

[4] Ackerly et al., *San Francisco Bay Area Summary Report*, p. 14.

- Public Health
- Biological Resources
- Agriculture
- Energy Consumption
- Infrastructure

Because local governments largely determine the shape of development through land-use plans, regulations, and implementing decisions, local governments play an important role in developing climate change strategies including resiliency planning and adaptation. Inasmuch as local governments play an important role in adaptation strategies through local land use plans and policies, many climate adaptation strategies will need to be coordinated as part of a larger regional, or statewide strategy requiring cooperation by many local governments, and decision making and regulatory bodies.

This section addresses future conditions anticipated to result from climate change as well as resiliency planning and adaptation strategies at the statewide, regional, and local levels, where applicable. Information in this section is primarily derived from the *Adapting to Rising Tides: Contra Costa County Assessment and Adaptation Project*, the *Bay Area Sea Level Rise Analysis and Mapping Project*, the California Energy Commission's Cal-Adapt tool, the *Marin Shoreline Sea Level Rise Vulnerability Assessment*, and the *Climate Change: How Will Marin Adapt*. The *Marin County Multi-Jurisdiction Local Hazard Mitigation Plan (2018*) was reviewed, but provides a discussion of regional and local hazards that takes climate change into account but does not focus on the effects of climate change and does not specify any impacts or recommendations for Tiburon in regards to climate change and adaptation. For an overview of hazards discussed in the *Marin County Multi-Jurisdiction Local Hazard Mitigation Plan (2018*), please see the *Hazards and Safety Existing Conditions Report*.

Ocean Warming

California has recently experienced unprecedented events along its coasts including a historic marine heat wave, record harmful algal blooms, fisheries closures, and a significant loss of northern kelp forests. These events increase concern that coastal and marine ecosystems are being transformed, degraded, or lost due to climate change impacts, particularly sea-level rise, ocean acidification, and warming. From 1900 to 2016, California's coastal oceans warmed by 1.26°F.

"The Blob," a very warm patch of ocean water off the coast of California from 2013-2016, demonstrated that anomalously warm ocean temperatures can produce unprecedented events, including the mass abandonment of sea lion pups and California's record-setting drought. Rising bay water and groundwater levels will also increase salinity intrusion and subsurface flooding. If this groundwater intrudes into sewer systems, treatment processes will become more expensive and wastewater recycling capabilities will be reduced. Additionally, climate change will require improved stormwater management in the Bay Area as extreme storm events increase in size and frequency (State of California, 2018).

Extreme Heat

Temperature is a climate variable, and is directly affected by changes in global atmospheric and oceanic temperatures. While trends in average annual temperature are an important indicator of climate change, extreme temperature events have greater impacts on society due to their episodic nature. Therefore, the vulnerability and risk assessment tends to specifically focus on extreme heat events and not on average temperature changes.

The United Nations' Intergovernmental Panel on Climate Change (IPCC) defines extreme heat events as a period of abnormally hot weather. While extreme heat events can have various durations, Cal-Adapt defines an extreme heat event as a period of five or more consecutive extreme heat days. Cal-Adapt defines an extreme heat day in a given region as a day

in April through October where the maximum temperature exceeds the 98th historical percentile of maximum temperatures for that region based on daily temperature data from 1961 to 1990. The 98th historical percentile of maximum temperatures varies by locality and inland areas tend to be at a greater risk of extreme heat events when compared to areas near the coast.

There was a major heat wave in California from mid- to late July 2006, with 10 days of record-breaking temperatures. Across the state, at least 140 extreme heat-related deaths were reported, and researchers estimate that the heat wave resulted in over 16,166 more emergency department visits than average and 1,182 more hospitalizations than average (Knowlton et al., 2009).

Increasing numbers of extreme heat days are projected in the coming decades. The *California's Changing Climate 2018* report points out that increasing high heat days from climate change have a number of impacts on communities, including direct heat-related mortalities and worsening of chronic health conditions. The Cal-Adapt tool identifies that average annual temperature in Marin County would increase from approximately 69.5 °F during the period for 1961 to 1990, to between 73.7 °F to 76.4°F (dependent on the scenario selected[5]) for the period from 2070 to 2099 (California Energy Commission, 2019). The Cal-Adapt tool also identifies that, for Tiburon, while there was an average of four days per year of extreme heat days during the historical period from years 1961 to 1990, it is projected that there will be an average of 11 to 19 days of extreme heat days per year (dependent on the RCP scenario selected) during the model projections for the period from years 2070 to 2099 (California Energy Commission, 2020). Table 1 below summarizes historical observed minimum and maximum average annual temperatures and projected minimum and maximum average annual temperatures under the RCP 4.5 and RCP 8.5 scenarios for the Tiburon area. Figure 1 illustrates historical and projected average annual minimum temperatures in the Planning Area under both scenarios and Figure 2 illustrates historical and projected average annual maximum temperatures in the Planning Area under both scenarios.

TABLE 1: AVERAGE ANNUAL MINIMUM TEMPERATURE, MAXIMUM TEMPERATURE, AND PRECIPITATION FOR THE TIBURON AREA (HISTORICAL AND PROJECTED)

	HISTORICAL (OBSERVED): 1961-1990	RCP 4.5 PROJECTED: 2070-2099	RCP 8.5 PROJECTED: 2070-2099
AVERAGE ANNUAL MINIMUM TEMPERATURE (°F)			
Minimum	47.1	49.9	51.9
Average	48.3	52.4	55.4
Maximum	49.7	54.9	59.7
AVERAGE ANNUAL MAXIMUM TEMPERATURE (°F)			
Minimum	65.4	68.5	70.4
Average	67.1	71.4	74.1
Maximum	68.9	74.2	78.7
AVERAGE ANNUAL PRECIPITATION (INCHES)			
Minimum	12.3	11.3	11.3
Average	27.6	31.4	34.9
Maximum	54.5	60.3	78.2

SOURCE: CAL-ADAPT, 2020 (HTTPS://CAL-ADAPT.ORG/TOOLS/ANNUAL-AVERAGES/)

[5] To address the uncertainty in future emissions of greenhouse gases and aerosols, California's 4th Climate Assessment uses so-called Representative Concentration Pathways (RCPs), which encapsulates different possible future greenhouse gas and aerosol emission scenarios. RCP 4.5 is a "medium" emissions scenario that models a future where society attempts to reduce greenhouse gas emissions, while RCP 8.5 is a more "business as usual" scenario.

PRECIPITATION

Precipitation change is a climate variable that is directly affected by changes in global atmospheric and oceanic temperatures. Projected changes in precipitation include annual trend changes as well as extreme precipitation events. An extreme weather event is an occurrence that is significantly different from typical weather at a specific location and time of year. Extreme precipitation events can lead to flooding, mudslides and other damaging events. In a changing climate the frequency and intensity of such events will likely change across California.

The Cal-Adapt tool identifies the estimated intensity and frequency of extreme precipitation events in Tiburon. During the historical period from October 1961 through September 1990, the average level of precipitation during an extreme precipitation event (i.e. those precipitation events that are on average exceeded once every 20 years) was approximately 7.7 inches, whereas during the forecasted period from October 2070 through September 2099, precipitation levels during extreme precipitation events are expected to range from approximately 8.8 inches to 10.6 inches (dependent on the RCP scenario selected). Separately, the Cal-Adapt tool provides that the number of extreme precipitation events in a given year (defined as those events with 2-day rainfall totals above an extreme threshold of 1.82 inches) in Tiburon would increase from approximately 2 during the historical period from 1961 to 1990, to 3 or 4 (dependent on the RCP scenario selected) during the forecasted period from 2070 through 2099 (California Energy Commission, 2020). Table 1 summarizes historical average annual precipitation and projected average annual precipitation under the RCP 4.5 and RCP 8.5 scenarios for the Tiburon area. Figure 3 illustrates historical average annual precipitation in the Planning Area as well as projected average annual precipitation under both scenarios.

WILDFIRES

Wildfire occurs as a result of conditions affected by complex interactions between primary variables (including precipitation, and temperature) and other factors (including changes in cover type). Wildfires are unplanned, natural occurring fires and may be caused by lightning, accidental human ignitions, arson, or escaped prescribed fires. Weather is one of the most significant factors in determining the severity of wildfires; natural fire patterns are driven by conditions such as drought, temperature, precipitation, and wind, and also by changes to vegetation structure and fuel (i.e., biomass) availability. Wildfires pose a great threat to life and property, particularly when they move from forest or rangeland into developed areas.

Climate change will make forests more susceptible to extreme wildfires. By 2100, if greenhouse gas emissions continue to rise, one study found that the frequency of extreme wildfires burning over approximately 25,000 acres would increase by nearly 50%, and that average area burned statewide would increase by 77% by the end of the century. In the areas that have the highest fire risk, wildfire insurance is estimated to see costs rise by 18% by 2055 and the fraction of property insured would decrease.

In recent years, the area burned by wildfires has increased in parallel with increasing air temperatures. Wildfires have also been occurring at higher elevations in the Sierra Nevada mountains, a trend which is expected to continue under future climate change. Climate change will likely modify the vegetation in California, affecting the characteristics of fires on the land. Land use and development patterns also play an important role in future fire activity. Because of these complexities, projecting future wildfires is complicated, and results depend on the time period for the projection and what interacting factors are included in the analysis. Because wildfires are affected by multiple and sometimes complex drivers, projections of wildfire in future decades in California range from modest changes from historical conditions to relatively large increases in wildfire regimes.

Moreover, continued global warming will alter natural ecosystems and biological diversity within the state. For example, alpine and sub-alpine ecosystems are expected to decline by as much as 60% to 80% by the end of the century as a result of increasing temperatures. The productivity of the state's forests is also expected to decrease as a result of global warming. The Cal-Adapt tool identifies that for the Town of Tiburon, under modeled average conditions, the average annual mean area burned is forecasted to increase from an annual average of 4.8 and an annual maximum of 18.0 hectares for the 1961-1990 period to an annual average of 5.6 to 5.9 hectares and an annual maximum of 17.0 to 19.0 hectares (dependent on the RCP scenario selected) for the 2070-2099 period (California Energy Commission, 2020).

FLOODING & SEA LEVEL RISE

Riverine and local flooding is influenced by precipitation and local conditions, such as ground cover and soil conditions. Riverine flooding occurs when heavy rainfall causes rivers or creeks to overtop their banks and inundate surrounding areas during extreme weather events. Urban flooding commonly occurs when local stormwater infrastructure is overwhelmed during extreme precipitation events.

Global models indicate that California will see substantial sea level rise during this century, with the exact magnitude depending on such factors as, global emissions, rate at which oceans absorb heat, melting rates and movement of land-based ice sheets, and local coastal land subsidence or uplift. Sea level rise is virtually certain to increase beyond the 6 inches that much of California experienced in the past century, but there are important questions involving how fast and how extreme the rates of sea-level rise will be. The National Oceanic and Atmospheric Administration models predict that sea level rise will increase by 0.3 to 2.5 meters (12 to 98 inches) by 2100, depending on the future GHG emissions levels (National Oceanic and Atmospheric Administration, 2017). Resultant effects could include increased coastal flooding, saltwater intrusion, and disruption of wetlands. As the existing climate throughout California changes over time, mass migration of species, or failure of species to migrate in time to adapt to the perturbations in climate, could also result.

Statewide damages from rising sea levels could reach nearly $17.9 billion from inundation of residential and commercial buildings under 50 centimeters (~20 inches) of sea-level rise, which is close to the 95th percentile of potential sea-level rise by the middle of this century. A 100-year coastal flood, on top of this level of sea-level rise, would almost double the costs. Rising sea levels, more intense coastal storms, and warmer water temperatures will increasingly threaten the state's coastal regions. Rising sea levels would inundate coastal areas with saltwater, accelerate coastal erosion, threaten vital levees and inland water systems, and disrupt wetlands and natural habitats.

Building resilience to sea level rise in California requires approaches tailored to communities' needs, climate impacts, and many other factors. Options to protect communities and ecosystems include combinations of armoring, natural infrastructure, and hybrid approaches. Decision-makers need tools to evaluate the economic and environmental costs and benefits of alternative strategies with more complete information. The *California's Fourth Climate Change Assessment* (Fourth Assessment) contributed to this need by supporting the expansion of CoSMoS, which is a tool that can simulate sea-level rise in combination with storm events and other coastal dynamics.

Coastal protection strategies can include the restoration of tidal marshes, judiciously-placed coastal armoring, and beach renourishment for highly accessed urban locations (e.g., adding large volumes of sand, an expensive solution lasting only 1-2 years). However, by 2050, with increasing sea-level rise and coastal storms, localities may need to begin considering shoreline retreat strategies. The restoration of marine plants and seaweeds in coastal environments is a tactic that could increase dissolved oxygen levels, at least for local areas. Ocean and coastal vegetation including marshes also sequester

carbon, and quantifying the locations and contributions that marine plants can make to reducing carbon dioxide in local waters is needed. Other actions include reducing nutrient runoff from sewage disposal and excess agricultural fertilizer.

The San Francisco Bay Conservation and Development Commission (BCDC) mapped sea level rise scenarios for the Tiburon Peninsula and Angel Island along coastline of the Planning Area. Figures 4a and 4b illustrates the level and location of sea level rise inundation over four sea level rise scenarios using the BCDC's *Adapting to Rising Tides (ART) Sea Level Rise and Shoreline Analysis* maps. Figure 4a illustrates the impacts of a 12-inch sea level rise and 36-inch sea level rise on the Planning Area and Figure 4b illustrates the impacts of 66-inch and 96-inch sea level rise. As shown, all of the land adjacent to the coast would be inundated to varying degrees under these scenarios; however, portions of Tiburon along the western coast appear to be inundated at a higher degree, with the downtown area and Boardwalk Shopping Center adjacent to Belvedere experiencing the most extreme flooding under the most extreme sea level rise and storm surge scenarios. These scenarios provide a range of sea level rise approximately consistent with the predictions for sea level rise by the National Oceanic and Atmospheric Administration, which predicts that that sea level rise will increase by 0.3 to 2.5 meters (12 to 98 inches) by 2100, depending on the future GHG emissions levels.

Separately, the *Marin Shoreline Sea Level Rise Vulnerability Assessment* was prepared in June 2017 as part of the BayWAVE program to understand and identify the effects of sea level rise on the seaside communities with Marin County. Sea level rise estimates used in this analysis are from the USGS Coastal Storm Modeling Systems (CoSMoS) and are viewable online through the Our Coast Our Future (OCOF) Flood Map tool. The six OCOF scenarios selected for the Vulnerability Assessment analysis are identified in Table 2 and illustrated on Figures 5a through 5c. These scenarios are consistent with the National Research Council's 2012 estimates, as Scenarios 1 and 2 represent the near-term projection anticipated by 2030, Scenarios 3 and 4 represent the medium-term projection by 2050, and Scenarios 5 and 6 represent the long-term projection by 2100.

Table 2: BayWAVE Sea Level Rise & Storm Scenarios

Scenario	Sea Level Rise and Storm	Term Projection
1	10 inches	Near-Term
2	10 inches + 100-year storm surge	
3	20 inches	Medium-Term
4	20 inches + 100-year storm surge	
5	60 inches	Long-Term
6	60 inches + 100-year storm surge	

Source: Marin County Department of Public Works, June 2017.

Tiburon is located along an extensive peninsula projecting into Richardson's and San Pablo Bays. The peninsula is generally steep with several areas of reinforced shoreline. However, as shown on Figures 5 through 5c, the low-lying Blackie's Pasture, Paradise Cay, and Cove and Boardwalk Shopping Center areas could be vulnerable in the Long-Term (i.e., Scenarios 5 and 6), with only small portions of these areas appearing to be inundated in the Near- and Medium-Terms These areas feature housing and a number of business, civic, recreation, historic and visitor serving uses. At-a-glance, the long-term projection impacts of sea level rise under a 100-year storm surge (i.e., Scenario 6) could result in over $400 million in assessed value damage and nearly $600 million in the single-family market in Tiburon (Marin County Department of Public Works, June 2017), as well as approximately 2.5 miles of flooded roadways exposed to saltwater and erosion.

Specifically, in near- and medium-term scenarios 1, 2, 3, and 4, about fifty acres could be vulnerable; however, by the long-term, 106 acres could be vulnerable to sea level rise and 135 acres could be vulnerable with an additional 100-year storm surge. Despite the numeric jump, these figures account for less than 1% of Tiburon's land area. In terms of parcels, about

45 to 50 parcels could be vulnerable in the near- and medium-terms. However, in the long-term, this number triples to 150 vulnerable parcels. An additional 100-year storm surge at five feet of sea level rise could triple this figure again, to 450 flooded parcels (Marin County Department of Public Works, June 2017).

Table 3 identifies the number of parcels by land use that are in the exposed area of the community under the BayWAVE scenarios without a 100-year storm surge (i.e., Scenarios 1, 3, and 5). Additionally, Table 4 identifies how many buildings could be impacted under each scenario.

Table 3: Tiburon Vulnerable Parcels by Land Use

Land Use	Scenarios					
	1		3		5	
	Number of Parcels	Total Acres	Number of Parcels	Total Acres	Number of Parcels	Total Acres
Commercial (Improved)	4	1.0	5	1.0	32	18.0
Commercial (Unimproved)	0	0	0	0	4	1.0
Residential	34	10.0	42	10.0	87	19.0
Multi-Family (Improved)	*12*	*3.0*	*12*	*3.0*	*12*	*3.0*
Multi-Family (Unimproved)	*2*	*0.5*	*2*	*0.5*	*4*	*0.5*
Single Family (Improved)	*13*	*6.0*	*13*	*6.0*	*62*	*15.0*
Single Family (Unimproved)	*7*	*0.5*	*7*	*0.6*	*7*	*0.6*
Tax Exempt	8	18.0	8	18.0	20	36.0
Total	46	29.0	55	29.0	143	

Source: Marin County Department of Public Works, June 2017.

Table 4: Tiburon Vulnerable Buildings

Scenarios		Vulnerable Buildings	
		Number	Percent[1]
Near-Term	1	26	1
	2	42	1
Medium-Term	3	42	1
	4	44	1
Long-Term	5	153	4
	6	261	7

1. Represents the percent of the total buildings in Tiburon in 2017
Source: Marin County Department of Public Works, June 2017.

When taking a closer look at land use, a striking 65% of commercial properties could be vulnerable to long-term levels of sea level rise. In this scenario, tidal flooding could extend down Tiburon Boulevard. Additional stormwater from the hillsides would only exacerbate his flooding during storms. Reductions in service or loss due to building or inventory damage could have significant economic and employment repercussions for Tiburon. In earlier scenarios, roughly 10% of commercial parcels could face tidal flooding at mean higher high water (MHHW). Comparatively, it is anticipated that less than 3% of

residential parcels in Tiburon could face tidal flooding. In terms of buildings, as shown in Table 4, 26 to 44 buildings in the near- and medium-terms, and 153 buildings in the long-term are vulnerable to tidal flooding at MHHW. When a 100-year storm surge also occurs, approximately 260 buildings would flood temporarily. The difference in scenario 6 parcel and building figures may be attributed to the nature of bluff side development, where the parcels could be impacted at the water's edge with the building safely elevated above and/or back from the edge.

Overall, according to the *Marin Shoreline Sea Level Rise Vulnerability Assessment*, increased sea level rise and storm surges could significantly compromise Tiburon community in the following ways:

- Highly valued Main Street shoreline shops and restaurants could be vulnerable in the near-term.
- Homes along the interface of the bluffs and shoreline could be vulnerable to increased erosion and bluff collapse during storms.
- The Tiburon and Angel Island ferries may face complications with loading during extreme high tides, and may experience compromised American Disabilities Act (ADA) access.
- Vehicular access along Tiburon Blvd. could be compromised at the Cove Shopping Center and in downtown in the long-term.
- The Tiburon Fire Department, library, post office, and municipal facilities may be vulnerable to tidal flooding in the long-term.
- The Bay Trail and hotels downtown are compromised in the near-term.
- Corinthian Yacht Club facilities could be vulnerable to storm damage and flooding in the medium- to long-terms.
- The Cove Shopping Center is vulnerable in the long-term to sea level rise, though could suffer sooner from combinations of higher tides and stormwater.
- If US 101 is compromised, so is service and goods delivery to Tiburon businesses.
- Access to Tiburon from Corte Madera could also flood in the medium-term.
- Homes high in the hills could become isolated and cut off from necessities and the ability to leave the community, as alternative access routes are not available at this time.
- Several historic sites downtown and the old shipping terminal could flood with saltwater as early as the near-term.

WATER RESOURCES

A vast network of man-made reservoirs and aqueducts capture and transport water throughout the state from northern California rivers and the Colorado River. The current distribution system relies on Sierra Nevada snowpack to supply water during the dry spring and summer months. Rising temperatures, potentially compounded by decreases in precipitation, could severely reduce spring snowpack, increasing the risk of summer water shortages.

The state's water supplies are also at risk from rising sea levels. An influx of saltwater would degrade California's estuaries, wetlands, and groundwater aquifers. Saltwater intrusion caused by rising sea levels is a major threat to the quality and reliability of water within the southern edge of the Delta, a major state fresh water supply.

Current management practices for water supply and flood management in California may need to be revised for a changing climate. This is in part because such practices were designed for historical climatic conditions, which are changing and will continue to change during the rest of this century and beyond. As one example, the reduction in the Sierra Nevada snowpack, which provides natural water storage, will have implications throughout California's water management system. Even under the wetter climate projections, the loss of snowpack would pose challenges to water managers, hamper hydropower generation, and nearly eliminate all skiing and other snow-related recreational activities.

The San Francisco Bay Area's water agencies rely on a diverse portfolio of local and imported sources. The reliability of these sources will vary dramatically in both the short and long term as the climate changes. Climate impacts — such as earlier melting of snowpack, increasing seawater intrusion into groundwater, increased rates of evapotranspiration, and levee failures or subsidence that contaminate Delta supplies — will affect both the quantity of water available and the quality of supplies (State of California, 2019).

Reliability concerns can be mitigated with more diverse water supply portfolios, additional water storage infrastructure above and belowground, and innovative groundwater management. Strategies for increasing supply reliability are being pursued by individual agencies and as part of a regional effort called the Bay Area Regional Reliability (BARR) partnership made up of several large water suppliers serving six counties. Alternatives under consideration by BARR and other Bay Area agencies include: expanding storage and conveyance infrastructure; increasing non-potable water recycling; implementing potable reuse and/or seawater desalination; promoting groundwater augmentation, banking, and conjunctive use; constructing interties between systems to enable additional water transfers; and harvesting stormwater. Reducing water demand can also increase reliability (State of California, 2019).

The Marin Municipal Water District (MMWD) currently provides potable water service to the Town. MMWD covers approximately 147 square miles and serves a population of approximately 190,000 customers through about 61,800 active service connections (MMWD, June 2016). MMWD's water supply does not come from snowmelt nor from coastal aquifers, but rather from local runoff and the Russian River, a rainfall-driven river. This precipitation is stored in local reservoirs and released during the drier summer months. MMWD is currently very storage-limited; existing storage capacity represents only about two years of demand. There are no remaining economically-feasible sites for new surface water storage facilities and no underlying groundwater basin or alluvial aquifers of any significance as a supply.

In 2017, the MMWD prepared the *Water Resources Plan 2040* to understand how reliability threats could impact the district and its ability to meet the needs of its customers and the local environment. As part of its *2015 Urban Water Management Plan (UWMP)*, the MMWD reported current 2015 water demands and developed water demand projections through 2040. As part of the MMWD's *Water Resources Plan 2040*, the MMWD simulated potentially events that could occur to the MMWD system. The reliability threat scenarios (i.e., Drought Reliability Threats, Climate Change Reliability Threat, Wildfire Reliability Threat, Earthquake Reliability Threat, Water Quality Event Reliability Threats, Landslide Reliability Threat, and Power Reliability Threat) were tested to determine whether they would produce supply deficits with a projected 2040 demand of 24,200 acre-feet (AF) and with 25% emergency storage in MMWD's reservoirs. Supply shortfalls in MMWD's system were nearly encountered under simulations during peak demand months of the reliability threats in which an earthquake disabled San Geronimo treatment plant for one month, or a reliability threat in which Nicasio Lake was unusable due to water quality issues for six months. Under modeled climate change scenarios, MMWD's system is expected to result in overall lower levels of storage, which may increase MMWD's vulnerability to catastrophic events with short, intense impact periods such as earthquakes. Overall, the *Water Resources Plan 2040* identifies that climate change would result in 89 years of hydrology impacts to supplies and demands of potable water[6].

Given that MMWD is storage-limited, it can and has experienced changes in storage very quickly. From December 2012 to January 2014, MMWD experienced a period of very low precipitation, and its reservoirs reached significantly low storage conditions that nearly triggered significant mandatory reductions. Water supply circumstances then changed in early February 2014 when the district received 15 inches of rain, more than the total rain during the prior 400 days combined (MMWD,

[6] RMC. 2017. *Water Resources Plan 2040* [pgs. 4-1 to 4-5]

June 2016). Additionally, as previously noted, the estimated intensity and frequency of extreme precipitation events and storms is expected to increase in Tiburon. Extreme precipitation events and intense storms have the potential to affect surface runoff and storage, as well as the stored water quality.

PUBLIC HEALTH

Heat waves, the natural disaster responsible for the most deaths in California over the last 30 years, are an example of the current and future risk climate change poses to people. The 2006 heat wave killed over 600 people, resulted in 16,000 emergency department visits, and led to nearly $5.4 billion in damages. The human cost of these events is already immense, but research suggests that mortality risk for those 65 or older could increase ten-fold by the 2090s because of climate change. Studies show that while air conditioning can reduce mortality and illness from heat, increased electrical demand for cooling due to hotter conditions could also drive up emissions. However, the state is rapidly moving to cleaner electricity generation. Greenhouse gas emissions from electricity generation in 2016 were about 37% lower than emissions in 1990 (State of California, 2018).

Nineteen heat-related events occurred in California from 1999 to 2009 that had significant impacts on human health, resulting in about 11,000 excess hospitalizations. However, the National Weather Service issued Heat Advisories for only six of the events. Heat-Health Events (HHEs), which better predict risk to populations vulnerable to heat, will worsen drastically throughout the state.

Higher temperatures are expected to increase the frequency, duration, and intensity of conditions conducive to air pollution formation. Climate change poses direct and indirect risks to public health, as people will experience earlier death and worsening illnesses. Air quality could be further compromised by increases in wildfires, which emit fine particulate matter that can travel long distances depending on wind conditions.

In addition, under the higher warming scenario, there would be a substantial increase in the number of high heat days per year by 2100. For example, in Sacramento, there could be up to 100 more days per year with temperatures above 95°F in Sacramento by 2100. This is a large increase over historical patterns and approximately twice the increase projected if temperatures remain within or below the lower warming range. Rising temperatures will increase the risk of death from dehydration, heat stroke/exhaustion, heart attack, stroke, and respiratory distress caused by extreme heat.

In addition to the health impacts related to air and water quality, warmer temperatures and drought conditions can contribute to the spread of diseases by aiding development and spread of the vectors that transmit them. A vector-borne disease (VBD) is one caused by a virus, bacteria, or protozoan that spends part of its life cycle in a host species (e.g., mosquitoes, ticks, fleas, rodents), which subsequently spreads the disease to other animals and people.

Regional research assessments have previously concluded that climate change and variability are highly likely to influence current VBD spread, including both short-term outbreaks and shifts in long-term disease trends. For example, as temperatures rise, mosquito reproductive cycles are shortened, allowing more breeding cycles each season, and viral transmission rates to rise sharply. Mosquitoes are an increasing vector of concern, particularly those species that have been introduced from other countries because changes in temperature and precipitation conditions can allow exotic species to become established in places where they could not previously survive year-round. Marin County health advisors in recent years have identified several infectious diseases that may increase due to increase temperatures, including the West Nile

Virus and Zika Virus[7]. Additionally, in March 2018, Marin County Public Health issued a warning that potentially lethal levels of shellfish toxins, probably caused by "an increasingly unpredictable climate," were detected in the waters of Drakes Bay and north of Stinson Beach.[8]

Climate change will affect California's diverse people and communities differently, depending on their location and existing vulnerabilities. While research shows that all Californians will likely endure more illness and be at greater risk of early death because of climate change, vulnerable populations that already experience the greatest adverse health impacts will be disproportionately affected.

In February 2017, the *Marin County Climate Change and Health Profile Report* was prepared to provide a County-level summary of information on current and projected risks from climate change and potential health impacts. The *Marin County Climate Change and Health Profile Report* found that a larger part of the population is vulnerable to intermediate or socioeconomic factors such as preexisting physical and mental health conditions, cultural or physical isolation, occupations involving outside or high-risk work, a precarious socioeconomic status, or lack of social cohesion and collective efficacy that would make them more vulnerable to the effects of climate change. In 2012, nearly 35% of adults in the County reported one or more chronic health conditions including heart disease, diabetes, asthma, severe mental stress or high blood pressure. In 2012, 16% of adults reported having been diagnosed with asthma. In 2012 approximately 14% of adults were obese (statewide average was 25%). Additionally, in 2012, nearly 9% of residents aged 5 years and older had a mental or physical disability (statewide average was 10%).

In addition to preexisting physical and mental health conditions, social and demographic inequities affect individual and community vulnerabilities to the health impacts of climate change. For example, in 2010, 5% of households in the County did not have a household member 14 years or older who spoke English proficiently (called linguistically isolated; statewide average was 10%) and approximately 8% of adults aged 25 years and older had less than a high school education (statewide average was 19%). Additionally, 7% of the population had incomes below the poverty level (the statewide average was 14%) and 22% of households paid 50% or more of their annual income on rent or a home mortgage (statewide average was 22%). In 2012, approximately 58% of low-income residents in the County reported they did not have reliable access to a sufficient amount of affordable, nutritious food (called food insecurity; statewide average was 42%)[9].

The effects of climate change can exacerbate existing health conditions and compound the risks of adverse health outcomes. The age-adjusted death rate, which takes into account the effect of the population's age distribution, is a basic indicator of the health status of communities. In 2010, the age-adjusted death rate in Marin County was lower than the state average. Disparities in death rates among race/ethnicity groups highlight how certain populations disproportionately experience health impacts. Within the County, the highest death rate occurred among African-Americans and the lowest death rate occurred among Hispanics/Latinos[10].

Climate-related health impacts identified in the *Marin County Climate Change and Health Profile Report* include:

[7] Richard Halsted, "Marin Supervisors Receive Harrowing Report on Climate Change, Sea Level Rise," Marin Independent Journal, April 13, 2019. https://www.marinij.com/2019/04/13/marin-supervisors-receive-harrowing-report-on-climate-change-sea-level-rise/
[8] County of Marin, "Public Health Warning for Shellfish Toxins," news release, March 7, 2018, https://www.marincounty.org/main/county-press-releases/press-releases/2018/hhs-shellfishtoxins-030718
[9] Maizlish N et al., 2017 *Climate Change and Health Profile Report* pg. 17
[10] Maizlish N et al., 2017 *Climate Change and Health Profile Report* pg. 22

Extreme Weather-Related Injury, Mental Health, and Displacement: Extreme weather events (storms, flooding) can cause fatal and nonfatal injuries from drowning, being struck by objects, fire, explosions, electrocution, or exposure to toxic materials. A widespread weather-related natural disaster may destroy or ruin housing, schools, and businesses and cause temporary or permanent displacement. Individuals and families may experience post-traumatic stress, depression, and increased risk of suicide.

Health Impacts of Heat: Increased temperatures manifested as heat waves and sustained high heat days directly harm human health through heat-related illnesses ranging from mild heat stress to fatal heat stroke and the exacerbation of pre-existing conditions in the medically fragile, chronically ill, and vulnerable. Increased heat also intensifies the photochemical reactions that produce smog, ground level ozone, and fine particulates (PM2.5), which contribute to and exacerbate respiratory disease in children and adults. Increased heat and carbon dioxide increase plant pollen production, which is associated with allergies.

Health Impacts of Drought: Lack of moisture increases the risk of wildfires, which reduce water quality and increase the risk of landslides or mudslides. Health risks include fire-related injuries, local and regional transport of smoke, ash, and fine particles increases respiratory and cardiovascular risks. Increasing temperatures and changes in precipitation may lead to intensified drought conditions, which decreases the availability and quality of water for humans. Drought may increase exposure to health hazards including wildfires, dust storms, extreme heat events, flash flooding, degraded water quality, and reduced water quantity. Dust storms associated with drought conditions have been associated with increased incidents of Valley fever, a fungal pathogen.

Vector-borne Illnesses: Climatic changes alter the range, biogeography, and growth of microbes and the vectors of food, water, and vector-borne illnesses, including the changes in aquatic environments that could increase harmful algal blooms and lead to increases in foodborne and waterborne illnesses.

Food Insecurity: Climate change is expected to have global impacts on food production and distribution systems. This can cause food prices to increase, which makes food less affordable and increases food insecurity, obesity, and malnutrition in economically constrained households.

Sea Level Rise, Mold, and Indoor Air Quality: Through sea level rise, salt water may intrude into coastal aquifers thus reducing quality and quantity of water supply. Coastal erosion can contribute to the loss of recreational venues and pose a variety of hazards to infrastructure and public safety. Water intrusion into buildings can result in mold contamination leading to indoor air quality problems.

Socioeconomic Disruption: Widespread social and economic disruption includes damage associated with climate-related events to health care infrastructure, including health care facilities, water treatment plants, and roads. Increased burden of disease and injury will test the surge capacity of health care facilities. Economic disruption can lead to income loss, income insecurity, food insecurity, housing insecurity, and mental health problems, which in turn may increase substance abuse, suicide, and other health problems. Energy production and distribution is also threatened by heat and wildfires through loss of efficiency, generating capacity, and fires disrupting transmission lines. California's ports that provide the gateway to goods for California, national, and international markets are at risk from sea level rise and coastal storms.

BIOLOGICAL RESOURCES

The Tiburon Peninsula provides ample bird habitat, fishing, and other open water habitats. Small marshes also support wetland species. Projected climate changes are likely to result in a number of interrelated and cascading ecosystem impacts. At present, most projected impacts are primarily associated with increased air and water temperatures, sea level rise, changes

in upwelling, ocean acidification, and changes in nutrient loading[11]. Warmer temperatures can compromise the health and resilience of aquatic and terrestrial species and make it more challenging for them to compete with nonnative species for survival. Competition for habitat and food will intensify with climate change. Further, changes in seasonal runoff patterns may place additional stress on native species by affecting, for example, adult and juvenile migrations.

The Tiburon Peninsula habitats are very narrow and may already be drowned out at existing high tides. As sea level rises, these habitats could become dominated by standing water. Eelgrass is also a critical tidal habitat, typically in slightly deeper, saltier waters, associated with rocky ground. Eelgrass has been observed off Tiburon Point off the high bluff extending into the San Francisco Bay (Marin County Department of Public Works, June 2017). Eelgrass beds are recognized by both federal and state agencies as sensitive and highly valuable habitat for a suite of species. Thus, eelgrass beds are listed as a Habitat Area of Particular Concern because they are susceptible to degradation, especially ecologically important, and/or located in an environmentally stressed area. As mean low tide rises closer to the bluff edge, these essential plants would be stressed by inadequate sunlight threatening the ecological setting. Additionally, sea level rises also could impact a number of wildlife species. For example, seal pups cannot swim nor climb on rocks and thus depend on sandy shores for survival, which could also be reduced as a result of sea level rise[12]. Additionally, the San Pablo Song sparrow is unique to the Tiburon area and lives in potentially vulnerable habitat that would be reduced by sea level rise.

Ocean acidification is described as the ongoing decrease in the pH of the Earth's oceans caused by the uptake of carbon dioxide from the atmosphere. As levels of atmospheric carbon dioxide increase from human activity such as burning fossil fuels (e.g., car emissions) and changing land use (e.g., deforestation), the amount of carbon dioxide absorbed by the ocean also increases. When carbon dioxide is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions and a decrease in the pH of the Earth's oceans[13]. Ocean acidification is already impacting many ocean species, especially organisms like oysters and corals that make hard shells and skeletons by combining calcium and carbonate from seawater. For this reason, ocean acidification threatens the oysters farmed near Marin's coast, which could result in impacts to the sustainability of the commercial industry.

AGRICULTURE

Increased GHG emissions are expected to cause widespread changes to the agriculture industry reducing the quantity and quality of agricultural products statewide. Although higher carbon dioxide levels can stimulate plant production and increase plant water-use efficiency, California's farmers will face greater water demand for crops and a less reliable water supply as temperatures rise.

Plant growth tends to be slow at low temperatures, increasing with rising temperatures up to a threshold. However, faster growth can result in less-than-optimal development for many crops, so rising temperatures are likely to worsen the quantity and quality of yield for a number of California's agricultural products. Products likely to be most affected include wine grapes, fruits and nuts, and milk.

[11] Marin County. July 2015. *Marin County Climate Action Plan (2015 Update)* pg. 8-5.
[12] Marin County. July 2015. *Marin County Climate Action Plan (2015 Update)* pg. 8-5
[13] National Oceanic and Atmospheric Administration. April 2020. *Ocean Acidification.* Available at: https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-acidification

Crop growth and development will be affected, as will the intensity and frequency of pest and disease outbreaks. Rising temperatures will likely aggravate ozone pollution, which makes plants more susceptible to disease and pests and interferes with plant growth.

In addition, continued climate change will likely shift the ranges of existing invasive plants and weeds and alter competition patterns with native plants. Range expansion is expected in many species while range contractions are less likely in rapidly evolving species with significant populations already established. Should range contractions occur, it is likely that new or different weed species will fill the emerging gaps. Continued global warming is also likely to alter the abundance and types of many pests, lengthen pests' breeding season, and increase pathogen growth rates.

ENERGY CONSUMPTION

Energy is California is consumed from a wide variety of sources. Fossil fuels (including gasoline and diesel fuel, natural gas, and energy used to generate electricity) are the most widely used form of energy in the State. However, renewable sources of energy (such as solar and wind) are growing in proportion to California's overall energy mix. A large driver of renewable sources of energy in California is the State's current Renewable Portfolio Standard (RPS), which requires the State to derive at least 44% of electricity generated from renewable resources by December 31, 2024, 50% by December 31, 2026, 52% by December 31, 2027, 60% by December 31, 2030, and 100% by December 31, 2045.

Overall, in 2015, California's per capita energy usage was ranked 49th in the nation (U.S. EIA, 2019), lower than any other state except Hawaii. Additionally, California's per capita rate of energy usage has remained relatively constant since the 1970's. Many State regulations since the 1970's, including new building energy efficiency standards, vehicle fleet efficiency measures, as well as growing public awareness, have helped to keep per capita energy usage in the State in check.

The consumption of nonrenewable energy (primarily gasoline and diesel fuel) associated with the operation of passenger, public transit, and commercial vehicles results in GHG emissions that ultimately result in global climate change. Other fuels such as natural gas, ethanol, and electricity (unless derived from solar, wind, nuclear, or other energy sources that do not produce carbon emissions) also result in GHG emissions and contribute to global climate change.

Electricity Consumption

California relies on a regional power system composed of a diverse mix of natural gas, renewable, hydroelectric, and nuclear generation resources. Approximately 71% of the electrical power needed to meet California's demand is produced in the state. Approximately 29% of its electricity demand is imported from the Pacific Northwest and the Southwest (California Energy Commission, 2019). In 2010, California's in-state generated electricity was derived from natural gas (53.4%), large hydroelectric resources (14.6%), coal (1.7%), nuclear sources (15.7%), and renewable resources that include geothermal, biomass, small hydroelectric resources, wind, and solar (14.6%) (California Energy Commission, 2019). The percentage of renewable resources as a proportion of California's overall energy portfolio is increasing over time, as directed the State's Renewable Portfolio Standard (RPS).

According to the California Energy Commission (CEC), total statewide electricity consumption increased from 166,979 gigawatt-hours (GWh) in 1980 to 279,402 GWh in 2019. Marin County consumed approximately 1,335 GWh of electricity in 2019 (California Energy Commission, 2020).

Higher temperatures will increase annual electricity demand for homes, driven mainly by increased use of air conditioning. High demand is projected in inland regions, and more moderate increases are projected in cooler coastal areas. However, in California, the increased annual residential energy demand for electricity is expected to be offset by reduced use of natural

gas for space heating. Increases in peak hourly demand during the hot months of the year could be more pronounced than changes in annual demand. This is a critical finding for California's electric system, because generating capacity must match peak electricity demand.

Oil

The primary energy source for the United States is oil, which is refined to produce fuels like gasoline, diesel, and jet fuel. Oil is a finite, nonrenewable energy source. World consumption of petroleum products has grown steadily in the last several decades. As of 2009, world consumption of oil had reached 96 million barrels per day. The United States, with approximately 5% of the world's population, accounts for approximately 19% of world oil consumption, or approximately 18.6 million barrels per day (Central Intelligence Agency, 2009). The transportation sector relies heavily on oil. In California, petroleum-based fuels currently provide approximately 96% of the state's transportation energy needs (California Energy Commission, 2018).

Natural Gas/Propane

Natural gas supplies are derived from underground sources and brought to the surface at gas wells. Once it is extracted, gas is purified and the odorant that allows gas leaks to be detected is added to the normally odorless gas. Natural gas suppliers, such as PG&E, then send the gas into transmission pipelines, which are usually buried underground. Compressors propel the gas through the pipeline system, which delivers it to homes and businesses.

The state produces approximately 12% of its natural gas, while obtaining 22% from Canada and 65% from the Rockies and the Southwest (California Energy Commission, 2019). Total statewide demand of natural gas has decreased from approximately13,712 million cubic feet of natural gas in 2000 to 13,158 million cubic feet of natural gas in 2019. Consistent with the statewide trend, demand of natural gas in Marin County has also decreased with the County consuming approximately 92 million therms of natural gas in 2000 and 70 million therms of natural gas (California Energy Commission, 2020).

Cooling Degree and Heating Degree Days

Cooling Degree and Heating Degree Days are often used by utilities and other energy sector planners to understand energy demand for cooling and heating. A Cooling Degree Day (CDD) is defined as the number of degrees by which a daily average temperature exceeds a reference temperature, which is typically 65 degrees Fahrenheit. Conversely, a Heating Degree Day (HDD) is defined as the number of degrees by which a daily average temperature is below a reference temperature. As California's climate changes, historical observed climate is becoming an increasingly poor proxy for future energy demand for cooling and heating. For example, an increase in the number and magnitude of hot days is expected to increase demand for air conditioning.

The Cal-Adapt tool identifies the projected changes in CDDs and HDDs in Tiburon. During the historical period from 1961 through 1990, the average number of CDDs in Tiburon was 160 days, whereas during the forecasted period from 2070 to 2099, the average number of CDDs in Tiburon is projected to increase to between 597 to 1,116 days (dependent on the RCP scenario selected). Separately, the average number of HDDs in Tiburon during the historical period from 1961 to 1990 was 2,826 days, whereas the average number of HDDS during the forecasted period from 2070 to 2099 is projected to decrease to between 1,206 to 1,729 days (dependent on the RCP scenario selected). Table 5 identifies the projected average number of CDDs and HDDs in Tiburon under the RCP 4.5 and RCP 8.5 scenarios for the Tiburon area.

TABLE 5: AVERAGE COOLING AND HEATING DEGREE DAYS FOR THE TIBURON AREA (HISTORICAL AND PROJECTED)

	HISTORICAL (OBSERVED): 1961-1990	RCP 4.5 PROJECTED: 2070-2099	RCP 8.5 PROJECTED: 2070-2099
BASE TEMPERATURE 65°F			
Average Cooling Degree Days	160	597	1,116
Average Heating Degree Days	2,826	1,729	1,206

SOURCE: CAL-ADAPT, 2020 (HTTPS://CAL-ADAPT.ORG/TOOLS/DEGREE-DAYS/)

INFRASTRUCTURE

California's Fourth Climate Change Assessment provides in-depth analyses that support proactive steps to protect California's energy, transportation, and water infrastructure systems and the communities they serve. These systems face increasing risks from climate change as temperatures warm, sea levels rise, and other climate impacts worsen. These systems are interconnected, and disruption in one part can impact other connected parts with both direct and indirect economic effects.

Energy resources can be considered from both supply and demand perspectives. Fourth Assessment studies found infrastructure that supplies energy along the coast – particularly docks, terminals, and refineries – will increasingly be exposed to coastal flooding. Meanwhile, electrical power lines, rails, and roads are primarily at risk from increasing wildfire. Costs and impacts of wildfire to electricity transmission and distribution systems are expected to grow as climate change impacts increase.

California's roads, railroads, pipelines, waterways, ports, and airports are critical for the movement of people and goods. They will be significantly affected by climate change. A growing threat to California's transportation system is wildfire, which can also have cascading effects like landslides and mudslides that occur after rain falls on newly burned areas. Rising temperatures are also expected to increase road construction costs between 3 and 9%. Adapting roadway materials to withstand higher temperatures is needed to avoid potential costs of over $1 billion by 2070. Additionally, one-hundred fifteen miles of railroad could be at risk of coastal flooding by 2040, with an additional 285 miles at risk by 2100.

Infrastructure located along low-lying areas within Tiburon are at the greatest risk of coastal flooding within the Planning Area. As shown in Figures 4a and 4b and 5, due to sea level rise over time, low-lying roadways are at particular risk during flooding events. According to the *Marin Shoreline Sea Level Rise Vulnerability Assessment*, approximately 2.5 miles of roadway could be impacted from the long-term projection impacts of sea level rise under a 100-year storm surge (i.e., Scenario 6). Table 6 on the following page identifies Tiburon transportation routes by when they are estimated to be exposed to salt water at MHHW, as shown in Figures 5a through 5c.

TABLE 6: TIBURON VULNERABLE TRANSPORTATION ASSETS

NEAR-TERM		MEDIUM-TERM		LONG-TERM	
SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4	SCENARIO 5	SCENARIO 6
None	Brunini Way [L]	None	Road from Scenario 2	Road from Scenario 2 and 4 Beach Road [L] Blackfield Drive [L] Blackies' Pasture Road [L] Cecilia Way [L] Claire Way [L] Harriet Way [L] Juanita Lane [L] Lagoon Vista [P] Leland Way [L] Main Street [L] Mar West Street [L] Marsh Road [P] Pamela Court [L] Paradise Drive [L,M]	Roads in Scenarios 2, 4, & 5 Tiburon Boulevard [C] Jefferson Drive [L] Washington Court [L]
0.0 miles impacted	0.01 miles impacted	0.0 miles impacted	0.01 miles impacted	1.5 miles impacted	2.5 miles impacted

M = MARIN COUNTY; C = STATE OF CALIFORNIA; L = LOCAL MUNICIPALITY; P = PRIVATE
SOURCE: MARIN COUNTY DEPARTMENT OF PUBLIC WORKS, JUNE 2017.

Roads could erode and deteriorate faster if they are repeatedly exposed to salt water. Vehicles can also be destroyed by salt water exposure. Temporary closures to the road and bicycle network could have significant impacts on commuting to and from the peninsula to US Highway 101, completing daily routines, recreational opportunities, and emergency vehicle access. If public transportation gets cut off because roads are inundated, people who travel through or to the area for work would be cut off. Similarly, people with mobility or health constraints will be affected.

Tiburon also features a robust boating center with the Corinthian Yacht Club, the Blue and Gold commuter ferry to San Francisco, and the Angel Island Ferry. These sites can typically adjust to higher tides, though they made need to be elevated. If the adjacent land severely floods, access to these water transportation features may not be available. This could significantly impact commuting to San Francisco via ferry, and travel to Angel Island. In addition, several private docks could be vulnerable in their current elevations. These facilities are anticipated to tolerate higher tides; however, storms are known to damage piers, docs, and other marina structures.

Refineries, pipelines, electrical power distribution (substations) and generation facilities are energy sector assets are also vulnerable to sea level rise. Tiburon will likely face utility issues common in other shoreline communities in the study area, including:

- Underground pipes face compounding pressure forces from water and the road;
- Road erosion and collapse with underlain pipes;
- Saltwater inflow and infiltration causing inefficiencies in wastewater treatment;

- Continuously subsiding soils or fill, and escalating activity, capacity demands, energy consumption, and wear and tear on pump stations in stormwater and wastewater systems;
- Aging individual site connections for water, sewer, and electrical; and
- Flood water interrupting access for employees to reach work sites[14].

Sanitary District No. 5 of Marin County provides collection and treatment of wastewater to parts of the Tiburon Peninsula and the City of Belvedere. The District serves over 3,500 households and has been servicing the area since the early 1940s[15]. The smaller of two treatment plants in Sanitary District No. 5, the Paradise Cove Plant, would be impacted at scenario 6, 5 feet of sea level rise, plus 100-year storm surge. The main issues are worsening erosion and flooding at this site, saltwater intrusion for sewer lines along Tiburon Boulevard that run along the beach, a manhole at Beach Road and Tiburon Boulevard that already floods, and pump station electrical panels. The primary treatment facility off Tiburon Boulevard could anticipate some flooding during storm surges in the parking lot. This flooding may also create access issues for employees and cause wear and tear on facility vehicles and equipment (Marin County Department of Public Works, June 2017).

Existing Greenhouse Gas Emissions in Tiburon

Community and Municipal Operations GHG Emissions Inventories

The Town of Tiburon, in collaboration with Marin Climate and Energy Partnership, had previously developed community and municipal operations greenhouse gas inventories for baseline year 2005. In 2018, the Town of Tiburon, in collaboration with Marin Climate and Energy Partnership, developed the *Greenhouse Gas Inventory for 2016 Community Emissions and 2015 Municipal Operations*. Additionally, in April 2020, the Marin Climate and Energy Partnership updated the community emissions greenhouse gas inventory to analyze 2018. These inventories provide a comparison to baseline 2005 emissions and identifies the sectors where significant reductions in greenhouse gas emissions have occurred. In some instances, previous year emissions were updated with new data and/or recalculated to ensure the same methodology was employed for all inventory years. The following sections will compare the community and municipal operations greenhouse gas inventories for baseline year 2005 to the 2018 community emissions greenhouse gas inventory and the 2015 municipal operational greenhouse gas inventory.

Tiburon Community GHG Emissions

Tiburon publishes annual community greenhouse gas (GHG) emissions estimates through the Marin Climate & Energy Partnership (MCEP). Annual inventories help the Town to more closely monitor its progress in meeting its local goal to reduce community emissions 15% below baseline (2005) emissions by 2020 and to meet the statewide goal to reduce emissions 40% below 1990 levels by 2030. The community greenhouse gas inventory tracks emissions in the following seven sectors that occurred within the Tiburon town limits:

- The **Residential** sector represents emissions generated from the use of electricity, natural gas, and propane in Tiburon homes.
- The **Non-Residential** sector represents emissions generated from the use of electricity and natural gas in commercial, industrial and governmental buildings and facilities.
- The **Transportation** sector includes tailpipe emissions from passenger vehicle trips originating and ending in Tiburon, as well as a share of tailpipe emissions generated by medium and heavy-duty vehicles and buses travelling

[14] Marin County Department of Public Works. June 2017. *Marin Shoreline Sea Level Rise Vulnerability Assessment*. Pg. 218
[15] Sanitary District No. 5 of Marin County website. Accessed on December 2020. Available at: https://www.sani5.org/about

on Marin County roads. The sector also includes emissions from Marin Transit and Golden Gate Transit buses a as these vehicles travel within Tiburon's boundaries. Electricity used to power electric vehicles is embedded in electricity consumption reported in the Residential and Non-Residential sectors.

- The **Waste** sector represents fugitive methane emissions that are generated over time as organic material decomposes in the landfill. Although most methane is captured or flared off at the landfill, approximately 25% escapes into the atmosphere.
- The **Off-Road** sector represents emissions from the combustion of gasoline and diesel fuel from the operation of off-road vehicles and equipment used for construction and landscape maintenance.
- The **Water** sector represents emissions from energy used to pump, treat and convey potable water from the water source to Tiburon water users.
- The **Wastewater** sector represents stationary, process and fugitive greenhouse gases that are created during the treatment of wastewater generated by the community, as well as emissions created from electricity used to convey and treat wastewater.

Table 7 compares the 2005 baseline community-wide greenhouse gas inventory, as updated, to the 2018 update. The inventory utilizes data from the Town of Tiburon, Marin Municipal Water District, Sewerage Agency of Southern Marin (SASM), and Sanitary District No. 5 for wastewater and water usage; PG&E and MCE for energy usage; MTC, Marin Transit, Golden Gate Transit, and the California Air Resources Board (CARB) for on-road transportation and off-road vehicles and equipment, and CalRecycle and Marin County Solid and Hazardous Waste JPA for solid waste[16]. Data analysis methodology for the inventory follows the standards of the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, published by ICLEI USA.

TABLE 7: TIBURON COMMUNITY GHG EMISSIONS BY SECTOR – 2005 AND 2018

SECTOR	2005		2018		% CHANGE FROM 2005
	EMISSIONS (MT CO_2E/YEAR)	PERCENT OF TOTAL EMISSIONS	EMISSIONS (MT CO_2E/YEAR)	PERCENT OF TOTAL EMISSIONS	
Residential	22,444	37.3%	14,982	33.5%	-33%
Non-Residential	5,382	9.0%	2,824	6.3%	-48%
Transportation	27,938	46.5%	23,439	52.5%	-16%
Waste	2,945	4.9%	2,642	5.9%	-10%
Off-Road	776	1.3%	554	1.2%	-29%
Water	376	0.6%	10	<0.1%	-97%
Wastewater	240	0.4%	224	0.5%	-7%
Total	**60,101**	**100%**	**44,676**	**100%**	**-26%**

MT CO_2E/YEAR = METRIC TONS OF CARBON DIOXIDE EQUIVALENTS PER YEAR

SOURCE: TOWN OF TIBURON GREENHOUSE GAS INVENTORY FOR COMMUNITY EMISSIONS FOR THE YEAR 2018, APRIL 2020.

In 2005, the transportation sector resulted in the largest share of greenhouse gas emissions, accounting for 46.5% of total emissions. The second largest share of greenhouse gas emissions in 2005 was the residential sector, accounting for approximately 37.3% of emissions, followed by the non-residential sector, accounting for approximately 9.0% of emissions.

[16] Marin Climate and Energy Partnership. April 2020. *Town of Tiburon Greenhouse Gas Inventory for Community Emissions for the Year 2018* [Appendix A: Community Emissions Data Sources and Calculation Methodologies pg. A-4 to A-6]

The remaining emissions were the waste sector (approximately 4.9% of emissions), the off-road sector (approximately 1.3% of emissions), the water sector (approximately 0.6% of emissions), and the wastewater sector (approximately 0.4%).

In 2018, the transportation sector also resulted in the largest share of greenhouse gas emissions, accounting for 52.5% of total emissions. Consistent with the 2005 greenhouse gas emission inventory, the second largest share of greenhouse gas emissions in 2018 was also the residential sector, accounting for approximately 33.5% of emissions, followed by the non-residential sector, accounting for approximately 6.3% emissions. The remaining emissions were the waste sector (approximately 5.9% of emissions), the off-road sector (approximately 1.2% of emissions), the wastewater sector (approximately 0.5%), and the water sector (approximately <0.1% of emissions).

Overall, the baseline community-wide greenhouse gas inventory totaled 60,101 MT of CO_2e in 2005 while the 2018 community-wide greenhouse gas inventory saw a total reduction of 15,425 MT of CO_2e for a total of 44,676 MT of CO_2e. As shown in Table 7, The greatest reductions have occurred in the Residential sector (7,462 MTCO2e), followed by the Transportation sector (4,499 MTCO2e) and the Non-Residential sector (2,558 MTCO2e). While the Tiburon community has reduced emissions 26% since 2005 and met its 2020 goal, Tiburon needs to reduce emissions another 14,025 MTCO2e to meet the State target for 2030 and another 34,460 MTCO2e to meet the State target for 2050, which is 80% below 1990 levels

Tiburon Municipal Operations GHG Emissions

The Town of Tiburon is a general law city and operates under the council-city manager form of government. The local government operates administrative, planning, building, public works, and police departments. In 2015, there were 38 full-time employees and 5 part-time employees.

Data analysis methodology follows the Local Government Operations Protocol V 1.1 (LGOP) published by the CARB, California Climate Action Registry, The Climate Registry, and ICLEI USA. The LGOP categorizes municipal sectors by the following sub-sectors for local government operations: 1) buildings and other facilities, 2) streetlights and traffic signals, 3) water delivery facilities, 4) port facilities, 5) airport facilities, 6) vehicle fleet, 7) transit fleet, 8) power generation facilities, 9) solid waste facilities, 10) wastewater facilities, and 11) all processes and fugitive emissions. Local government operations are discussed only in terms of sectors and sub-sectors the City has operational control over. The Town of Tiburon does not have operational control of an airport, port, power generation facility, or wastewater facility. Therefore, the municipal operations greenhouse gas emissions inventory analyzed the following sectors:

- Building and other facilities;
- Public lighting;
- Water delivery facilities;
- Vehicle fleet'
- Solid waste; and
- Employee commute.

Table 8 compares the 2005 baseline municipal operations greenhouse gas inventory to the 2016 greenhouse gas inventory update. In 2005, Tiburon's government operations produced approximately 513 metric tons CO2e. In 2015, those activities resulted in approximately 331 metric tons CO2e, a reduction of 182 metric tons, or 35%. The local government's share of community emissions is 0.7%

TABLE 8: TIBURON MUNICIPAL OPERATIONS GHG EMISSIONS BY SECTOR – 2005 AND 2015

SECTOR	2005		2015		% CHANGE FROM 2005
	EMISSIONS (MT CO_2E/YEAR)	PERCENT OF TOTAL EMISSIONS	EMISSIONS (MT CO_2E/YEAR)	PERCENT OF TOTAL EMISSIONS	
Building and Facilities	78	15.2%	51	15.4%	-35%
Public Lighting	27	5.3%	19	5.7%	-29%
Water Delivery	0.1	0.0%	0.0	0.0%	-46%
Vehicle Fleet	127	24.8%	119	36.0%	-7%
Solid Waste	111	21.6%	41	12.4%	-63%
Employee Commute	170	33.1%	101	30.5%	-41%
Total	**513**	**100%**	**331**	**100%**	**-35%**

MT CO_2E/YEAR = METRIC TONS OF CARBON DIOXIDE EQUIVALENTS PER YEAR

SOURCE: TOWN OF TIBURON GREENHOUSE GAS INVENTORY FOR COMMUNITY EMISSIONS (2016) AND GOVERNMENT OPERATIONS EMISSIONS (2015), DECEMBER 2018.

As shown in Table 8, the vehicle fleet sector was the largest emitter of greenhouse gas emissions in 2015 (36% of total emissions), followed by the employee commute sector (31%) and buildings and facilities sector (15%). Additionally, when compared to the 2005 emissions, the 2015 greenhouse gas emissions from government operations were reduced in all sectors. The greatest reduction occurred in the waste and employee commute sectors, where emissions dropped 69 metric tons CO2e in each sector. Other significant reductions occurred in the buildings and facilities sector (27 metric tons) and the public lighting sector (8 metric tons).

Table 9 shows a summary of the Town's greenhouse gas government operational emissions by source. The greatest decreases occurred in emissions from gasoline (87 metric tons) and solid waste (69 metric tons). Despite the decrease in gasoline emissions, gasoline was the largest source of greenhouse gas emissions in Tiburon's governmental operations in 2015, contributing 60% of all emissions.

TABLE 9: TIBURON MUNICIPAL OPERATIONS GHG EMISSIONS BY SOURCE – 2005 AND 2015

SOURCE	2005		2015		% CHANGE FROM 2005
	EMISSIONS (MT CO_2E/YEAR)	PERCENT OF TOTAL EMISSIONS	EMISSIONS (MT CO_2E/YEAR)	PERCENT OF TOTAL EMISSIONS	
Electricity	90	17.6%	55	16.6%	-39%
Natural Gas	14	2.7%	15	4.5%	2%
Gasoline	283	55.2%	197	59.5%	-31%
Diesel	14	2.7%	23	6.9%	59%
Solid Waste	111	21.6%	41	12.3%	-63%
Refrigerants	1	0.2%	1	0.2%	60%
Total	**513**	**100%**	**331**	**100%**	**-35%**

MT CO_2E/YEAR = METRIC TONS OF CARBON DIOXIDE EQUIVALENTS PER YEAR

SOURCE: TOWN OF TIBURON GREENHOUSE GAS INVENTORY FOR COMMUNITY EMISSIONS (2016) AND GOVERNMENT OPERATIONS EMISSIONS (2015), DECEMBER 2018.

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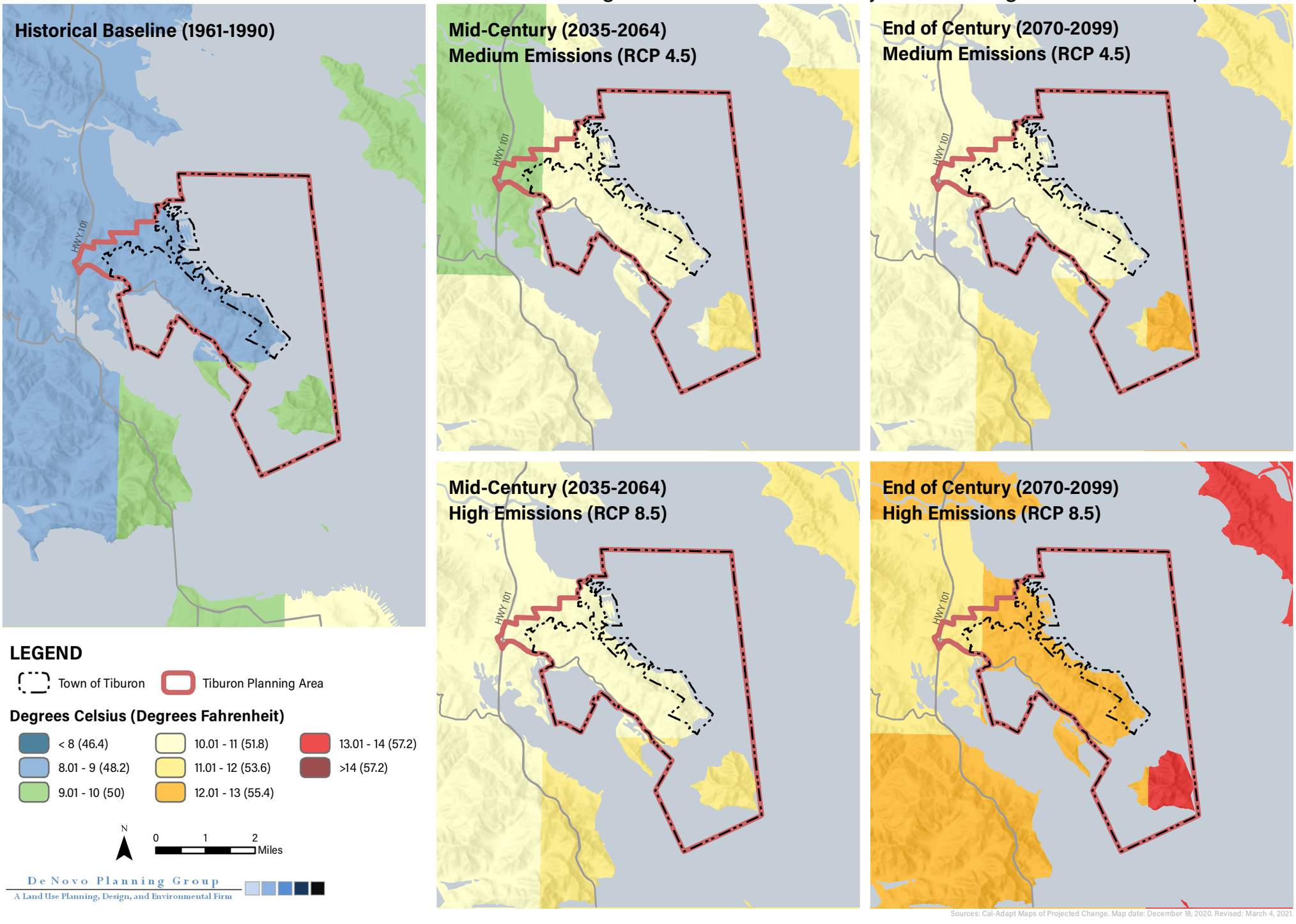
Figure 1. Historical and Projected Average Minimum Temperatures



Sources: Cal-Adapt Maps of Projected Change. Map date: December 18, 2020. Revised: March 4, 2021.

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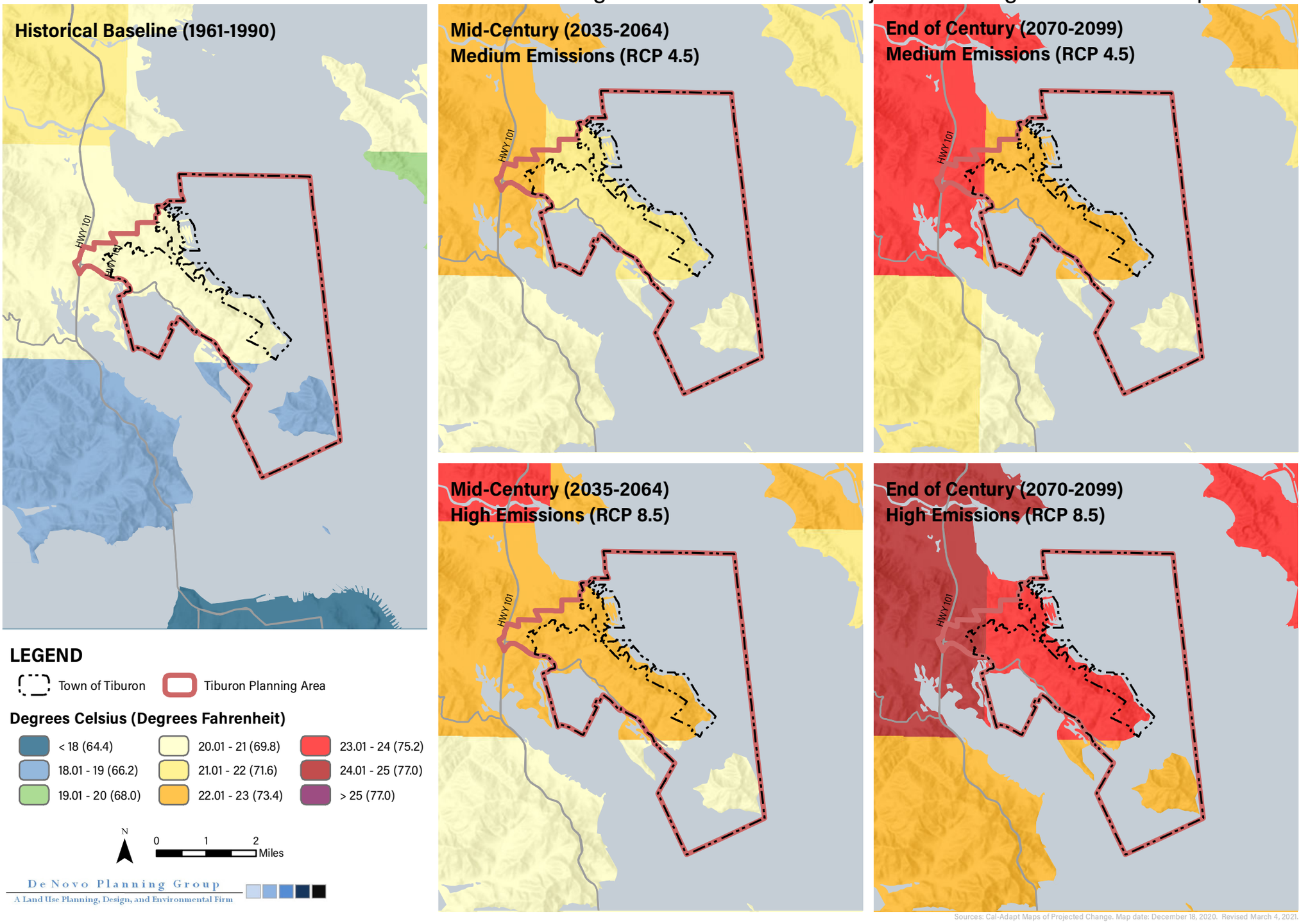
Figure 2: Historical and Projected Average Maximum Temperatures



Sources: Cal-Adapt Maps of Projected Change. Map date: December 18, 2020. Revised March 4, 2021.

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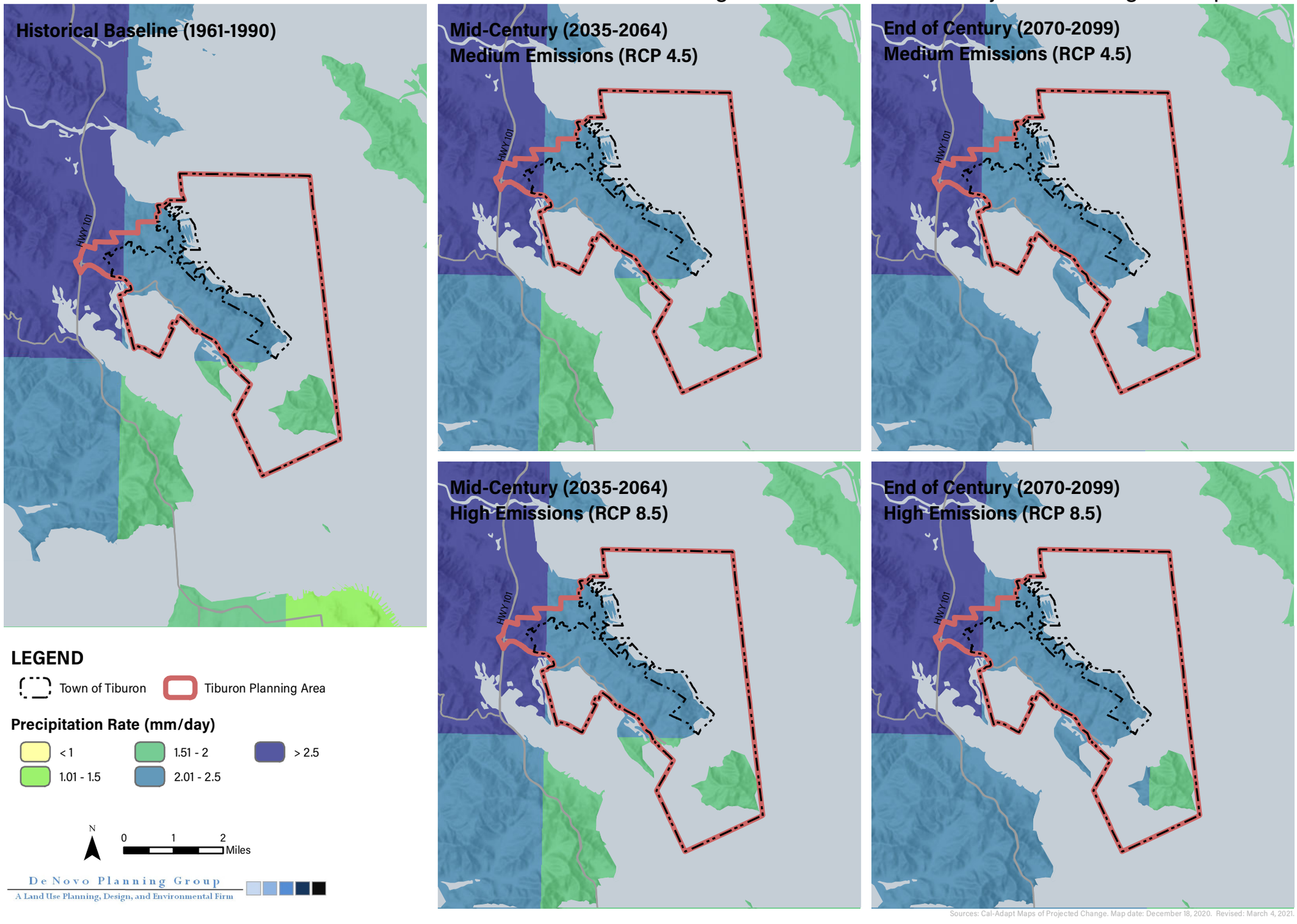
Figure 3: Historical and Projected Average Precipitation



Sources: Cal-Adapt Maps of Projected Change. Map date: December 18, 2020. Revised: March 4, 2021.

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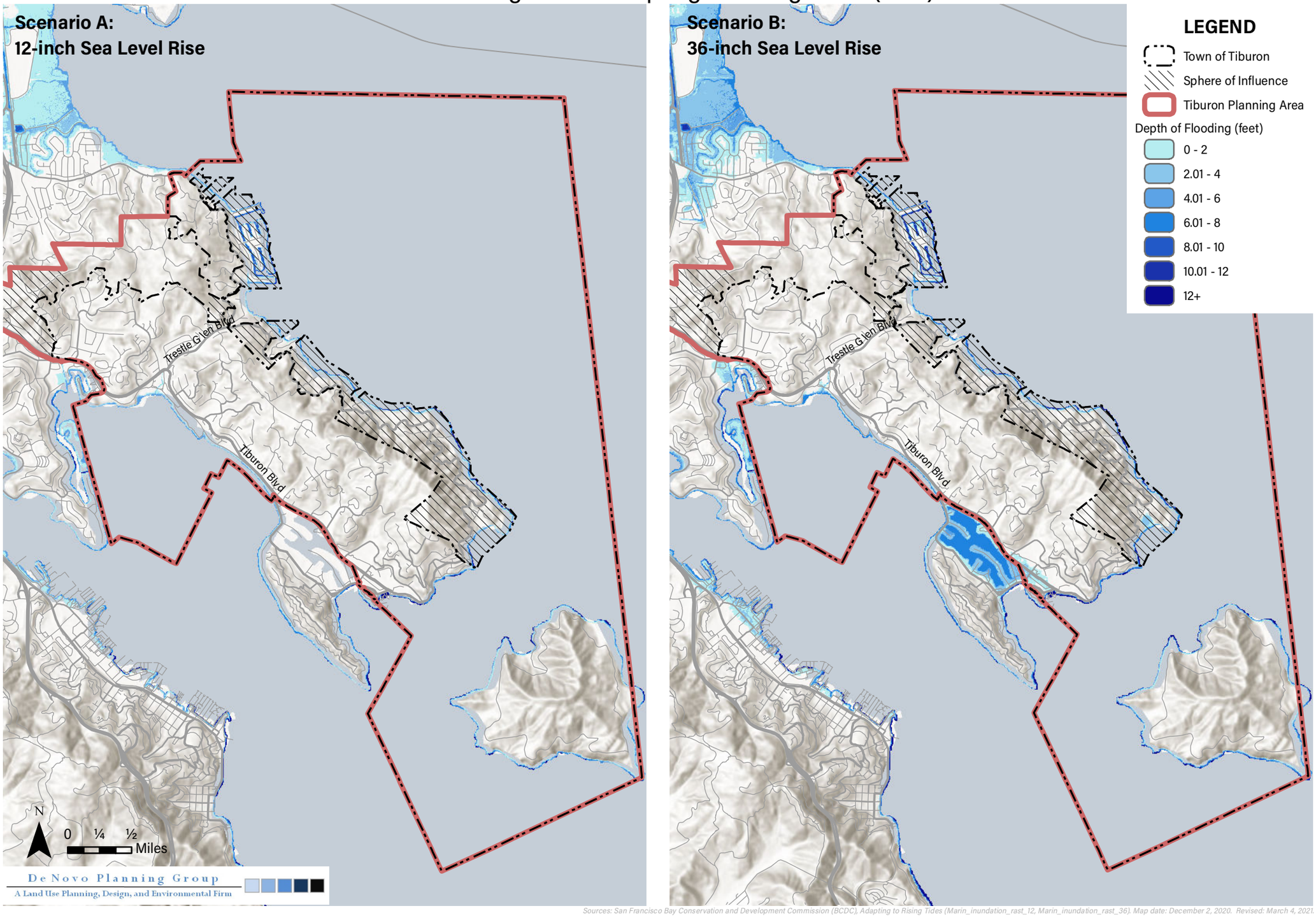
Figure 4a: Adapting to Rising Tides (ART) Sea Level Rise Scenarios A and B



Sources: San Francisco Bay Conservation and Development Commission (BCDC), Adapting to Rising Tides (Marin_inundation_rast_12, Marin_inundation_rast_36). Map date: December 2, 2020. Revised: March 4, 2021.

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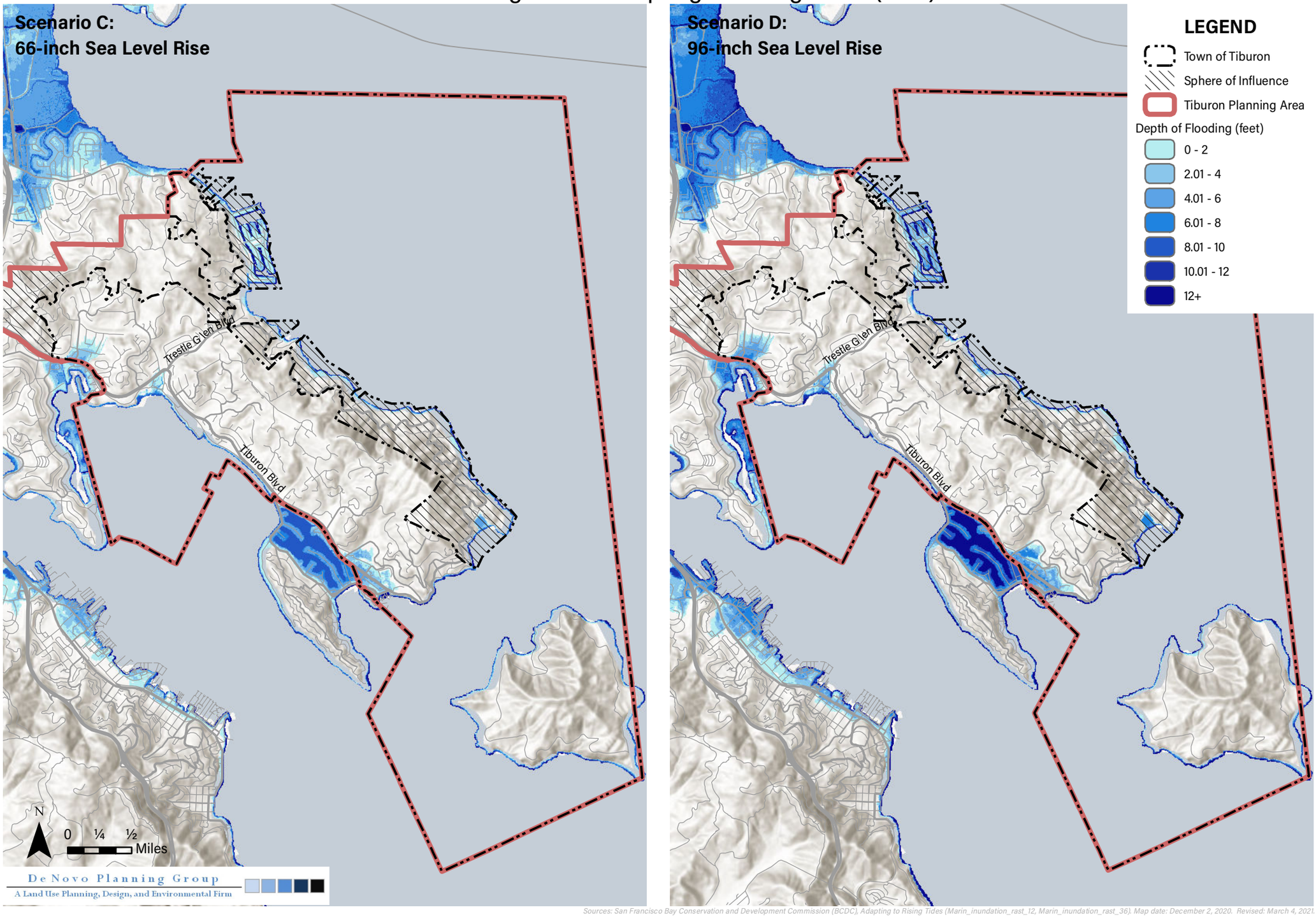
Figure 4b: Adapting to Rising Tides (ART) Sea Level Rise Scenarios C and D



Sources: San Francisco Bay Conservation and Development Commission (BCDC), Adapting to Rising Tides (Marin_inundation_rast_12, Marin_inundation_rast_36). Map date: December 2, 2020. Revised: March 4, 2021.

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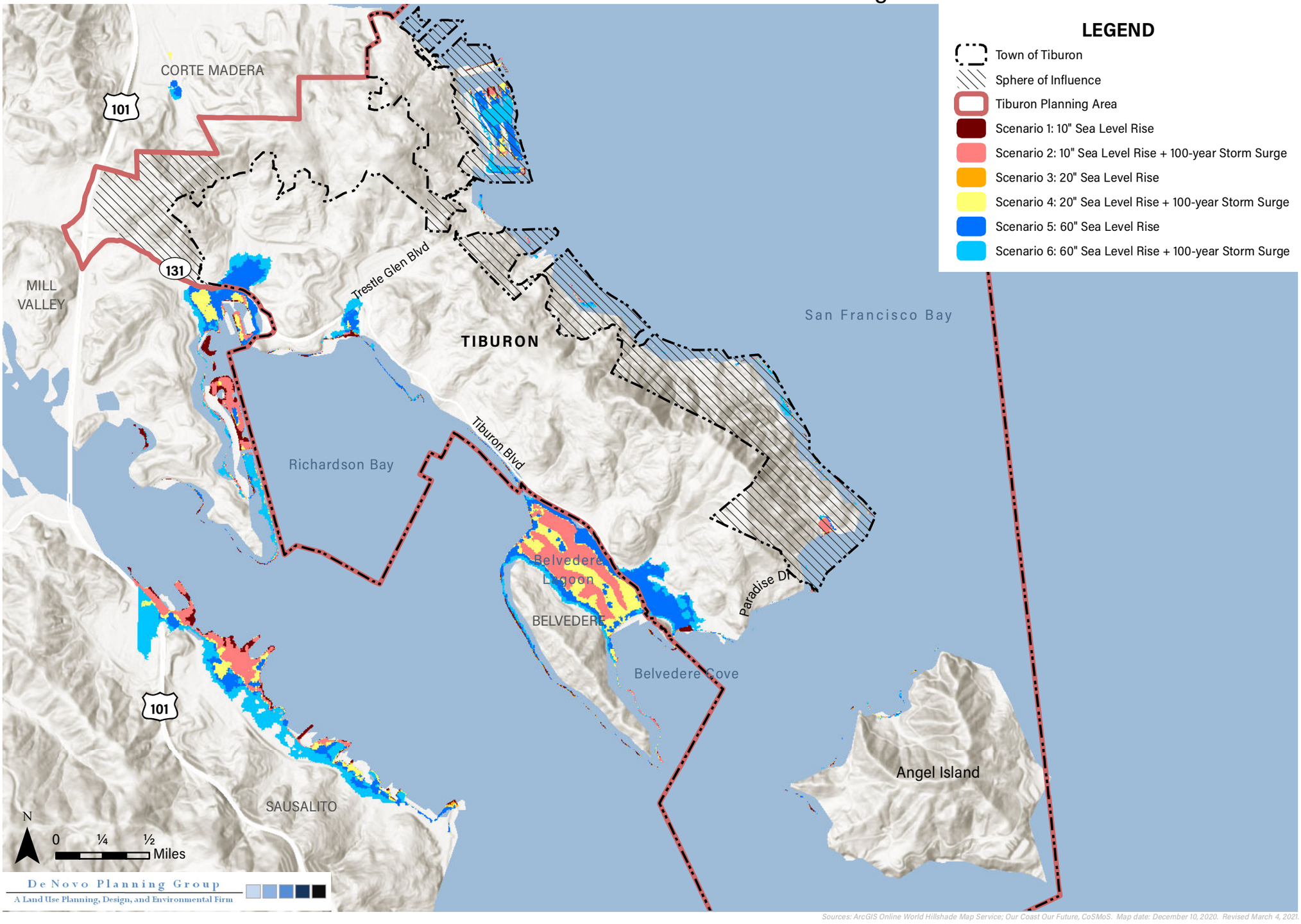
Figure 5. OCOF Sea Level Rise Scenarios



Sources: ArcGIS Online World Hillshade Map Service; Our Coast Our Future, CoSMoS. Map date: December 10, 2020. Revised March 4, 2021.

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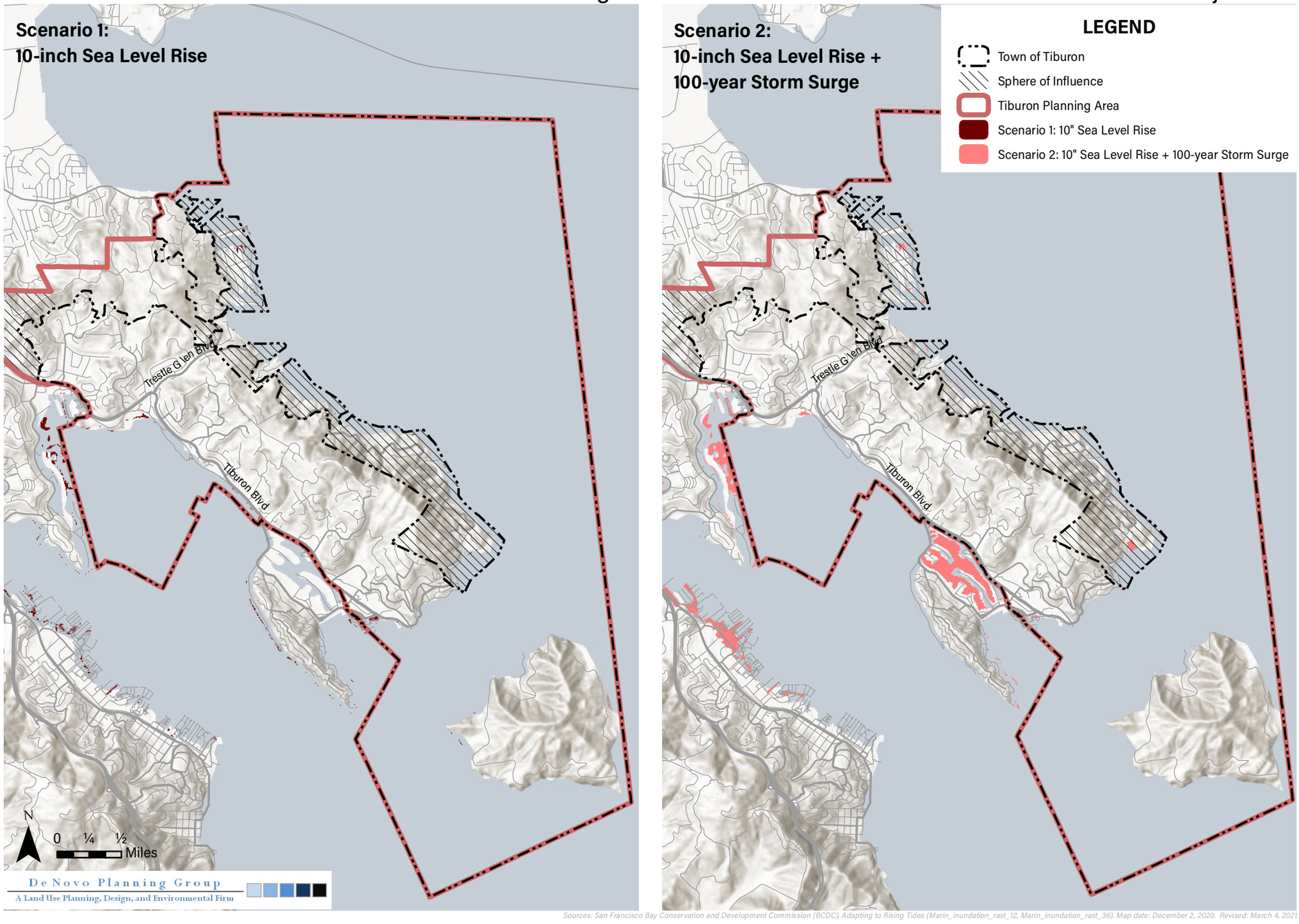
Figure 5a: OCOF Sea Level Rise Scenarios - Near-Term Projections



Sources: San Francisco Bay Conservation and Development Commission (BCDC), Adapting to Rising Tides (Marin_inundation_rast_12, Marin_inundation_rast_36). Map date: December 2, 2020. Revised: March 4, 2021

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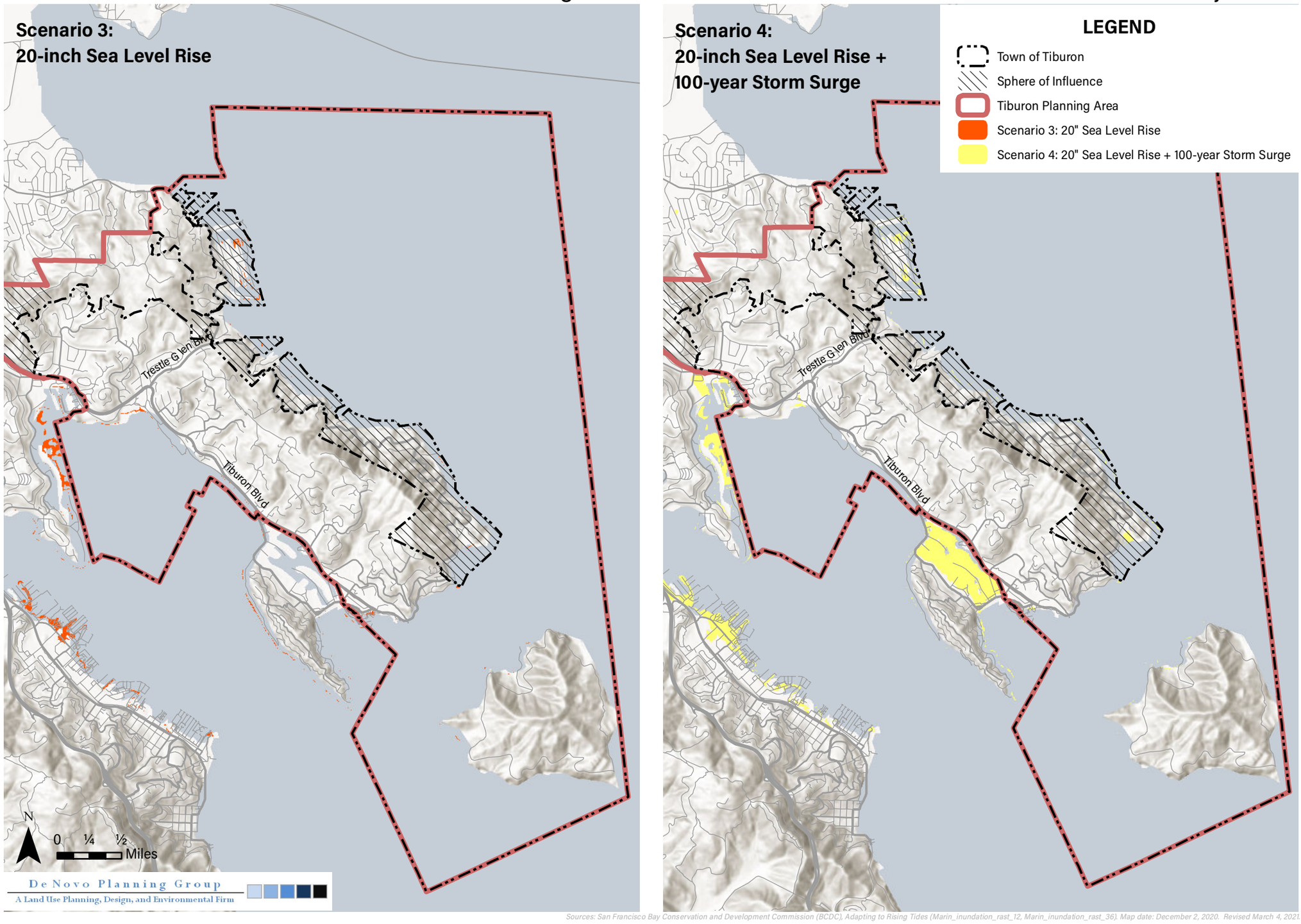
Figure 5b: OCOF Sea Level Rise Scenarios - Medium-Term Projections



Sources: San Francisco Bay Conservation and Development Commission (BCDC), Adapting to Rising Tides (Marin_inundation_rast_12, Marin_inundation_rast_36). Map date: December 2, 2020. Revised March 4, 2021

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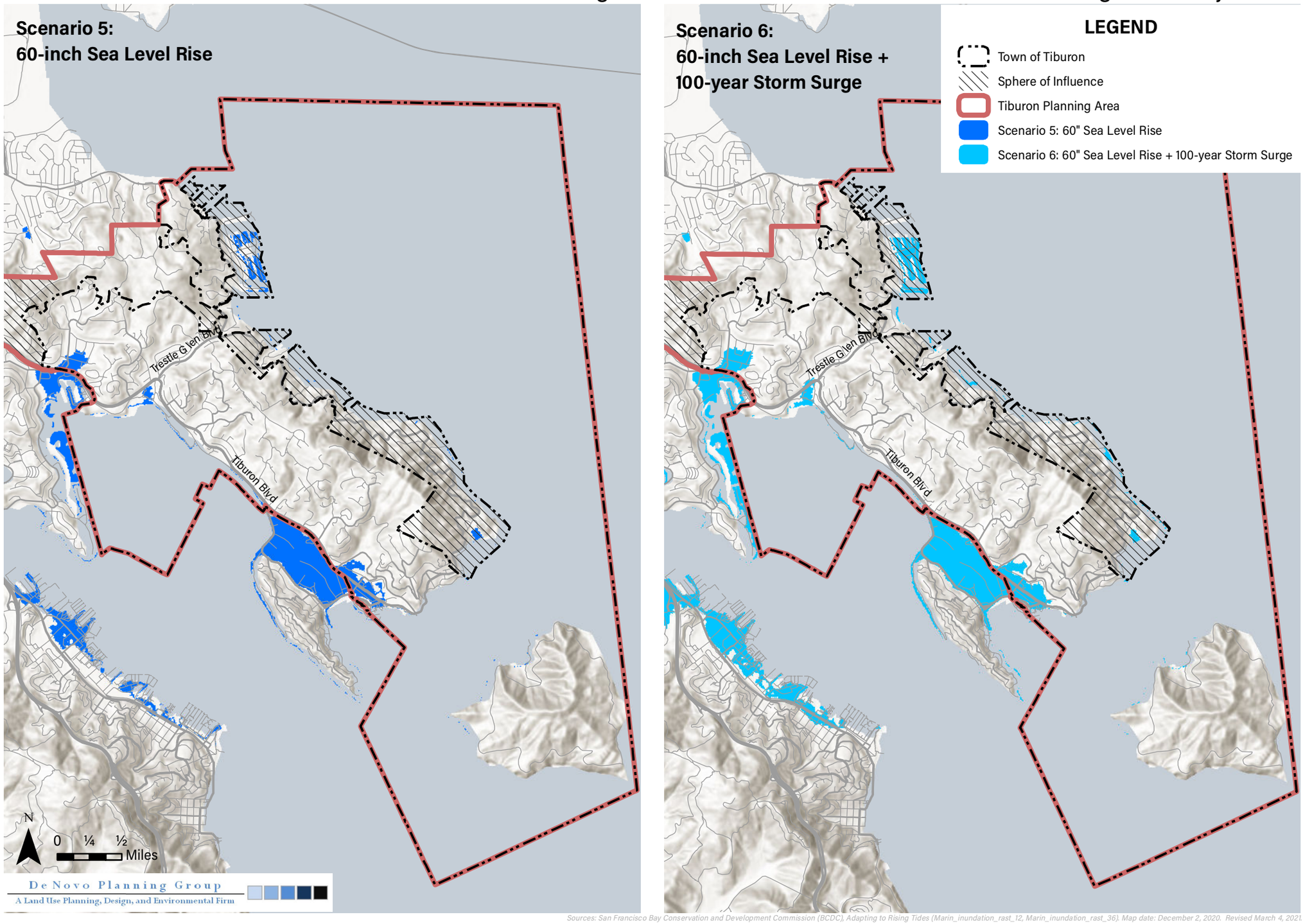
Figure 5c: OCOF Sea Level Rise Scenarios - Long-Term Projections



Sources: San Francisco Bay Conservation and Development Commission (BCDC), Adapting to Rising Tides (Marin_inundation_rast_12, Marin_inundation_rast_36). Map date: December 2, 2020. Revised March 4, 2021

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