



CHAPTER 3

Asset Inventory

June 2022

This chapter describes the assets within Alameda, including the people, economy, buildings, and infrastructure at risk in natural disasters. A detailed asset inventory is provided **Appendix D**.

The People of Alameda

In 2020, Alameda’s population was approximately 79,000 with a diverse array of businesses employing an estimated 25,000 people. Alameda’s population at 89,000 with the commissioning of the Alameda Naval Air Station (NAS) in 1940 declined rapidly following its closure in 1997; however, the City has seen slight growth (2.1 percent) since 2000. This is partly due to residential growth in the former military installations, as well as in the formerly industrial Northern Waterfront; this growth is expected to continue in the coming decade.

The Association of Bay Area Governments projects that the San Francisco Bay Area will add 2.1 million new residents by 2040.¹ Alameda’s population is projected to reach 92,000 by 2040. To meet that demand, the City of Alameda will add 10,000 to 12,000 new housing units over the next 20 years.² Alameda’s projected population increase will result largely from residential development in industrial areas and former military installations, which are susceptible to liquefaction and coastal flooding. New housing development is planned at Alameda Point and Alameda Landing, and along the Northern Waterfront with mitigations planned to account for coastal hazards. These areas are designated as priority development areas in the regional plan, Plan Bay Area. Both areas are also subject to sea level rise, liquefaction in earthquakes and tsunamis. Additional housing opportunities exist for accessory units and additional units on existing residential properties, and along the Park Street and Webster Street commercial corridors and the community’s several shopping center sites. All new infrastructure in these areas are built to modern day standards. A Master Infrastructure Plan was completed for Alameda Point in December 2014 that addresses flood protection and site grading with extensive consideration given to projected sea level rise.

Age Characteristics

Alameda’s population is becoming older over time – see Table 3-1. As with many communities in the county and across the nation, there has been an increase in the percentage of community members over the age of 55, while the percentage of children is declining and especially with the pandemic. This shift toward an older population is important in planning for future disasters, as seniors may have more difficulty preparing for disasters and may need additional assistance when a disaster occurs.

Table 3-1 Population Age Distribution, 2000–2019

Age Group	Alameda Population		
	2000	2010	2019
Under 15	18.0%	17.1%	17.4%
15 – 19	5.5%	5.7%	4.9%
20 – 34	20.4%	18.3%	20.3%
35 – 54	34.0%	31.7%	27.9%

¹ <http://projections.planbayarea.org/>

² Alameda 2040 General Plan

55 – 64	8.8%	13.8%	12.7%
65 +	13.3%	13.5%	16.9%
Total	100.0%	100.0%	100.0%

Sources: 2000 and 2010 Census, 2019 American Community Survey

Race and Ethnicity

Alameda has a diverse population and has become more diverse over the last two decades. The non-Hispanic white population declined 9 percent from 2000 to 2019. At the same time, the Asian population grew 4 percent since 2000. American Indian and Pacific Islanders decreased and the Hispanic population (of every race) grew by 2 percent.

Table 3-2 Race and Ethnicity Distribution, 2000–2019

Race and Ethnicity	Alameda Population		
	2000	2010	2019
White alone	56.9%	50.8%	48.2%
Black or African American alone	6.2%	6.4%	7.4%
American Indian or Alaska Native alone	0.7%	0.6%	0.5%
Asian alone	26.1%	31.2%	30.3%
Native Hawaiian or other Pacific Islander alone	0.6%	0.5%	0.3%
Some other race alone	3.3%	3.3%	5.1%
Two or more races	6.1%	7.1%	8.2%
<i>Total</i>	<i>100.0%</i>	<i>100.0%</i>	<i>100.0%</i>
Hispanic (of any race)	9.3%	11.0%	11.5%

Sources: 2000 and 2010 Census, 2019 American Community Survey

Household Composition

The City of Alameda had 30,418 total households.³ 9,401 households have children under 18 in the home and 8,734 households have members over 65. Alameda has an average 2.54 people per household. 34.9% of residents over 5 years old speak a language other than English at home. 5.9% of Alameda residents under 65 are living with a disability. These residents may have additional challenges responding to a disaster.

Income and Employment

Alameda's per capita income is \$52,448 and 66.9% of residents over 16 years old are in the labor force.⁴ According to the ACS, the median household income in 2019 was \$109,545, which is significantly higher

³ U.S. Census Bureau, American Community Survey, 2015-2019

⁴ U.S. Census Bureau, American Community Survey, 2015-2019

than both the county (\$99,406). As shown in **Table 3-3**, more than one-third of the households in Alameda are categorized as lower income.

Table 3-3 Households by Income Level, 2017

Income Level	Renter Occupied		Owner Occupied		Total	
	No.	%	No.	%	No.	%
Extremely Low Income ≤30% of AMI	3,440	11.2%	985	3.2%	4,425	14.5%
Very Low Income >30 to ≤50% of AMI	1,540	5.0%	820	2.7%	2,360	7.7%
Low Income >50 to ≤80% of AMI	2,170	7.1%	1,305	4.3%	3,475	11.4%
Moderate >80 to ≤100% of AMI	1,960	6.4%	1,055	3.4%	3,015	9.9%
Above Moderate >100%+ of AMI	7,085	23.2%	10,225	33.4%	17,310	56.6%
Total	16,195	53.0%	14,390	47.0%	30,585	100.00%

Source: [CHAS 2013–2017 ACS](#)

The US Department of Housing and Urban Development’s (HUD) 2017 Comprehensive Housing Affordability Strategy (CHAS) data set provides information on households by income group for the City of Alameda. According to the CHAS data, in 2017, approximately 4,425 households (14.5 percent of total households) in the City of Alameda were extremely low income. Of those households, 3.2% percent were owner-occupied and 11.2 percent were renter-occupied households (see **Table 3-3** above).

Forty four percent of all renters and 28 percent of all homeowners in Alameda are housing burdened, meaning they spend more than 30 percent of their income on housing costs.⁵ 20% of renters and 10% of homeowners spend more than 50 percent of their income on housing costs. Low-income, Black and Latinx, Native American and female renters are more likely to be rent burdened. Black and Latinx homeowners are also more likely to be rent burdened.

⁵ Bay Area Equity Atlas, <https://bayareaequityatlas.org/>

Social Vulnerability Assessment

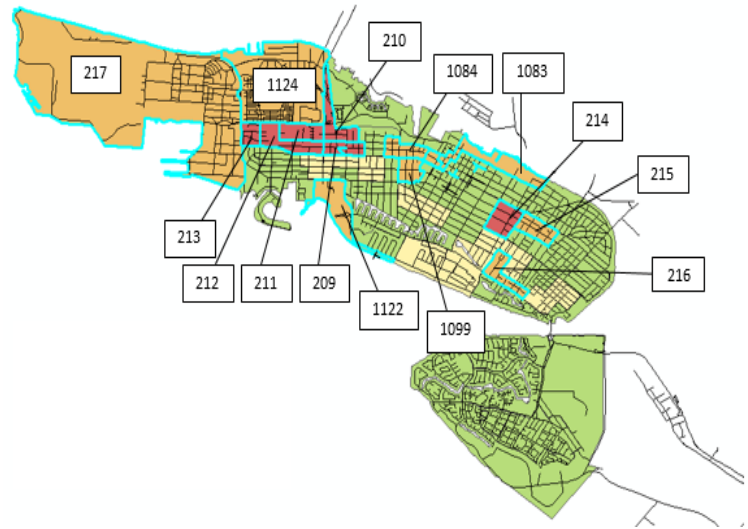
As Alameda prioritizes and implements adaptation actions, the City must continue to consider how vulnerable populations may be disproportionately impacted and ensure that residents with the fewest resources to protect themselves are given the support they need.

To guide strategy development, Alameda’s Climate Action and Resiliency Plan examined social factors affecting Alamedans’ ability to respond to climate threats like extreme heat and wildfire smoke. The results are documented in a SVA included in its entirety in **Appendix G** of the CARP. Building on previous work by the ART Program and ABAG, the SVA used 10 indicators of social vulnerability based on census household data:

- Transit-dependent (no personal vehicle);
- Renters;
- Severe housing cost burden;
- Residents under 5;
- Residents over 65 living alone;
- Disabled;
- Single-parent households;
- No high school degree;
- Very low-income;
- Communities of color;
- Limited English proficiency; and
- Not U.S. citizens.

Figure 3-1 presents the number of social vulnerability indicators that are within the 70th or 90th percentile when compared against the rest of the Bay Area for each of the 57 census block groups in Alameda (with high and highest vulnerability block groups outlined in blue and labeled by block group number). See **Table G-3** in **Appendix G** of **CARP** for a description of each individual block group and its bordering streets. Key takeaways from the SVA include the following:

- Households with multiple indicators face unique challenges and exacerbated vulnerabilities. For example, an individual who is low-income and a renter may have fewer options to invest in flood-proofing their home and may struggle to replace possessions damaged in a flood. Considering the causes and effects of compounded vulnerability is crucial for developing effective resilience strategies.
- Most of the neighborhoods prone to flooding in the near term are among the 14 most socially vulnerable block groups identified.



Social Vulnerability Level		Number of Indicators
Highest		8 or more in the 70 th percentile 6 or more in the 90 th percentile
High		6-7 in the 70 th percentile 4-5 in the 90 th percentile
Moderate		4-5 in the 70 th percentile 3 in the 90 th percentile
Low		Does not meet any of the above criteria

Figure 3-1. Social vulnerability index for City of Alameda.

- All 14 of the most vulnerable block groups have a high rate of transit dependence, and 12 of those 14 have a large proportion of low-income households. Building resilience can result in increased tax burden, which could be particularly harmful for low-income residents.
- A significant population of households speak English “less than very well”; almost half of these households primarily speak Chinese.
- It is important to not only create programs and services for climate resilience, but also to ensure that residents know about them, trust them, and know how to use them. For example, for a wildfire smoke communications service to be effective, it must be available in multiple languages, provided through a variety of relevant media, and delivered in a user-friendly format.
- The SVA informed both the vulnerability assessment and the recommended strategies to address those vulnerabilities.

Alameda Economy

Employment

Just as with population growth, employment history has been turbulent in Alameda over the past decades. Jobs decreased in the 1990s as the result of the NAS and FISC closures and declined again between 2000 and 2010 as result of the nationwide economic recession. Job growth is expected to rise in the decades ahead in Alameda with the redevelopment of the former NAS and the Northern Waterfront. Currently, the largest private employers in Alameda include Penumbra Inc., Abbott Diabetes Care, Exelixis Inc., Alameda Hospital, Bay Ship and Yacht, and Safeway Stores. The largest employment industries are restaurants and drinking establishments; media, computer technology & professional services; maritime industries; and life sciences & alternative energy. **Table 3-4** shows current and projected jobs for Alameda and Alameda County; however, these projections do not consider experienced and expected economic shifts as a result of the coronavirus pandemic.

Table 3-4 Historic and Projected Employment, 2010–2040

Year	Alameda		Alameda County	
	Total Employment	% Change	Total Employment	% Change
2010	29,265	--	705,540	--
2020	38,905	32.9%	858,685	21.7%
2030	41,730	7.3%	901,080	4.9%
2040	42,420	1.7%	952,940	5.8%

Source: ABAG Projections 2018

The City continues to grow, as industrial and former military lands are turned into residential housing, and as densities increase in already built out area. Rents and housing prices continue to rise as tech workers from Silicon Valley, San Francisco, and the San Mateo Peninsula are priced out of the housing markets there. The short-term effect is the decreased resiliency of residents who must spend more of their disposable income on housing, and less on disaster preparation and recovery. The likely long-term

effects will be a shift to a more affluent population, and the loss of retirees, people with disabilities, families with young children, and more diverse populations.

With the coronavirus pandemic, Alameda's economy, along with the entire world, has changed significantly. Many businesses were forced to close or change drastically to respond to public health restrictions. Many workers were laid off, but some sectors of the economy continued to do very well, especially in the highly skilled knowledge sectors. Deep inequities in the economy were exposed during the pandemic, as those without access to internet or unable work from home experienced significantly more economic hardship than those who were more easily able to work remotely. At the time of this writing, it is still too early to tell what exactly the economy of the future will look like, however Alameda seeks to strengthen and diversify our business community and economy, encouraging a broad range of businesses to provide for the needs of Alamedans on the island, promoting and enhancing our two main commercial streets, and increasing on-island employment opportunities (General Plan Land Use Element *draft*, 2021). Alameda seeks to actively break down barriers to full and meaningful employment for historically marginalized populations, such as youth, senior, people with disabilities, formerly incarcerated residents and those with limited English proficiency. Making the economy work for everyone will create a more resilient community that is better able to respond to disruptions such as natural disasters and enhance quality of life for all members of the community.

Buildings

Alameda's building stock contains a wide range of building types, ages and uses that house and serve the residents and businesses of Alameda. According to Assessor's Parcel Data (date), the City of Alameda contains 18,868 buildings, ranging in age from the mid 1800's to present. The majority of Alameda's buildings are privately owned, but the city and other public agencies own and maintain many buildings critical to the functioning of the community. Many of Alameda's buildings are vulnerable to flooding from sea level rise, storm surge, and major rainfall events, primarily due to access issues created by flood events and the resulting inability to provide services. Alameda's mild climate combined with its older building stock means that many buildings are not properly weatherized and can be uncomfortable in very cold or hot days and older buildings are also not designed to protect occupants from the effects of poor air quality. Many of Alameda's older buildings are also vulnerable to damage in earthquakes, particularly buildings with cripple walls, soft-stories, unreinforced masonry buildings, nonductile concrete buildings, and tilt ups. Even most newly constructed buildings built to code are designed to protect the safety of the occupants inside, but not necessarily to be reused following a major earthquake. These building types and their vulnerability to earthquakes is described in more detail in **Appendix E**.

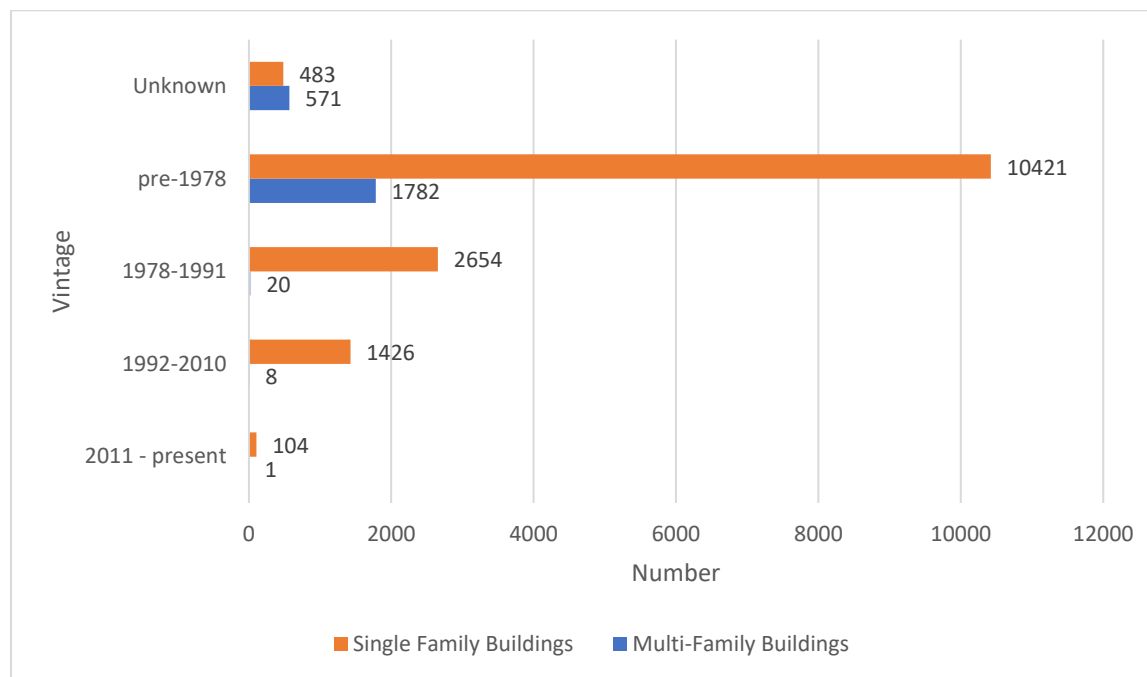
This section describes the general building stock of Alameda. A more detailed inventory of City owned buildings is provided in **Appendix D**.

Residential Buildings

The vast majority (92.5%) of Alameda's building stock is residential.⁶ Alameda's residential building stock includes 15,088 single family residential buildings and 2,382 multi-family buildings, containing 14,679 units, meaning about half of Alameda's residential units are multi-family and half are single family, including townhomes and duplexes. About half of Alameda's residents are renters and half own their homes. Seventy percent of Alameda's residential buildings were built before 1978 when most modern

⁶ Electrifying Alameda's Existing Residential Buildings, 2021

building and energy codes took effect, and very few were built in the last decade, however current ongoing development projects will provide more newer homes in the coming years than Alameda saw over the previous decade. These pre-1978 homes and apartments are in the greatest need of upgrades and retrofits for weatherization, energy efficiency, and seismic and flood. They are also more likely to have issues with lead, asbestos and mold that can impact the health and safety of residents.



Source: [Electrifying Existing Residential Buildings in Alameda, 2021](#)

Figure 3-2 Breakdown of residential buildings by year-built

City Owned Buildings

The City of Alameda’s building portfolio consists of 47 structures, totaling approximately 575,000 square feet of property. The properties vary greatly, both by age and design. By way of comparison the City’s oldest building, City Hall, was constructed in 1895, and it’s most recent, Krusi Park Recreational Center, was built in 2021. Alameda’s critical facilities are equipped with backup generators. Other City buildings are being equipped with technology to enhance the standard HVAC filtration, enabling fresh filtered air beyond the HVAC unit’s standard specifications. Buildings without central air handling are furnished with mobile filtration units. In an effort to provide fresh air and cooling respite during periods of heat and/or poor air quality from wildfire smoke, renovations are nearly complete at the Mastick Senior Center and West End Library to designate them as Fresh Air and Cooling Centers. The West End Library is also replacing its natural gas furnace and water heater with electric ones in an effort to reduce the building’s carbon emissions, in line with the City’s Climate Action and Resiliency Plan. The new Krusi Park Recreation Center was built all-electric as well.

Buildings Owned by Other Agencies

The City houses a number of facilities belonging to other governmental agencies and school districts. These include buildings of the Alameda Housing Authority, Alameda Unified School District, Peralta Community College District, Alameda County, East Bay Regional Park District, the State of California,

and the U.S. Government. Many of these buildings serve vulnerable populations including children and people with low incomes.

Care Facilities

The City is home to a number of facilities that serve and/or house vulnerable populations, such as day cares, elder cares, medical offices and clinics, a hospital, private schools, and others. These facilities range from private homes to larger facilities and range in age and construction type as well. The City maintains a listing of current locations as this is critical information for effective disaster response that includes:

- Health Care
 - Alameda Hospital
 - Medical offices, clinics, urgent care centers, pharmacies, and laboratories
 - Six skilled nursing and rehabilitation facilities
- Child care
 - 68 child care and family day care centers
- Adult care and housing
 - Six assisted living facilities
 - Three adult day care facilities
 - 11 elder care residential facilities
 - One housing facility for people with disabilities
- Schools
 - College of Alameda
 - Public K-12 schools
 - Private K-12 schools

Land Use

The goal of Alameda’s 2040 General Plan Land Use Element is to “maintain and enhance safe, healthy, sustainable, complete and connected neighborhoods, districts, and waterfronts that support a high quality of life and fair and equitable access to affordable housing, employment, education, recreation, transportation, services, and participation in public decision making.” Alameda contains a variety of land use classifications that describe the existing and intended location, distribution, intensity and physical character and form of development and land use across the city, as shown in **Figure 3-3**. Since 2016, most new development in Alameda has occurred in designated mixed-use areas along the Northern Shoreline and Alameda Point. Development in these areas must be designed to accommodate at least two feet of sea level rise with adaptive measures to accommodate future sea level rise, including preserving inland land and right of way along the perimeter of the site such that existing shorelines and floodwalls could be elevated to manage sea level rise. While more development has occurred in areas vulnerable to natural hazards in recent years, the mitigation actions described here are working to minimize that vulnerability.



Source: Alameda 2040 General Plan

Figure 3-3 Land Use Designations

Given Alameda’s exposure to a wide range of climate hazards, most notably sea level rise and storm surge flooding, existing and future land use planning needs to incorporate adaptation strategies to keep residents and businesses out of harm’s way. This involves important decisions about how to modify existing land use, where development opportunities still exist, and how to design new development and redevelopment that can adapt to future climate conditions—particularly flood and liquefaction risk. Land use policies are an important avenue to creating a resilient Alameda.

Utilities

The broad types of utilities in the City are overhead (power, telecom), underground-dry (power, telecom, gas), underground-wet (water, sanitary sewer, storm drain), and utility buildings (substations, telecom switching, pump stations). In addition, there is solid waste handling (trash pickup and landfills), and there are abandoned fuel pipelines on Alameda Point. The City owns and maintains the sanitary sewer collection system (excluding the interceptor pipes that convey flow to the regional treatment plant), storm and electrical infrastructure. The City also is responsible for the Doolittle Landfill. Potable water and natural gas are provided by the East Bay Municipal Utility District (EBMUD) and Pacific Gas and Electric (PG&E), respectively. The following entities manage and maintain utility systems in Alameda:

- Stormwater system = City of Alameda;
- Wastewater system = EBMUD (treatment and transmission) and City of Alameda (sewer collection system within city limits);
- Drinking water system = EBMUD and City of Alameda (Alameda Point water system);
- Electric System = AMP;
- Natural Gas System = PG&E; and
- Communications = varied (private).

These agencies have completed assessments on some utility sectors in Alameda, including the PG&E vulnerability assessment, City of Alameda storm drain modeling, and EBMUD water supply assessments. Plans are in place for specific utility sectors, including the City of Alameda Storm Drain Master Plan, City of Alameda Sewer Master Plan, EBMUD 2015 Urban Water Management Plan, and EBMUD Sewer System Management Plan. Collectively, these plans address key vulnerabilities to the city's utility systems to ensure climate change impacts are integrated into short- and long-term planning.

City-owned water, sewer, storm, and electrical utilities are summarized in **Table 3-5**.

Table 3-5. City-Owned Sewer, Storm and Electrical Utilities

Utility	Amount
Sewer Mains	142 miles
Sewer Manholes	3,122 each
Sewer Pump Stations	42 each
Storm Pipes and Cross Culverts	90 miles
Storm Manholes	2,058 each
Storm Pump Stations	11 each
Other Storm Structures (ex. Catchbasins, outlets)	401 each
Storm Outfalls	227 each
Alameda Point Water System	35.8 miles
Alameda Municipal Power Distribution Overhead	86 pole miles
Alameda Municipal Distribution Underground	181 circuit miles
Alameda Municipal Transmission Overhead	6.8 pole miles
Alameda Municipal Transmission Underground	1.9 circuit miles

The sewer, storm and electrical systems are vulnerable to a variety of hazards. In storm events downed trees can damage overhead lines and flooding can impact pump station function. In earthquakes electrical substation and pump station components can be destroyed by strong shaking, often requiring more extensive and time intensive repairs to return service. Underground pipes can shear, crack or reverse grade. Alameda Municipal Power recognizes that large earthquakes may damage key facilities and that electric power might be lost for limited periods of time. The potential for a loss of power means that emergency and critical uses should have dedicated emergency power sources.

Stormwater and Sewer Systems

Stormwater

Drainage generated within Alameda's main island and Bay Farm Island watersheds can come from a variety of sources such as storm events, residential sump pump groundwater discharges, vehicle washing, hydrants/firefighting, pressure washing of sidewalks, and illegal mopwater discharges from restaurants directly into the gutter. On the main island, Central Avenue is the "spine," or high point that runs east/west through Alameda, and drainage generated from these sources flows either north or south from Central Avenue along street gutters, crossing intersections along the way via channels cut under the sidewalks. A closed-system network located in the lower elevations of the island composed of catch basins, manholes, and pipes receives this drainage when it has increased in volume and discharges it either to the estuary to the north, and to the south either to the Alameda West Lagoon system or directly to the Bay (depending on the outfall location). Pump stations located around the main island lift stormwater up that has drained to low points around the island and discharge it directly to the Bay.

There are 5 lagoons interconnected by bridges and cross-culverts that make up the lagoon system. This salt-water fed system plays an important role in Alameda's stormwater treatment, because it receives runoff containing oils, greases, and trash that has accumulated on pavement and properties throughout the watershed and can trap them within the lagoons rather than discharging them directly to the Bay. The lagoon system also receives runoff from approximately half of the South Shore Center property. Due to the two-mile length of the lagoon system, it has stilling qualities for pollutants and sediments and ultimately discharges out of a concrete weir and outfall channel that crosses under Bayview Avenue to the Elsie Romer Bird Sanctuary.

In recent years full trash capture (FTC) devices have been installed in many catch basins to trap items greater than 5mm in size and preventing them from flowing downstream. The City has an ongoing maintenance program that cleans out the FTC devices on a periodic basis.

Sewer

The City of Alameda owns and maintains the sanitary sewer system that includes 142 miles of sewer mains and 43 pump stations. When the network reaches a low point, sewer pump stations lift wastewater and help it further along to its ultimate destination.

Collected wastewater is conveyed to East Bay Municipal Utility District's (EBMUD) regional. EBMUD treats wastewater for seven communities in its wastewater service area, including Alameda. It owns and operates an award-winning wastewater treatment plant near the Bay Bridge that serves 650,000 customers in the San Francisco Bay, including Alameda residents.

The City's Sewer Master Plan includes a hydraulic capacity assessment and recommendations for upgrades and replacements. As the state and others release new guidance, the City of Alameda can determine the best way to incorporate climate change in sewer system modeling and planning. Potential impacts from climate change include infrastructure damage associated with flooding (e.g., to sewer pumps), rising groundwater levels (e.g., to pipes and other subsurface assets), and low flow during periods of drought and increased water conservation efforts.

Drinking Water System

EBMUD provides high-quality drinking water for 1.3 million customers in Alameda and Contra Costa counties. EBMUD owns and maintains all water lines within Alameda. Water service to the City of Alameda is provided by four underwater pipeline crossings at three separate locations between the City of Oakland, Alameda Island, and North Bay Farm Island. The two locations that serve Alameda's main island are under Oakland inner Harbor, and run between Marina Village Parkway and Oakland's Embarcadero, and between Broadway and Oakland's Derby Avenue. The pipeline serving Bay Farm Island runs under the Tidal Canal from the end of Veterans Court to Towata Park on the main island. Failure of one of three existing crossing locations could lead to a reduction in the level of service for existing customers and potentially reduce the available water supply to Alameda Island and North Bay Farm Island. Three new pipeline crossings are proposed to replace the existing pipeline crossings to ensure long-term reliability of the water distribution system, meet existing and future water needs, and facilitate repair and replacement of aging infrastructure.

In the future, EBMUD plans to extend its recycled water service to the City of Alameda, including Alameda Point. EBMUD's source of recycled water for Alameda Point is generated at their Main Wastewater Treatment Plant (MWWTP) located at the eastern landing of the Bay Bridge. The recycled water facilities at the MWWTP utilize microfiltration and extra disinfection to produce recycled water that meets or exceeds the California Department of Health standards for unrestricted use.

EBMUD is internationally recognized for its proactive seismic improvements of facilities in its service area, as well as strengthening vulnerable portions of aqueducts, dams and Sierra reservoirs. The District also works closely with other agencies on emergency responses planning and hazard mitigation.

Many residences in Alameda have private wells on their property that are primarily used for irrigation. These however in an emergency these wells could potentially be used for drinking water if the EBMUD system is down. These wells are generally deep and not impacted by surface contaminants or saltwater intrusion from rising sea levels. It is currently unknown how many of these wells currently exist and are in operation.

Alameda Point Water System

The Alameda Point water system is a community water system serving the area formerly known as the Alameda Naval Air Station. The water system is located within the street network east of Main St. The City of Alameda has caretaker responsibilities for the water system pursuant to a Cooperative Agreement between the City and United States Department of the Navy. As part of the planned development at Alameda Point, the water system will be upgraded in accordance with the Alameda Point Master Infrastructure Plan and will be owned and operated by EBMUD.

The Alameda Point water system is a water distribution system but it does not include water treatment plants. The City of Alameda contracts with EBMUD to operate and maintain the water system. Water distributed by the Alameda Point water system was purchased from EBMUD and treated in EBMUD's Orinda or Upper San Leandro Water Treatment Plants.

Electric System

AMP serves all of Alameda and has approximately 86 pole miles of overhead distribution lines, 181 circuit miles of underground distribution lines, 6.8 pole miles of overhead transmission lines, and 1.9 circuit miles of underground transmission lines. It serves approximately 34,809 customers, comprised of

approximately 30,650 residential customers and 3,779 commercial customers, and 370 other users, and had a peak demand of approximately 61.5 megawatts.

AMP sources its 100% clean power from a variety of geothermal, wind, landfill gas, and hydropower generation resources across northern California. Power is delivered to Alameda through PG&E's transmission system. AMP's transmission lines cross beneath the estuary to Oakland in two locations - one to the north and one south. These lines provide redundant service to Alameda and if one line goes out, the other can supply all of Alameda's power demand. In the unlikely event that enough transmission lines serving the greater Bay Area are taken offline by PG&E, it is possible curtailment affecting Alameda could occur.

Rolling blackouts can occur when the California electric grid becomes overtaxed. This occurred recently in August 2020 during a heat event when projected power demand exceeded capacity. There is an elevated risk of additional CAISO supply shortages over the coming summers due to the drought (drought impacts the availability of hydropower) and continued extreme heat events. AMP has procured sufficient resources to meet AMP's loads, however, during rolling outages all utilities must participate in load shedding. If a rolling blackout is called for, AMP will typically have one of 10 circuits (2,000 –4,000 customers each) on outage for 30-60 minutes before rotating to the next circuit in the list. A circuit will not repeat until all other circuits have experienced an outage.

If there is limited power available in the grid, AMP will coordinate with the Northern California Power Agency (NCPA) to support Alameda's system. Two Combustion Turbines (CTs) NCPA are located in Alameda, each with a capacity of approximately 25 megawatts. Along with two other CTs owned by NCPA, these facilities provide peak load and reserve capacity for NCPA member communities and districts. Central Dispatch Center in Roseville can remotely start or stop each turbine, and bring these units fully online within ten minutes. These facilities possess dual fuel capability, with natural gas as the primary fuel and diesel fuel being available in the event of a natural gas curtailment. The CTs cannot independently provide power to Alameda however; they provide additional resources to the grid and can help relieve pressure on the local area's transmission lines.

AMP is planning to install a 2.0-megawatt photovoltaic solar facility at Doolittle Landfill (Mt. Trashmore) at the intersection of Doolittle Drive and Harbor Bay Parkway. The electricity will be fed directly into the electric grid from an interconnection point adjacent to the site. Transformers and switchgear will potentially be located at the bottom of the property. The landfill is being monitored by City of Alameda while decomposition occurs beneath the landfill cap. An open space park is planned at the former landfill in 25 years when the site is anticipated to be safe for public use. Increasingly residents also have rooftop solar with battery storage on their homes and businesses. This technology is becoming more widespread and affordable and provides a resilient local supply of clean energy with added resiliency during grid outages.

As part of modernization of its system, AMP is in the process of undergrounding its electrical system. About half of Alameda's power system has already been undergrounded since the inception of the program in 1984. The undergrounding projects typically convert overhead wires to underground, install pad-mounted equipment, install updated streetlighting poles, and install a joint trench with other utilities, including City use.

City-owned electrical assets are summarized in **Table 3-5** and examined in detail in **Appendix D**.

Natural Gas System

PG&E provides natural gas to Alameda residents. PG&E has a staff of 20,000 prepared to respond to restore service after disasters and storms. They also have a well-established priority system for restoring power to emergency services before other community needs.

Natural gas infrastructure is subject to damage and disruption in areas with soil failure, for example landslide and liquefaction. Natural gas lines can also rupture in earthquakes when buildings are damaged or when natural gas appliances topple. Broken lines can create fires if ignited until the fuel supply is exhausted. The repair of damaged underground lines will take time. Following the Loma Prieta earthquake, it took about 30 days to repair damaged lines in the San Francisco Marina.

The large-scale natural gas transmission lines that service the cities along the East Bay shoreline of Alameda County are primarily located near the bay shore. The transmission line does not run through the City of Alameda but instead runs along a single corridor through Albany, Berkeley, Emeryville before splitting into two parallel lines in Oakland that run through Oakland, San Leandro and Hayward. Across the entirety of the natural gas line between Albany and Hayward the natural gas transmission line(s) pass through medium-level susceptibility zones with some lines passing through very high liquefaction susceptibility zones in East Oakland and San Leandro.

Communications and Technology Systems

The City owns a variety of communications and technology infrastructure.

Webster Street Smart Corridor

In 2016, City and Alameda County Transportation Commission (Alameda CTC) completed a Smart Corridor on Webster Street and Constitution Way, two of Alameda's most travelled corridors and island ingress/egress routes. The corridor includes CCTV cameras, video detection systems, dynamic message signs, microwave detection, and emergency vehicle and transit priority equipment on existing traffic signal infrastructure on Webster Street between the exit of the Webster Street Tube and Central Avenue and surrounding areas. Wireless communications were also installed via the unlicensed 5GHz wireless band to facilitate the management of the corridor infrastructure; however, the City does not currently engage the Smart Corridor infrastructure for traffic management, which could be a later project phase.

Citywide 5G Deployment

As the climate for wireless service changes, many large service providers are actively pursuing opportunities for 5G installations via collocation on public equipment or on public property. In light of that, Public Works staff proactively developed a City ordinance, permitting, procedure, and design guidelines to support the deployment of 5G equipment in Alameda. Public Works now has an approved master license agreement with Verizon, which would allow Verizon to deploy small wireless facilities on City street light poles to enhance 5G coverage. This is currently limited to commercial use by Verizon subscribers/customers.

Development-Built Infrastructure

The City requires developers to install empty conduit to serve future City communications needs in the vicinities of new development projects. Empty conduit has been deployed in this manner under several development projects in the last several years, including, but not limited to:

- Alameda Point – Two 2-inch conduits roughly bounding the project along Tower Avenue, Pan Am Way, Midway Avenue, and Saratoga Street.
- Webster-Posey Tube Interconnection (Caltrans) – One 4-inch conduit along Mitchell Avenue between Mariner Square Loop and Mariner Square Drive east of the tunnel portal buildings as AMP conduit.
- 2100 Clement – Two to three-inch conduit was installed on the project frontage and nearby cross street which is located at Clement Avenue and Willow Street as AMP conduit.
- Alameda Landing – One to two-inch conduit was installed for traffic signal interconnect in the general project vicinity, which is generally bounded by Fifth Street, Mitchell Avenue, Mariner Square Loop, and Willie Stargell Avenue as AMP conduit.
- Del Monte – Two to four-inch conduit for traffic signal communications is planned in the general project vicinity which is bounded by Entrance Street, Clement Avenue, Buena Vista Avenue, and Sherman Street.

Public Works-Built Infrastructure

In 2021, Public Works completed an installation of wireless radios along Webster Street, Park Street, and Constitution Avenue. The deployment placed 18 wireless radios along the corridor for wireless communication to support signal timing coordination along these key corridors.

Municipal Area Network

When founded originally, Alameda Municipal Power (AMP) was also intended to be a telecommunications provider and began development of a citywide fiber network. Financial constraints caused AMP to ultimately sell that portion of their business to Comcast. Despite the sale, AMP maintains a private fiber optic network that it uses to manage its own systems and also leases some of the infrastructure to the City for administrative use. The administrative network in use by the City is referred to as the Municipal Area Network (MAN). As part of this agreement, AMP provides the technical support and management of the MAN.

Currently, the MAN utilizes AMP fiber infrastructure to interconnect the City's various facilities, which are spread around the City. City buildings are interconnected via four core sites where key network infrastructure is housed. AMP has deployed layer 3 switches at all four core sites and each City facility. The four core sites are located at the City Hall Building 2, AMP's Service Center facility, the Corica Park Golf Course, and City Hall. The network topology is set up as a redundant ring for the core sites and hub and spoke topology for the edge sites. Each of these cores is interconnected with each other via AMP fiber to form a ring and the remaining facilities are interconnected in a spoke configuration via AMP fiber from one of the cores.

Planned Projects

In recent year when AMP has undergrounded electrical wires, the City has installed conduit for other City use as part of the joint trench and plans to do so on future undergrounding efforts. This effort includes the installation of conduits for communications interconnect of traffic signals. There is one upcoming undergrounding project on Otis Drive between Broadway and High Street, and on Broadway between Encinal Avenue and La Jolla Drive.

Private Communications Service Providers

Communications systems, including cellular networks (for mobile data and voice), fixed landlines and broadband internet systems are owned by a wide range of private operators. These networks also rely on private third-party operated fiber networks and data centers. Broadband internet connection is provided by cable, DSL, and increasingly, fiber networks. The largest internet providers in Alameda are Xfinity/Comcast and AT&T. The primary cellular operators are AT&T, Verizon, Sprint and T-Mobile.

Cellular networks are organized around cell sites, which transmit data from the user and the cell site via radio waves.⁷ Macro cell sites are typically located on buildings and cell towers, while small cell sites used to add capacity to the network or typically located on utility poles. Macro cell sites typically have battery backup for 4 to 12 hours, while small cell sites typically have no backup power. Small cell sites route data to hubs where it is aggregated and sent to switching centers via the fiber network. No hubs or switching centers are located in Alameda.

Alameda Community Radio 96.1 KACR-LP is a low power FM station that broadcasts from a rooftop on Park St. The frequency is shared with 96.1 KJTZ Encinal Radio, a Low-Power FM radio station operating at Encinal High School, and KEXU-LP broadcasting from Jack London Square in Oakland.

The communications system is critical to emergency services, and protections to ensure uninterrupted connectivity are very important. However, the varied ownership and oversight of the telecommunications system makes it difficult to implement adaptations because the City of Alameda does not directly control assets. In the event of an emergency where cell sites are damaged or there is no power, communications providers will deploy temporary generators or cell towers to augment and restore the network. Fuel is critical to the continued operation of the communications network when the power is out.

Transportation

The transportation sector contains a network of assets that are critical to social, economic, and physical well-being, as well as emergency response. These transportation assets connect Alameda to other services in neighboring Oakland and beyond, and they support vehicular movement (roads, bridges, tubes), public transit (buses and ferries), bicycle/pedestrian paths and water access (marinas, docks and waterways with private boats). Connections to adjacent communities are uniquely limited and therefore particularly sensitive and prone to congestion. Alameda has three ferry terminals operated by the Water Emergency Transportation Authority (WETA), five ways on/off the main island via bridges/tubes and three roadways in/out of Bay Farm Island. Access to BART stations in Oakland are relatively close but require using the already congested crossings. WETA also has their Central Bay Operations and Maintenance Facility located in Alameda Point. The facility, which opened in 2018, provides a base to maintain its fleet, includes an Operations Control Center for service dispatch and an Emergency Operations Center, which would serve as a primary location for WETA to coordinate the provision of emergency transportation services in the event of a regional disaster or transportation disruption.

The transportation sector's vulnerability to sea level rise and flooding from intensifying storm events not only puts these assets at risk, but also impacts other sectors, amplifying socioeconomic and public health risks. Some of the transportation system's vulnerability stems from its lack of redundancy. With limited connections on and off the island of Alameda, the community will strongly feel any disruptions to tubes,

⁷ [Lifelines Restoration Performance Project](#), City and County of San Francisco, 2020.

bridges, or ferry service. Some isolated areas, like Ballena Island, rely on single methods of access and are at elevated risk if inundation undermines or blocks transportation assets.

During and right after a disaster, transportation facilities serve vital functions of providing access for emergency vehicles, Public Works and utility repair teams, evacuation, distribution of food and supplies, and movement to shelters. For long term recovery, transportation corridors are needed to facilitate removal of debris, delivery of repair materials, and restoration of normal commuting and daily activities. Fuel is a vital part of the transportation system. Power and telecom are needed for full restoration of traffic signal, SMART technology functions as well as electric vehicles, which are estimated to total at least 1,500 in Alameda. **Table 3-6** summarizes street ownership/responsibility within City limits. The City of Alameda is also responsible for 89 signalized intersections.

Table 3-6. Street Inventory

Street Owned By	Mileage
City - Local Classification	113.2
City - Arterial Classification	33.5
Caltrans	4.9
Private & Federal	39.4
<i>Total:</i>	<i>191.0</i>
Bikeways	51.2

In addition to the City and State maintained streets, the following transportation structures are located within the City of Alameda and owned by the agencies listed:

- High Street bridge (Alameda County)
- Park Street bridge (Alameda County)
- Miller-Sweeney bridge at Fruitvale Avenue (Alameda County)
- Fruitvale rail bridge - abandoned (U.S. Army Corps of Engineers)
- Bay Farm Island vehicular and bike/pedestrian bridges (Caltrans)
- Webster and Posey Tubes (Caltrans)
- Constitution Way Overcrossing (Caltrans)
- Grand St bridge (City of Alameda)
- Ballena bridge (City of Alameda)

Shoreline, Natural, and Recreation Areas

Alameda is unique in that it is an island community with dense, urban development. It has approximately 23 miles of combined perimeter shoreline, between the main island and Bay Farm Island. Shoreline consists of a mixture of both engineered shorelines (primarily seawalls or levees and associated riprap and other armoring) and a variety of natural shoreline habitats. Alameda’s main island is composed mostly of riprap shoreline, and to a lesser extent bulkheads, natural shoreline, and beach. Bay Farm

Island's shoreline is almost exclusively riprap of large diameter, due to the wave action that can be seen coming from the west. Susceptibility of shoreline to wave action has played a large role in determining the shoreline protection level required.

In many areas, including the full perimeter of Bay Farm Island, shorelines provide a protective distance between the Bay waters and residential homes, buildings, properties, utilities, and other infrastructure. Shorelines also provide a public access area for the public to enjoy the waterfront and many parts of it are designated as the San Francisco Bay Trail.

The engineered structures and natural shorelines that surround Alameda are not FEMA-accredited, and it is unknown how they will behave in the event of a large-scale coastal flooding or earthquake event - given development of Alameda in many places (particularly Bay Farm Island) mainly consisted of placing a few feet of sandy fill over the existing young bay mud. Several shoreline protection projects currently underway have the goal of becoming FEMA accredited.

Like engineered shorelines, natural shorelines can attenuate waves and mitigate the impacts of sea level rise and storms. They also provide ecosystem benefits, including open space, water quality, air quality, carbon sequestration, and species habitats. Shoreline areas include wetlands, tidal flats, and marshes. Both engineered and natural shorelines provide recreational benefits, as the San Francisco Bay Trail and other public shoreline access points run along them. Both engineered and natural shorelines face risks of overtopping, erosion, and potential failure as San Francisco Bay water levels rise, and they will need to be adapted over time. Deferred maintenance of some flood protection structures makes them more vulnerable.

The City of Alameda also maintains 24 parks and a total of 492 acres of parkland as shown in **Source:** Alameda 2040 draft General Plan

Figure 3-4. Alameda parks include a variety of sports facilities, playgrounds, open space, pools, recreations centers and a golf complex. 94% of Alamedans use the parks at least once annually and the golf complex receives over 25,000 visitors a year.



Source: Alameda 2040 draft General Plan

Figure 3-4 Existing and Planned Parks and Open Space in Alameda

While open spaces may not be required during or immediately after a disaster, quick recovery of these facilities is necessary for the full recovery of the City. Restoration of open spaces is also needed for the recovery of the wild animals and plants that call Alameda home. Some recreation facilities, including the O’Club and Alameda Point Gym are designated staging and pickup sites for the school district in the event of an emergency. City owned park and open space facilities are examined in **Appendix D**.

Contaminated Lands and Waste

Properties with land use histories that include heavy industrial and manufacturing operations could potentially have contaminants in their soil and groundwater. Contaminants at these properties are addressed through remedial action plans that are implemented under the oversight of the California Environmental Protection Agency (CalEPA) or, in the case of federal properties and Superfund properties, the U.S. EPA. These types of properties can be vulnerable to sea level rise impacts such as flooding and rising groundwater if those changes result in a release of hazardous substances. CalEnviroScreen (June 2018) identifies several contaminated and cleanup sites within Alameda. Additional information regarding contaminated sites within Alameda can be found at the CalEPA Department of Toxic Substances Control (DTSC) [EnviroStor website](#) and the CalEPA [RWQCB GeoTracker website](#).

Case Study: Alameda Point

Alameda Point can be used as a case study for how contaminated sites can be managed to account for the effects of sea level rise. Alameda Point is the former naval air station previously located on the western portion of Alameda. The naval base operated from 1940 until it was officially closed in 1997. During its operation, a number of industrial activities across the base resulted in residual contamination in soil and groundwater that continue to be addressed today. Contaminants in soil and groundwater include petroleum hydrocarbons, metals, chlorinated solvents, semi-volatile organic compounds, and radiological isotopes. The U.S. Navy is required to complete remedial activities under the oversight of the U.S. EPA as well as the DTSC and the RWQCB. Remedial technologies implemented at Alameda Point generally include the following:

- **Excavation and removal:** Soil contamination is excavated from the property and disposed of at a facility outside of Alameda. Under this scenario, it is not expected that sea level rise will adversely affect the site because the source material has been removed.
- **In situ groundwater treatment:** These technologies typically use substrates that can be injected into the groundwater to degrade the specific contaminant. They are generally used for sites that have chlorinated solvents or petroleum hydrocarbons in groundwater. The Alameda Point remedial plan requires extensive monitoring during remediation and post-remediation to verify that the remedial action can achieve its goals. The monitoring programs can assess what a change in condition (e.g., rising groundwater levels) has on the contaminant in question. These remedial activities typically degrade the contaminant to concentrations that are protective of human health and the environment; therefore, it is not expected that sea level rise will adversely affect the site.
- **Capping and institutional/engineering controls:** In some instances, soil contamination or contamination within subsurface utilities is addressed through capping or institutional controls. Typically, a cap will require the installation of a layer of soil that eliminates direct contact with the contaminated soil and can prevent surface water from infiltrating into the contaminated soil and into the groundwater. Institutional controls are measures recorded in a property deed that restrict how a property is used and/or what activities are permissible. A remedy that includes these types of measures requires long-term monitoring to verify that the remedy remains protective of human health and the environment. Inspections are typically required annually, and the remedy must be evaluated in detail at five-year intervals. The additional monitoring will identify if changing conditions resulting from sea level rise are adversely affecting the environmental conditions at the site.



This former naval base is being remediated and provides opportunity to expand the existing wetlands. Photo credit: Richard Bangert.

Public Health and Welfare

Natural disasters can have major and insidious impacts on public health, the extent of which varies depending on geography, the number and severity of impacts affecting a particular population, socioeconomic status, and other factors. Socially vulnerable populations are particularly at risk. Climate hazard-related public health impacts affecting Alameda consist primarily of higher temperatures, increased air pollution from wildfires, increased flooding from sea level rise and rainstorm events, and severe drought.

Flooding can cause multiple public health impacts, such as mobilizing contaminants in soil (from hazardous waste sites), preventing access to safety, or preventing access to health care facilities due to flooded roads or public transit routes. More extreme heat events represent another major public health risk, as vulnerable populations (elderly, infants, those with existing health conditions, those living and working in areas without adequate shade, and those with limited access to air conditioning) can suffer heat exhaustion, stroke, difficulty breathing, and even death. When heat is combined with air pollution impacts, such as elevated ozone levels and wildfire smoke, the impacts are exacerbated. In addition, Alamedans are inexperienced in dealing with extreme heat and wildfires and therefore lack adequate preparation. Others lack resources to purchase air conditioning. More energy use for air conditioning results in increased costs, further affecting those with limited resources. It also increases GHG emissions, which further affects climate change and its associated impacts.

California's Fourth Climate Change Assessment highlights the indirect effects of climate change in the Bay Area, such as the combined impacts of increased allergens, air pollution, harmful algal blooms, heat, and disease vectors (e.g., insect and rodent populations). While each of these stressors can seem minor in isolation, their combined effects represent significant public health impacts to socially vulnerable populations who lack the financial capacity to respond.

Earthquakes and tsunamis would also have widespread significant public health impacts and are the two hazards likely to cause significant fatalities in Alameda. Both hazards will also damage a significant number of residences and buildings and result in widespread displacement. Disruptions to schools, housing and basic services will stress vulnerable populations especially and the very long recovery and rebuilding period following a major event will disrupt everyone's daily lives for many years.