### SUMMARY

The San Francisco Bay Conservation and Development Commission Adapting to Rising Tides Program developed a dataset to better understand community vulnerability to current and future flooding due to sea level rise and storm surges. The community vulnerability shapefile contains 4 categories of information:

1. Social Vulnerability Indicators

Certain socioeconomic characteristics may reduce ability to prepare for, respond to, or recover from a hazard event. Census block groups with high concentrations (relative to the 9 county Bay Area) of these characteristics are flagged as socially vulnerable, with each block group assigned a rank of highest, high, moderate, and low. Data are from American Community Survey (ACS) 2016 5-year estimates.

1. Contamination Vulnerability Indicators

The presence of contaminated lands and water raises health and environmental justice concerns, which worsen with flooding and sea level rise. A rank of highest, high, moderate, and lower for the severity of contamination in each block group was calculated using data compiled by CalEPA Office of Environmental Health Hazard Assessment (OEHHA) for use in [CalEnviroScreen 3.0](https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30).

1. Residential Exposure to Sea Level Rise

Calculated by intersecting [Metropolitan Transportation Commission 2010 residential parcel data](https://github.com/bayareametro) with [2017 ART Bay Area Sea Level Rise and Shoreline Analysis data](https://explorer.adaptingtorisingtides.org/download), FEMA 100 and 500 year flood zone data, and San Francisco 100 year precipitation data to generate percent residential exposure at each water level by block group. The number of residential units exposed in each block group was divided by total residential units per block group.

1. Complementary Community Vulnerability Screening Tools

Many screening approaches exist to characterize disadvantaged or vulnerable communities. Often in the Bay Area, different designations of disadvantaged/vulnerable communitites are located in the same area. It is recommended to use the ART approach in combination with other complementary tools and designations. The following are included in this shapefile as fields for cross-referecing: CalEnviroScreen 3.0 total score, [Metropolitan Transportation Commission Community of Concern](http://opendata.mtc.ca.gov/datasets/mtc-communities-of-concern-in-2018-acs-2012-2016) designation, [UC Berkeley Displacement and Gentrification Typologies](http://www.urbandisplacement.org/map/sf).

### DEVELOPMENT PROCESS

This dataset originated in the 2015 [Stronger Housing, Safer Communities](http://resilience.abag.ca.gov/projects/stronger_housing_safer_communities_2015/) project. The project’s advisory committee of recognized experts, including community advocates, selected social characteristics which contribute to vulnerability to hazards (flood and seismic), drawing on professional experience, local knowledge, and consultation of academic and federally-sponsored research. Additional attributes ranking the presence of contaminated sites were added to the dataset following input from the working group for the [ART Bay Area project](http://www.adaptingtorisingtides.org/project/art-bay-area/), [Policies for a Rising Bay project](http://www.bcdc.ca.gov/prb/Policies-for-a-Rising-Bay.pdf), and [BCDC Environmental Justice and Social Equity Bay Plan Amendment](http://www.bcdc.ca.gov/ejwg/BPAEJSE.html). Data and methods should be continually updated as thinking surrounding community and social vulnerability evolves.

### DESCRIPTION OF DATA AND USE LIMITATIONS

Characteristics included are only those with publicly-available data that can be consistently compared (quantitatively) across the 9 County Bay Area region. Not all characteristics that influence community vulnerability are included in this dataset. Indicators were developed as a regional screening tool to help identify neighborhoods where community members may be at greater risk. This shapefile is for planning purposes only and should not be used for permitting, regulatory, or other legal uses. A value of -9999 indicates “not calculated” due to highly unreliable or unavailable ACS estimates, low population (less than 100 people and/or less than 100 households) and/or unreliable or unavailable parcel data (in sea level rise exposure field). Residential sea level rise exposure was calculated using the most current data available in 2018, and exposures to very high levels of sea level rise (which correspond with later time horizons) should be used cautiously as they were not calculated using populations projections.

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### MORE INFORMATION

Social vulnerability indicators

Triggering methodology identifies block groups that have a concentration of individuals or households with a particular characteristic that is either in the 70th percentile or 90th percentile. The shapefile contains for each block group contains the percent of individuals or households with each indicator and the total count of indicators for the two triggering rates. Indicators in each category are counted the same, when in real life they do not contribute equally to vulnerability. For example, income may contribute more to community vulnerability than the presence of young children, but it is difficult to quantify how much more. The combination of both these characteristics results in higher vulnerability than either one on its own, which is why a total count method is used. The table below provides more information about measures used, sources, and the rates associated with the 70th and 90th percentile for each indicator.

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| --- | --- | --- | --- | --- | --- |
| Socioeconomic characteristics that may increase vulnerability | | | | | |
| **Populations or households that are:** | **Measure** | **70th pctl rate** | **90th pctl rate** | **2012-2016 American Community Survey (ACS) table number** | **ACS Universe** |
| **Renters** | % Renter occupied households | 58% | 81% | **B25003**: Tenure | Occupied housing units |
| **Under 5** | % People under 5 | 7% | 10% | **B01001**: Sex by age | Total population |
| **Very low income** | % People under 200% poverty rate; and/or % Households with income less than 50% of Area Median Income | 30% ; 35% | 50% ; 52% | **C17002**: Ratio of income to poverty level in the past 12 months; and/or **B19001**: Household income in the past 12 months (in 2016 inflation-adjusted dollars) with Dept. of Housing and Community Developent [State Income Limits for 2016](http://www.hcd.ca.gov/grants-funding/income-limits/state-and-federal-income-limits/docs/inc2k16.pdf) | Population for whom poverty status is determined & Households |
| **Not U.S. citizens** | % People not U.S. citizens | 17% | 26% | **B05002**: Place of birth by nativity and citizenship status | Total population |
| **Without a vehicle** | % Households without a vehicle | 9% | 22% | **B25044**: Tenure by vehicles available | Occupied housing units |
| **People with disability** | % Households with 1 or more persons with a disability | 26% | 35% | **B22010**: Receipt of food stamps/snap in the past 12 months by disability status for households | Households |
| **Single parent families** | % Single parent families | 11% | 21% | **B11004**: Family type by presence and age of related children under 18 years | Families |
| **Communities of Color** | % People of Color | 70% | 91% | **B03002**: Hispanic or Latino origin by race | Total population |
| **65 and over living alone** | % Households with 1 or more people 65 years and over | 11% | 19% | **B11007**: Households by presence of people 65 years and over, household size and household type | Households |
| **Limited English proficiency** | % Limited English speaking household | 11% | 21% | **C16002**: Household language by household limited english speaking status | Households |
| **Without a high school degree** | % People 25 years and older without a high school degree | 15% | 30% | **B15003**: Educational attainment for the population 25 years and over | Population 25 years and over |
| **Severely housing cost burdened** | % Households spending greater than 50% income on housing; renter-occupied and/or owner-occupied | 32% ; 20% | 47% ; 33% | **B25070**: Gross rent as a percentage of household income in the past 12 months & **B25091**: Mortgage status by selected monthly owner costs as a percentage of household income in the past 12 months | Renter-occupied housing units & Owner-occupied housing units |

Rankings of social vulnerability were assigned by looking at the distributions of the data. Block groups labeled “**Highest social vulnerability”** have:

* 8 or more social vulnerability indicators with rates in the 70th percentile, relative to nine county Bay Area; *and/or*
* 6 or more social vulnerability indicators with rates in the 90th percentile, relative to nine county Bay Area

Block groups labeled “**High social vulnerability”** don’t meet criteria in “Highest” category, and have:

* 6-7 indicators in the 70th percentile; *and/or*
* 4-5 indicators in the 90th percentile

Block groups labeled “**Moderate social vulnerability”** don’t meet criteria in “Highest” and “High” categories, and have:

* 4-5 indicators in 70th percentile; *and/or*
* 3 indicators in the 90th percentile

Block groups labeled “**Low social vulnerability**” don’t meet any of the criteria above, and those labeled “**Not calculated**” contained characteristics that were not estimated in the American Community Survey, due to low population and other factors leading to low survey response.

**Use limitations to consider when working with American Community Survey (ACS) data:**

ACS estimates are available by geographical unit, in this dataset the block group, and do not represent where people actually live within that block group. [Statistical testing to determine significance](https://www2.census.gov/programs-surveys/acs/tech_docs/statistical_testing/2016StatisticalTesting5year.pdf) is recommended to definitively state that values in one block group are different than another block group. Statistical testing was not conducted for every block group in the Bay Area, as this dataset functions as a regional screening tool. ACS data are reported with an *estimate* and a *margin of error*, which represents 90% confidence that the actual value is within that range. In instances where the *margin of error* represents over half the *estimate*, this data should be treated as unreliable. For more information, refer to: [ACS Handbook for Data Users (Researchers)](https://www.census.gov/content/dam/Census/library/publications/2009/acs/ACSResearch.pdf)

Contamination Vulnerability Indicators

Contamination indicators represent degradation or threats to communities and the natural environment from pollution. The presence of contaminated lands and water raises health and environmental justice concerns, which worsen with flooding and sea level rise. A percentile score for the severity of contamination in each block group was calculated using data compiled by CalEPA Office of Environmental Health Hazard Assessment for use in the Environmental Effects category of [CalEnviroScreen 3.0](https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30). In CalEnviroScreen calculations, the Environmental Effects component is weighted half when incorporated into the total pollution burden. By looking at the Environmental Effects components isolated from the CalEnviroScreen total score, specific risk to contamination becomes more clear. The 5 specific types of contamination are:

* Land with hazardous substances undergoing cleanup actions, original source data from Dept. Toxic Substances Control and US EPA (Superfund Sites)
* Sites that may impact groundwater and require cleanup, original source data from State Water Resources Control Board
* Presence of hazardous waste generators and permitted facilities that are involved in the treatment, storage, or disposal of hazardous waste, original source data from DTSC
* Water bodies that do not meet water quality standards, listed as impaired under Section 303(d) of the Clean Water Act. Data from State Water Resources Control Board.
* Presence of solid waste sites and facilities, original source data from CalRecycle and DTSC

Rankings of social vulnerability were assigned by looking at the distributions of the data. Block groups labeled “**Highest contamination vulnerability**” have:

* 4 or more contamination indicators with rates in the 90th percentile, relative to the state; *and/or*
* Total contamination score above 90th percentile, relative to the state

Block groups labeled “**High contamination vulnerability**” don’t meet criteria in “Highest” category, and have:

* 5 indicators in the 70th percentile; *and/or*
* Total contamination score between 80th – 90th percentile

Block groups labeled “**Moderate contamination vulnerability**” don’t meet criteria in “Highest” and “High” categories, and have:

* 4 indicators in the 70th percentile; *and/or*
* Total contamination score between 70th – 80th percentile

Block groups labeled “**Lower contamination vulnerability**” don’t meet any of the criteria above.

Complementary Tools

Disadvantaged communities have a specific definition in California law. CA Senate Bill 535[[1]](#footnote-1) directs funds from the State’s cap-and-trade program to benefit “disadvantaged communities” and tasked CalEPA with the responsibility to develop the method to identify these communities. CalEPA Office of Environmental Health Hazard Assessment (OEHHA) created and updates the [CalEnviroScreen](https://oehha.ca.gov/calenviroscreen) tool, which combines pollution burden and population characteristics to generate a percentile score by census tract, relative to other tracts around the state. Funds directed to disadvantaged communities was increased with CA Assembly Bill 1550.[[2]](#footnote-2) CalEnviroScreen3.0 is the most recent version. In addition to the 5 contamination indicators described in the previous section, CalEnviroScreen3.0 includes data about direct exposure to Drinking water contaminants, Diesel PM, PM2.5, Ozone, Pesticides, Traffic, Toxic releases from facilities. Population characteristcs used are rates of Asthma, Cardiovascular disease, Low birth-weight infants, Educational attainment, Housing burdened low income households, linguistic isolation, unemployment, poverty.

The Metropolitan Transportation Commission (MTC) is a partner of the ART Program also working at the regional scale. MTC works to prepare Plan Bay Area (PBA), the integrated Sustainable Communities Strategy and Regional Transportation Plan for the San Francisco Bay Area. If implemented, PBA works to reduce greenhouse gas emissions from passenger vehicles through coordinated transportation, housing, and land use planning, as instructed by CA Senate Bill 375 (SB 375).[[3]](#footnote-3) MTC convened a regional equity working group to develop [Communities of Concern (CoC)](http://opendata.mtc.ca.gov/datasets/mtc-communities-of-concern-in-2018-acs-2012-2016), designed to represent where communities may be disadvantaged or exhibit vulnerabilities now, and in response to future growth. [The equity analysis of PBA 2040](http://2040.planbayarea.org/sites/default/files/2017-07/Equity_Report_PBA%202040%20_7-2017.pdf) analyzes the positive and negative impacts of PBA strategies on CoCs, compared with impacts on the remainder of the region. The ART approach includes (and supplements) the same characteristics as CoCs, and CoCs are at the larger geographic unit of census tract.

Displacement screening was added to this dataset after the ART Bay Area project working group made clear that it is necessary to consider displacement in early stages of the project—during researching community vulnerability, and not only considered when evaluating the impacts of potential adaptation strategies later in the project. [UC Berkeley Center for Community Innovation](http://communityinnovation.berkeley.edu/) Regional Early Warning System for Displacement and Gentrification Typologies were developed for use in evaluating gentrification and displacement risks associated with transit-oriented development, relevant to the implementation of SB 375. The typologies and [associated mapping tool](http://www.urbandisplacement.org/map/sf) are supported by [case studies of nine communities](http://www.urbandisplacement.org/case-studies/ucb), developed in collaboration with MTC’s [Bay Area Regional Prosperity Plan](https://mtc.ca.gov/our-work/plans-projects/economic-vitality/bay-area-regional-prosperity-plan). Regression models were developed identify indicators that can serve as predictors for loss of low income households and gentrification processes, and includes data about the age of buildings, employment density, housing market, and presence of rail station.

The Governor’s Office of Planning and Research guide [Defining Vulnerable Communities in the Context of Climate Adaptation](http://www.opr.ca.gov/docs/20180723-Vulnerable_Communities.pdf) provides an overview and comparison of more community vulnerability screening approaches.

1. De León, Chapter 830, Statutes of 2012 [↑](#footnote-ref-1)
2. [Gomez, Chapter 369, Statutes of 2016](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB1550) [↑](#footnote-ref-2)
3. [Sustainable Communities Act, Chapter 728, Statutes of 2008](http://www.leginfo.ca.gov/pub/07-08/bill/sen/sb_0351-0400/sb_375_bill_20080930_chaptered.pdf) [↑](#footnote-ref-3)