

Climate-Smart Cities™ Denver

Model Criteria

11/22/2017

Goal/Criteria	Methodology	Data (Description, Date)	Data & Source
CSC Goal: Connect (20%)			
GHG benefits of proposed trails	<p>20.0%</p> <p>This model quantifies the benefits of proposed active transportation projects (i.e., bicycle and pedestrian trails/routes) including reduced greenhouse gas emissions, reduced air pollution, household transportation savings, reduced mortality and reduced driving. At the heart of our methodology is a method for estimating reductions in vehicle trips and vehicle miles traveled due to bicycle facilities that was developed by the California Air Resources Board (ARB) in 2005. There are other methods available to estimate the transportation impacts of bicycle and pedestrian facilities, but the ARB methodology combines several key advantages:</p> <ul style="list-style-type: none"> - Widely Used - Simple - Widely Applicable <p>Proposed pedestrian and bicycle routes are prioritized based on the total number of reduced driving trips per year calculated for all proposed bike facilities using a natural breaks classification.</p>	<p>Proposed Bike Trails Suitable Streets Network Average Annual Daily Traffic Light Rail Station and Bus Stops Libraries Community Centers Grocery Stores Healthcare Facilities Businesses Slope Derived from Digital Elevation Model Area Type Derived from Population Density</p>	<p>Denver Open Data Catalog Trust for Public Land ESRI Denver Open Data Catalog ESRI Denver Open Data Catalog ESRI</p>
Routes to Schools	<p>10.0%</p> <p>This model prioritizes the streets and/or trail routes that provide the shortest (most direct) access to the closest school. Schools were separated into Elementary (K - 5), Middle (6 - 8), and High Schools (9 - 12) based on grade level. Each census block with a population greater than 0 people was routed to the nearest school, with a travel distance of no more than one mile for Elementary schools and 2 miles for Middle and High schools. Routes were buffered by 100 ft., converted to raster, and combined using a cell maximum. This was scored using a natural breaks classification based on the total number of times the route was identified as the most direct to reach a school.</p> <p>Very High: >15 High: 7 - 15 Moderate: 3 - 7</p>	<p>Schools Suitable Street Network Census blocks</p>	<p>DRCOG Street Map Premium 2016 Census</p>

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Routes to Parks	10.0%	<p>This model prioritizes the streets and/or trail routes that provide the shortest (most direct) access to the closest park within 2 miles from each census blocks with a population greater than 0 people. Routes were buffered by 100ft, converted to raster, and scored using a natural breaks classification based on the total number of times the route was identified as the most direct to reach a park.</p> <p>Very High: >9 High: 4 - 9 Moderate: 3 - 4</p>	<p>Parks Suitable Street Network Census blocks</p>	<p>The Trust for Public Land Park Serve StreetMap Premium 2016 Census</p>
Routes to Major Employers	10.0%	<p>This model prioritizes the streets and/or trail routes that provide the shortest (most direct) access to the closest major employer within 2 miles from each census blocks with a population greater than 0 people. A major employer was considered to be either 1) a business with more than 1,000 employees or 2) a hotspot of multiple business (created using a kernel density surface). Both route types were buffered by 100ft, converted to raster, and scored using a natural breaks classification based on the total number of times the route was identified as the most direct to reach a major employer. They were then combined using a Cell Maximum.</p> <p>Very High: >9 High: 4 - 9 Moderate: 3 - 4</p>	<p>Businesses Suitable Street Network Census blocks</p>	<p>ESRI Business Analyst StreetMap Premium 2016 Census</p>
Routes to Light Rail Stations	10.0%	<p>This model prioritizes the streets and/or trail routes that provide the shortest (most direct) access to the closest light rail station within 2 miles from each census blocks with a population greater than 0 people. Routes were buffered by 100 ft., converted to raster, and scored using a natural breaks classification based on the total number of times the route was identified as the most direct to reach a light rail station.</p> <p>Very High: >9 High: 4 - 9 Moderate: 3 - 4</p>	<p>Light rail stops Suitable Street Network Census blocks</p>	<p>RTD StreetMap Premium 2016 Census</p>

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Routes to Grocery Stores	10.0%	<p>This model prioritizes the streets and/or trail routes that provide the shortest (most direct) access to the closest grocery store within 2 miles from each census blocks with a population greater than 0 people. Routes were buffered by 100ft, converted to raster, and scored using a natural breaks classification based on the total number of times the route was identified as the most direct to reach a grocery store.</p> <p>Very High: >9 High: 4 - 9 Moderate: 3 - 4</p>	Grocery Stores Suitable Street Network Census blocks	Denver Open Data Catalog StreetMap Premium 2016 Census
Park Equity	10.0%	<p>This model identifies areas where residents do not live within at least a 10- minute walk (half-mile) of a park. All areas outside of a 10-minute walk were then given priority ranks based on population density with areas outside of a 10 minute walk with the largest number of people receiving the highest priority (5). This methodology is taken from The Trust for Public Land Park Serve project. More information here: ParkServe.org</p>	Parks Suitable Street Network	The Trust for Public Land Park Serve StreetMap Premium
Vision Zero School Proximity	10.0%	<p>This model prioritizes areas identified as Children Communities of Concern in Denver's Vision Zero Plan. The Children Community of Concern includes: 1) the number of children within one mile of the school they attend, 2) the proximity to a school, and 3) the density of schools.</p> <p>Very High (5) = Children Communities of Concern Score of 20 or 25 High (4) = Children Communities of Concern Score of 15 Moderate (3) = Children Communities of Concern Score of 10</p> <p>Areas around schools are key places for park and other multi benefit infrastructure improvements. They are also areas where traffic injuries are most likely and safety improvements are needed.</p>	Children Communities of Concern	Denver Vision Zero (https://geospatialdenver.maps.arcgis.com/apps/MapJournal/index.html?appid=e333ca7679ec40c2a3ef449e3b111743)

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Gaps in Transit	10.0%	This model identifies areas where residents do not live within at least a 10- minute walk (half-mile) of public transit. All areas outside of a 10-minute walk were then given priority ranks based on population density with areas outside of a 10 minute walk with the largest number of people receiving the highest priority (5).	Bus stops and Light rail stops Census blocks Suitable Street Network	RTD StreetMap Premium 2016 Census

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CSC Goal: Cool (20%)			
Daytime Urban Heat Islands	<p>80.0%</p> <p>This model identifies urban heat islands within the City & County of Denver with elevated daytime land surface temperature (LST) averaging at least 1.25 degrees Fahrenheit above the mean daily temperature during July and August. Mean temp over the whole study area is 98.3 degrees Fahrenheit. Above this mean the pixels are sliced into Moderate, High, and Very High priorities using Slice and Natural Breaks.</p> <p>Reclass: Very High (5) = 106.88 - 138.54 High (4) = 102.01 - 106.88 Moderate (3) = 99.58 - 102.01</p> <p>The model results were derived from Landsat satellite data, which provides a 30m downscaled average land surface temperature. Historical records show the warmest months in Denver are July and August.</p>	<p>The Landsat Land Surface Temperature for each Landsat scene was derived using a methodology developed by ESRI that converts the thermal bands of the imagery into degrees Fahrenheit using the raster function template editor. A more detailed description of the methodology can be found here - https://blogs.esri.com/esri/arcgis/2014/01/06/deriving-temperature-from-landsat-8-thermalbands-tirs/</p> <p>Scenes are from August 12th, 2014, June 9th, 2014, August 15th, 2015, and August 17th, 2016</p>	USGS
Nighttime Urban Heat Islands	<p>10.0%</p> <p>This model identifies urban heat islands within the City & County of Denver with elevated nighttime land surface temperature (LST) averaging at least 1.25 degrees Fahrenheit above the mean nighttime LST during July and August. Mean LST temperature over the study area is 72.58 degrees Fahrenheit. Above this mean the pixels are sliced into Moderate, High, and Very High priorities using Slice and Natural Breaks.</p> <p>Reclass: Very High (5) = 79.40 - 87.70 High (4) = 76.19 - 79.40 Moderate (3) = 73.80 - 76.19</p> <p>The model results were derived from ASTER satellite data, which provides a 90m resolution average land surface temperature. Historical records show the warmest months in Denver are July and August.</p>	<p>ASTER Land Surface Temperature</p> <p>Scenes from 21 July 2012 and 19 June 2012</p>	NASA

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Risk of Ash Borer	10.0%	<p>This model identifies risk of emerald ash borer by estimating the tree canopy by block group, and then determines the change to the tree canopy percent under a scenario of 100% ash tree fatality. Emerald ash borer is a predatorless tree insect. In some cities, the insect has killed every single ash tree. Denver has approximately 1.45 million ash trees. Significant infestation of the ash borer would exacerbate heat island issues as well as cause significant economic impacts.</p> <p>To calculate tree canopy risk, the tree canopy polygons were intersected with block group area and percent of ash tree canopy was calculated for each block group. Percent of ash trees was determined using the tree inventory point data, and therefore represents the percent of ash trees over the population of trees managed by the Department of Parks and Recreation in the City and County of Denver, not including trees in private yards. This is a proxy for total ash tree density until better data are available. Block groups with a high percentage of ash tree canopy were prioritized as follows: Very High (5) = >33% High (4) = 18% - 33% Moderate (3) = 10% - 18%</p> <p>The Denver Parks and Recreation 2017 Game Plan Update identified a tree-canopy cover of 15% to 18 % in urban residential areas and 10% in the central business district by 2025 as a goal.</p>	Metro Denver Urban Forest Assessment	Metro Denver Urban Forest Assessment

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CSC Goal: Climate Equity (20%)			
Minority Populations	0.08%	EJ Screen (2017)	EPA
<p>This model identifies socially vulnerable populations based on the percent of individuals within a block group who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino. The percentage of individuals identifying as a person of color were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 73.9% to 99.3% to 100% High (4) = 50.5% to 73.8% Moderate (3) = 28.3% to 50.4 %</p> <p>The model is based on data collected for the EPA Environmental Justice Screening Tool. "EPA should pay particular attention to the vulnerabilities of these populations because they have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population. (http://www.epa.gov/sites/production/files/2015-05/documents/ejscreen_technical_document_20150505.pdf)"</p>			

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source
Low-Income Populations	0.08%	EJ Screen (2017)	EPA

This model identifies socially vulnerable populations based on the percent of households within a block group where the household income is less than or equal to twice the federal "poverty level." The percentage of households with incomes less than or equal to twice the federal "poverty level" were broken into 0 to 5 priority classes using a quantile slice classification.

The break points for the moderate to high priority classes were as follows:

Very High (5) = 57.6% to 99.6%

High (4) = 40.1% to 57.5%

Moderate (3) = 27.6% to 40.0%

The model is based on data collected for the EPA Environmental Justice Screening Tool. "EPA should pay particular attention to the vulnerabilities of these populations because they have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population.

(http://www.epa.gov/sites/production/files/2015-05/documents/ejscreen_technical_document_20150505.pdf)

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Linguistic Isolation	<p>0.08%</p> <p>This model identifies socially vulnerable populations based on the percent of people in a block group living in linguistically isolated households. A linguistically isolated household is a household in which all members age 14 years and over speak a language other than English and also speak English less than "very well" (have difficulty with English). Block groups with linguistically isolated households were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 14.2% to 48.0% High (4) = 5.7% to 14.1% Moderate (3) = 2.4% to 5.6%</p> <p>The model is based on data collected for the EPA Environmental Justice Screening Tool. "EPA should pay particular attention to the vulnerabilities of these populations because they have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population. (http://www.epa.gov/sites/production/files/2015-05/documents/ejscreen_technical_document_20150505.pdf)"</p>	EJ Screen (2017)	EPA

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Less than HS Education	<p>This model identifies socially vulnerable populations based on the percent of people age 25 and older in a block group that do not have a high school diploma. Block groups with populations without a high school degree were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 29.1% to 63.4% High (4) = 13.6% to 29.0% Moderate (3) = 5.3% to 13.5%</p> <p>The model is based on data collected for the EPA Environmental Justice Screening Tool. "EPA should pay particular attention to the vulnerabilities of these populations because they have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population." http://www.epa.gov/sites/production/files/2015-05/documents/ejscreen_technical_document_20150505.pdf</p>	EJ Screen (2017)	EPA
Children Under 5	<p>This model identifies socially vulnerable populations based on the percent of people in a block group under the age of 5. Block groups with individuals under the age of 5 were broken into 0 to 5 priority classes using a natural breaks slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 10.0% to 22.9% High (4) = 7.3% to 9.9% Moderate (3) = 4.9% to 7.2%</p> <p>The model is based on data collected for the EPA Environmental Justice Screening Tool. "EPA should pay particular attention to the vulnerabilities of these populations because they have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population." http://www.epa.gov/sites/production/files/2015-05/documents/ejscreen_technical_document_20150505.pdf</p>	EJ Screen (2017)	EPA

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Children 5 to 19	<p>0.08%</p> <p>This model identifies socially vulnerable populations based on the percent of people in a block group between the ages of 5 to 19. Block groups with individuals between the ages of 5 to 19 were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to very high priority classes were as follows: Very High (5) = 24.1% - 48% High (4) = 18.8% - 24.1% Moderate (3) = 12.7% - 18.8%</p> <p>The model is based on data compiled by ESRI. Evidence indicates that impacts from climate change vary with age, while the very young and the very old have shown to be the most sensitive, all children have increased vulnerabilities than the general population. https://health2016.globalchange.gov/populations-concern</p>	2016 Census Block Groups	ESRI
Seniors over 64	<p>0.07%</p> <p>This model identifies socially vulnerable populations based on the percent of people in a block group over the age of 64. Block groups with individuals over age 64 were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 16.95% to 76.2% High (4) = 11.2% to 16.94% Moderate (3) = 8.0% to 11.1%</p> <p>The model is based on data collected for the EPA Environmental Justice Screening Tool. "EPA should pay particular attention to the vulnerabilities of these populations because they have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population." http://www.epa.gov/sites/production/files/2015-05/documents/ejscreen_technical_document_20150505.pdf"</p>	EJ Screen (2017)	EPA

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Disabled Population	0.08%	<p>This model identifies socially vulnerable populations based on the percent of people with a disability. Block groups with individuals with disabilities were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 19.8%- 28.8% High (4) = 12.8% - 19.8% Moderate (3) = 9.5% - 12.8%</p> <p>The model is based on data collected from the American Community Survey. There is heightened vulnerability of people with disabilities in disaster and emergency situations. Climate change-related health impacts may affect people with disabilities more than others.</p>	<p>The American Community Survey (ACS) is an ongoing survey of the US population conducted by the US Census Bureau. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a subsample of the population and includes more detailed information on socioeconomic factors such as households that own a car. [ACS table = P041 in the list, DEC_00_SF3_P041 in downloads]</p>	US Census Bureau
Households w/o cars	0.07%	<p>This model identifies socially vulnerable populations based on the percent of households that do not own a car. Block groups with households that do not own a car were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: High (5) = 16.85% to 61.9% High (4) = 7.77% to 16.84% Moderate (3) = 3.9% to 7.76%</p> <p>The model is based on data collected by the US Census Bureau. "Vehicle ownership is a measure of mobility and access to transportation. Transportation is a critical resource for survival, because it improves access to evacuation and shelter from environmental exposures, such as wildfire, air pollution, heat waves, and flooding, allowing people to move to cooler areas or other safe areas.(https://archive.cdph.ca.gov/programs/Documents/CalBRACE%202015CHPR/Car Ownership_37_Narrative_9-6-16.pdf)". Identifying populations without cars is also useful for targeting areas for transportation related projects.</p>	<p>The American Community Survey (ACS) is an ongoing survey of the US population conducted by the US Census Bureau. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a subsample of the population and includes more detailed information on socioeconomic factors such as households that own a car. [ACS table = ACS Tenure by vehicles available: ACS_15_5yr_B25044]</p>	US Census Bureau

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Single Parent Households	0.05%	<p>This model identifies socially vulnerable populations based on the percent of single-parent households. Block groups with single-parent households were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 26.7% - 82% High (4) = 17.9% - 26.7% Moderate (3) = 10.4% - 17.9%</p> <p>The model is based on data collected by the US Census Bureau. In Applied Studies in Climate Adaptation, the authors showed that single parent and renting households showed significantly higher vulnerability to extreme weather events. (Jean P. Palutikof, Sarah L. Boulter, Jon Barnett, David Rissik John Wiley & Sons, Oct 27, 2014 - Science - 496 pages)</p>	<p>The American Community Survey (ACS) is an ongoing survey of the US population conducted by the US Census Bureau. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a subsample of the population and includes more detailed information on socioeconomic factors such as households that own a car. [ACS table = Family type by presence and age of own children under 18 years: ACS_15_5YR_B11003,]</p>	US Census Bureau
Renter Percent	0.05%	<p>This model identifies socially vulnerable populations based on the percent of renting households. Block groups with renters were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 74% - 100% High (4) = 53% - 74% Moderate (3) = 39% - 53%</p> <p>The model is based on data collected by the US Census Bureau. In Applied Studies in Climate Adaptation, the authors showed that single parent and renting households showed significantly higher vulnerability to extreme weather events. (Jean P. Palutikof, Sarah L. Boulter, Jon Barnett, David Rissik John Wiley & Sons, Oct 27, 2014 - Science - 496 pages)</p>	<p>The American Community Survey (ACS) is an ongoing survey of the US population conducted by the US Census Bureau. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a subsample of the population and includes more detailed information on socioeconomic factors such as households that own a car. [ACS table = Tenure table: ACS_15_5YR_B25003]</p>	US Census Bureau

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Risk of Displacement	<p>0.08%</p> <p>This model identifies socially vulnerable population based on risk of displacement identified in the Denver Office of Economic Development (OED) study- Gentrification Study: Mitigating Involuntary Displacement. OED used to methodology developed Lance Freeman and applied by Lisa Bates to characterize and map gentrification typology of each census tract. The details of the study can be found here (https://www.denvergov.org/content/dam/denvergov/Portals/690/Reports%20and%20Studies/GENT%20STUDY%20051816.pdf) . Vulnerable neighborhoods were also determined based on whether two of the following three criteria are met: median household income is lower than Denver's, percent renter-occupied units is higher than Denver's, or percent residents with less than a Bachelor's Degree is higher than Denver's. Census tracts were reclassified into priority classes as follows:</p> <p>Very High (5) = Early housing gentrification and Early population gentrification High (4) = Current and ongoing loss and Susceptible to gentrification Moderate (3) = Late stage gentrification and Continued loss gentrification OR census tracts that do not fit in the above categories that are considered "Vulnerable Neighborhoods"</p>	<p>Results of the Gentrification Study: Mitigation Involuntary Displacement were tagged to ESRI tract data layer</p>	<p>OED and ESRI</p>
Seniors Living Alone	<p>0.07%</p> <p>This model identifies socially vulnerable populations based on the percent of seniors living alone. Block groups with renters were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 13.1% - 63% High (4) = 8.7% - 13.1% Moderate (3) = 5.8% - 8.7%</p> <p>The model is based on data collected by the US Census Bureau. Seniors living alone are a particularly isolated segment of the population. In Applied Studies in Climate Adaptation, the authors concluded that households with multiple disadvantages are the most vulnerable to climate change. (Jean P. Palutikof, Sarah L. Boulter, Jon Barnett, David Rissik John Wiley & Sons, Oct 27, 2014 - Science - 496 pages)</p>	<p>The American Community Survey (ACS) is an ongoing survey of the US population conducted by the US Census Bureau. Unlike the decennial census, which attempts to survey the entire population and collects a limited amount of information, the ACS releases results annually based on a subsample of the population and includes more detailed information on socioeconomic factors such as households that own a car. [ACS table = Households with one or more people 65 years and over & 1 person household :ACS_15_5YR_B11007]</p>	<p>US Census Bureau</p>

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CSC Goal: Absorb & Protect (20%)			
Priority Scorecard Basins	<p>80.0%</p> <p>This model prioritizes the basins identified in the City of Denver Stormwater Quality Prioritization and BMP Opportunity Analysis Plan as priorities for improving stormwater quality. The priority Water Quality Scorecard basins were mapped through a GIS-based prioritization process including land use, imperviousness, parcels, storm drain networks, locations of parks, and census data, and they represent areas that have a need for stormwater quality improvement that also have opportunity for implementing a Best Management Practice.</p> <p>The Scorecard Priority Basins were reclassified as follows: Very High (5) = Scorecard Basin Priority of High High (4) = Scorecard Basin Priority of Medium-High Moderate (3) = Scorecard Basin Priority of Medium</p>	City of Denver Stormwater Quality Prioritization and BMP Opportunity Analysis Plan	City of Denver
Strom Drain Thalwegs	<p>20.0%</p> <p>This model identifies significant thalwegs, natural drainage path for priority Scorecard Basins and prioritizes the area within 1000 ft. of the thalweg. Thalwegs identified are major overland storm runoff flow paths that would be expected to produce runoff in excess of existing storm drainage collection system capacities in the storm drainage basins that have been identified in the Stormwater Quality Prioritization and BMP Opportunity analysis Plan as priorities for improving stormwater quality</p>	City and County of Denver Storm Drainage Master Plan (2014)	City of Denver

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CSC Goal: Health Equity (20%)				
High Blood Pressure	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with High blood pressure. Census tracts with individuals with high blood pressure were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 28.7% - 47.5% High (4) = 26.2% - 28.7% Moderate (3) = 24.3% - 26.2%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project. Harmful air pollutants, like ozone and particulate matter, as well as allergens expected to increase with climate change. Populations with existing conditions, specifically high blood pressure, diabetes, chronic obstructive pulmonary disorder (COPD), or asthma, will be at increased risk of exacerbating their existing conditions (https://www.cmu.edu/steinbrenner/EPA%20Factsheets/ej-health-climate-change.pdf).</p>	<p>Center for Disease Control and Prevention (CDC) used an innovative peer-reviewed approach predict to individual disease risk and health behaviors in a multi-level modeling framework, and estimates the geographic distributions of population disease burden and health behaviors. The primary data sources for this project are the CDC Behavioral Risk Factor Surveillance System, the Census 2010 population, and the American Community Survey estimates. High Blood Pressure measure includes respondents aged ≥18 years who report ever having been told by a doctor, nurse, or other health professional that they have high blood pressure. Women who were told high blood pressure only during pregnancy and those who were told they had borderline hypertension were not included.</p>	CDC

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source
Cancer	<p>This model identifies health vulnerability of the population based on the percent of adults with cancer. Census tracts with individuals with cancer were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 6.2% - 12.9% High (4) = 5.4% - 6.2% Moderate (3) = 4.5% - 5.4%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project Harmful air pollutants, like ozone and particulate matter, expected to increase with climate change. A decline in air quality increases the risk of lung cancer (https://www.niehs.nih.gov/research/programs/geh/climatechange/health_impacts/cancer/index.cfm). Increased exposure to toxic material following heavy rainfall or flooding is also known to increase risk of cancer. (https://www.niehs.nih.gov/research/programs/geh/climatechange/health_impacts/cancer/index.cfm)</p>	<p>Center for Disease Control and Prevention (CDC) used an innovative peer-reviewed approach predict to individual disease risk and health behaviors in a multi-level modeling framework, and estimates the geographic distributions of population disease burden and health behaviors. The primary data sources for this project are the CDC Behavioral Risk Factor Surveillance System, the Census 2010 population, and the American Community Survey estimates. Cancer includes respondents aged ≥18 years who report ever having been told by a doctor, nurse, or other health professional that they have any other types (besides skin) of cancer.</p>	CDC
Asthma	<p>This model identifies health vulnerability of the population based on the percent of adults with High blood pressure. Census tracts with individuals with high blood pressure were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 8.7% - 10.6% High (4) = 8.3% - 8.7% Moderate (3) = 8% - 8.3%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project. Harmful air pollutants, like ozone and particulate matter, as well as allergens expected to increase with climate change. Populations with existing conditions, specifically high blood pressure, diabetes, chronic obstructive pulmonary disorder (COPD), or asthma, will be at increased risk of exacerbating their existing conditions (https://www.cmu.edu/steinbrenner/EPA%20Factsheets/ej-health-climate-change.pdf).</p>	<p>The Colorado Department of Public Health and Environment has developed community-level estimates based on modeled survey data collected in the Colorado Behavioral Risk Factor Surveillance System (BRFSS) and incorporating population, race, gender, and age estimates for each census tract from the American Community Survey. Current Asthma is defined as ever being diagnosed with Asthma and still having the condition. The estimate for each census tract represents an average that was derived using multiple years of BRFSS survey responses (2013-2016) and American Community Survey population & demographic estimates.</p>	CDPHE

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Model Criteria

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source	
Coronary Heart Disease	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with heart disease. Census tracts with individuals with coronary heart disease were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 3.1% - 6.5% High (4) = 2.6% - 3% Moderate (3) = 2.2% - 2.5%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project. Those with heart disease have an increased sensitivity to heat stress. (https://www.cmu.edu/steinbrenner/EPA%20Factsheets/ej-health-climate-change.pdf).</p>	<p>The Colorado Department of Public Health and Environment has developed community-level estimates based on modeled survey data collected in the Colorado Behavioral Risk Factor Surveillance System (BRFSS) and incorporating population, race, gender, and age estimates for each census tract from the American Community Survey. Coronary Heart Disease is defined as ever being diagnosed with either Angina or Coronary Heart Disease. The estimate for each census tract represents an average that was derived using multiple years of BRFSS survey responses (2013-2016) and American Community Survey population & demographic estimates. Coronary Heart Disease includes respondents aged ≥18 years who report ever having been told by a doctor, nurse, or other health professional that they had angina or coronary heart disease.</p>	CDPHE

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Model Criteria

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source
COPD	<p>This model identifies health vulnerability of the population based on the percent of adults with chronic obstructive pulmonary disorder (COPD). Census tracts with individuals with chronic obstructive pulmonary disorder (COPD) were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 5.8% - 9.4% High (4) = 4.7% - 5.8% Moderate (3) = 3.9% - 4.7%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project. Harmful air pollutants, like ozone and particulate matter, as well as allergens expected to increase with climate change. Populations with existing conditions, specifically high blood pressure, diabetes, chronic obstructive pulmonary disorder (COPD), or asthma, will be at increased risk of exacerbating their existing conditions (https://www.cmu.edu/steinbrenner/EPA%20Factsheets/ej-health-climate-change.pdf).</p>	<p>Center for Disease Control and Prevention (CDC) used an innovative peer-reviewed approach predict to individual disease risk and health behaviors in a multi-level modeling framework, and estimates the geographic distributions of population disease burden and health behaviors. The primary data sources for this project are the CDC Behavioral Risk Factor Surveillance System, the Census 2010 population, and the American Community Survey estimates. Chronic obstructive pulmonary disease (COPD) includes respondents aged ≥18 years who report ever having been told by a doctor, nurse, or other health professional that they had chronic obstructive pulmonary disease (COPD), emphysema, or chronic bronchitis.</p>	CDC
Stroke	<p>This model identifies health vulnerability of the population based on the percent of adults who have experienced a stroke. Census tracts with individuals with who have experienced a stroke were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 3.1% - 6.0% High (4) = 2.6% - 3.1% Moderate (3) = 2.1% - 2.6%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project. Increased hospital admissions for stroke have been found with extreme cold and heat events, which are expected to increase with climate change.</p>	<p>Center for Disease Control and Prevention (CDC) used an innovative peer-reviewed approach predict to individual disease risk and health behaviors in a multi-level modeling framework, and estimates the geographic distributions of population disease burden and health behaviors. The primary data sources for this project are the CDC Behavioral Risk Factor Surveillance System, the Census 2010 population, and the American Community Survey estimates. Stroke includes respondents aged ≥18 years who report ever having been told by a doctor, nurse, or other health professional that they have had a stroke.</p>	CDC

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Model Criteria

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source	
Diabetes	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with diabetes. Census tracts with individuals with diabetes were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 9.3% - 11.1% High (4) = 7.4% - 9.2% Moderate (3) = 6.5% - 7.4%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project. Harmful air pollutants, like ozone and particulate matter, as well as allergens expected to increase with climate change. Populations with existing conditions, specifically high blood pressure, diabetes, chronic obstructive pulmonary disorder (COPD), or asthma, will be at increased risk of exacerbating their existing conditions. Diabetes is also known to increase a person's sensitivity to heat stress. Diabetics are further at risk from extreme events when it limits their access to needed medicine. https://www.cmu.edu/steinbrenner/EPA%20Factsheets/ej-health-climate-change.pdf.</p>	<p>The Colorado Department of Public Health and Environment has developed community-level estimates based on modeled survey data collected in the Colorado Behavioral Risk Factor Surveillance System (BRFSS) and incorporating population, race, gender, and age estimates for each census tract from the American Community Survey. Diabetes is defined as ever being diagnosed with Diabetes, and this definition does not include gestational, borderline, or pre-diabetes. The estimate for each census tract represents an average that was derived using multiple years of BRFSS survey responses (2013-2016) and American Community Survey population & demographic estimates.</p>	CDPHE

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Model Criteria

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source	
High Cholesterol	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with high cholesterol. Census tracts with individuals with high cholesterol were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 36% - 47% High (4) = 34.3% - 36% Moderate (3) = 32.9% - 34.3%</p> <p>The model is based on data collected by the Colorado Department of Public Health and Environment. Populations with existing conditions, specifically high blood pressure, diabetes, chronic obstructive pulmonary disorder (COPD), or asthma, will be at increased risk of exacerbating their existing conditions. In addition, behaviors associated with high cholesterol and obesity (lack of activity, single vehicle use, eating processed foods, etc.) are also activities that are associated with increases in GHG emissions. http://journals.sagepub.com/doi/abs/10.1177/1559827613502452#articleCitationDownloadContainer</p>	<p>Center for Disease Control and Prevention (CDC) used an innovative peer-reviewed approach predict to individual disease risk and health behaviors in a multi-level modeling framework, and estimates the geographic distributions of population disease burden and health behaviors. The primary data sources for this project are the CDC Behavioral Risk Factor Surveillance System, the Census 2010 population, and the American Community Survey estimates. High cholesterol includes respondents aged ≥18 years who report having been told by a doctor, nurse, or other health professional that they had high cholesterol.</p>	CDC

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Model Criteria

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Goal/Criteria		Methodology	Data (Description, Date)	Data & Source
Chronic Kidney Disease	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with chronic kidney disease. Census tracts with individuals with chronic kidney disease were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 3% - 4.3% High (4) = 2.1% - 3% Moderate (3) = 1.1% - 2%</p> <p>The model is based on data collected by the Center for Disease Control (CDC) 500 Cities project. Research indicates that climate change may be accelerating rates of chronic kidney disease. (American Society of Nephrology (ASN). "Climate change may contribute to rising rates of chronic kidney disease." ScienceDaily. ScienceDaily, 5 May 2016. <www.sciencedaily.com/releases/2016/05/160505222718.htm>.)</p>	<p>Center for Disease Control and Prevention (CDC) used an innovative peer-reviewed multi-level regression and post stratification (MRP) approach that linked geocoded health surveys and high spatial resolution population demographic and socioeconomic data. This approach predicts individual disease risk and health behaviors in a multi-level modeling framework, and estimates the geographic distributions of population disease burden and health behaviors. The primary data sources for this project are the CDC Behavioral Risk Factor Surveillance System, the Census 2010 population, and the American Community Survey estimates. Chronic kidney disease includes respondents aged ≥18 years who report ever having been told by a doctor, nurse, or other health professional that they have kidney disease.</p>	CDC

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Model Criteria

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Goal/Criteria		Methodology	Data (Description, Date)	Data & Source
Frequent Mental Distress	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with mental health issues. Census tracts with individuals with mental health issues were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 10.5% - 11.6% High (4) = 9.7% - 10.5% Moderate (3) = 9.2% - 9.6%</p> <p>The model is based on data collected by the Colorado Department of Public Health and Environment. "Research indicates that extreme weather events such as large storms, flooding, droughts and heat waves are likely to become more frequent or more intense with climate change. Experiencing disasters related to climate and weather can cause significant stress and distress for many and contribute to more serious mental health issues. (https://www.psychiatry.org/patients-families/climate-change-and-mental-health-connections)"</p>	<p>The Colorado Department of Public Health and Environment has developed community-level estimates based on modeled survey data collected in the Colorado Behavioral Risk Factor Surveillance System (BRFSS) and incorporating population, race, gender, and age estimates for each census tract from the American Community Survey. Frequent Mental Distress is defined as experiencing more than 14 mentally unhealthy days within the past 30 days in which mental health was "not good." Health conditions for measuring mental health include stress, depression, and problems with emotions. The estimate for each census tract represents an average that was derived using multiple years of BRFSS survey responses (2013-2016) and American Community Survey population & demographic estimates.</p>	CDPHE

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Model Criteria

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source	
Poor Physical Health	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with poor physical health. Census tracts with individuals with poor physical health were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 11.1% - 13.4% High (4) = 10.2% - 11.1% Moderate (3) = 9.5% - 10.2%</p> <p>The model is based on data collected by the Colorado Department of Public Health and Environment. Populations with existing conditions, specifically high blood pressure, diabetes, chronic obstructive pulmonary disorder (COPD), or asthma, will be at increased risk of exacerbating their existing conditions.</p>	<p>The Colorado Department of Public Health and Environment has developed community-level estimates based on modeled survey data collected in the Colorado Behavioral Risk Factor Surveillance System (BRFSS) and incorporating population, race, gender, and age estimates for each census tract from the American Community Survey. Frequent Physical Distress is defined as experiencing more than 14 physically unhealthy days within the past 30 days in which physical health was "not good." Health conditions for measuring physical health include physical illness and injury. The estimate for each census tract represents an average that was derived using multiple years of BRFSS survey responses (2013-2016) and American Community Survey population & demographic estimates.</p>	CDPHE

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Model Criteria

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Goal/Criteria	Methodology	Data (Description, Date)	Data & Source	
Obesity	8.3%	<p>This model identifies health vulnerability of the population based on the percent of adults with obesity. Census tracts with individuals with obesity were broken into 0 to 5 priority classes using a quantile slice classification.</p> <p>The break points for the moderate to high priority classes were as follows: Very High (5) = 21.4% - 24.6% High (4) = 18.2% - 21.2% Moderate (3) = 16.6% - 18.2%</p> <p>The model is based on data collected by the Colorado Department of Public Health and Environment. Populations with existing conditions, specifically high blood pressure, diabetes, chronic obstructive pulmonary disorder (COPD), or asthma, will be at increased risk of exacerbating their existing conditions. In addition, behaviors associated with high cholesterol and obesity (lack of activity, single vehicle use, eating processed foods, etc.) are also activities that are associated with increases in GHG emissions. (http://journals.sagepub.com/doi/abs/10.1177/1559827613502452#articleCitationDownloadContainer)</p>	<p>The Colorado Department of Public Health and Environment has developed community-level estimates based on modeled survey data collected in the Colorado Behavioral Risk Factor Surveillance System (BRFSS) and incorporating population, race, gender, and age estimates for each census tract from the American Community Survey. Obese is defined as a BMI of 30 or greater. BMI is calculated from self-reported height and weight. The estimate for each census tract represents an average that was derived using multiple years of BRFSS survey responses (2013-2016) and American Community Survey population & demographic estimates.</p>	CDPHE