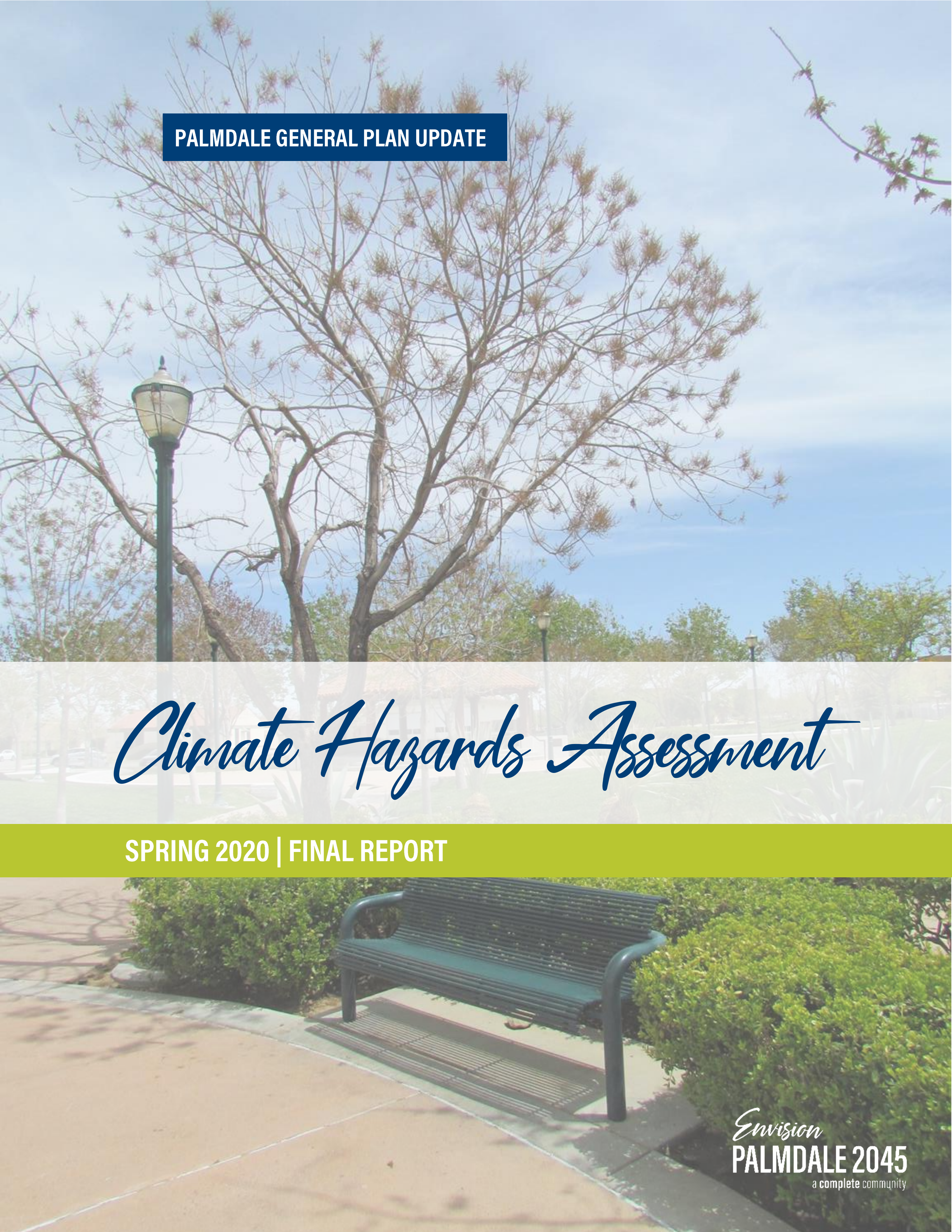
PALMDALE GENERAL PLAN UPDATE

Climate Hazards Assessment

SPRING 2020 | FINAL REPORT



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Chapter 11: Climate Hazards Assessment

This chapter provides an overview of historical and projected trends for climate hazards within the City of Palmdale. It summarizes the best available data for temperature and precipitation change, urban flooding, extreme heat, drought, and air quality. As much as feasible, the memorandum describes the nature, frequency, and magnitude of the hazards in the region.[1] *Establishing an understanding of climate hazards based on a review of observed records and future projections is the first step to understand the vulnerability of populations, infrastructure, ecosystems, economy, buildings and property, and other assets to climate change, and to develop and prioritize adaptation strategies and investments.*

1 Climate hazards information is based on the best available information at the time of publication. It is consistent with the California's 4th Climate Assessment and the Los Angeles Region Report. The data contained within this document is generally based on the Los Angeles region or the City of Palmdale, unless otherwise indicated.

Key Findings

Climate change presents the City of Palmdale with a series of overlapping challenges. Both gradual climate change and climate hazard events can expose people, infrastructure, economy, building and property, and ecosystems to a wide range of stress-inducing and hazardous situations. These hazards and their impacts are likely to disproportionately affect the most sensitive populations in the City. The following summarizes key findings for climate hazards in Palmdale and provides an example of the potential impacts of climate change in the area. These findings are consistent with trends across California (Table 11.1) and in the Los Angeles region.

- **Average temperatures** will continue to rise in Palmdale. Annual maximum temperatures are projected to increase between 4.9°F and 6.3°F by mid-century (2040-2060) and between 6°F and 9.8°F by end of century (2080-2100).[2]
- **Extreme heat** days will increase considerably in Palmdale. Historically, the city experienced 43 extreme heat days annually. Under a business-as-usual scenario by mid-century, the City will experience 78 extreme heat days annually and by the end of the century, 106 extreme heat days annually. Extreme heat is one of the most significant health impacts of climate change. In the US, extreme heat causes more deaths annually than floods, storms, and lightning combined.[3]
- While Palmdale can expect about the same amount of **annual precipitation** as the past several decades, dry and wet extremes are anticipated to increase.
    - Regionally, the wettest day of the year is expected to increase, with some locations experiencing 25-30% increases under a high emissions scenario. Areas in **flood hazard** zones are near Amargosa Creek, Anaverde Creek, Little Rock Wash, Big Rock Wash, and urban areas near the center of Palmdale and a region just east of four corners.
    - **Droughts** are expected to increase in Palmdale. The last California 6-year drought (2011-2016) was the driest recorded period in the state's history.
- Projections suggest that **wildfire risk** will continue to increase in Southern California. The City is in a wildfire severity zone, particularly the area south and west of the California Aqueduct, including Ritter Ranch Park and the adjacent open space. This area consists of undeveloped open space with chaparral, trees and grassland groundcover which provide fuel for wildfires.
- Despite improvements in regional **air quality**, many climate projections expect air quality to worsen in the City. Currently, the Mojave Desert Air Basin

2 Temperature change range represent lower and higher-emissions scenario for Palmdale. California Energy Commission. (2017). Cal-Adapt. Retrieved from: http://cal-adapt.org/.

[3] Berko, Jeffrey, Deborah D. Ingram, Shubhayu Saha, and Jennifer D. Parker. 2014. "Deaths Attributed to Heat, Cold, and Other Weather Events in the United States, 2006-2010." National Health Statistics Reports, no. 76 (July): 1–15.

does not meet State and federal standards for ozone and particulate matter (PM_{10}).

- There is currently **no funding** for major flood control and water management improvements in unincorporated areas.

Table 11.1 Description of Current Understanding of Historical and Expected Climate Impacts in California

Climate Change Hazards	Historical Trend	Future Change	Confidence for Future Change
Primary Climate Change Impacts			
Average Temperature	Warming (last 100+ years)	Warming	Very High
Extreme Heat	Rising (last 100+ years)	Rising	Very High
Annual Precipitation	No significant trends (last 100+ years)	Unknown	Low
Heavy Precipitation Events	No significant trends (last 100+ years)	Increasing	Medium-High
Secondary Climate Change Impacts			
Drought	No significant trends (last 100+ years)	Increasing	Medium-High
Air Quality	Improving (30+ years)	Worsening	Low
Wildfire	Increasing (last 30+ years)	Increasing	Medium-High

Source: Adapted from California's Fourth Climate Change Assessment (2018).[4]

4 Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). (2018). Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

Climate Change Projections

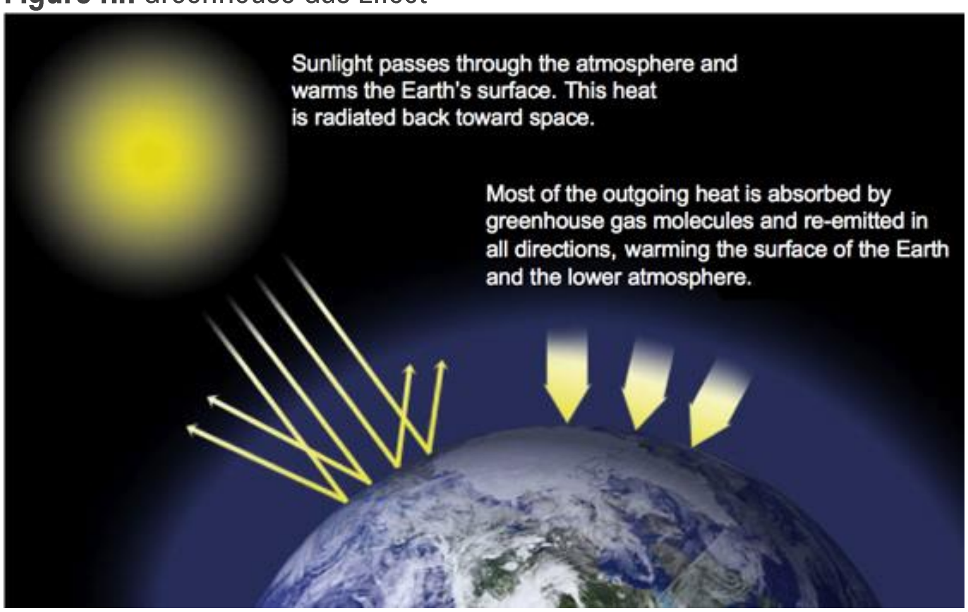
The data, maps, and analysis presented within this summary include historic information about the climate and projections of future climate. Climate is the long-term behavior of the atmosphere – typically represented as averages – for a given time of year. This includes average annual temperature, snowpack, or rainfall.

While climate projections cannot predict what will happen at a certain date in the future, projections can provide cities with information about what to expect from the climate in the future. For example, climate projections can estimate how much warmer the temperature will be in summer or how many more extreme weather events are likely to occur in the future. Climate projections, however, cannot forecast with precision when those events will actually occur.

Future climate projections are created using global climate models. These models simulate climate conditions both in the past and in the future. Climate scientists can use these models to test how the climate will change (or not) based on scenarios of greenhouse gas emissions.

Human emissions of carbon dioxide and other greenhouse gas emissions are important drivers of global climate change. Greenhouse gases trap heat in the atmosphere, resulting in warming over time, as shown in Figure 11.1.

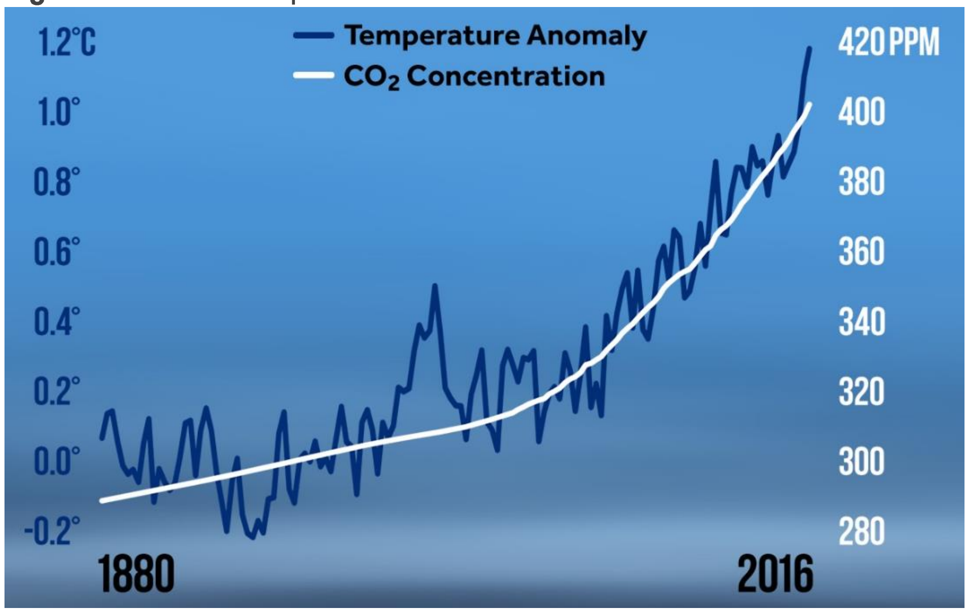
Figure 11.1 Greenhouse Gas Effect



Source: NASA (2018).

This atmospheric warming leads to other changes in the earth systems, including changing patterns of rainfall and snow, melting of glaciers and ice, and warming of oceans. Figure 11.2 shows the closely related historic trends in carbon dioxide (CO_2) and global temperatures since 1880.

Figure 11.2 Global Temperatures and Greenhouse Gas Emissions



Source: Climate Central (2018).

The extent of climate change in the future depends in part on the amount of greenhouse gas emissions now and in the future. Greenhouse gas emissions are driven by economic systems, land use patterns, transportation and energy systems, and other social and political factors. As such, climate scientists cannot be certain how emissions and the climate will change in the future.

Scientists use greenhouse gas emission scenarios to understand a range of potential climate projections. These include: a higher emission (or business-as-usual) scenario where emissions continue to rise, along with population growth through 2050 and plateau around 2100, and a lower-emissions scenario where emissions peak around mid-century then decline, due to worldwide efforts to reduce them. This document typically includes data and forecasts representing an average climate model for the higher-emissions scenario (business-as-usual scenario).

Temperature

During the last century, average surface temperatures in California rose steadily. Between 1918 and 2006, the average minimum temperature increased by 0.3°F per decade, and the average maximum temperature increased by 0.13°F per decade. The rate of warming intensified from 1970 to 2006, with average minimum temperatures increasing 0.56°F per decade and average maximum temperatures rising 0.49°F per decade. Average minimum and maximum temperatures in Southern California rose faster than the State as a whole. Between 1970 and 2006, the average minimum temperature rose by 0.67°F per decade and the average maximum temperature increased by 0.74°F per decade across the region.[5] The top 5 warmest years, in terms of annual average temperature, have all occurred since 2012: 2014 was the warmest, followed by 2015, 2017, 2016, and 2012.

Climate change models indicate that temperatures will continue to rise in Palmdale. Annual maximum temperatures are projected to increase between 4.9°F and 6.3°F by mid-century (2040-2060) and between 6°F and 9.8°F by end of century (2080-2100).[6] By the end of the century, the average future temperature in the climate scenario with the least warming is greater than the very warmest year of the historic record.[7] Figure 11.3 and 11.4 show the projected change in average annual minimum and maximum temperatures. The grey lines illustrate the observed, past temperature and the green lines shows the climate scenario projection.

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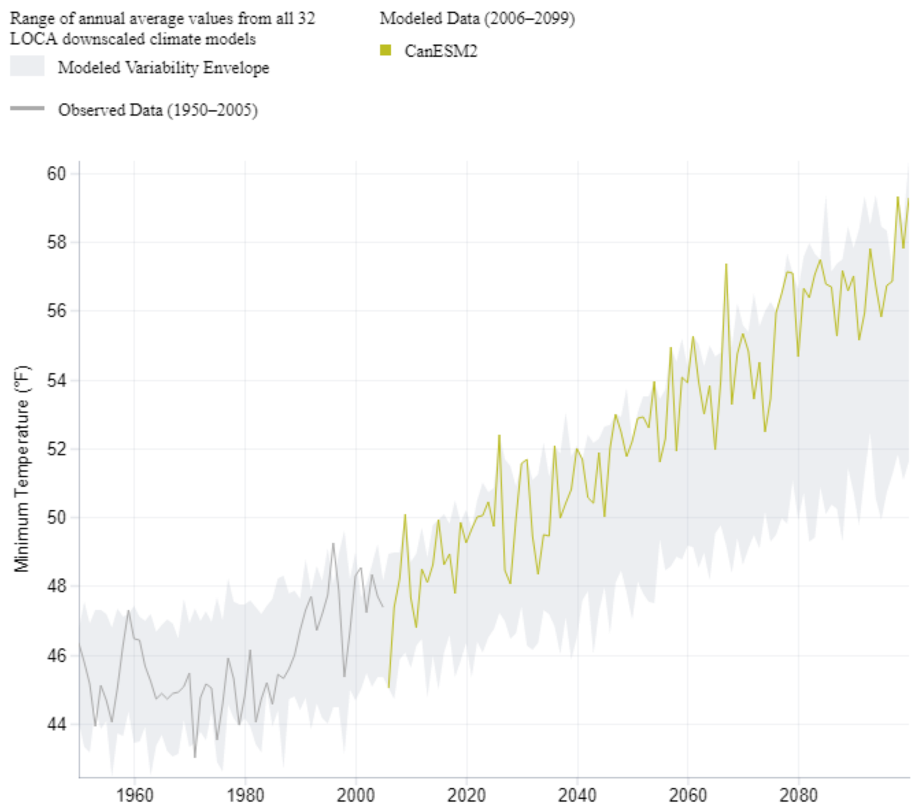
5 Cordero, E. C., W. Kessomkiat, J. Abatzoglou, and S. A. Mauget. (2011). The identification of distinct patterns in California temperature trends. Climatic change 108:357– 382.

6 Temperature change range represent lower and higher-emissions scenario for Palmdale. California Energy Commission. (2017). Cal-Adapt. Retrieved from: http://cal-adapt.org/.

7 Fengpeng S, et al. (2015). A Hybrid Dynamical–Statistical Downscaling Technique. Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region. Journal of Climate. 28:4618-4636.

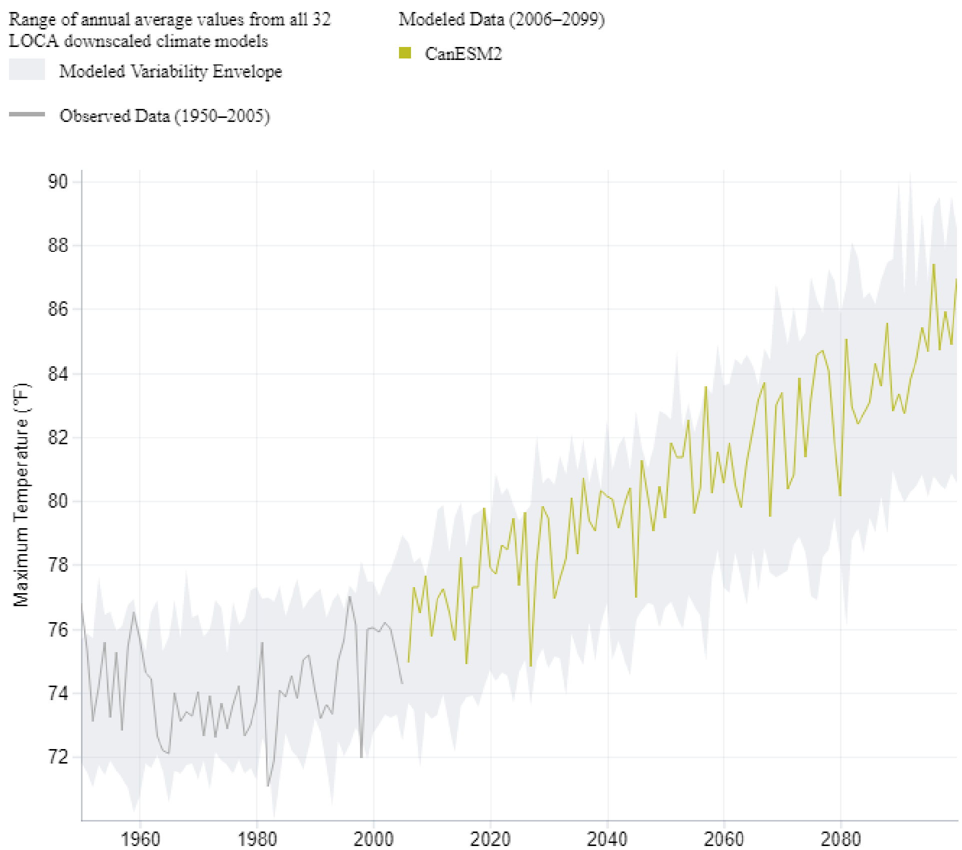
Figure 11.3: Projected Change in Average Annual Minimum Temperatures in Palmdale



Note: Business as Usual Scenario (High Emissions), CanESM2 Model (Average)
Source: CalAdapt (2018).[8]

8 CalAdapt. (2018). Business as Usual Scenario (High Emissions), CanESM2 Model (Average). Retrieved from: https://cal-adapt.org/tools/annual-averages/

Figure 11.4: Projected Change in Average Annual Maximum Temperatures in Palmdale



Note: Business as Usual Scenario (High Emissions), CanESM2 Model (Average)
Source: CalAdapt (2018).[9]

9 CalAdapt. (2018). Business as Usual Scenario (High Emissions), CanESM2 Model (Average). Retrieved from: https://cal-adapt.org/tools/annual-averages/

Extreme Heat Days

With climate change, extreme heat events in California and Palmdale are becoming more frequent, more intense, and longer lasting. An extreme heat day is defined as a day between April and October when the maximum temperature exceeds a given heat threshold.[10] Heat waves, defined as three or more days with temperatures above 90°F, are also projected to occur more frequently by the end of the century.

Extreme heat days and heat waves can negatively impact human health. While the human body has cooling mechanisms that help auto-regulate body temperature within one or two degrees of 98.6 degrees, heat stress can cause fatigue, headaches, dizziness, nausea, and confusion. The combination of heat and high humidity is particularly lethal; it can result in heat stroke, which can lead to death, even among healthy people.[11] Historically, the city experiences 43 extreme heat days annually.

Extreme heat days and heat waves are predicted to impact larger areas, last longer, and have higher temperatures. In particular, coastal areas in Southern California are projected to experience an increase in humid nighttime heat waves.[12]

The number of extreme heat days is anticipated to increase significantly across the Los Angeles region during the next century, but more so in inland areas than coastal cities. By mid-century, Palmdale is expected to have 78 extreme heat days under a business-as-usual scenario. By the end of century, Palmdale is projected to experience 106 extreme heat days. Figures 11.5-11.7 show the projected number of extreme heat days across the region for various time periods.

10 This threshold is often calculated as the 98th percentile of historical maximum temperatures between April 1 and October 31 based on observed daily temperature data.

11 Brink, S. (2013). How 100 Degrees Does a Number on You." National Geographic. Retrieved from: https://news.nationalgeographic.com/news/2013/07/130716-heat-wave-dehydration-stroke-summer-sweat/

12 Gershunov, A., and Guirguis, K. (2012). California heat waves in the present and future. Geophysical Research Letters, 39(18), 7.

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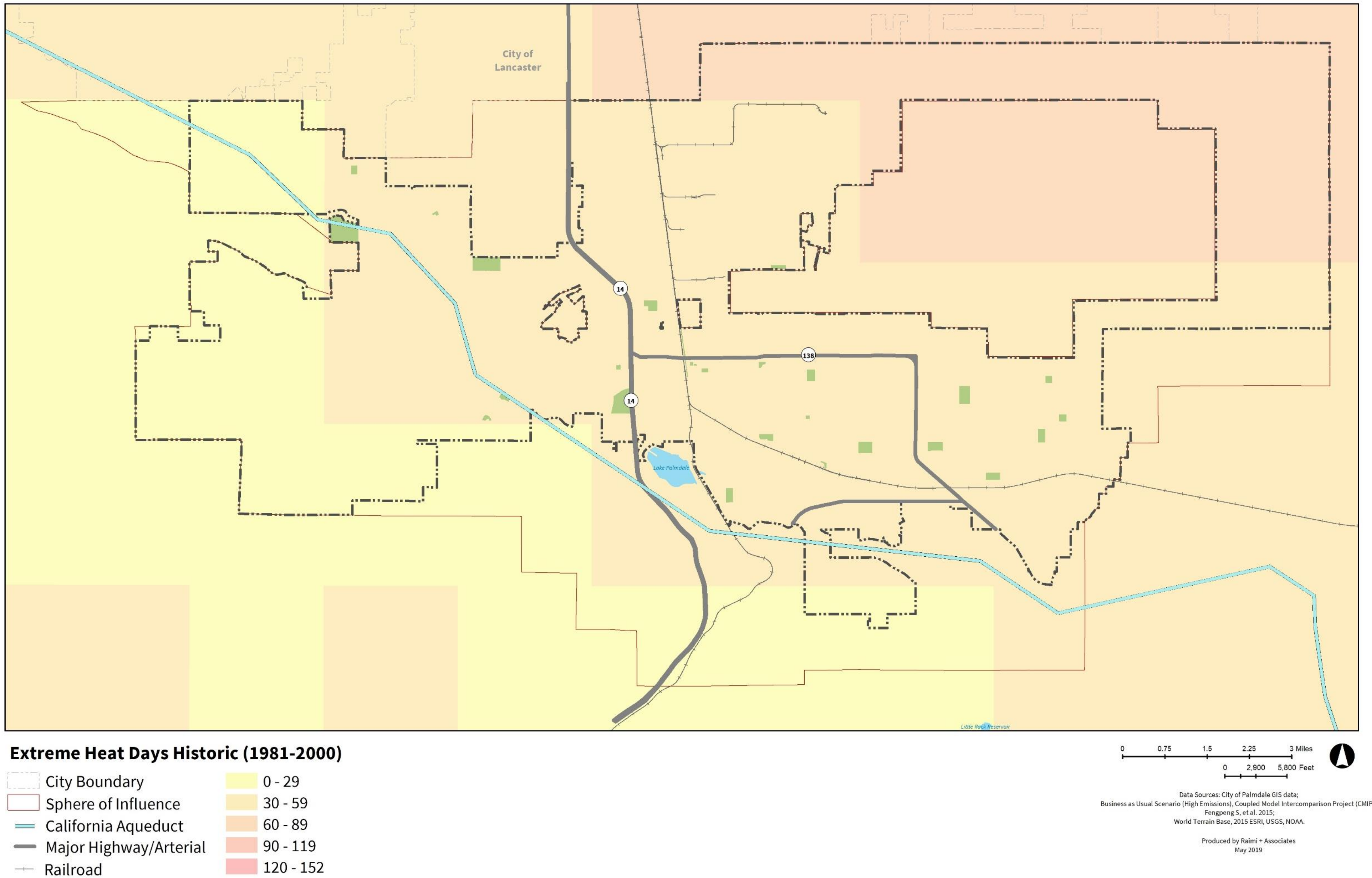
Figure 11.5 Historic Number of Extreme Heat Days in Palmdale (1981-2000)

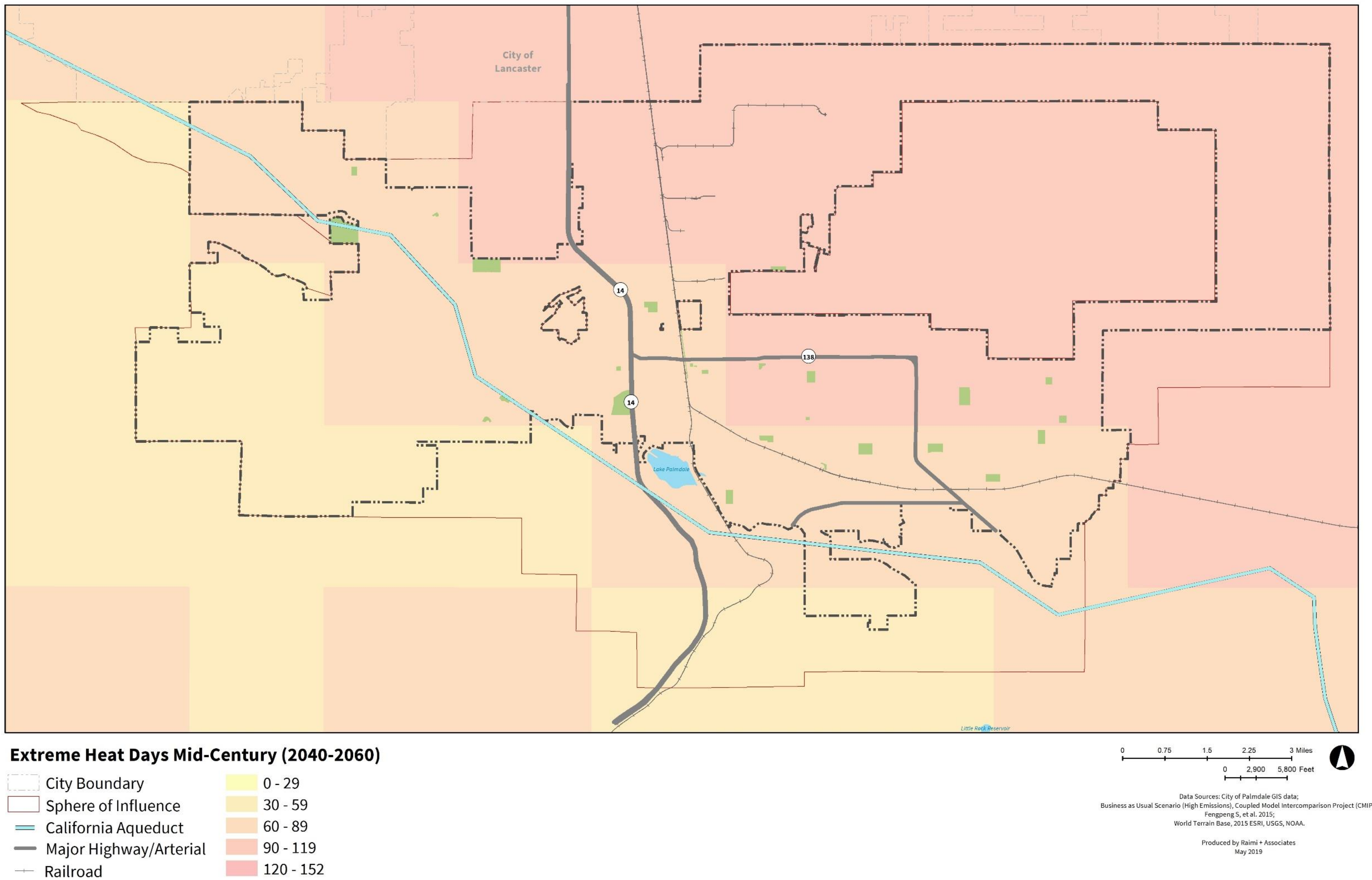


Note: Business as Usual Scenario (High Emissions), Coupled Model Intercomparison Project (CMIP5)

Source: Fengpeng S, et al. (2015).[13]

13 Fengpeng S, et al. (2015). A Hybrid Dynamical–Statistical Downscaling Technique. Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region. Journal of Climate 28:4618-4636.

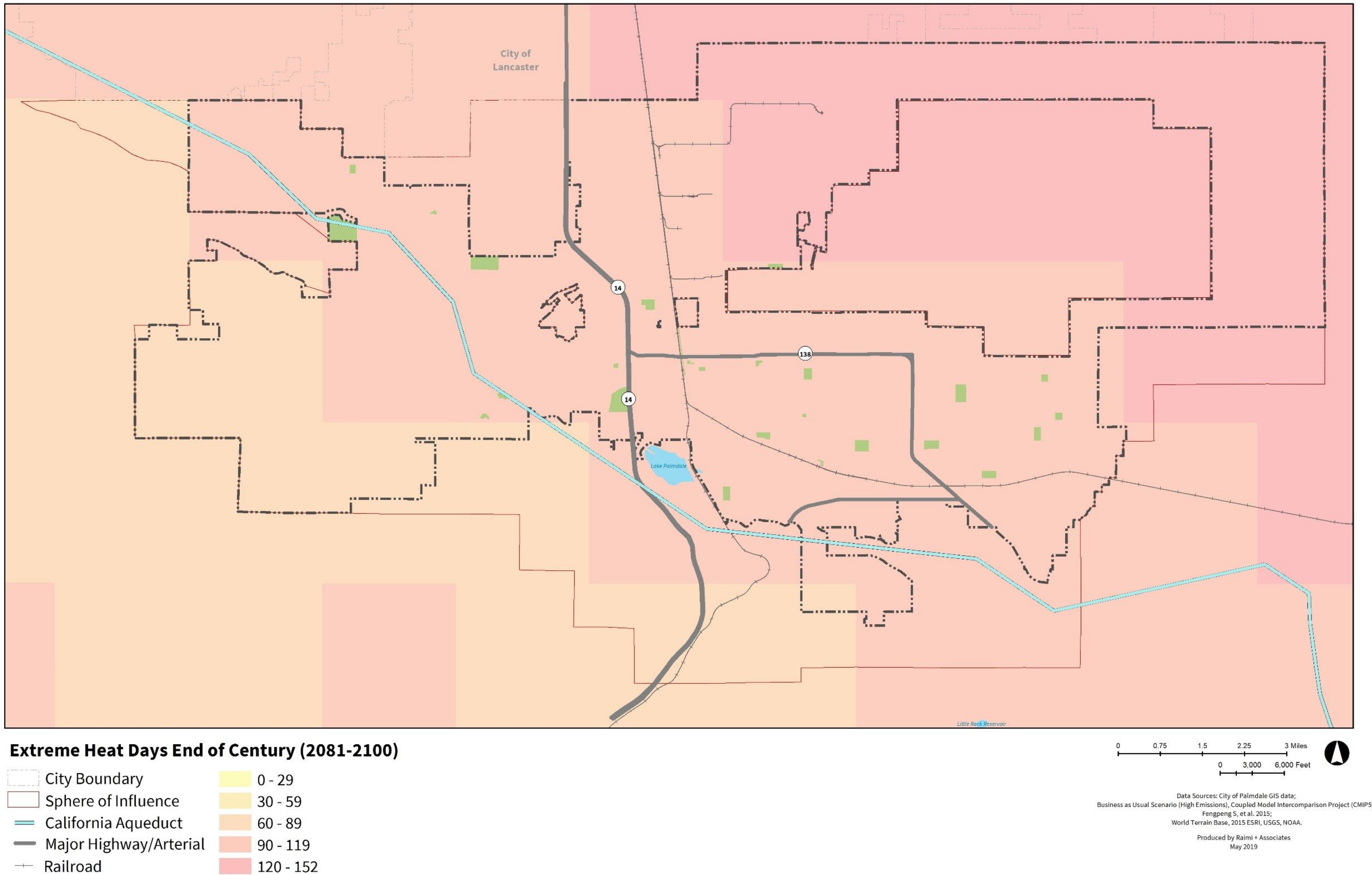
Figure 11.6 Projected Extreme Heat Days in Palmdale - Mid-Century (2040-2060)



Note: Business as Usual Scenario (High Emissions), Coupled Model Intercomparison Project (CMIP5)
Source: Fengpeng S, et al. (2015).[14]

14 Fengpeng S, et al. (2015). A Hybrid Dynamical–Statistical Downscaling Technique. Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region. Journal of Climate 28:4618-4636.

Figure 11.7 Projected Extreme Heat Days in Palmdale - End of Century (2081-2100)



Note: Business as Usual Scenario (High Emissions), Coupled Model Intercomparison Project (CMIP5)
Source: Fengpeng S, et al. (2015).[15]

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15 Fengpeng S, et al. (2015). A Hybrid Dynamical–Statistical Downscaling Technique. Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region. Journal of Climate 28:4618-4636.

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Precipitation

Between 1950 and 2005, the historic annual precipitation mean in Palmdale was approximately 11.3 inches as shown in Figure 11.8.[16] Annual precipitation, however, varies significantly between years. In the present-day climate, the region experiences wide swings in precipitation from year-to-year, and this variability is expected to continue under climate change with fluctuations between wet years and dry years.[17] Southern California's annual variability originates primarily from fluctuations of the biggest storms, with much of the variability coming from the wettest 5% of wet days.[18] Therefore, drought happens during years missing a few large storms and wet years occur when there are large storms. Figure 11.8 shows the projected annual variability in precipitation, which is relatively consistent with historic observations. The grey lines illustrate the observed, past precipitation, and the green lines show the climate scenario projection.[19]

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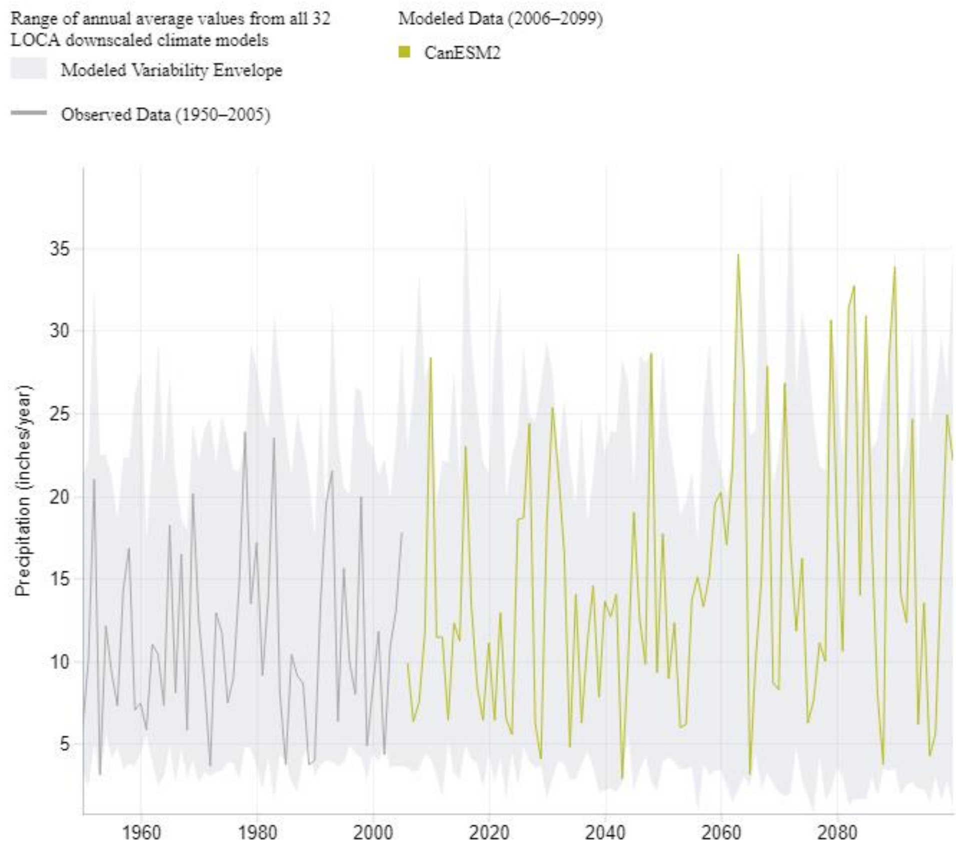
16 California Energy Commission. (2017). Cal-Adapt. Retrieved from: http://beta.cal-adapt.org/.

17 Berg, N, et al. (2015). Twenty-Frist Century Precipitation Changes over the Los Angeles Region. Journal of Climate. 28: 401 – 421.

18 Dettinger, M.D., and Cayan, D.R. (2014) Drought and the California Delta—A matter of extremes: San Francisco Estuary and Watershed Science, 12(2).

19 California Energy Commission. (2017). Cal-Adapt. Retrieved from: http://beta.cal-adapt.org/.

Figure 11.8 Palmdale Annual Precipitation Variability 1950 to 2100



Note: Business as Usual Scenario (High Emissions), CanESM2 Model (Average)
Source: CalAdapt. (2018).[20]

Overall changes in future precipitation are highly variable among climate models and relatively uncertain. Some precipitation projections for the region show a slight increase in annual rainfall, others show a slight decrease, and others show no change at all.[21] During the next century, Palmdale can expect approximately the same amount of total annual precipitation as it has received in the last few decades of the 20th century.

Drought

A drought occurs during an extended period of time in which a region experiences below average precipitation, which results in a reduced supply of surface and ground water. Climate change is likely to increase the duration and severity of droughts in California. Increasing temperatures and changing precipitation patterns can create periods of abnormally dry weather that produce hydrologic imbalances and result in water supply shortages. Reduced water supplies can

20 CalAdapt. (2018). Business as Usual Scenario (High Emissions), CanESM2 Model (Average). Retrieved from: https://cal-adapt.org/tools/annual-averages/

21 Berg, N, et al. (2015). Twenty-Frist Century Precipitation Changes over the Los Angeles Region. Journal of Climate. 28: 401 – 421.

have direct and indirect impacts on natural vegetation, wildlife, agricultural yields, and water supply.

Five historic drought periods in Southern California and Palmdale between 1928 and 2017 are described below:

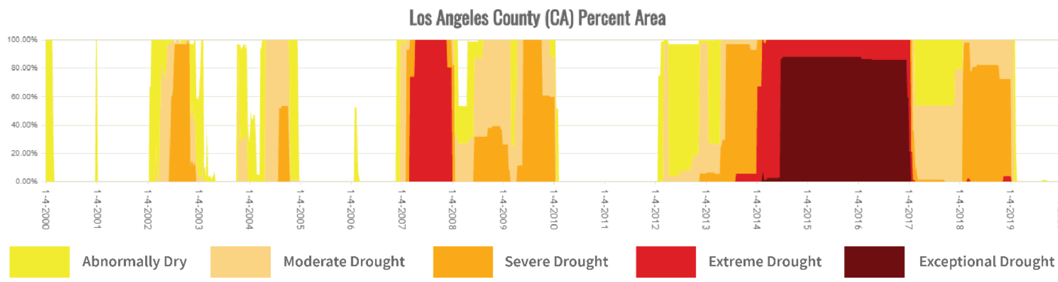
- **1929 – 1934:** This drought was remembered for its length and severity. It occurred at the same time as the “Dust Bowl”.
- **1976 – 1977**: These are two of the 30 driest years on record in California. The drought spurred water conservation efforts. Across the state, a federal report placed the economic losses of the impacts on agriculture and ranching at more than $1 billion.[22]
- **1987 – 1992**: The State underwent one of the longest-periods of drought in its history. The Antelope Valley region experienced severe flooding in 1980, 1983, and 1987.
- **2007 – 2009:** This is the 12th driest three-year period in recorded history.[23] The year 2007 included significant wildfires in Southern California.
- **2011 – 2016:** This drought was considered the driest period in the state’s recorded rainfall history. In 2013, California received less rain than in any year since becoming a state in 1850.

Figure 11.9 graphically depicts Los Angeles County’s worsening drought conditions. The chart is based on drought conditions from 2000-2020. By February 2014, most of the county was designated as extreme or exceptional drought conditions. With the higher than normal rain over the last couple of years, drought conditions have now changed.

22 Grad, S and Harrison, S. (2015). California Retrospective: 3 Crippling Droughts that Changed California. Los Angeles Times. Retrieved from: http://www.latimes.com/local/california/la-me-california-retrospective-20150413-story.html.

23 Christian-Smith, J. (2011). Impacts of the California Drought from 2007 – 2009. Pacific Institute. Retrieved from: http://pacinst.org/app/uploads/2013/02/ca_drought_impacts_full_report3.pdf.

Figure 11.9 Los Angeles County Drought Conditions 2000 – 2020



Source: Drought Monitor Time Series (2019).[24]

Flooding

Localized flooding occurs in Palmdale when rainfall is heavy and prolonged. The Antelope Valley Integrated Water Management Plan identified flash flooding and inland flooding as likely to increase due to climate change.[25]

Flood hazard areas include Amargosa Creek, Anaverde Creek, Little Rock Wash and Big Rock Wash. These regions are subject to a one percent-annual-chance-flood, also referred to as a 100-year flood or high flood risk areas. Flat plains and natural depressions are also subject to flooding, some of which are in 500-year flood zones or low to moderate flood risk areas. These include urban areas near the center of Palmdale and a region just to the east of Four Corners. Figure 11.10 depicts Federal Emergency Management Agency (FEMA) Flood Insurance Program designated flood zones in the City.

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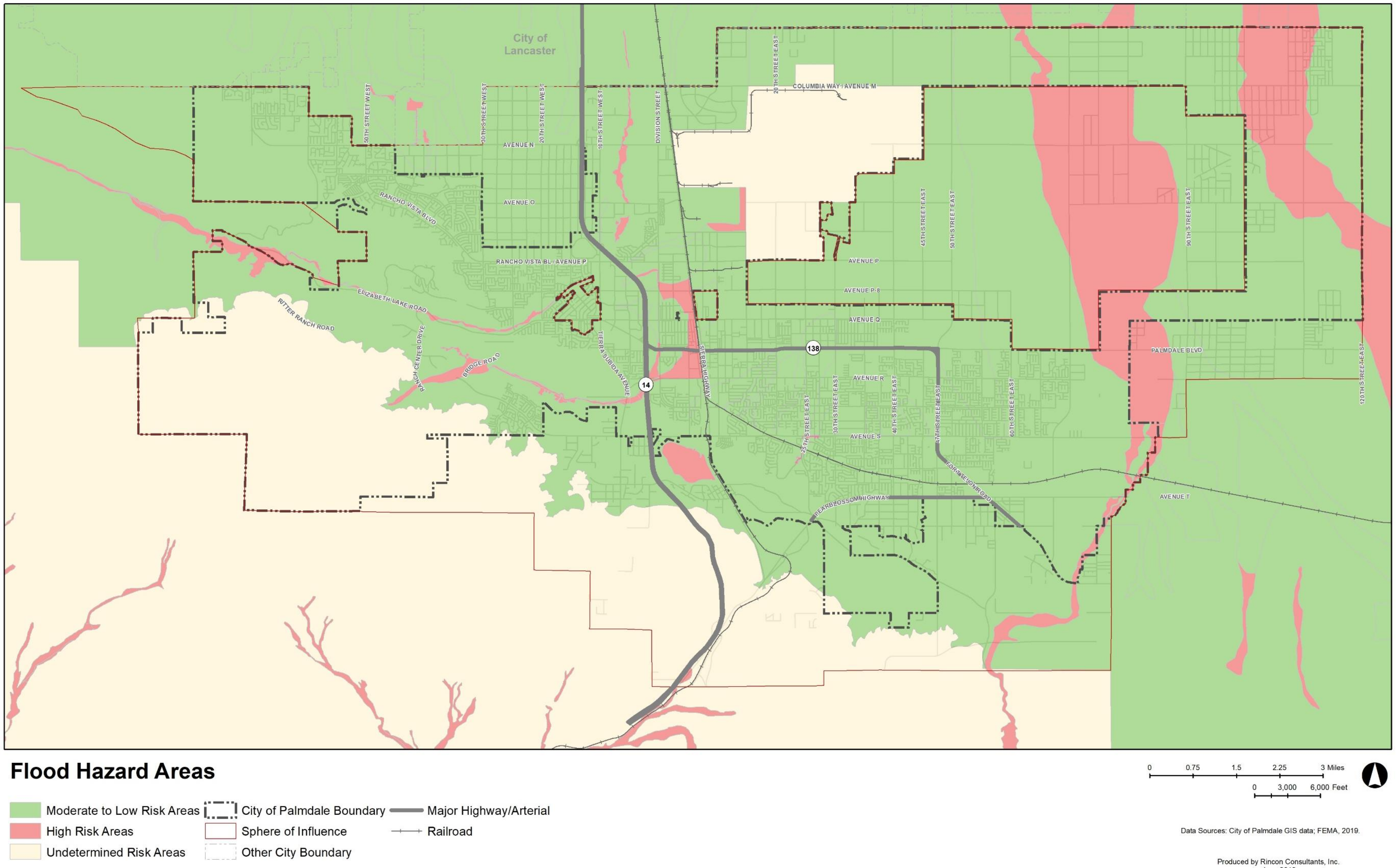
[24] Los Angeles County Drought Monitor Time Series. (2019). National Drought Mitigation Center. Retrieved from: https://droughtmonitor.unl.edu/Data/Timeseries.aspx

[25] 2013. Antelope Valley Integrated Regional Water Management Plan. Retrieved from http://www.avwaterplan.org/

Figure 11.10 Palmdale Flood Hazard Zones



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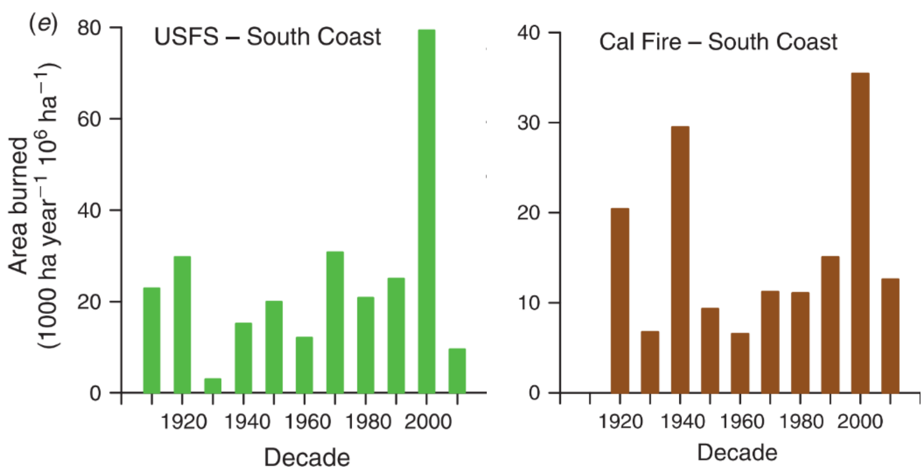
Wildfire Hazards

Wildfire risk is determined by a combination of factors including precipitation, winds, temperature, and landscape and vegetation conditions. Based on these factors, Palmdale has been identified by the California Department of Forestry (USFS) and Fire Protection (CAL FIRE) as being within a wildland-urban interface, which includes areas where homes or other structures are built near or among lands prone to wildland fire.

Wildfires have increased over the Western US and Southern California in recent decades. These changes in wildfire pattern are often attributed to climate change and fire suppression techniques. As shown in Figure 11.11, the South Coast region, which includes Palmdale, had significant peaks in the area burned in the 1920s, 1940s, 2000s in CalFire state lands and 1920s, 1970s, and 2000s in USFS federal lands. The South Coast region was among the few areas within the State that had an increase in burned area in recent decades.[26]

Figure 11.11 Decadal Burning on US Forest Service and Cal Fire Managed Lands



Source: Keeley, J.E. and A.D. Syphard (2017).[27]

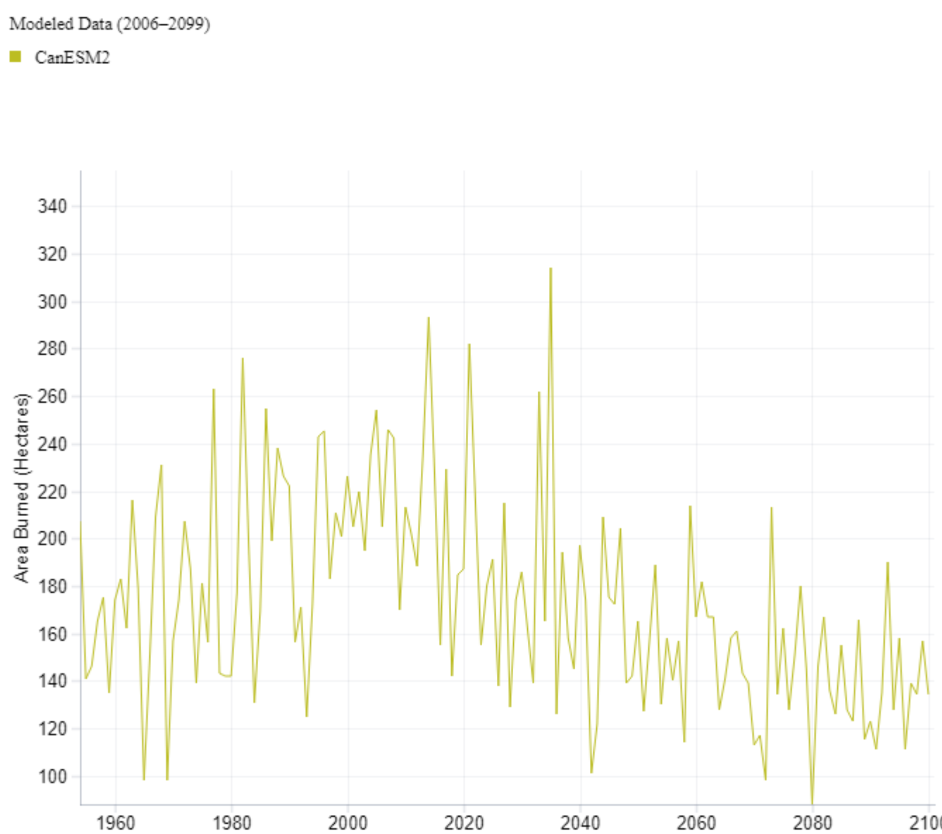
Figure 11.13 identifies the wildfire severity zones around Palmdale. The area south and west of the California Aqueduct, including Ritter Ranch Park and the adjacent open space is a CAL FIRE recommended very high fire hazard severity zone under local responsibility. This area consists of undeveloped open space, which is largely vegetated with typical chaparral, trees and grassland groundcover which provide

26 Keeley, JE, AD Syphard. (2017). Different historical fire–climate patterns in California. International Journal of Wildland Fire 26(4): 253-268.

27 Keeley, JE, AD Syphard. (2017). Different historical fire–climate patterns in California. International Journal of Wildland Fire 26(4): 253-268.

fuel for wildfires. Development within very high fire hazard severity zones is considered unsafe, as fire suppression is impeded by lack of water, rugged terrain, and delayed response times. The remainder of Palmdale and north of the City is not under significant wildfire hazard risk. The sparse vegetation and urban development do not provide significant fuel for wildfire propagation. Under many climate scenarios, wildfires are projected to increase in the future. Warmer, drier summers, high wind events, such as the Santa Ana winds, and increased vegetation growth, can create conditions suitable for wildfires.[28] Figure 11.12.[29] shows the projected change in average area burned by wildfires around Palmdale and figures 11.14-11.16 show the project change over the next eighty years. While the trend appears to be a stabilization of burn areas, it should be noted that wildfires can be attributed to many other causes besides climate change.

Figure 11.12 Projected Changes in Average Area Burned by Wildfires for Palmdale



Note: Business as Usual Scenario (High Emissions), CanESM2 Model (Average)
Source: CalAdapt (2018).[30]

28 Sawyer, S., Hooper, J., and Safford, H. (2014). A summary of current trends and probable future trends in climate and climate-driven processes for the Angeles and San Bernardino National Forests. USDA Forest Service.

29 California Energy Commission. (2017). Cal-Adapt. Retrieved from: http://cal-adapt.org/.

30 CalAdapt. (2018). Retrieved from: https://cal-adapt.org/tools/wildfire/

Wildfires can be a significant source of air quality pollution in Southern California. Wildfires burning within 50 to 100 miles of a city routinely cause air quality to be 5 to 15 times worse than normal, and often two to three times worse than the worst non-fire day of the year.[31] Emissions from wildfires can lead to excessive levels of particulate matter, ozone, and volatile organic compounds.[32]

31 Kenward, A, et al. (2013). Wildfires and Air Pollution: The Hidden Health Hazards of Climate Change. Climate Central. Retrieved from: http://assets.climatecentral.org/pdfs/WildfiresAndAirPollution.pdf.

32 Phuleria, HC, et al. (2005). Air Quality Impacts of the October 2003 Southern California Wildfires. Journal of Geophysical Research. 110(D7).

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Figure 11.13 Fire Hazard Severity Zones

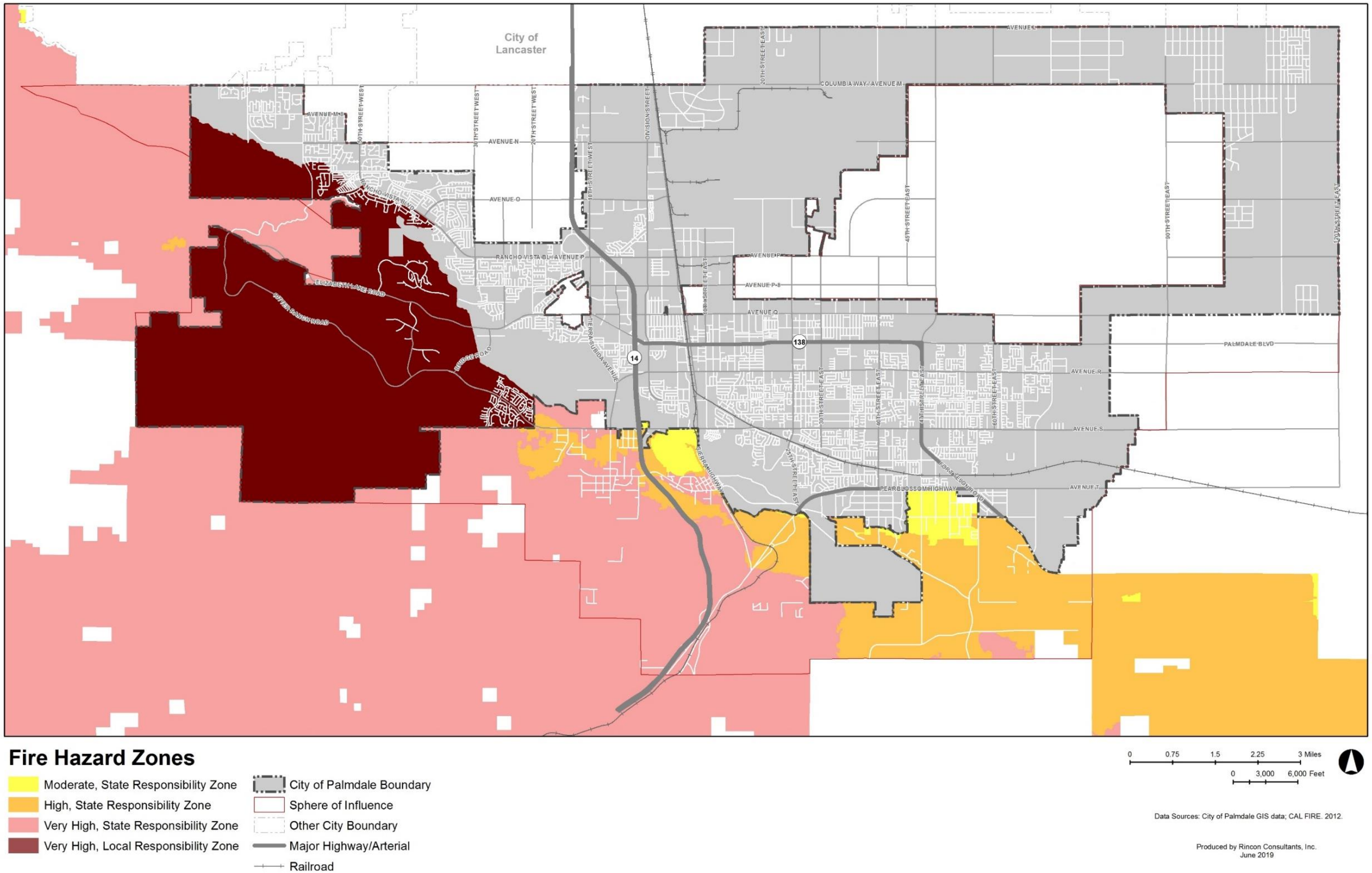
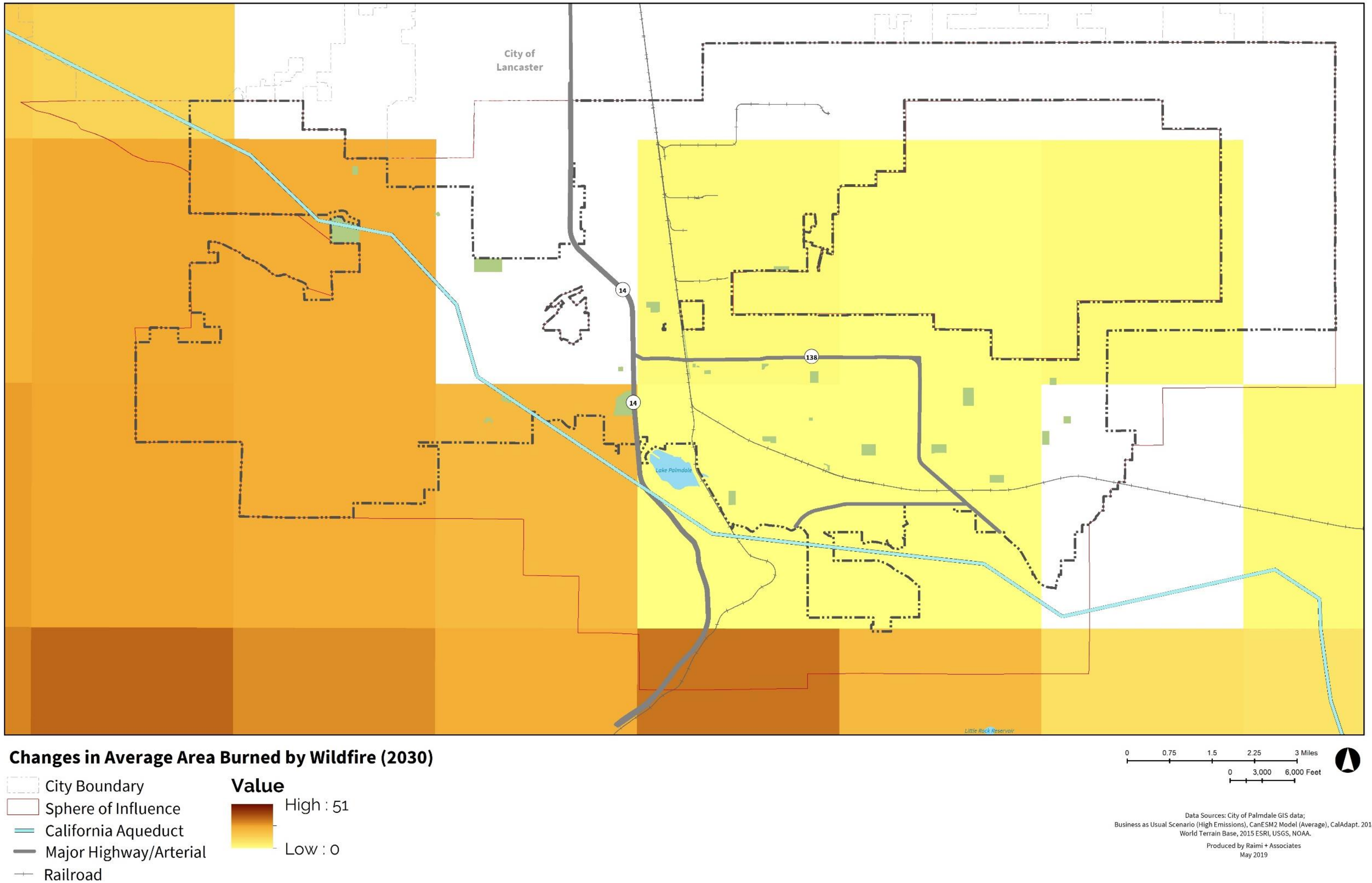


Figure 11.14 Projected Changes in Average Area Burned by Wildfires for Palmdale (2030)



Note: Business as Usual Scenario (High Emissions), CanESM2 Model (Average)
Source: CalAdapt. (2018).[33]

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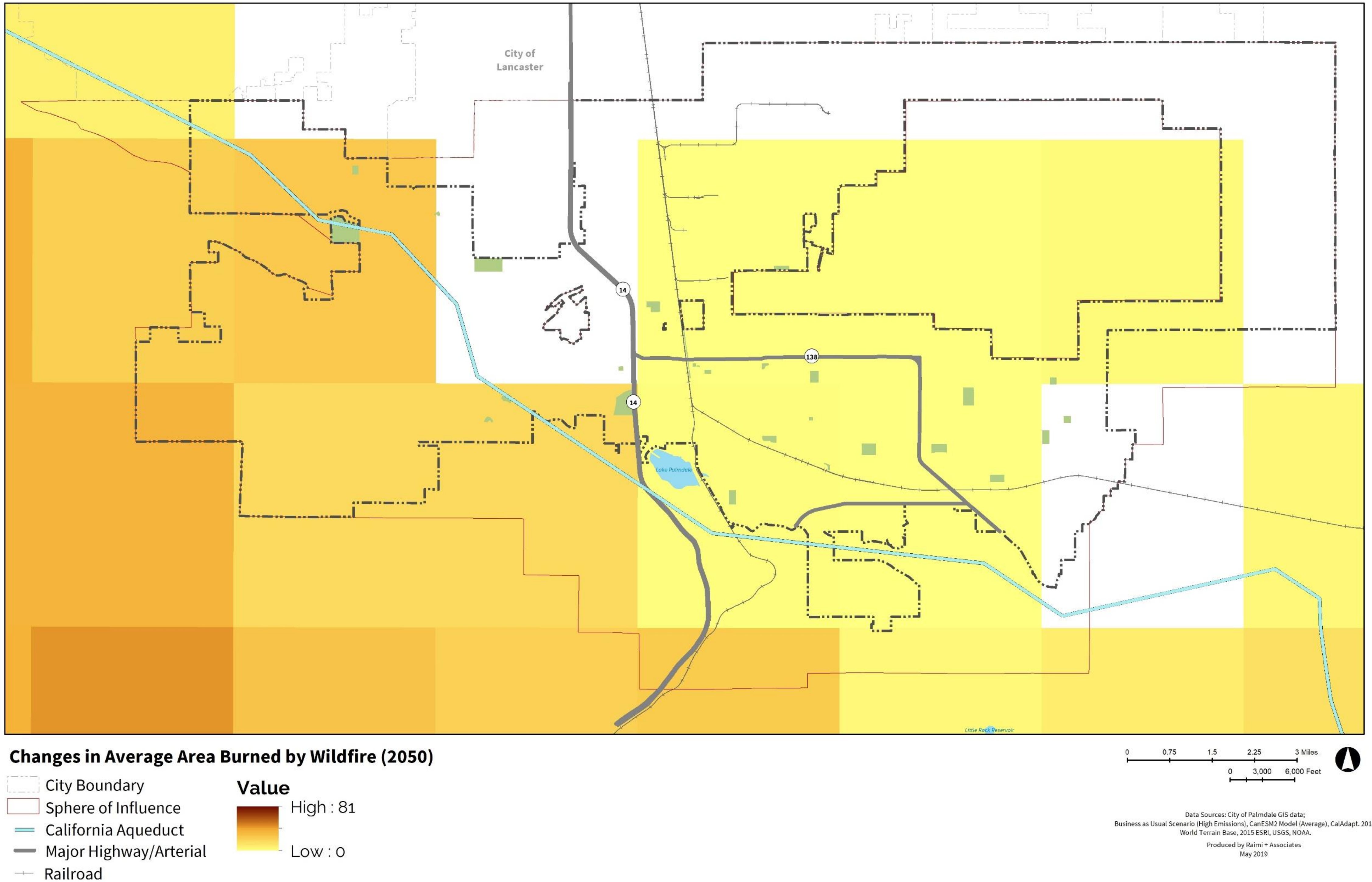
33 CalAdapt. (2018). Retrieved from: https://cal-adapt.org/tools/wildfire/

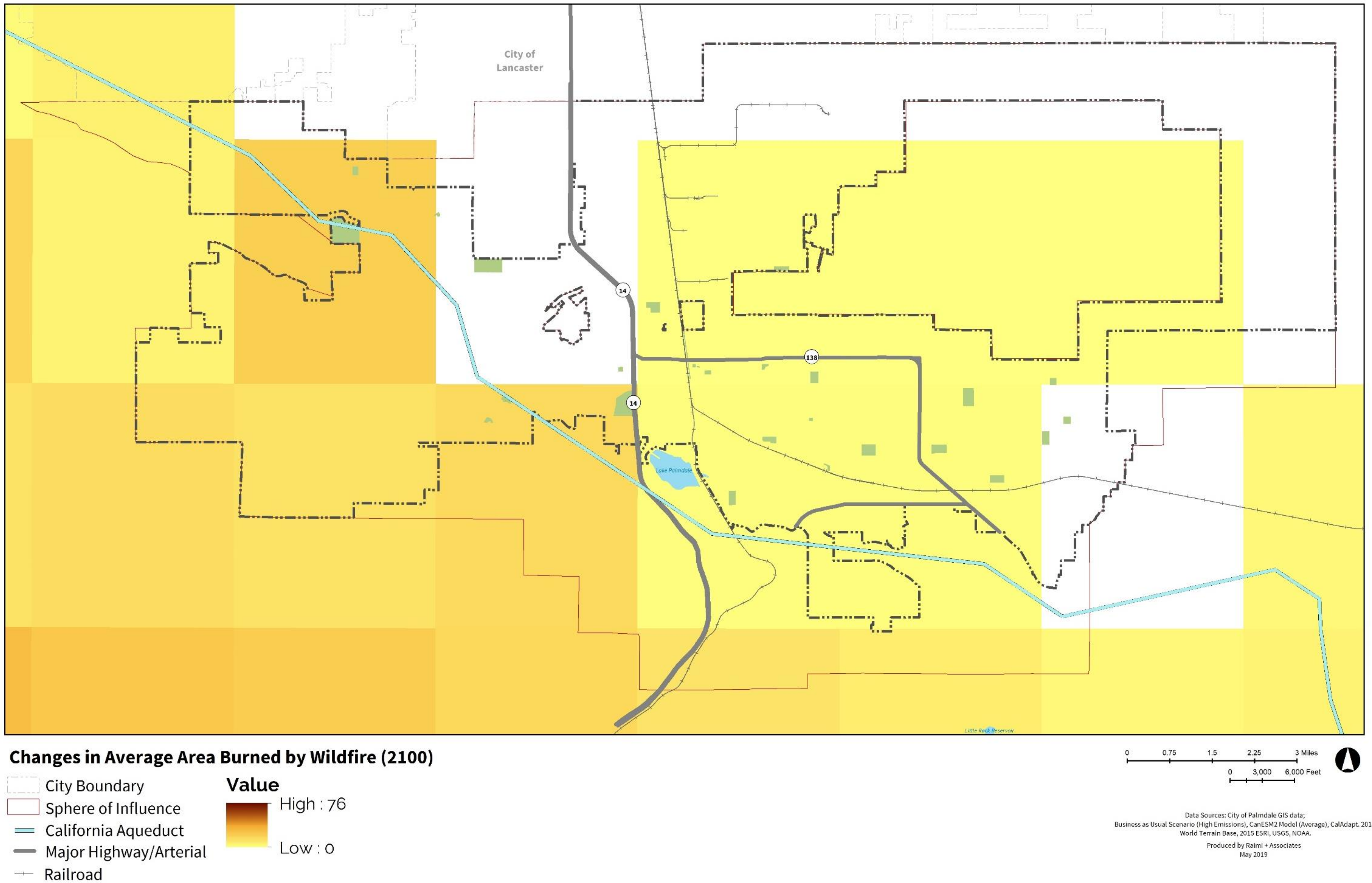
Figure 11.15 Projected Changes in Average Area Burned by Wildfires for Palmdale (2050)



Note: Business as Usual Scenario (High Emissions), CanESM2 Model (Average)
Source: CalAdapt. (2018).[34]

34 CalAdapt. (2018). Retrieved from: https://cal-adapt.org/tools/wildfire/

Figure 11.16 Projected Changes in Average Area Burned by Wildfires for Palmdale (2100)



Note: Business as Usual Scenario (High Emissions), CanESM2 Model (Average)
Source: CalAdapt. (2018).[35]

35 CalAdapt. (2018). Retrieved from: https://cal-adapt.org/tools/wildfire/

Air Quality

Air quality is expected to worsen with climate change. Air quality is strongly dependent on weather, and climate change is expected to impact air quality through warming temperatures and more frequent episodes of stagnant air. Many strategies that are used to reduce greenhouse gases, however, will also reduce emissions of air pollutants, such as ozone and particulate matter.

Local air districts and CARB monitor ambient air quality to ensure that air quality standards are met and, if they are not met, to also develop strategies to meet the standards. Air quality monitoring stations measure pollutant ground-level concentrations (typically, ten feet above ground level). Depending on whether the standards are met or exceeded, the local air basin is classified as in “attainment” or “non-attainment.” Some areas are unclassified, which means no monitoring data are available, but the area is considered to be in attainment. Table 11.2 summarizes the California Ambient Air Quality Standards (CAAQS) and the National Ambient Air Quality Standards (NAAQS) for each criteria pollutant as well as the attainment status of the Mojave Desert Air Basin (MDAB). As shown in the table, the MDAB is in non-attainment for the State standard for ozone and PM_{10}.

Climate change will generate multiple pollution stressors on the environment. Air quality could worsen with the increased occurrence of stagnation events, a term that describes the phenomenon of contaminated air lingering over a region combined with a lack of rain and wind.[36] Stagnation events lead to an increased concentration of pollution exposure, and thus, increased risk of heart disease and respiratory illnesses. Additionally, ozone production generally increases with hotter temperatures, which can result in the number of ozone days increasing up to 9 days by 2050.[37]

In California, rising temperatures could also see an increase between 22-30 days in the annual number of ozone days with over 90 ppb.[38] The current EPA standard for ground-level ozone is 70 parts per billion (ppb), based on scientific evidence of the effects of ozone on public health, including asthma attacks, emergency room visits, and premature death. Air quality is further discussed in Chapter 12.

36 Horton, D., et. al. (2014). “Occurrence and persistence of future atmospheric stagnation events.” Nature Climate Change 4 (8): 698-703.

37 Shen, L., et. al. (2016). “Impact of increasing heat waves on U.S. ozone episodes in the 2050s: Results from a multimodel analysis using extreme value theory.” Geographical Research Letters 43: 4017-4025.

38 Mahmud, A., et. al. (2008). “Statistical downscaling of climate change impacts on ozone concentrations in California.” Journal of Geophysical Research 113.

Table 11.2 Ambient Air Quality Standards and Basin Attainment Status

Pollutant	Averaging Time	California Standards			Federal Standards		
		Concentration	Attainment Status	Days in Exceedance	Concentration	Attainment Status	Days in Exceedance
Ozone	1-Hour 8-Hour	0.125 ppm 0.104 ppm	**N** **N**	5 48	n/a 0.104 ppm	n/a **N**	n/a 48
Carbon Monoxide	1-Hour 8-Hour	1.2 ppm 1.0 ppm	A A	0 0	1.2 ppm 1.0 ppm	U/A U/A	0 0
Nitrogen Dioxide	1-Hour Annual	47.6 ppb 47.6 ppb	A A	0 0	47.6 ppb 47.6 ppb	U/A U/A	0 0
Sulfur Dioxide	Annual 24-Hour 3-Hour 1-Hour	n/a * n/a 9.9 ppb	n/a A n/a A	n/a * n/a 0	* * 0.006 ppm 0.0099 ppm	U/A U/A U/A U/A	* * 0 0
PM_{10}	Annual 24-Hour	* 89.3 µg/m³	**N** **N**	* *	n/a 89.3 µg/m³	n/a U/A	n/a 0
$PM_{2.5}$	Annual 24-Hour	11.9 µg/m³ n/a	A n/a	0 n/a	11.9 µg/m³ 40.4 µg/m³	U/A U/A	0 1
Lead	30-Day Quarter Rolling 3-Month	* n/a n/a	A n/a n/a	* n/a n/a	n/a * *	n/a U/A U/A	n/a * *

Note: Data for ozone, NO_2 (1-Hour), PM_{10} (24-Hour), and $PM_{2.5}$ (24-Hour) from the CARB Lancaster-43301 Division Street monitoring station (2018). Data for CO and NO_2 (Annual) from the USEPA Lancaster-43301 Division Street monitoring station (2018). Data for SO_2 (3-Hour and 1-Hour) from the USEPA Victorville-Park Avenue monitoring station (2018). Data for $PM_{2.5}$ (Annual) from the USEPA Lancaster-43301 Division Street monitoring station (2013).

ppm = parts per million
ppb = parts per billion
µg/m³ = micrograms per cubic meter
n/a = not applicable
A = "Attainment"
N = "Non-attainment"
U = "Unclassified"
* = data not available

Sources: CARB 2019, https://www.arb.ca.gov/adam/topfour/topfour1.php; USEPA 2019, https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors; AVAQMD 2017, https://avaqmd.ca.gov/files/e0986ab83/AVAQMD+2017+Attainment+Status+Table.pdf

Antelope Valley Water Management

Los Angeles County and the Antelope Valley have developed plans that adapt to climate change impacts to water supply and quality. In 1987, The Los Angeles Department of Power and Water prepared the Antelope Valley Comprehensive Plan of Flood Control and Water Conservation. The plan was developed after severe flooding in the region in 1980, 1983, and 1987. This plan proposed flood plain management in hillside areas, structural improvements in the urbanizing areas and non-structural management approaches on the rural areas. The management in the hillside areas restricts development into areas outside of entrenches water courses. For the areas prone to flooding, the plan recommends open channel conveyance facilities and storm drains through communities as well as detention and retention basins (located at the mouths of the large washes).

In 2014, the Antelope Valley region formed the Regional Water Management Group with 11 agencies: Antelope Valley-East Kern Water Agency (AVEK), Antelope Valley State Water Contractors Association (AVSWCA), City of Lancaster, City of Palmdale, Littlerock Creek Irrigation District, Los Angeles County Sanitation District (LACSD) Nos. 14 and 20, Los Angeles County Waterworks District No. 40 (LACWD 40), Palmdale Water District (PWD), Quartz Hill Water District (QHWD), and Rosamond Community Services District (RCSD). These 11 agencies signed a Memorandum of Understanding for implementing the 2007 Integrated Regional Water Management Plan, share information, and assist in future grant applications for the priority projects identified in the Plan.

In 2007, the region developed the Antelope Valley Integrated Regional Water Management Plan to plan for regional concerns on water supply reliability, water quality, flood protection, environmental resources, and land use management. This plan is State sponsored and makes grant funds available to support the implementation. There is no funding for major improvements in unincorporated areas. Unincorporated areas belong to Los Angeles County and they have limited revenue from developer fees to construct facilities.