A Wildfire Assessment Report
for
Lower Arroyo Seco Canyon
Pasadena, California
December, 2021

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EXECUTIVE SUMMARY

This document presents a Wildfire Assessment Report for the Lower Arroyo Seco Canyon area in Pasadena, CA. Over many decades, the wildfire environment in the Lower Arroyo has evolved into one that could potentially support a significant wildfire, resulting in catastrophic impacts to surrounding neighborhoods. This Report reviews past fire history and existing documents that have been created over time to address potential wildfire issues as well as the natural environment in the Lower Arroyo. The Report presents the most current wildfire research and data related to the increasing severity and frequency of fires, in addition to identifying the best practices known today to help prevent structure ignitions during wildfires. This Report was requested by local residents and concerned citizens to focus on wildfire impacts, and maximize efforts to improve the natural landscape in the Canyon. Ultimately, the Report presents 12 Conclusions and Recommendations as follows:

1. It is not a question of whether a wildfire will occur, but only a question of when.
2. Enact vegetation management plans that will begin to reduce the density of flammable vegetation, along with potential fire behavior and spread. These plans will also have the added benefit to remove non-native species in the Lower Arroyo, and create a more natural and fire resilient landscape.
3. Establish a long-term maintenance plan to ensure the vegetation programs continue well into the future.
4. Consider establishing a Firewise USA® Recognition Program and Fire Safe Council(s) in neighborhoods adjacent to the Lower Arroyo, and encourage more active participation from residents.
5. Consider the development of a Community Wildfire Protection Plan.
6. Provide a more robust education and information program for home hardening, defensible space efforts, and consider enforcing the immediate "home ignition zone" concept around homes with a non-combustible feature.
7. Provide better understanding of wildfire impacts beyond just the VHFHSZ areas in the Lower Arroyo and the west. The entire City will be impacted and must be prepared.
8. Implementation of Vegetation Management Measures and Ordinances.
9. Endorsement and Support of Structure Resiliency Best Practices for Existing Structures.
10. Consideration of a Wildfire during High Fire Danger and/or Red Flag Warning.
11. Consideration of Evacuation Complications during High Fire Danger and High attendance event at the Rose Bowl.
12. Consideration of true wildfire cost from fire suppression to community, ecological and economic recovery.

Finally, the Report includes a series of Appendixes that provide current direction based on Pasadena's Vegetation Management Plans, as well as other documents. This concludes with a more detailed Appendix that outlines recommended treatments to be made in the Lower Arroyo to reduce potential wildfire impacts, return the waterway into a more natural habitat, and create a more fire resilient landscape for surrounding neighborhoods.

INTRODUCTION

The Arroyo Seco is a major tributary to the Los Angeles River, which flows out of the San Gabriel Mountains in the northwest corner of the City of Pasadena. As seen in the aerial view below, the Lower Arroyo extends from the Colorado Street Bridge on the north, to the South Pasadena City limits on the south. This Wildfire Assessment Report (Report) is being written to focus specifically on the potential wildfire impacts that might occur in this urban park area and the surrounding neighborhoods of the Arroyo.

Figure 1: The Lower Arroyo extends from the Colorado Street Bridge on the right, to the South Pasadena City limits on the left.

A number of topics will be discussed in this Report. It will present a current overview of the wildfire situation that California and many other areas around the world are experiencing. There will be a review of wildfire history in this area, and how the historical evolution of the Lower Arroyo has affected the potential of wildfire behavior. Adjacent neighborhoods are currently at a higher threat from wildfire impacts than at any time in the recent past, primarily due to overgrown vegetation which could contribute to intense wildfire activity, threatening lives and property. This Report will provide an analysis of the current state of vegetation within the Lower Arroyo, and focus on potential modifications that could help reduce the impacts of a wildfire to the adjoining communities.

There have been a number of studies and efforts to address numerous aspects of the Lower Arroyo, including the Lower Arroyo Master Plan, Fuel Management Plans, and ongoing efforts of habitat and public use restoration. This Report will provide a link to these various plans, all with a focus on wildfire impacts, and how those impacts must be incorporated as part of the long-term planning process to provide a more cohesive and resilient environment for the Lower Arroyo into the future.

In the end, this Report will offer recommendations on how projects and planning efforts can both complement and enhance the current plans in place, while providing a higher level of safety not only for the park area itself, but also for the surrounding neighborhoods.

WILDFIRE ENVIRONMENT IMPACTING THE LOWER ARROYO

In recent years, the frequency and severity of wildfire events are unlike anything we have experienced in the past, requiring reexamination of our land use practices and fire management policies. This has become increasingly important when creating any current or long-term wildfire strategies across a large landscape. In established urban communities such as Pasadena, the primary challenge is how to incorporate changes that help reduce the impacts of a wildfire when they do occur. Recent trends indicate that wildfires are becoming worse. Between 2015 and 2021, wildfires in California have shown a progressively higher frequency, stronger intensity, and larger footprints than in recorded history. Unfortunately, the loss of lives and the destruction of entire communities has become all too real, as has been witnessed over the past several years. In both 2020 and 2021 alone, a number of disturbing new wildfire records were set. This includes 6 of the top 7 largest wildfires in California's recorded history, more than 6.7 million acres burned, over 30 lives lost, and more than 10,000 structures destroyed.

These fires represent a substantial hazard to life and property in communities within the "Wildland Urban Interface" (WUI) zones, which are defined by the U.S. Fire Administration as areas where human-made structures and infrastructure are in or adjacent to areas prone to wildfires. They are reminders to all jurisdictions and neighborhoods, including Pasadena, that wildfires will occur and that it requires proactive and aggressive actions before a wildfire ignites to help reduce the risk. These efforts are intended to increase resiliency, and appropriately harden both structures and the landscape against the ravages of wildfires. Although wildfires can occur at any time of year, and in any climate, the risk of wildfires is greatly increased due to drought conditions, low humidity, high winds, and available fuels – which include both vegetation and man-made elements such as structures, vehicles, and other types of infrastructure.

To more fully understand the totality of wildfire impacts, it is important to not lose sight of the variables that wildfires have come to represent. On one hand, the public today has become all too familiar with the large, devastating Camp Fire that virtually destroyed the town of Paradise, CA, on November 8, 2018. Only one year earlier, the Tubbs, Nuns, and Atlas Fires ravaged communities throughout Napa and Sonoma Counties on October 8, 2017. The Thomas Fire, in December 2017 grew to become the largest wildfire in California's history at that time – only to be eclipsed by the larger Mendocino Complex just 6 months later. Even more records were set during 2020 and 2021 when over 6.7 million acres burned across the state. The unfortunate reality is there is broad agreement from the scientific and wildfire communities that these types of large, devastating wildfires will continue for the foreseeable future. Yet overall, they collectively still represent well under 3% of the total number of wildfires that ignite during any given year.

Although the large, devastating wildfires certainly gain the most attention, we cannot lose sight of the other 97% of wildfires, which are smaller, more frequent events that occur virtually every

day. It is important to point out the distinction of the two extremes, because in planning for wildfire prevention efforts, both extremes must be addressed. It is a natural reaction to focus on the larger, more destructive wildfires, if for no other reason than these are the ones that gain the most attention. And yes, they are also, of course, the most impactful. But while it is necessary to have productive dialogue about the potential of a large, devastating wildfire, you cannot forget to address the far more frequent, lower intensity fires that occur on a daily basis. The focus and planning for wildfire prevention must address both of these scenarios.

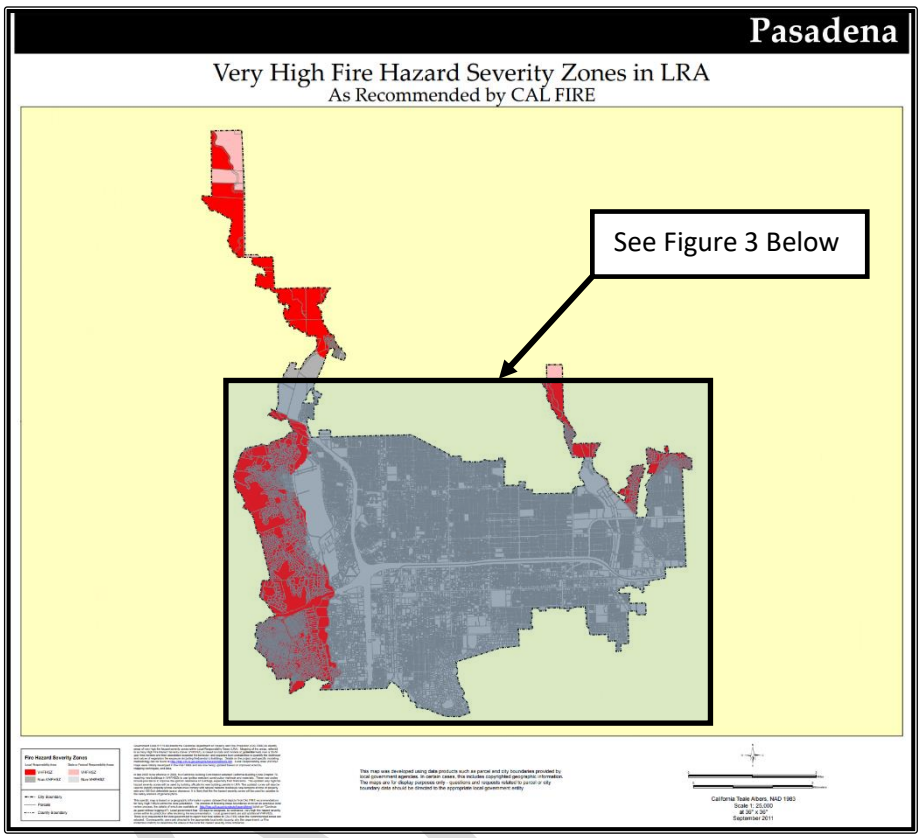


Figure 2: VHFHSZ areas within Pasadena, as reported by CAL FIRE

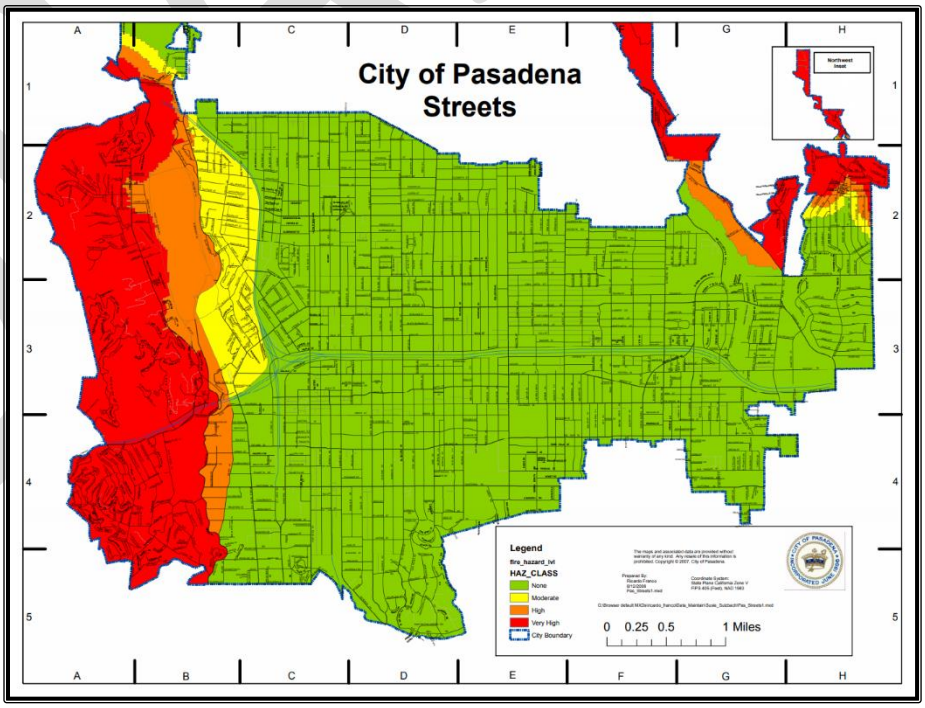


Figure 3: Fire Hazard Severity Zone Maps as adopted by Pasadena on July 1, 2008

Figure 2 at right identifies the Very High Fire Hazard Severity Zone (VHFHSZ) areas within Pasadena, shown in red, which encompasses most of the western portions of the City, including the Lower Arroyo. These maps were created by the California State Fire Marshal and CAL FIRE in order to identify the most vulnerable areas across the state from the threat of wildfire. The Fire Hazard Severity Zone (FHSZ) Maps incorporate three distinct levels

of wildfire threat, including Moderate, High, and Very High Zones. Pasadena adopted these zones on July 1, 2008, as shown in Figure 3. The Lower Arroyo lies within both high and very high designations. The current maps are in the process of being updated by CAL FIRE while this Report is being written, and may change in the near future. Pasadena has used these maps to provide input on emergency management and wildfire planning for the City, with a focus on increasing fire prevention activities and regulations. The highlighted area in the southwest corner of the City is expanded in Figure 4 below. This expanded view of the FHSZ's indicates that the entire Lower Arroyo basin in within these zones, although the neighborhood directly to the east is not included in this zone. Despite the fact that the eastern neighborhoods are not designated in the FHSZ does not easily translate into a substantially lower risk from wildfires. However, this map does provide an important context to wildfire threats in Pasadena that is critical to fully understanding the wildfire environment.

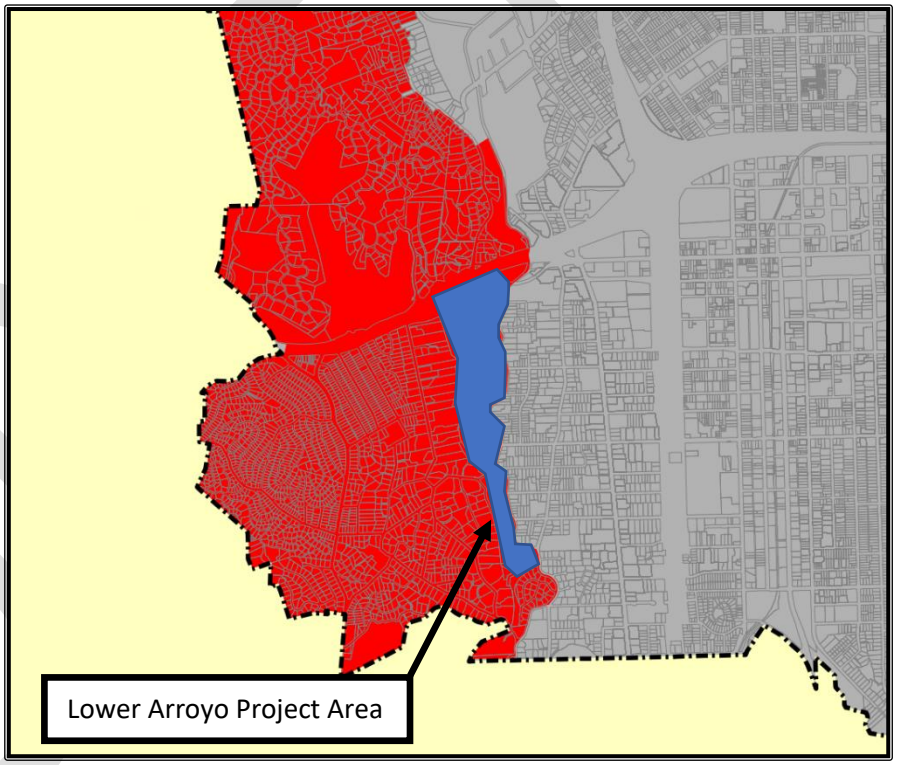


Figure 4: Enlarged view of VHFHSZ in Lower Arroyo and surrounding areas.

As described above, a complete wildfire prevention strategy must include discussions on both the more typical wildfires that burn at a lower intensity and with slower spread rates, as well as the larger, more devastating wildfires. The fact that the western portion of Pasadena, including the Lower Arroyo basin is designated as VHFHSZ indicates that the highest risk of a wildfire may impact the neighborhoods to the west. However, because the neighborhoods to the east are situated on hillsides above the Lower Arroyo, the influence of topography will still pose a significant risk to these communities. This will be explained in more detail below.

Although the concrete drainage channel represents the most prominent feature in the Lower Arroyo, the density of vegetation that currently exists adjacent to this channel presents a significant threat for an intense wildfire event. Because of the steep hillsides rising above the basin, a wildfire could potentially cause extensive damage to the neighborhoods surrounding

the Lower Arroyo. While there are many stakeholders who have an interest in the status and use of the Lower Arroyo, the City of Pasadena is fortunate to have the jurisdictional authority to determine what actions to take in this area to help reduce potential wildfire impacts. However, as past history has shown, there are competing visions as to what treatments in the Lower Arroyo should be taken to enhance the Arroyo's future. This Report is focused on the issues specifically related to wildfire, with proposed solutions to both reduce the risks from a wildfire event while also striving to provide consistency with other groups.

By acknowledging that a significant portion of the Lower Arroyo is filled with excessive vegetation that could contribute to aggressive fire behavior, coupled with the fact that the entire Lower Arroyo and all lands to the west are in areas designated as a VHFHSZ, the urgency to fully understand the wildfire environment, and potential impacts, is critical. One way to better understand the primary influences that determine wildfire behavior involve three major elements. These elements include topography, weather, and fuels. We will discuss each of these as they relate to Pasadena and the Lower Arroyo. One important factor to keep in mind as these three elements are discussed is that topography and weather are given factors that humans have little ability to change or control. Fuels, however, are the single element that we can change through vegetation maintenance projects or changes to homes that can reduce the likelihood of ignitions from a wildfire.

Topography: The Lower Arroyo within Pasadena consists of a relatively narrow, flat drainage channel oriented primarily in a north-south direction, which adds to the vulnerability of both the Arroyo and the adjacent neighborhoods. The sides of the Arroyo rise up to these neighborhoods above with fairly steep slopes, mostly covered with vegetation. During high wind events, such as the typical Santa Ana conditions that occur every fall, this north-south orientation can funnel the wind in a more forceful manner, adding to a fire's speed and intensity. In addition, the slopes that make up the sides of this canyon can add to the speed at which a fire burns uphill, specifically on western facing slopes that are exposed to more sun and heat. This aspect of the landscape causes vegetation to typically dry out even more, which contributes to the lower moisture content and is therefore more susceptible to ignition or fire spread. While this complicates the intensity of wind driven events, the western facing slopes are also more susceptible to rapid fire spread even on moderate to high fire danger days with very little wind. The drier vegetation will contribute to a higher rate of spread upslope due to the lower moisture content in the vegetation. Therefore, fires may burn with more intensity on these slopes with or without a wind event. The map of Pasadena and the surrounding vicinity in Figure 5 below identifies the steep mountainous terrain that exists to the north of Pasadena. These mountains have a significant fire history that will be discussed later in the Report. The fact that the Arroyo is a drainage channel for this portion of the San Gabriel Mountains offers opportunities for a fire during a north wind event to spread rapidly to the south into Pasadena, and through the Lower Arroyo.

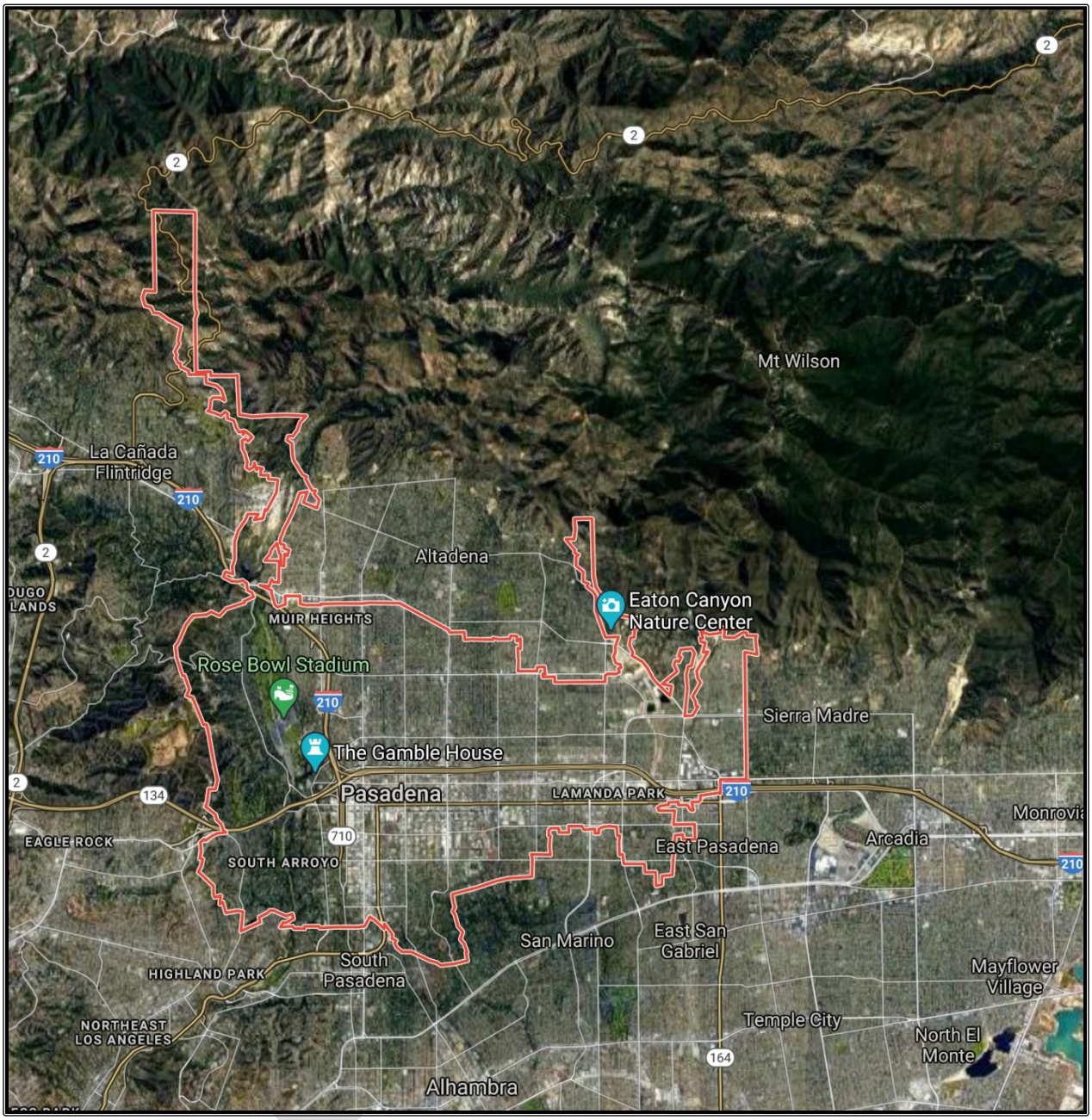


Figure 5: Pasadena and Vicinity as viewed from Google Maps

Weather: Weather has the most significant influence on the local vegetation to determine its Daily Fire Danger, ignition and burning potential. Weather is a natural environmental factor that we can do little to change, with winds being the single most important weather factor contributing to fire spread and intensity when relative humidity is low. Winds exceeding 25 miles per hour combined with low relative humidity often produces catastrophic wildland fire behavior, and will be discussed in more detail in the Fuels section below. Typical weather patterns in this area are flowing onshore from the Pacific Ocean, bringing moister and cooler breezes. However, as is well recorded, the later months of the year bring annual "Foehn" wind

events, which are locally known as Santa Ana Winds. These are dry, warm, down-slope winds that blow opposite of the normal wind patterns. There is a long list of catastrophic Santa Ana wind events throughout history in Southern California. In such a situation, suppression efforts may become ineffective. If fuels are heavy, embers produced by the fire may be transported downwind up to several miles. When these embers land on a susceptible fuel bed, they often ignite and further exacerbate the fire spread.

Fuels: When discussing wildfires, the term "fuels" is used to describe any flammable material that can burn, and feed the fire. Historically, the fuels that burn in a wildfire have mostly been confined to vegetation in forested lands, brush on slopes, or grassy fields. Structures have also provided fuel for wildfires, but the dramatic increase in structure losses today has forced a reexamination of how we view these losses, and what to do about it. With that basic understanding, it is also important to recognize that one of the factors that can limit a wildfire's spread or intensity is by reducing or removing any fuels that it could burn, thereby eliminating the "food" it needs to continue burning. This forms one of the basic premises for this Report – to reduce the amount of fuel that currently exists in the Lower Arroyo, and potentially reduce a wildfire's intensity and rate of spread. In addition to the excessive growth of vegetation in the Arroyo, a significant amount of it is non-native, and more conducive to wildfire spread and intensity. These fuels are highly susceptible to drought conditions, and typically contain very low fuel moistures as early as mid-summer. Due to continuing climate change impacts, these fuels are typically drier and more susceptible to ignition for a longer period of time throughout the year than in the past. The resulting fuel load is highly flammable, and can burn with high intensity. With a moderate amount of wind, a wildfire can develop with a critical rate of spread. The resulting embers being produced by a wildfire in these conditions can carry for a mile or more in front of the main fire, igniting new spot fires well ahead of the approaching fire.

California's Mediterranean climate provides growing conditions for plants that are able to sustain long dry summers. Native plant species are either annuals that grow during wet winter and spring then die in summer, or perennials with high oil content in order to withstand these annual summer droughts year after year. Many of these plants are also "fire adapted," meaning they expect natural fire to be part of their lifecycle and have therefore developed some level of resiliency to wildfires. The dead annuals and high oil content of perennial plants are typically very flammable during late spring, summer, and fall. The burning intensity of these plants is directly related to climatological conditions, live fuel moisture and local topography. Wildfire, overall, is a very natural part of the environment in this region, and the vegetation in this area has evolved over millenniums with periodic fires burning across the landscape. With the influx of development over the past 100 to 200 years, these periodic fires have largely been suppressed as quickly as possible in order to avoid impacting the built environment. This has resulted in an overgrowth of vegetation that is denser and covers more of the landscape than would have been normal in the past.

Over time, individual homeowners have planted vegetation for landscaping purposes, as well as privacy shields from neighbors and the public. In many cases, this has resulted in even more fuel loads than would have existed prior to the development of subdivisions. This landscaping

around homes has become "fuel" which in many cases is easily ignited by embers, and which can then ignite the adjacent structures. On many properties surrounding the Arroyo, this landscaping has not adhered to fire resistant principles, resulting in a higher level of ignition potential for structures. Typically, these landscaped yards are well watered, and thereby tend to have a higher moisture content than the surrounding natural vegetation. But this increased landscaping and reduction of its maintenance around structures has been determined to be a significant contributor to structure ignitions. It is important to understand that fire resistive landscaping does not mean fireproof – all plants will burn given the right conditions. The most important determination for structure ignitions is the location and maintenance of the landscaping, which will be discussed later. Therefore, when fires do occur in these areas today, fire activity has a tendency to exhibit more active fire behavior, accompanied by intense heat and aggressive fire spread due to the increased vegetation and structures in the area. One statistic that has been well documented is the fact that approximately 90% of all wildfire ignitions are the result of human intervention. The statistics also point out that most ignitions are accidental in nature. But accidental ignitions are also often accompanied by sometimes underlying negligent factors. Someone may not have intended to ignite a fire, but their lack of knowledge about the dry fuels and weather conditions led them to an action that may inadvertently cause a fire. The simple fact remains that the increased density of people in WUI zones continue to increase the potential of a wildfire ignition.

WILDFIRE HISTORY

Pasadena does not have a significant wildfire history within its immediate boundaries. However, there are numerous historical fires that have burned nearby as seen in Figure 6 below. Some may raise an argument that because there has not been a high occurrence of wildfires in this specific area in the recent past, it could be seen as being alarmist to raise these concerns now. But as discussed above, the frequency of large, more destructive fires is now occurring at a higher rate than we have recorded in the past. One element of wildfires that is well understood today is the fact that fires often have a tendency to repeat themselves in areas where past fires have been recorded. Despite the lack of significant fire history in this area, it is known that wildfires occurred in this area prior to the recorded history we have available. This means that future wildfires may occur in this area, repeating past history. The map above identifies a significant amount of wildfire activity surrounding the City of Pasadena over the past 50 years. The Lower Arroyo has all the elements that could support a wildfire event, which could dramatically impact the surrounding neighborhoods.

We have seen wildfires burn in areas where they burned in the past in many areas of the state with devastating consequences. One recent example is the Tubbs Fire, which burned from the town of Calistoga to Santa Rosa the night of October 8, 2017. The perimeter of this fire bore an eerily similar footprint to the Hanley Fire, which burned much of the same landscape in 1964. However, some stark contrasts stand out when comparing these two events. In 1964, there were very few homes built in the 53,000-acre footprint of the Hanley Fire, compared to thousands of structures that existed in 2017. While the Hanley Fire did destroy 84 homes, 24

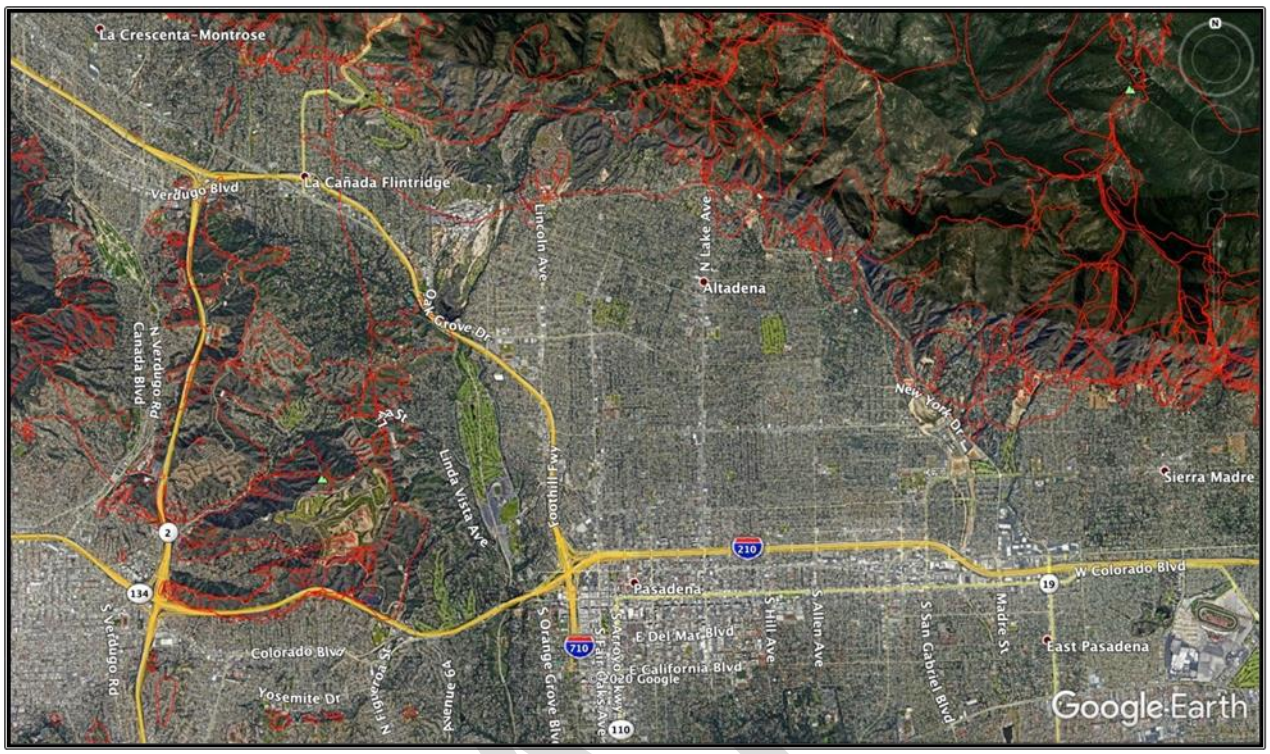


Figure 6: Wildfire "footprints" shown in red lines surrounding Pasadena

summer cabins and numerous farm buildings, there were no lives lost. Some of this is attributed to the fact that not only were there fewer people in the path of the fire, but it moved at a much slower pace than the 2017 Tubbs Fire. The devastation in 2017 made the Tubbs Fire, at that time, not only the deadliest fire in history, but also the most destructive. Unfortunately, both of these unwanted records were surpassed only one year later by the Camp Fire in Paradise. The fact remains that this, and numerous other examples of recent wildfires, show a preponderance of burning the same or nearby landscapes, but with much higher intensity and speed.

Wildfire history around Pasadena includes the following incidents:

1.	1878	Unknown Name	59,469 Acres	Verdugo Mtns., NW Of Lower Arroyo
2.	October 20, 1929	Ford No. 125	197 Acres	Same as Above
3.	August 8, 1935	Eagle Rock 44	98 Acres	Same as Above
4.	November 2, 1949	Katherine	142 Acres	Same as Above
5.	July 8, 1959	Unknown Name	67 Acres	Same as Above
6.	March 15, 1964	Unknown Name	1,458 Acres	Same as Above
7.	July 8, 1974	Unknown Name	14 Acres	Same as Above
8.	May 29, 1979	Unknown Name	4 Acres	Same as Above
9.	August 18, 1986	Flint Peak	71 Acres	Same as Above
10.	December 6, 1988	Glenoaks Canyon	353 Acres	Same as Above

The above list is a partial summary of ignitions near Pasadena, dating back to 1878. Of course, there have been other ignitions during this time, but those fires did not grow to a significant size, and therefore have been omitted. However, this list clearly indicates that wildfires have occurred quite close to the City of Pasadena over time. It is obvious that this list also shows a significant wildfire history northwest of the Lower Arroyo in the Verdugo Mountains. For the sake of brevity, a number of wildfires to the north of the City have not been identified, such as the Station Fire in August, 2009. This fire burned over 160,000 acres, and resulted in the deaths of two firefighters from the Los Angeles County Fire Department.

These fires occurred as early as March, and as late as December, but today we are witnessing wildfires occur year-round. Because there is past fire history very near the Lower Arroyo, especially to the north and west, it must be assumed it will happen again – but potentially with far greater speed and intensity than in the past. Unfortunately, recent wildfire trends indicate this sort of fire behavior may result in more destruction and potentially a higher loss of lives. The purpose of discussing these examples of fire return is to point out that past fire history in the area near the Lower Arroyo may very likely be repeated, and should be expected. It is also important to recognize that because the previous 150 years of fire history does not place a significant fire within the Lower Arroyo itself, it cannot be assumed a fire won't burn there in the future. The argument that there have not been recent wildfires in the area no longer have any merit to resist changes in wildfire prevention actions.

GENERAL ASSESSMENT, RISK ASSESSMENT, AND VALUES AT RISK

In order to more fully understand the wildfire environment discussed above, it is important to differentiate some commonly used terms such as risk, threat, and vulnerability. It is also important to understand how they interact to provide a more comprehensive risk assessment. These terms are described as follows:

- **Risk:** A risk is the statistical probability of an event occurring. From a wildfire standpoint, risk is defined as the chance of a fire starting from any cause, and the danger is defined as the combination of the potential fire to start (i.e. the risk) and the hazard presented should the fuel become ignited. This cannot be controlled.

- **Threat:** Anything that can exploit a vulnerability causing damage or destruction. The physical effects (or forces) of an event on people, property, and/or infrastructure. For example, heat from a fire.

- **Vulnerability:** A weakness in a system or physical asset. This is the one variable that can be minimized through planning and coordination, hardening of assets, and response force capabilities.

Together, these terms can be viewed in the context of any emergency as follows:

Threat + Vulnerability = Risk (T + V = R)

The risk of a large, uncontrollable wildfire within the City of Pasadena is low, but it would likely occur during occasional severe weather conditions, such as a high fire danger period, red flag warning or significant wind event. However, the consequences are high as they pose a risk to hundreds of homes adjacent to the Lower Arroyo. Depending on which direction the wind might push such an event, the impacts could disrupt businesses, various elements of infrastructure, traffic, and air quality, among other things.

Generally, the threat of a fire does not change regardless of other factors besides weather, which cannot be controlled. Physical damage from the fire will increase depending on weather conditions because in extreme conditions the fire can create so much energy that forward progress of the fire cannot be stopped, it becomes uncontrollable, and even structures with adequate defensible space and upgrades that provide "hardening" from ember and other fire impacts, may not be able to resist the heat and energy of the fire.

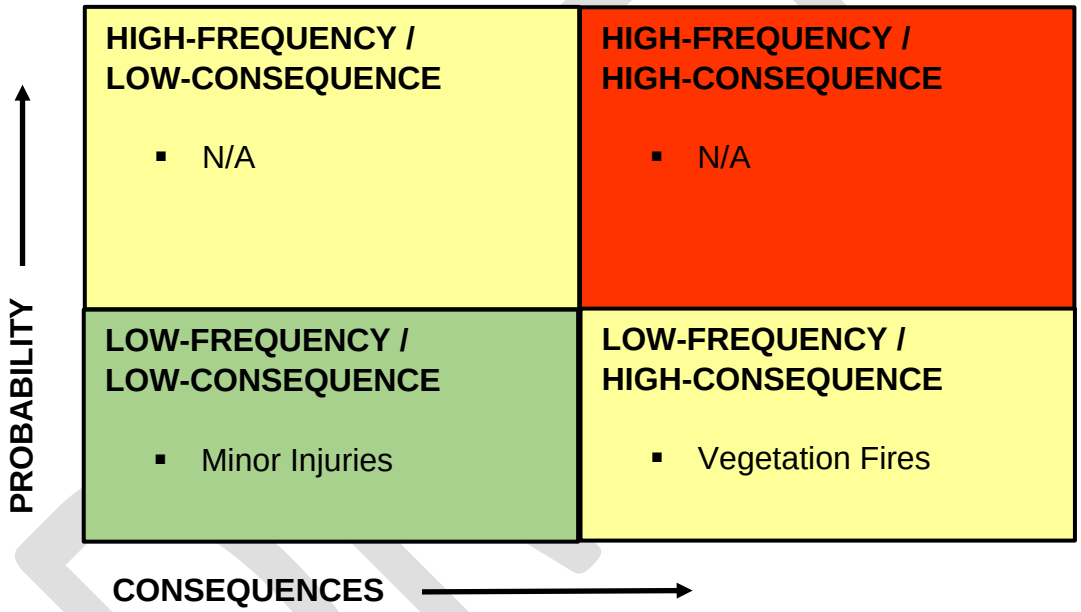


Figure 7: Frequency - Consequence Matrix

Vulnerability is the area where mitigations can help reduce the risk. Principally, this can be accomplished by slowing the spread of a fire during its early stages until sufficient firefighting forces can arrive. However, within an established community such as Pasadena, there are limited opportunities to improve the vulnerability of the community, meaning roads, infrastructure, and home sites will not change. Those efforts that can make a difference, such as "hardening" structures against wildfire impacts and changes in landscaping and vegetation, will be discussed as part of the recommendations for mitigation.

Risk management within Pasadena includes the analysis of the chance of an event occurring and the resulting damage that could occur as a result of the event. The challenge of risk management does not lie solely in the work necessary to assess the probabilities of an

emergency, but also with policymakers, who must decide how to address budgetary needs and regulatory policies to minimize or eliminate vulnerabilities.

The evaluation of fire risk must take into account the frequency and severity of wildfire potential. Determining risk by analyzing past statistical information, changing climate impacts, and changes to the existing landscape and built environment is an essential component of this analysis. It is represented in the following "Frequency-Consequence" matrix above.

In terms of wildfires and the WUI areas represented by the Lower Arroyo, a hazard is defined by the kind, arrangement, volume, condition, and location of the fuel complex, with these factors determining the ease of ignition and/or the resistance to fire control. Although the risk of ignitions around the Lower Arroyo is low, the consequences related to structure loss, evacuation challenges, smoke impacts, and injury or death from the fires is extremely high.

VEGETATION MANAGEMENT STRATEGIES FOR THE LOWER ARROYO

In order to provide a fully comprehensive Wildfire Assessment Report for the Lower Arroyo, acknowledgement must be given to previous reports that have addressed some of the issues related to this topic. These include the following reports and documents:

1. City of Pasadena Local Hazard Mitigation Plan, March, 2019
2. Lower Arroyo Master Plan, Adopted Sept. 29, 2003, Revised Feb. 2, 2015
3. Arroyo Seco Design Guidelines, Sept. 28, 2003
4. Lower Arroyo/Van De Kamp Bridge – Habitat Restoration, City of Pasadena
5. City of Pasadena Hazardous Vegetation Ordinance

Each of these reports and documents will be briefly reviewed now as they relate to this Report. Some of these documents include detailed recommendations related to plant species, vegetation management principles, inspection guidelines, environmental habitat management and erosion control, among other things. Appendix B will provide a summary of these recommendations, which will offer a consolidated overview of these guidelines.

1. The City of Pasadena Local Hazard Mitigation Plan (LHMP) guides the City of Pasadena towards greater disaster preparedness and resiliency in harmony with the character and needs of the city and its communities. The emphasis of the LHMP is on the assessment of current capabilities and relevant risk, and understanding current and past mitigation efforts, for the purposes of identifying mitigation measures to address existing

Figure 8: Local Hazard Mitigation Plan Matrix

exposures/vulnerability, thus reducing injuries and ensuring critical infrastructure are functioning after a disaster. Hazard mitigation strategies help to eliminate losses by limiting new exposures in identified hazard areas, diverting the hazard by reducing the impact, and developing an awareness of hazard area locations to avoid future development. The LHMP categorized Wildfire as the 2nd most relevant hazard in the City of Pasadena and a high priority because of wildfire's high impact and high probability ranking.

2. **The Lower Arroyo Master Plan (LAMP)** was prepared at the direction of the Pasadena City Council with full public participation, review by the Recreation and Parks Commission, Design Review Commission, Cultural Heritage Commission, and Planning Commission. In its approval, the City Council directed City staff to prepare a final plan that incorporated several key elements into the Master Plan. The LAMP has eight (8) Goals and Objectives. Of those 8, Goals 1, 6, and 7, as well as a list of Objectives align with this report's recommendations as follows:

> **Goal 1:** Restore, preserve, and enhance the natural character of the Arroyo in its urban setting as a self-sustaining, healthy system of people, plants, and animals interacting with the land. The natural character will continue to inspire people, as it has throughout time, and provide a setting for human activities now and in the future.
>
> **Goal 6:** Provide a safe and secure environment for recreational activities.
>
> **Goal 7:** Manage and maintain the area to balance natural habitat values, recreational needs and public health and safety.

Objectives:

- Implement a brush-clearing program to reduce fire hazards in critical areas.
- Maintain programs to control and manage erosion.
- Retain the flood-control function of the canyon.
- Maintain program to control invasive nonnative weedy species.
- Develop annual program for native tree and shrub plantings and replacement based on monitoring.

The LAMP recommends the mitigation of fire hazards. The LAMP reports that areas with frequent, repeat occurrences of fire or other disturbances tend to lose the dominant shrub community and allow ruderal vegetation that includes very aggressive and nonnative species to become established. In areas with sufficient dry- season moisture and shade, native and exotic vegetation can accumulate to levels that create a higher-than-normal fire hazard.

3. The purpose of the **Arroyo Seco Design Guidelines** is to provide design criteria for preservation, restoration, and conservation of the Arroyo Seco leading to a unified park design that reflects the natural environment, the heritage of the site, and its relationship to the traditions of the City of Pasadena; and a unifying set of design criteria for improvements set

forth in the Arroyo Seco Master Plans consistent with preservation and restoration of the natural environment.

The Design Guidelines also address fire mitigation on sloped areas that are the steep banks of the Arroyo Seco, some of which are identified as natural preservation areas by the Arroyo Seco Public Lands Ordinance. These areas have unique landscape requirements. Fire mitigation as described in this document is the management of the threat of fire, and is of great importance in the Arroyo Seco landscape.

4. **The Lower Arroyo/Van De Kamp Bridge – Habitat Restoration** document identifies the growing density of vegetation along the Lower Arroyo, along with the increasing number of non-native plant species. The accumulation of dense vegetation mixed with these non-native species has been acknowledged as one of the most significant contributors to the potential increase in wildfire spread and intensity. Because vegetation density and species type are some of the factors that can be controlled by management control projects, this document provides guidance in restoring the native habitat to help reduce these hazards. In addition, it also provides guidelines to help manage slope integrity and erosion control issues.

5. The final document included as a reference in this Report is the **Hazardous Vegetation Ordinance** by the City of Pasadena. This document includes the regulatory guidelines that are used to determine compliance during inspections by city personnel. While these guidelines are more focused on vegetation management around structures, there is also language that can be used to provide valuable guidance when dealing with open spaces or larger properties that include more space between structures.

The information presented above has been provided to address the current status of wildfire issues in the Lower Arroyo and surrounding neighborhoods, and highlight some of the documents that are being used to help address wildfire issues. The next portion of this Report will visit a number of actions and documents that have collectively been performed and written to address various issues related to wildfires in and around these areas. They have all addressed particular issues that need attention, and individually provide valuable information for the specific issue they are addressing.

PREVENTING STRUCTURE IGNITIONS

Through the abundance of reports, activities and actions taken by Pasadena, there is only a cursory acknowledgement of what has now been identified as one of the highest risks from wildfires – structure ignitions due to wind-blown embers. This is not a new phenomenon. The primary reason why so many homes were destroyed in the 1961 Bel Air Fire was directly attributed to embers igniting wood shake roofs. It was also one of the primary reasons for such a high structure loss in the 1991 Tunnel Fire in the Oakland hills. Firefighters have actually witnessed this happen on numerous occasions – ourselves included – as fire severity and

structure loss has increased since the early 2000's. CAL FIRE (California Department of Forestry and Fire Protection) created an electronic data collection program to gather information from damaged and destroyed structures in 2014. This program has been used successfully to collect data from large fires beginning in 2015, such as the Valley Fire in Lake County (approximately 2,000 structures lost) and the Butte Fire in Calaveras County (approximately 1,000 structures lost). Since 2015, this unique database now has well over 50,000 records of structures lost across the entire State of California, and is the only database of its kind in the world. Wildfire research and scientific communities around the globe are hard at work analyzing this database to better understand the causes of structure ignitions. As a result of these studies, important information has come forward.

Figure 9: Bark mulch burned up to gravel landscaping adjacent to house during Glass Fire. Note: Homeowner had bark mulch removed and replaced with rock landscaping only two weeks prior to start of Glass Fire.

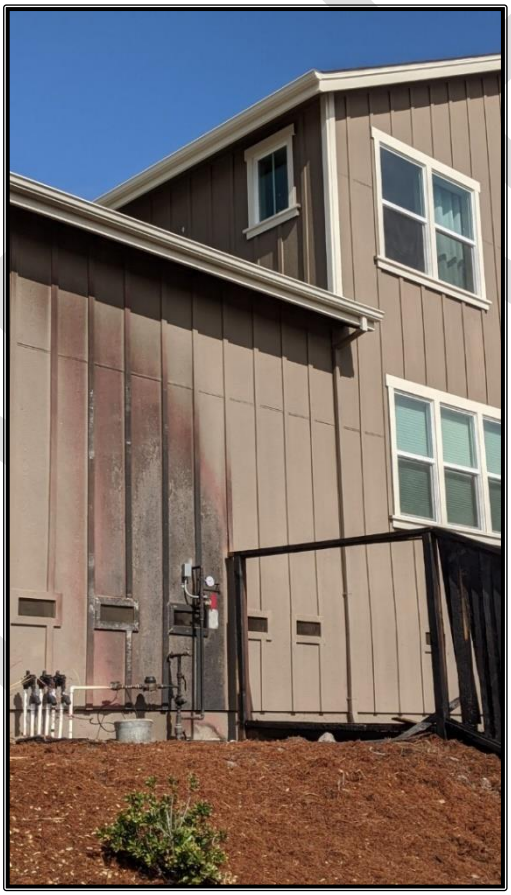


Figure 10: Home that survived the recent Glass Fire, showing impact of burning wood fence.

Figure 11: Same house from photo at left showing burned fence removed, and efforts by firefighters to rake away bark mulch from perimeter of home.

The data tells us that up to 90% of every structure ignited in a wildfire today is either directly or indirectly caused by embers. Again, this has been understood from an anecdotal standpoint by firefighters witnessing this phenomenon for many years. But the data collected now allows a more formal scientific focus to be made. This formulates the entire basis behind the concept of "home hardening" that has been mentioned previously in this Report. Embers will seek out any path possible to directly ignite a structure – whether it be vegetative debris accumulated in gutters or elsewhere on roofs, cracks in siding or openings around garage doors. There is a very long list of possible sources that embers will seek to ignite a structure. But if the structure has been carefully maintained with ember-resistant materials and details, the potential for these wind-blown embers to ignite a structure are dramatically reduced. This is most evident in tests conducted by the Insurance Institute for Business and Home Safety (IBHS) in their testing labs in South Carolina. Short video clips of these tests can be viewed on the IBHS website https://ibhs.org/risk-research/wildfire/.

In addition to direct ignition of structures from embers, they can also ignite surrounding landscaping, patio furniture, wooden decks, wooden fences and gates, and especially highly flammable wood bark mulch that is so popular as landscaping immediately surrounding homes and other buildings. These, and many other flammable items, may ignite from embers, which in turn may ignite the adjacent structure – this is referred to as indirect ignition. As fires move into more densely developed neighborhoods, such as in Pasadena, we have also seen an increase in structure-to-structure ignition. During high wind events, a burning structure can easily ignite other nearby structures due to radiant heat and direct flame impingement. In these instances, such as the Coffey Park neighborhood in Santa Rosa that was destroyed in the 2017 Tubbs Fire, or many areas in Paradise during the 2018 Camp Fire, a higher proportion of structures are ignited by neighboring structures. But even in these extreme cases, the direct or indirect ember ignition statistic still remains at or above 85%.

Either way – via direct or indirect ignitions – it is now recognized that this is the primary cause of structure loss in wildfires today. The data also tells us that once a structure ignites, there is a very low survivability rate – less than 10% in most fires. Therefore, if we know that embers are the cause of the vast majority of structure ignitions, and if the structure ignites, there is a very low probability of it surviving, it seems obvious that a majority of our focus should be on reducing the likelihood of ember ignitions.

To be fair, all of this statistical data is relatively new, and therefore has not found its way into the mainstream of previous reports. A recommendation would be to develop a Firewise USA® Program with assistance from the City's Fire Department. In addition, a much more focused effort could be made via education and information on this issue, with suggested solutions on how to prevent ember ignitions. In addition, the development of a Community Wildfire Protection Plan and the creation of a Fire Safe Council would be highly recommended for the Lower Arroyo communities.

These plans could include the new standards of maintaining a non-combustible zone directly adjacent to all structures for a minimum of 5 feet. This non-combustible zone has become

increasingly recognized as one of the most valuable elements to resist structure ignition from embers during recent fires. Figure 9 above shows a home in Santa Rosa that survived the recent Glass Fire using this technique. The homeowners replaced the wood bark mulch around their home with gravel only two weeks before the fire started, and although the remaining bark in their yard burned as shown in the photo, the fire was extinguished once it hit the noncombustible gravel area around the perimeter of the home. This single effort by these homeowners likely saved their house from possible destruction. Recent legislation in Sacramento has directed the Board of Forestry and Fire Protection (BOF) to amend existing fire safety regulations to include this strategy. While it may take a year or more for this to be enacted, it is a strategy that is proven to help reduce structure ignitions. There are a number of ways to look at this detail, which can be individually tailored to each home and property. In addition to the immediate "home ignition zone" in this 5-foot area, the data collected by CAL FIRE has also identified wood fences and gates as additional elements that contribute to structure ignitions. By simply replacing existing wooden fences and gates directly adjacent to structures with non-combustible materials, this ignition source can also be eliminated. The recommendation is to maintain a 5-foot separation from the structure to any wood or combustible fences or gates. Again, while this is not in state fire safety regulations yet, it is one of the recognized contributors to structure ignitions. Providing a more visible focus and detailed information on these details could help residents better understand these priorities.

ADDITIONAL IMPACTS

While this report has largely addressed wildfire impacts to neighborhoods in the Lower Arroyo, this Report cannot ignore the additional far-reaching impacts that a wildfire would pose on surrounding neighborhoods and the remainder of the City. As we have previously stated, the highest likelihood would come from an ignition located to the north of the City, and pushed by heavy Santa Ana winds, which primarily blow from north to south, or east to west. The resulting evacuations of thousands of residents will place a heavy burden on the entire street system throughout Pasadena as evacuees escape the approaching fire. This will clearly have a major effect on all neighborhoods in the remaining portions of Pasadena, as well as surrounding communities. We have all witnessed far too frequently the chaos that ensues during these evacuations, as sometimes the fire is moving with such speed that people are literally fleeing through smoke and flames to escape. There are far too many videos online from evacuees posting this sort of escape – and the goal is to never allow anyone from Pasadena to post another one of these chaotic videos.

Pasadena must maintain a plan to address the mass exodus that will occur in the event a fire threatens the Lower Arroyo and surrounding neighborhoods. Residents in this area must be aware of this plan, and know how to react and where to go when the time comes.

Yet another significant impact that a fire of this type would pose on the remainder of Pasadena and surrounding communities would be the effects of dangerous and unhealthy smoke. Not

only will it pose a significant health risk, especially to those with compromised breathing capacities, but the smoke can also cause significant impacts to homes, schools, and businesses. A clothing store, for example, could lose their entire inventory should smoke enter the premises and contaminate their products. Homes may need to be professionally cleaned before being deemed safe to reoccupy. Air systems in assisted living occupancies may need scrubbed before further use. Because of the worldwide spotlight that a fire in Pasadena would produce, there will be impacts to the hospitality industry due to cancellations amid fears of exposure to a wildfire. The list of impacts is long and non-discriminatory. It will affect everyone and everything throughout the entire City, as well as surrounding communities, before it is all over. Many communities, unfortunately, have suffered from these types of impacts in the recent past, and can provide advice and assistance on creating a solid plan for this impact. While emergency plans exist to address these types of impacts, they have not been forced to deal with them during an actual emergency in recent years. Coordinating "lessons learned" from other jurisdictions who have already suffered through these events can help them strengthen their plan and be better prepared.

One final impact that bears discussion, and which is present even now before a wildfire ever occurs, is related to insurance. The insurance industry as a whole has suffered tremendous losses from recent wildfires, and naturally have been forced to react. It is understood that some residents have seen insurance costs soar to new levels, while others have been notified that their carriers will not be renewing their policies. Maintaining insurance for some has been a challenge at best. As a last resort, the State of California has available the FAIR Plan, but in Pasadena, this may not be a viable option because the maximum amount of a policy from the FAIR Plan may not provide the necessary coverage required by the homeowner. The fact is that the insurance industry was not fully prepared for the increase in wildfire severity and frequency that suddenly hit California over the past 5 years. They have collectively worked hard at better understanding the wildfire environment, and how their risk analysis models need to change in order to more accurately reflect the current and anticipated impacts. This is a continuing work in progress, but the industry is making significant strides forward.

One of the most positive aspects of this evolution is that Pasadena is well situated to take full advantage of these changes. Overall, the insurance industry is seeking ways for their policyholders to reduce the risk of wildfire impacts to their properties. They are creating new models that recognize and value fire prevention activities to help reduce these risks. USAA Insurance Company began offering a discount to clients who live within the boundaries of a Firewise Community a number of years ago, and continues this practice today. This is in recognition of the fire safety aspects that are practiced by residents within those communities. Mercury Insurance has recently announced new programs that also recognize the value of the Firewise USA® Recognition Program, plus additional criteria for their clients who can demonstrate positive action towards home hardening and fire safe landscaping practices. These are just two examples of how the insurance industry is moving toward a stronger recognition of clients who take positive action towards helping to reduce their wildfire exposure and vulnerability. This aspect of the insurance industry is a work in progress. But it is safe to say that within the coming years, your efforts to improve the fire resiliency of your

home and property will become more positively recognized by the insurance industry. There may still be unspecified costs involved in the final results – it is most likely unrealistic to expect premiums to go down in the future – but it may become far easier to obtain insurance, especially if you have taken steps to improve your overall wildfire resiliency to your home and property. Please know that these statements are in no way a guarantee this scenario will come to fruition immediately, but it is the current trajectory as understood at this point in time.

CONCLUSION AND RECOMMENDATIONS

Residents living around the Lower Arroyo have been relatively proactive in addressing their wildfire vulnerabilities. The purpose of this Report has been to recognize the positive steps that have been taken, and collectively show how they all tie together to offer a positive path forward. Continuing the efforts already begun will continue to reduce the City's risk from a potentially damaging wildfire. This assessment is not the first to suggest that we must aggressively pursue paradigm shifts to be successful, and it will not be the last. Everyone has a role to play, and everyone must be encouraged to participate if we are to succeed and reduce these wildfire risks together.

Perhaps the strongest summary and intent behind this assessment can be encapsulated by Goal 7 of the **Lower Arroyo Master Plan**. It states the following:

> ***Goal 7: Manage and maintain the area to balance natural habitat values, recreational needs and public health and safety.***

This assessment highlights the value of the open space and the adjacent community. The list of items below provide a summary of these goals, with recommendations on how to move forward. They are as follows:

1. It is not a question of whether a wildfire will occur, but only a question of when.
2. Enact vegetation management plans that will begin to reduce the density of flammable vegetation, along with potential fire behavior and spread. These plans will also have the added benefit to remove non-native species in the Lower Arroyo, and create a more natural and fire resilient landscape.
3. Establish a long-term maintenance plan to ensure the vegetation programs continue well into the future.
4. Consider establishing a Firewise USA® Recognition Program and Fire Safe Council(s) in neighborhoods adjacent to the Lower Arroyo, and encourage more active participation from residents.
5. Consider the development of a Community Wildfire Protection Plan.
6. Provide a more robust education and information program for home hardening, defensible space efforts, and consider enforcing the immediate "home ignition zone" concept around homes with a non-combustible feature.

7. Provide better understanding of wildfire impacts beyond just the VHFHSZ areas in the Lower Arroyo and the west. The entire City will be impacted and must be prepared.
8. Implementation of Vegetation Management Measures and Ordinances.
9. Endorsement and Support of Structure Resiliency Best Practices for Existing Structures.
10. Consideration of a Wildfire during High Fire Danger and/or Red Flag Warning.
11. Consideration of Evacuation Complications during High Fire Danger and High attendance event at the Rose Bowl.
12. Consideration of true wildfire cost from fire suppression to community, ecological and economic recovery.

In addition to the recommendations and bullet points above, there are two reports we feel contribute to the education and understanding of wildfires, and how to protect your home and property in a more resilient manner. Rather than provide the entire document as attachments, we will provide the links to the documents here:

Wildfire Home Retrofit
http://www.readyforwildfire.org/wp-content/uploads/Wildfire_Home_Retrfit_Guide-1.26.21.pdf

Protect Your Property from Wildfire, California Edition
https://disastersafety.org/wp-content/uploads/2019/03/Wildfire-Retrofit-Guide-California_IBHS.pdf

By tying all the positive efforts together that residents around the Lower Arroyo will engage in, the vulnerability to wildfires will be reduced well into the future. These bullet points and recommendations are connected to the various documents and reports that have been referenced previously in this assessment. The Appendixes that follow provide excerpts from some of these reports, highlighting specific treatment plans and details that coordinate with this assessment.

We strongly believe that by coordinating efforts between all residents, the City of Pasadena, and other stakeholders surrounding the Lower Arroyo Seco Canyon, a more resilient landscape and wildfire resistant future is in store for all to enjoy.

APPENDIX A

Recommended Treatment for the Lower Arroyo Area Homes and Properties within the City of Pasadena's Fire Hazard Severity Zones

The Lower Arroyo Wildfire Assessment Recommendations are aimed to the potential fire environment that could mutually involve the built and open space areas. The City of Pasadena Hazardous Vegetation Ordinance provides mitigation guidance, as well as additional information that is provided in this report.

Homes within the City of Pasadena Very High Fire Hazard Severity Zone are subject to the City's Hazardous Vegetation Ordinance. A **Defensible Space** of 100 feet around a home is required by law. The goal is to protect the home while providing a safe area for firefighters. **Clearing and maintaining an area of 30 feet immediately surrounding a home is critical. This area requires the greatest reduction in flammable vegetation.** The vegetation reduction zone in the remaining 70 feet (or to property line) will depend on the steepness of the property and the vegetation. Spacing between plants improves the chance of slowing a wildfire before it impacts a home. The fire hazard reduction is conducted by creating horizontal and vertical spacing between plants. The amount of space will depend on how steep the slope is and the size of the plants.

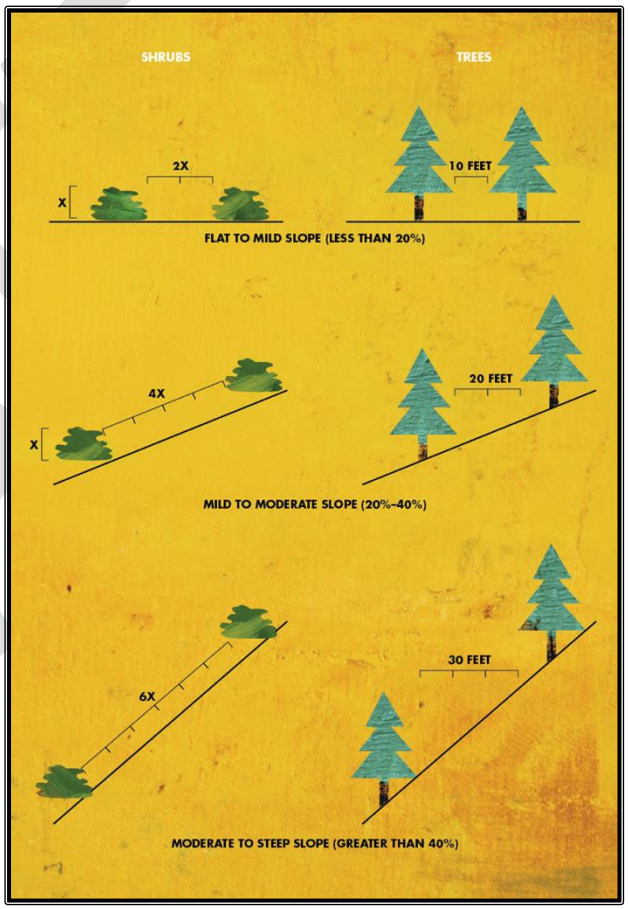


Figure 12: Managing Horizontal Continuity within 100' from the structures.

Large trees do not have to be cut and removed as long as all of the plants beneath them are well trimmed and maintained or removed, and the tree is trimmed and maintained. This eliminates a vertical "fire ladder." When reducing and maintaining vegetation, use care when operating equipment such as lawnmowers, weed trimmers, etc. One small spark may start a fire; a string trimmer is much safer than metal blades. Remove all build – up of needles and leaves from the roof and gutters. Keep tree limbs trimmed at least 10 feet from any chimneys and remove dead limbs that hang over the home or garage. The law also requires a screen over the chimney outlet. Other Fire Safety recommendations include cleaning leaves, needles and twigs from roof and gutters, proper watering of trees and shrubs help to maintain plant moisture content, pruning trees properly, keeping the property free of accumulated combustibles such

as dried vegetation, cuttings and wood piles and mulch flat planting areas three inches deep to suppress weeds.

Figure 13: Managing Vertical Fuel Continuity

Figure 14: Good example of open space around residence.

APPENDIX B

Pasadena Fire Department's Vegetation Management Inspection Program

Property owners and residents can help protect their homes by joining in partnership with their neighbors and the City to assure compliance with the City's Hazardous Vegetation Ordinance. The goals are to maintain tress and vegetation that beautify and benefit a property, and to remove hazardous vegetation that provides a combustible fuel supply for wildfire. This is important to every resident of Pasadena, where the fire season is year-round.

A working partnership between property owners, their neighbors and the City of Pasadena is the best defense against disastrous fires. Pasadena's Hazardous Vegetation Ordinance is designed to minimize fire danger by controlling the density and placement of dead, dying, overgrown and unmaintained vegetation. It does not recommend indiscriminate clearing of native chaparral and other vegetation that plays an important role in erosion control and habitat preservation. Fire hazard reduction can be achieved if all members of the Fire Prevention Partnership do their part.

The Pasadena's Hazardous Vegetation Ordinance requires property owners to:

♦ Remove all dead trees, shrubs, vegetation and keep grasses and weeds mowed within 100 feet of any building (including those on adjacent property), and within 10 feet of any roadway used for vehicular travel. In extremely hazardous areas, fire hazard reduction up to 200 feet from a structure and 50 feet from a fence or roadway may be required by the Fire Department.

♦ Grasses, shrubs, and other vegetation located more than 30 feet from any building and less than 18 inches in height may be maintained where necessary to stabilize soil and prevent erosion. Large trees and shrubs in that area should be 18 feet apart.

♦ Remove leafy foliage, dead wood, combustible groundcover, twigs or branches within three (3) feet of the ground from mature trees located within 100 feet of any building or within 10 feet of any roadway used for vehicular travel.

♦ Remove dead limbs, branches and other combustible matter from trees or other growing vegetation adjacent to or overhanging any structure.

♦ Remove any portion of a tree which extends within 10 feet of a chimney or stovepipe.

♦ Trim and maintain all vegetation away from curb line up to a height of 13.5 feet to accommodate emergency vehicles.

♦ Maintain five (5) feet of vertical clearance between roof surfaces and any overhanging portions of trees. These minimum standards are established to provide reasonable measures of controlling both fire and erosion hazards and to protect lives and property. Pasadena Fire Department personnel may introduce greater protection levels in high danger areas.

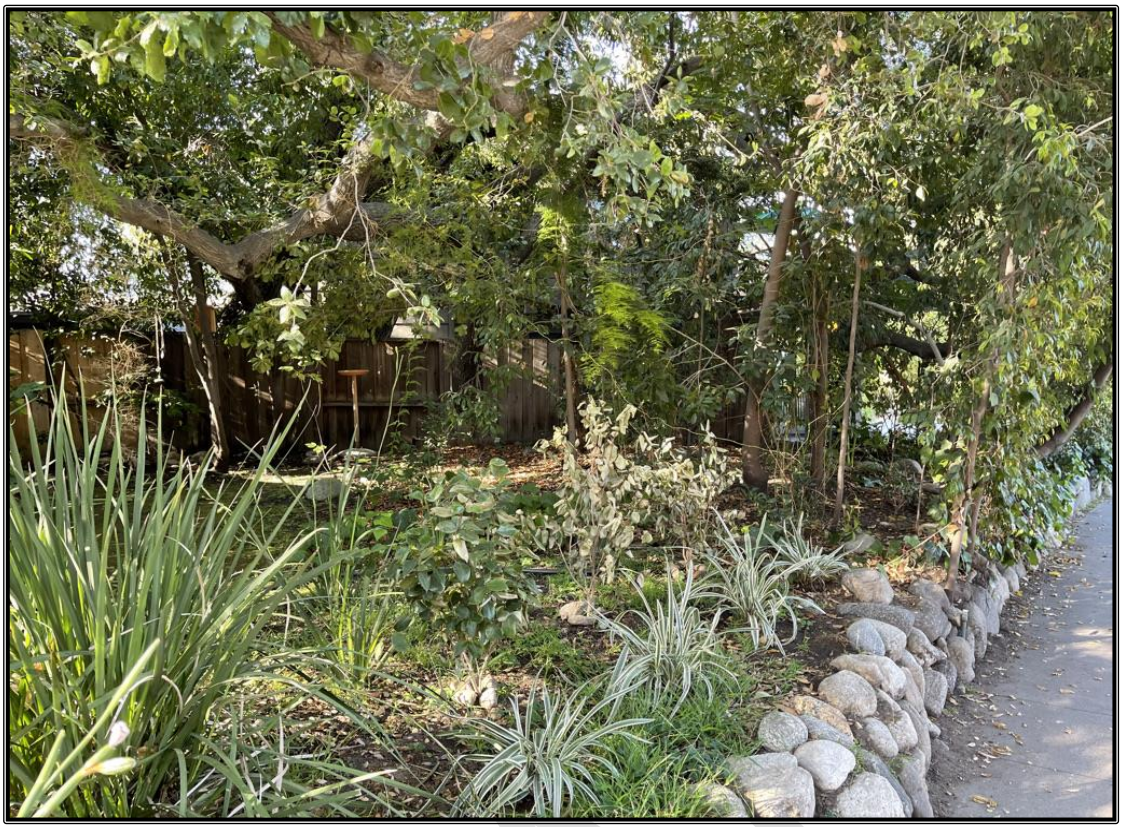


Figure 15: Current Examples: Overgrown Vegetation Adjacent to Homes

Figure 16: Current example of excessive vegetation near home

Figure 17: Current Examples: Maintained Vegetation

Figure 18: Current Examples: Maintained Vegetation

Creating Defensible Space

To create defensible space, we must think about the garden in three zones. Generally speaking, Fire-prepared landscapes have no combustibles within five feet of the home, lower plants closer to the home, larger plants and trees further away from the home, and areas of non-combustible materials in between.

From **0 to 5 feet** from the structure zone:
The objective is to create the most fire-prepared zone in the area immediately surrounding the home to avoid home ignition from blowing embers. The greatest hazards are created by plants against combustible siding and under or near windows or doors. Flames can ignite surfaces behind siding if allowed to enter at vulnerable points such as vents or any gaps close to the foundation. Flames rise 2 to 3 times the height of flammable surfaces.

To do:
Sparsely planted, low-growing, non-woody, herbaceous plants less than 18 inches tall (recommended). This may include vegetables, succulents, grasses, ground cover, seasonal flowering annuals, or lawn (and walkable lawn alternatives). Keep grass trimmed to less than one inch tall.

To use:
Non-combustible materials such as concrete, brick, pavers, decomposed granite, or gravel mulch.
To avoid:
No branches within 10 feet of chimney
No climbing plants
No litter in roof gutters
No combustible items under decks
No combustible containers, mulch, fencing, furniture, firewood, and other combustibles.
No combustible landscape items attached to house, including wood gates, fences, arbors, combustible mulch, and trellises.

Consistent plant and landscape maintenance of this zone is critical.

From **5 to 30 feet** from the structure zone:
The objective is to reduce heat and movement of flames by creating an organized and clean environment.

To do:
Plant low, well-irrigated plants like vegetables, succulents, grasses, groundcover, seasonal flowering annuals, or lawn (and walkable lawn alternatives) close to the house and larger shrubs and trees further away from the house. **Use non-combustible materials for walkways,** such as gravel, brick, or decomposed granite. **Break up mulched areas** with hardscape material such as gravel or stone. **Move firewood, lumber, and other common**

landscape items outside the first zone. **Allow ample plant spacing.** If budget allows, **consider adding a small water feature or patio** in this zone. If this zone extends into a neighbor's yard, **work together** to coordinate actions, and enhance the value of the collected efforts.

Consistent plant and landscape maintenance of this zone is critical.

From **30 to 100+ feet** from the structure zone:
The objective is to decrease the energy and speed of a fire by eliminating continuous, dense vegetation both vertically and horizontally. This is a transition zone on larger lots. It is the space between manicured gardens adjacent to the house and fringe areas abutting open space or between groups of houses surrounded by open space.

Plants farthest from the house may not need to be irrigated, but they should be well maintained. California native plants with low water needs may be a good choice. Move anything burnable during a nearby wildfire 30 feet away from structures. This includes patio furniture and BBQ propane tanks. Wood mulch is acceptable in this zone. Allow ample plant spacing**.** Work with neighbors to create continuity between actions and increase defensible space where possible.

Plant and Landscape Maintenance
When it comes to creating defensible space, the significance of proper plant and landscape maintenance cannot be overemphasized. Poorly maintained landscapes can easily become fire hazards – regardless of which plants are grown.

The goal of fire-prepared maintenance is to reduce fuel while preserving the ecological well-being of the environment.

a) Clean up
Fire starts when oxygen and heat come in contact with fuel. Fuel is anything that burns. Consider all the combustible items surrounding the house: plants, wood piles, propane tanks, plastic trash bins, door mats, garden tools, arbors, trellises, and more.

- Remove dead or dry plants, grass, weeds, trees, and branches.
- Remove dead or dry leaves and pine needles from the yard, roof, and rain gutters.
- Remove and replace struggling plants.
- Make sure all plants are accessible and healthy – especially during the dry season.
- Remove combustible debris on and under decks, overhangs, and fences.
- Mow grass before 10 am and not on hot or windy days.
- Use string trimmers (vs. lawnmowers or metal blades) for clearing vegetation to minimize the risk of creating sparks when metal blades hit a stone.
- Do not accumulate construction materials, recreational equipment, or other debris, including dry grass beneath patio decks or elevated porches.
- Use equipment properly to keep from sparking a wildfire.

b) Water

Water is a precious resource in our drought-prone climate. Overwatering can encourage quick and excessive plant growth, increasing the fuel load on the property. In addition to adhering to general and the City's irrigation guidelines and water conservation efforts, pay attention to these fire-prepared irrigation strategies.

• **Keep your plants well hydrated.** If water availability is restricted, keep high value landscape plants, such as trees, properly hydrated and remove low value plants that are overly stressed, creating fuel in the home's landscape.
• **Keep hoses accessible for firefighters.**
• **Clearly mark all emergency (and other) water sources.**
• **Store an extra hose** or two with emergency supplies.
• If your water comes from a well, consider purchasing an **emergency generator** to operate the pump during a power failure.
• **Keep irrigation system in good condition** by checking it regularly. Make any necessary repairs before the dry season.
• **Do not wet down the property on Red Flag warning days** as it depletes the water the fire departments need. Irrigate as normal.

C) Prune

Overgrown, diseased, or dead plant material creates excess fuel that can feed the spread of fire. Reduce the risk by keeping plants and trees adequately trimmed and pruned.

• Cut back woody, twiggy or overgrown shrubs that accumulate dry material (e.g. lavender, bougainvillea, etc.).
• Cut back vines and low-growing groundcovers (e.g. ivy) to remove build-up of dry stems and dead leaves.
• Thin and reduce tree canopies to remove twiggy growth, maintain separation between trees, and reduce overall fuel load.
• Remove dead or diseased branches.
• Gently thin and trim back tree canopies to remove twiggy growth and maintain separation between trees.
• Limb up trees 6 to 10 feet from the ground or up to one-third of their height.
• Avoid topping trees as this causes excessive branching, is unhealthy for the tree, and results in twiggy growth that can increase the fire hazard.
• Allow adequate space between plants and trees

For more information on Creating Defensible Space go to:
https://www.readyforwildfire.org/
https://ucanr.edu/sites/fire/Prepare/Landscaping/DefensibleSpace/
https://defensiblespace.org/

APPENDIX C

The City of Pasadena planned the development of several studies of the in City-owned open space with the goal of improving habitat functions and values, considering, and promoting the balance natural habitat values, recreational needs and public health and safety. The following studies provide the background and framework for the development of this assessment's recommendations that utilize the latest fire hazard reduction and habitat restoration methodologies **for the Open Space Areas**.

The **2018 Multi-Hazard Mitigation Plan** establishes Wildfire as High Priority Hazard due to its High Probability and High Impact. Wildfire is only second to earthquakes.

Section 5.4.1.2.4 Probability of Wildfire Occurrence
The majority of work done to estimate the probability of wildfire occurrence has been around identifying the potential areas for wildfire to occur. As previously mentioned, vegetation and topography were the significant elements in wildfire threat. The area north and west of the city of Pasadena is marked by steep terrain. These mountains and canyons are covered in susceptible vegetation. A large amount of the native vegetation in the Pasadena area is commonly called chaparral, it is a dense and scrubby bush that has evolved to persist in a fire-prone habitat. Chaparral plants will eventually age and die; however, they will not be replaced by new growth until a fire rejuvenates the area. Chamise, manzanita and ceanothus are all examples of chaparral which are quite common in the Pasadena area.

This knowledge and understanding is a key driver in the methodology of the Fire and Resource Assessment Program (FRAP) under CAL FIRE. According to the CAL FIRE, the FRAP "Very High" Fire Hazard Severity Zone maps are based on data and models of potential fuels over a 30 to 50-year time horizon and their associated expected fire behavior and expected burn probabilities to quantify the likelihood and nature of vegetation for exposure to buildings. This indicates a very high likelihood of wildfire occurrence in the area. As such, Pasadena is susceptible to annual wildfire risk. As identified earlier in this Report, the Lower Arroyo and West Pasadena developed areas are in the Very High Fire Hazard Severity Zones.

The Arroyo Seco Watershed Ecosystem Restoration Study

The purpose of the Arroyo Seco Watershed Ecosystem Restoration Study is to evaluate opportunities for restoring ecosystem function along the 11-mile reach of the Arroyo Seco, which extends from the Angeles National Forest border to approximately 0.5 miles from its confluence with the Los Angeles River.

The objectives of this study are to provide an overview and analysis of Arroyo Seco's water-related resources. Available data was collected and reviewed, and problems and issues were identified. Using this information, candidate "spin-off" projects will be conceptualized and

evaluated at a survey level to identify those projects that are most likely to effectively provide ecosystem restoration benefits and that could be implemented to contribute to the overall restoration of the ecological function of the watershed. Each spin-off study will be recommended for feasibility-level study that would develop recommended ecosystem restoration plans.

Section 3.6.3 Future Without-Project Conditions
The potential for disruption of rainfall and weather pattern, and increased wildfire risks associated with global climate change could have future adverse effects on the Arroyo Seco watershed under the future without-project conditions. Changes in weather and rainfall patterns could alter the flow of the creek and runoff patterns, as well as increase the chance for extreme flooding and droughts and increase the risk of wildfires. This could exacerbate existing problems such as channel instability, degraded water quality, loss of fish and wildlife habitat, and flood damage. The loss of habitat quality and diversity could increase fuel loading, which increases the potential for natural catastrophic wildfires.

3.16.2 Wildfire Safety
While most of Los Angeles County and municipalities surrounding the Arroyo Seco study area are urbanized, much of the Arroyo Seco watershed contains or is adjacent to hills and mountains that include areas of undeveloped land supporting a variety of vegetation types, including shrubs, stands of trees, and forested upland areas with brushy understory. Because many of these areas are un-maintained open space, considerable ground fuel (e.g., dry leaves, woody debris, snags, limbs and tree fall) has accumulated in some areas.

In July 2007, CAL FIRE, the Governor's Office of Emergency Services, the Los Angeles County Fire Department, and several regional councils teamed up to form the California Fire Alliance. The mission of the Alliance is to facilitate interagency and public collaboration in protecting the quality of life threatened by wildfire in southern California. A main focus of the Alliance is to promote and support the development of local Community Wildfire Protection Plans (CWPP).

The Lower Arroyo Master Plan Goals and Objectives consider and promote the balance natural habitat values, recreational needs and public health and safety.

Goals and Objectives:

Goal 1: Restore, preserve, and enhance the natural character of the Arroyo in its urban setting as a self-sustaining, healthy system of people, plants, and animals interacting with the land. The natural character will continue to inspire people, as it has throughout time, and provide a setting for human activities now and in the future.

Objectives:

- Maintain the Arroyo's function as a corridor for wildlife and people.

- Increase plant and habitat diversity for the benefit of wildlife and to enhance recreational experiences.
- Use only native plants indigenous to the area in any habitat restoration activities.

Goal 6: Provide a safe and secure environment for recreational activities.

Objectives:

- Encourage an active Neighborhood Watch Program with regular
- meeting/reporting protocol.
- Expand patrols by security personnel and volunteers.
- Provide security lighting and/or cameras at key locations.
- Provide ADA-accessible trails where feasible.

Goal 7: Manage and maintain the area to balance natural habitat values, recreational needs and public health and safety.

Objectives:

- Implement a brush-clearing program to reduce fire hazards in critical areas.
- Maintain programs to control and manage erosion.
- Retain the flood-control function of the canyon.
- Maintain program to control invasive nonnative weedy species.
- Develop annual program for native tree and shrub plantings and replacement based
- on monitoring.

Goal 8: Enrich and promote the unique natural character of the Lower Arroyo Seco Park.

Objectives:

- Encourage use of the Lower Arroyo as a living laboratory.
- Develop volunteer/docent programs.
- Maintain public awareness/education programs
- Coordinate with local school districts and other educational organizations.
- Provide interpretive signage/information at appropriate locations.

Section 2.5 5 The Natural Environment addresses the importance of maintaining the native plant communities and habitat natural function by preventing the impact of repeated fire occurrences.

"Areas with frequent, repeat occurrences of fire or other disturbances tend to lose the dominant shrub community and allow ruderal vegetation that includes very aggressive nonnative species to become established. Once established, this plant community is sustained by repeated fire or other disturbance to the exclusion of shrubby species. Ruderal vegetation may occur on virtually any direction or aspect of level or sloping terrain where fire or conditions such as mechanical grading are present. This nonnative, terrestrial natural community offers

comparatively little value to most native wildlife species."

Additionally, this opportunistic nonnative community present a greater fire danger to the Open Space and surrounding homes.

Section 3.2.2 Restoration of Plants and Wildlife Habitats states *"In areas with sufficient dry-season moisture and shade, native and exotic vegetation can accumulate to levels that create a higher-than-normal fire hazard."*

Section 3.2.2 Recommendations:

- Restore and maintain native plants in selected areas;
- Modify the Arroyo Seco Public Lands Ordinance to limit restoration plantings to species indigenous to the Arroyo Seco watershed;
- Maintain irrigation system capability for establishment plantings;
- Mitigate fire hazards and erosion in critical areas;
- Control the establishment and spread of nonnative invasive plants;
- Continue monitoring low-flow stream system and other restoration areas;
- Consider acquiring title or easement control of poorly maintained areas to improve vegetation cover, reduce erosion and control the spread of nonnative plants.

Projects Descriptions:

Clear Brush and Create Fuel Modification Zone
A brush-clearing program will eliminate high fuel volume and create a fuel modification zone using fire retardant native plantings in the area bordering the Busch Gardens. This project will also create a more appealing screen of the wooden fence in Busch Garden's neighborhood.

Restore the Banks of the Lower Arroyo.
This project element proposes to restore the banks of the Lower Arroyo Seco through the following methods: Providing for a wildlife corridor along the banks of the Lower Arroyo, stabilizing the banks and controlling erosion, and actively restoring and conserving the native plant communities. Implementation of these projects will address the safety concerns in the Lower Arroyo Seco related erosion and fire danger.

The Arroyo Seco Design Guidelines also addresses fire hazard mitigation, erosion, and habitat restoration in Section 2.3. Fire Mitigation.

2.3.3 General Guidelines for Fire Mitigation
1. Fire mitigation shall be balanced with habitat conservation and slope protection.
2. Denuding of slopes shall be prohibited.

Figures 19 (above) and 20 (below): Current Conditions Lower Arroyo East

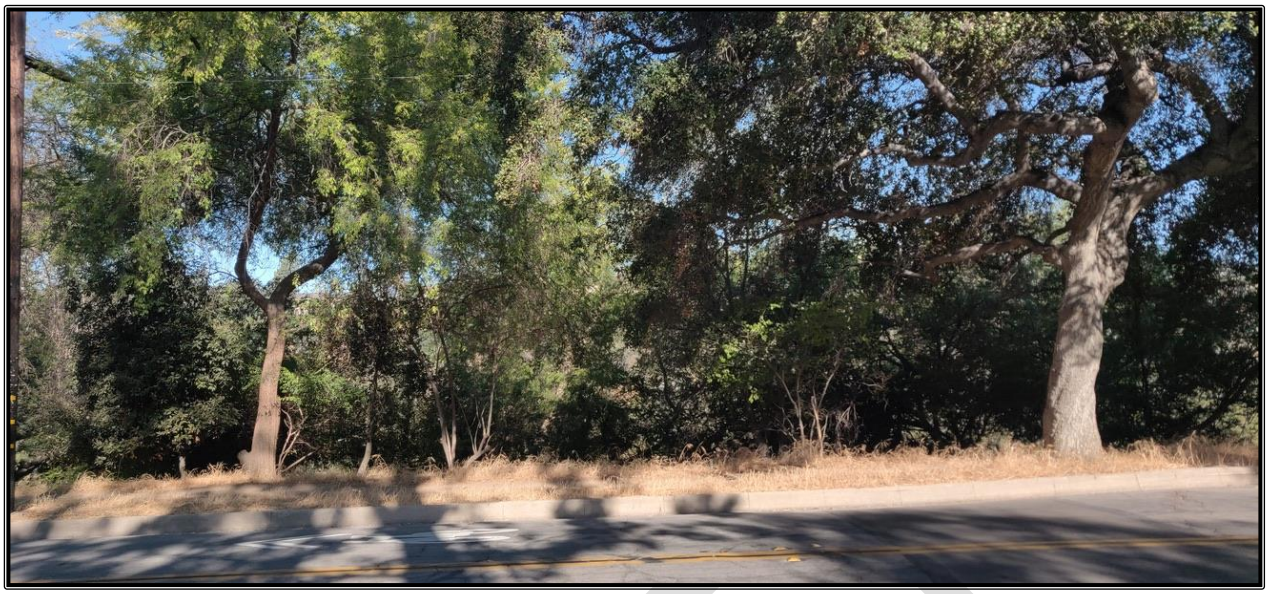
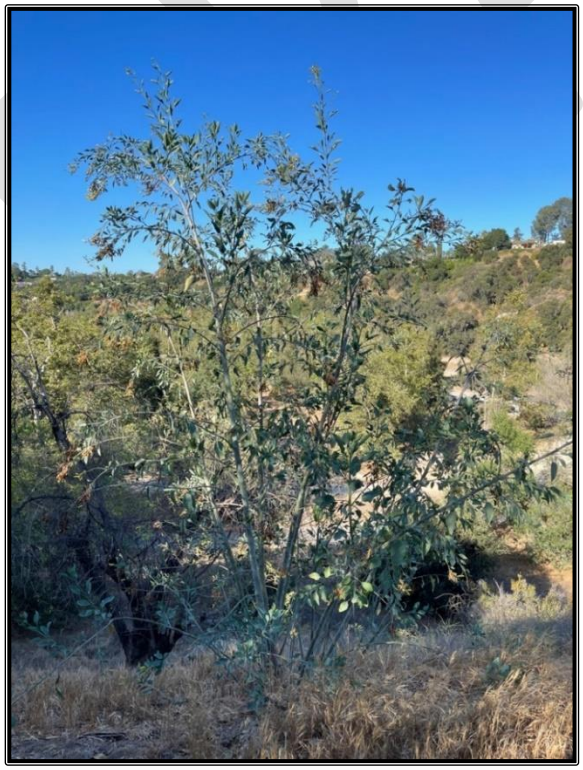


Figure 21 (above), 22 and 23 (below): Current conditions Lower Arroyo East

Figures 24 and 25 (above), 26 and 27 (below): Invasive species in Lower Arroyo Seco



Figures 28 (above) and 29 (below): Current Conditions Lower Arroyo West

APPENDIX D

Recommended Treatments for the Open Space Areas

There are a few factors that have negatively impacted the health and ecological functionality of the Lower Arroyo habitat.

Drought

Droughts are a recurring feature of California's climate and are becoming increasingly severe due to climate change. The most significant statewide drought since 2000 occurred in a five-year period from 2012 to 2016 with record-high temperatures and record-low levels of snowpack and precipitation. In 2021, more than 85 percent of the state is in extreme drought with water conditions at the end of the wet season far below normal for the second year in a row. Los Angeles had 40% of normal precipitation. At its peak, the California snowpack was just 59% of average.

Reduced soil moisture

Soil moisture can impact cloud formation, and hence precipitation. When water from wet soil evaporates, it contributes to the formation of rain clouds, which return the water back to the earth. When land is drier than usual, moisture still evaporates into the atmosphere, but not at a volume adequate to form rain clouds. The land effectively bakes, removing additional moisture and further exacerbating dry conditions.

Soil moisture conditions affect plant root water absorption and leaf transpiration, which further affect dry matter accumulation, ultimately affect plant growth, increases the plant dieback, and plant die-off. Reduced soil moisture affects plant Live Fuel Moisture (LFM) which is an important vegetation property controlling fuel ignition and fire propagation. LFM varies seasonally, and is controlled by precipitation, soil moisture, evapotranspiration, and plant physiology.

Invasive Plants

Non-native plant intrusions can have a variety of effects on wildlands, including alteration of ecosystem processes; displacement of native species; support of non-native animals, fungi, or microbes; and alteration of gene pools through hybridization with native species. The invasive species that cause the greatest damage are those that alter ecosystem processes such as nutrient cycling, intensity and frequency of fire, hydrological cycles, sediment deposition, and erosion.

The increased duration and repetition of these various factors has adversely impacted the Lower Arroyo leading to habitat declination and increasing the potential for habitat loss and wildfire propagation.

Based on the current conditions of the open space areas of the Lower Arroyo and the directives from the above-mentioned studies, Fire Hazard Reduction and Habitat Restoration treatments with minimal impact at the landscape level are recommended for the open space areas. The

objective of the treatments is to reduce, modify, and manage vegetation within designated areas to enhance mitigation efforts in the event of a wildland fire situation and restore the habitat's health and functionality. These treatments do not remove all vegetation in a given area. The purpose is to reduce the amount of combustible material so that when a fire hits the treated area it will decrease in intensity, reduce ember propagation, cool down, and drop from the canopy to the ground. Additionally, the restoration of the habitat function and sustainability are priority for these treatments.

One of the more common and successful vegetation management practices is the creation of shaded fuel breaks, which are a carefully planned thinning of shrubs and tree cover and the thinning of underlying brush, overgrown, dead and dying vegetation and removal of nonnative species. The treatments units should be placed in strategic locations along ridgelines, access roads, and locations adjacent to the structure's defensible space. The treatments priority would be from the built environment out into the open space.

The treatment should provide added fire protection and improve habitat health. These treatments are generally constructed to separate communities and clusters of communities from open space vegetation to protect both the developed area and the adjacent wildlands. They are commonly found along ridgelines, natural or manmade hurdles like roads and structure's defensible space where fire control efforts are focused.

The most advantageous location and design must be individually determined after considering vegetation, topography, weather, exposures and other constructed or planned improvements. Soil stabilization, erosion prevention measures and long-term maintenance requirements must receive thorough consideration during the planning and implementation phase.

A fire hazard reduction project is defined as a defensible location, where vegetation has been modified, that can be used by fire suppression resources to suppress oncoming wildfires. Any fire hazard reduction project by itself will NOT stop a wildfire. It is a location where the vegetation has been modified to increase the probability of success for fire suppression activities, reduction of fire propagation and impact on the treated wildlands. Ground resources can use the location for direct attack or firing out. Air resources can use the location for fire retardant drops. The public and fire resources can use the location for more efficient ingress and egress.

Fire hazard reduction projects act as strategic "defensible landscape" to reduce fire speed and severity, improve suppression by ground crews and air attack. The purposes of strategic vegetation modification are to separate communities or groups of structures from the open-space vegetation and break up large expanses of flammable fuel into smaller blocks, all with the purpose of reducing fire loss and damage.

Fire hazard reduction projects are intended to correct two conditions that have limited the effectiveness of fire control: the difficulty of quick, safe staffing of critical line locations when needed and the need for widening many fire breaks before they can be used effectively. Fire

hazard reduction projects are not expected to control a fire in themselves but provide points of access to facilitate control of the flanks and provide possible backfire action in the face of an advancing fire head. A fire hazard reduction project system may utilize existing road systems. Most projects include roadways for vehicle access, or other continuous strips, which serve as a barrier to the spread of fire through the fine fuels or as a line from which to backfire.

Homes with defensible space may make little difference when the neighborhood is threatened by a wide flame front. While defensible space addresses the need to remove the fuels close to individual structures, vegetation management in the open space focuses on programs that address such methods as fire hazard reduction projects and other vegetation modification practices on the broader landscape.

Fire hazard reduction and habitat restoration projects goals:

- Controlling fire behavior by reducing ladder fuels.
- Opening the canopy.
- Treating ground fuels.
- Facilitate fire suppression (ground and air attack).
- Mitigate soil erosion.
- Restore habitat health and functionality.

Treatment locations:
Treatment should be focused on the lower arroyo west facing slopes along South Arroyo Boulevard, Bush Gardens Drive and Bush Gardens Court. The treatment priority is from the structures defensible space and streets out into the open space.

The same focus applies to the east facing slopes on the west side of the Lower Arroyo. The challenge for this area is land ownership. There is a mix of mostly private properties and some public lands.

Erosion Control Considerations for Fire Hazard Reduction and Habitat Restoration Projects
Due to the Lower Arroyo soil types and steepness of the slopes, the thinning of vegetation must be done selectively in a manner that favors preserving the ability of vegetation to hold the soil. The preservation of tree and shrub canopies help prevent soil erosion by reducing the impact of rain onto the ground. The water drains down the leaves and branches and soaks into the soil. The root systems of treated ground cover, low lying shrubs and trees should not be disturbed. In a regular year, ground cover and shrubs are expected to sprout within one season, carpeting the ground and extending roots to retain the soil and feed on the composting mulched material.

The remains of treated plants should be lopped in fragments of six inches or less, scattered and left in place forming a natural mulch cover to protect the soil from compaction and erosion maintaining soil moisture for the existing vegetation. This treatment changes the fuel arrangement from “open” to “compacted” state It also provides seed coverage, reduces splash erosion, improves soil structure and nutrients, reduces surface crust formation, restrains, and

reduces runoff, and moderates soil temperature. Larger down trees and branches should be placed perpendicular to the slope to aid with soil stabilization and provide wildlife habitat. Additionally, these treatments reduce the germination of invasive plants species and decreases the area maintenance. The litter, duff, and down woody materials can reduce water turbidity, erosion rates, and sediment yields. The ideal erosion-control promotes germination and plant growth while it protects the soil from short-term erosion.

The treatment areas should be separated with treatment breaks and alternate native vegetation clusters should be left in place to avoid long water runs and dissipate water velocity to effectively control erosion.

Finding balance between fire hazard reduction and erosion control is a priority for fire hazard reduction and habitat restoration projects. Restoring ecosystem structure, composition, and function while reducing fire hazard are primary goals of land management in many fire-prone landscapes. The selected treatments leave sufficient organic matter to trap sediment but have sufficiently low fuel loading and/or enough fuel discontinuity or patchiness to limit fire spread. A cover of surface fuels provides the greatest opportunity to minimize the potential for erosion. It is also known that failing to reduce fire hazard can result in severe erosion when wildfire ultimately occurs.

Figure 30: Existing Shaded Fuel Break in the Lower Arroyo