Statewide Assessment of Economic and Environmental Risk from Wildfire in Texas

Technical Report

February 2025

Texas A&M Forest Service

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Executive Summary

Wildfire in Texas is a growing concern. Since 2005, the state has experienced 243,969 wildfires that have burned over 13.9 million acres and destroyed 5,374 homes. Texas consistently ranks near the top for the most wildfires each year and is second only to California with the greatest number of housing units at high to extreme risk of wildfire damage. This is especially problematic, since 86% of all Texas wildfires occur within two miles of a community. Once primarily considered a rural issue, wildfire is clearly a statewide concern, with 12% of the state's land area (20.9 million acres) characterized as having more than a 1% burn probability in a given year.

Annually, the total cost of wildfires in the state is estimated to be between $37 billion and $83 billion. Costs are expected to continue in this range if the actual proportion of land burned meets the predicted burn probabilities. However, if actual wildfire occurrence exceeds the probabilities, potential costs could be vastly higher, as much as $263 billion.

The challenges of wildland firefighting in Texas are increasing as the state experiences more impactful wildfire seasons, substantial population growth, and increasing resource limitations. Urbanization and land subdivision contribute to fragmentation of landscapes that were once actively managed with similar goals and practices. Development in previously wild areas increases the risk of fires near homes and infrastructure, and creates barriers to effective land management practices, such as prescribed burns, timber harvesting, and grazing which are essential for reducing fuel loads. Additionally, shortages of personnel, equipment, and financial resources hampers both wildfire response and prevention efforts in Texas.

This assessment was conducted to evaluate economic and environmental risks and losses associated with wildfire across the state and recommend strategies for addressing this increasing challenge. Key factors examined include climatic conditions, population growth, vegetation, historical wildfires, land use, and mitigation measures. Addressing these and other Texas wildfire challenges requires ongoing investment in land stewardship, wildfire prevention, risk mitigation, response, and recovery efforts, increased coordination across all levels of government, effective policy and regulations, and enhanced community engagement.

Introduction

According to the National Interagency Fire Center, roughly 60,000 wildfires burn eight million acres in the United States each year (NIFC, n.d.). This represents a total annual cost between $394 billion to $893 billion, when accounting for losses to real estate value, property damage, health impacts including injury and death, watershed pollution, income loss, and a range of other factors (U.S. Congress JEC, 2023). Texas consistently ranks near the top of the list of states with the most wildfires each year, often trailing only California. This is due to the state's expansive geography, significant population growth, variable climate, diverse vegetation, and changing land use.

For Texas, wildfire is a growing issue. Since 2005, the state has experienced 243,969 wildfires that burned over 13.9 million acres, with lengthy, high-impact wildfire seasons occurring every two to three years. The largest wildfire in recorded Texas History, the Smokehouse Creek wildfire, ignited in Hutchinson County in February 2024 burning over one million acres of the Canadian River drainage in 36 hours.

Additionally, most Texas wildfires now threaten homes. Once primarily considered a rural issue, wildfires are clearly a statewide concern, threatening towns and communities along with farms, ranches, and forests. In 2011, the Bastrop County Complex burned through the iconic Lost Pines region, destroying 1,673 homes before it could be extinguished.

Spatial analysis indicates that 86% of wildfires since 2005 occurred within two miles of a community. These wildfires in Texas have threatened, and in some cases, burned through towns and communities, destroying a reported 5,374 homes. Texas is ranked the second most dangerous state for wildfires (behind California), based on the number of housing units at high to extreme risk of wildfire damage (Howard, 2024).

As the state experiences more impactful wildfire seasons, requests for state assistance have increased. Over the last ten years, Texas A&M Forest Service responded to, on average, 11% of the wildfires that occurred in the state each year, accounting for 81% of the total acres burned. However, during the last five years, the agency responded to 13% of wildfires, accounting for 89% of the total acres burned across the state.

What Causes Texas Wildfires

Fire occurrence statistics show that over 90% of wildfires occurring in Texas are human caused. The most common cause of ignition is outdoor debris burning. Other causes include utility infrastructure, industrial equipment, vehicle exhaust systems, and arson. Lightning strikes are a relatively small proportion of all ignitions; however, they are more often the cause of large, intense wildfires. Moreover, three primary factors facing Texas today combine to create intense fire seasons — population growth, changing land use, and changing weather patterns, particularly increasing drought frequency. These factors and others are discussed in greater detail throughout this report.

How Texas Responds to Wildfires

One of the primary roles of government is to help ensure the safety of its citizens. Since its inception in 1915, Texas A&M Forest Service has been tasked with the responsibility for wildfire suppression, defending both the property and lives of Texans. The State of Texas assigns Texas A&M Forest Service the authority to take all actions deemed necessary for the prevention and suppression of wildland fires.

Under the leadership of Texas A&M Forest Service, Texas has a tiered strategy for wildland fire response. This involves local fire departments, Texas A&M Forest Service, and other state agencies, as well as firefighters and equipment from across the nation.

Local fire departments are the first responders to wildland fires in Texas. They are the first line of defense. However, if they determine that their capacity to control a fire is exceeded, suppression assistance is requested from Texas A&M Forest Service. This may occur quickly or over time as a wildfire grows and becomes increasingly destructive. Even moderately sized wildfires can involve multiple fire departments, numerous pieces of county equipment, local law enforcement, emergency medical services, and resources from Texas A&M Forest Service and other state agencies.

Augmenting the efforts of Texas A&M Forest Service, additional firefighters are mobilized through the Texas Intrastate Fire Mutual Aid System (TIFMAS) to assist in suppression efforts. TIFMAS resources are mobilized under jurisdiction of the state to respond to wildfire incidents across the state. TIFMAS is capable of quickly deploying qualified firefighting resources directly to significant fires or pre-positioning to locations impacted by forecasted high fire danger days.

When situations escalate, Texas A&M Forest Service is also able to access national response resources from federal and out-of-state land management agencies. These resources have been vital to fire suppression efforts in recent years. Without out-of-state resources, these wildfires would not have been suppressed as quickly, resulting in significantly more losses to human life and property. However, there are disadvantages to continuing to mobilize national resources. Aerial firefighting equipment and firefighting personnel are not always readily available, and where they are, there may be a three- to five-day lag time before they arrive on site. In addition, national mobilization costs are generally three to four times greater per unit than Texas resources.

Wildfire Risk Regions

Throughout this report, we reference five general geographic regions of the state: Central, East, North, South, and West. These regions are defined in the Texas Wildland Fuels Fuel Model Guide to include broadly similar wildland vegetation characteristics as related to wildland fuels, and are more fully discussed in the Regional Vegetation and Fuel Sources section of this report. The regions reflect the geographic variation of wildfire risk and associated mitigation strategies across the state.

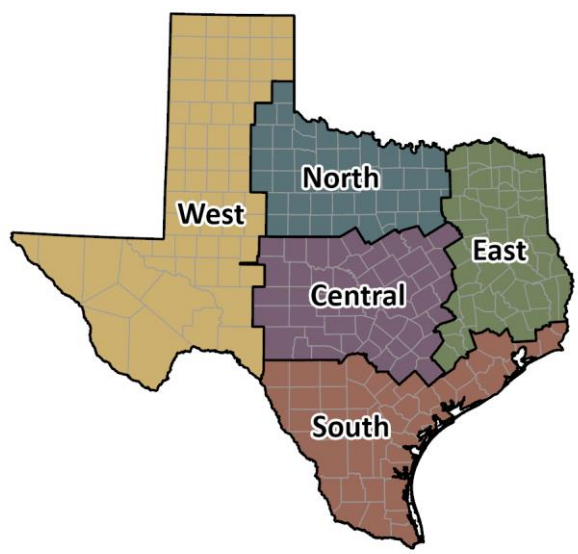


Figure 1. Map of regions of Texas used in this report

Historical Wildfire Data

Though wildfires can occur throughout the year, Texas has two primary wildfire seasons: late winter/early spring and late summer. The greatest risk for large, fast-moving wildfires occurs during the late winter/early spring wildfire season when grasses are dormant and subject to high winds surrounding dry cold front passages. The late summer fire season typically experiences a higher volume of wildfire in timber and brush due to hot temperatures and dry air, which typically pose control problems because these heavier fuels retain heat and can burn for several days even after the initial fire spread is stopped.

Historically, the high and rolling plains of West Texas have experienced the largest wildfires in Texas (Table 1). Since 2005, this area has faced eight of the top fifteen largest wildfires, accounting for 75% of the 4.4 million acres burned. In fact, the largest wildfire in Texas history, the Smokehouse Creek fire, occurred in the northern Texas panhandle, burning over 1 million acres in 2024. Other areas across West Texas have also seen large wildfires during this period.

The most destructive wildfire in Texas history, in terms of homes and structures lost, was the Bastrop County Complex in 2011, where 1,673 homes were destroyed, accounting for 62% of the homes lost since 2005. This wildfire occurred due to a rare alignment of extremely dry pine timber and critical fire weather produced by Tropical Storm Lee. The deadliest wildfire in Texas occurred in 2006 when 13 fatalities resulted from the East Amarillo Complex which was associated with the Southern Plains Wildfire Outbreak weather pattern.

While the largest wildfires have occurred in the western portion of the state, the eastern — more densely populated — portion of the state experiences the greatest number of wildfires, especially in the Pineywoods region in East Texas (Figure 2). Over the last twenty years, 34% of all wildfires that occurred in Texas were in this region. The majority of these wildfires can be controlled by the agency in a single operational period, however, when fire conditions are elevated, major damages can occur. In 2011, the Bear Creek wildfire, the largest in East Texas history, burned over 41,000 acres and destroyed 92 homes.

Table 1. Average annual number of wildfires and acres burned with average fire size (in acres) by region, 2005 to 2024

Region	Average Annual Number of Wildfires	Average Annual Acres Burned	Average Fire Size
Central	2,714	73,636	27
East	4,176	35,192	8
North	2,625	142,207	54
South	1,508	54,654	36
West	1,174	392,332	334
Overall	12,198	698,021	57

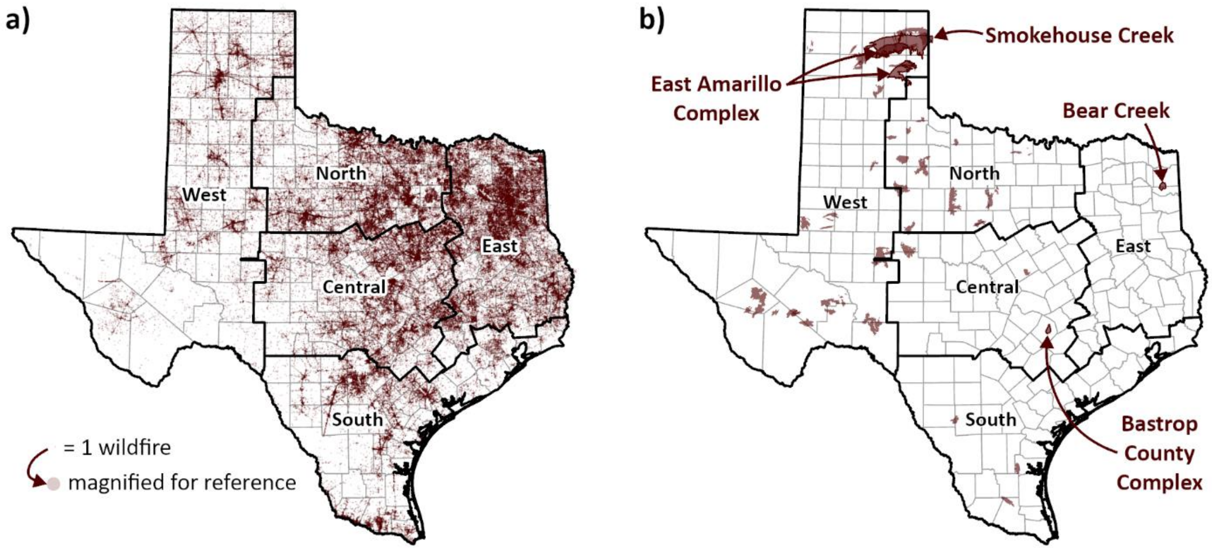


Figure 2. a) Wildfire occurrence from 2005 to 2024 shown by semi-transparent dots (darker colors on the map correspond to areas with many wildfires) and b) area burned by large wildfires (at least 25,000 acres) from 2005 to 2024

Wildfire Potential

The likelihood of a wildfire occurring in a given location depends on a number of factors related to physical attributes of the landscape, human activities or uses of the landscape, and weather and climatic conditions. Three primary factors are contributing to the increased wildfire risk faced by Texans — population growth, changes in land use, and changing weather patterns.

Projections from the Texas Demographic Center indicate that the rapid population growth the state has experienced will likely continue. In 2022, the population of Texas surpassed 30 million people. By 2050, the state's population is expected to increase to more than 40 million people (Texas Demographic Center, 2024). Most of this growth will occur in urban centers and their suburban surroundings. Many communities are expanding and developing into previously undeveloped areas, or the wildland-urban interface. This area is where humans and their structures meet or intermix with undeveloped wildland vegetation.

Texas communities in the wildland urban interface are at a substantially higher risk from wildfire, and the state is ranked second in the nation for having the highest number of single-family homes at risk of wildfire damage (CoreLogic, 2023). Using spatial datasets of landscape-wide wildfire risk components, the Texas Wildfire Risk Assessment determined that 57% of the state's population and housing units are at risk of direct or indirect exposure to wildfire.

To add to the complexity of the wildfire issue, 95% of the land in Texas is privately owned and managed. With expansion and growth into wildland areas, changes in land use and barriers to traditional effective land management opportunities, a buildup of hazardous vegetation is common in many regions of the state. Without mitigation, this may result in catastrophic loss to communities during a wildfire incident.

Burn Probability

Burn probability is the likelihood of wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. It is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs.

In Texas, burn probability generally increases from east to west, with most of the area of high burn probability occurring in West Texas (Figure 3). Statewide, 12% of the land area (20.9 million acres) has more than a 1% probability of burning in a given year.

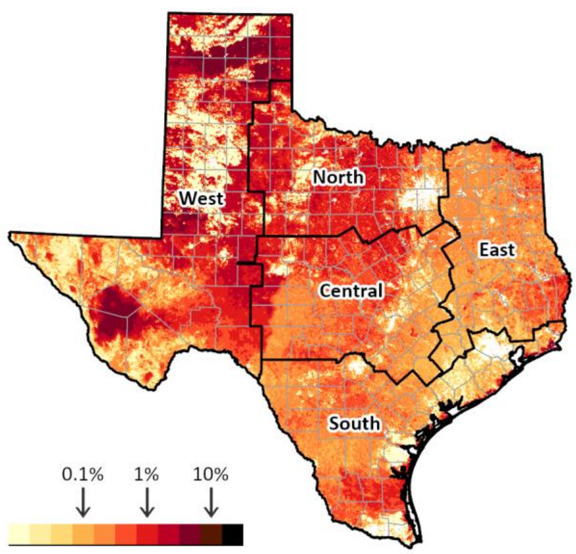


Figure 3. Map of burn probability in Texas in a given year

Characteristic Fire Intensity

Characteristic Fire Intensity Scale (FIS) specifically identifies where significant fuel hazards and associated dangerous fire behavior potential exist if a fire were to occur, based on fuel and weighted across a full range of wind and weather conditions.

Similar to the Richter scale for earthquakes, FIS provides a standard scale to measure potential wildfire intensity. FIS consists of 5 classes where the order of magnitude between classes is ten-fold. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 5, represents very high wildfire intensities (Table 2).

Table 2. Descriptions of characteristic fire intensity scales classes

Class 1, Very Low	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
Class 2, Low	Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.
Class 3, Moderate	Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.
Class 4, High	Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.
Class 5, Very High	Flames exceeding 200 feet in length; expect extreme fire behavior.

Characteristic fire intensity varies across Texas, with more intense wildfire classes proportionally covering more area in the North, West, and Central regions (32%, 24%, and 14% of the area of each of those regions, respectively). Very little area in Texas is attributed to Class 5 (less than 2,000 acres total).

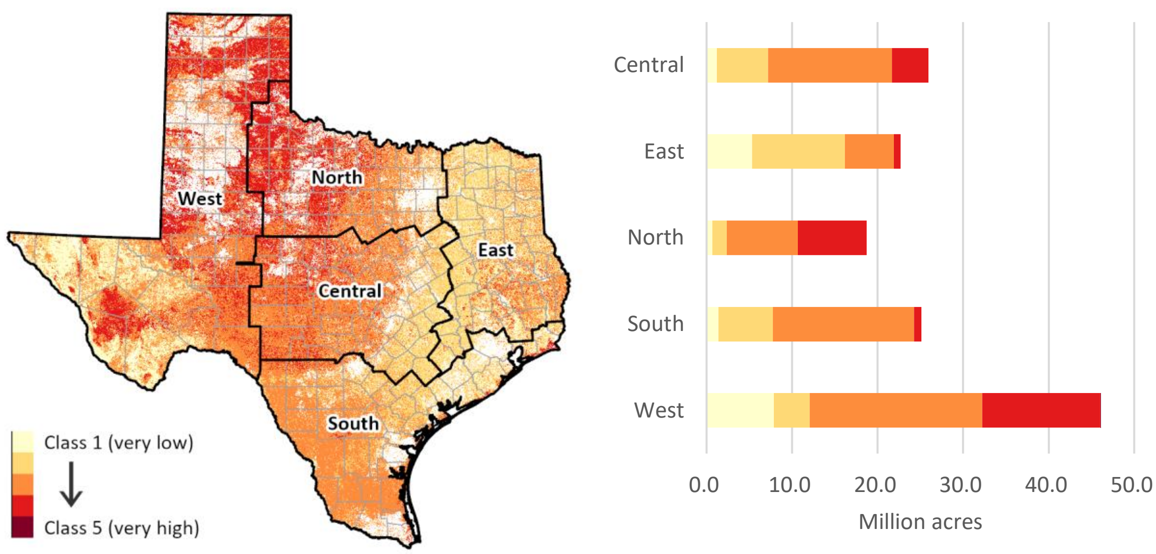


Figure 4. Map of characteristic fire intensity with chart showing area in each class by region

Texas Climate

Due to its vast size and unique location, Texas has a wide range of climatic conditions over several diverse geographic regions. The state's climate is greatly influenced by three primary geographic features: the Rocky Mountains that block moist Pacific air from the west and channel arctic air masses southward during winter; the relatively flat central portion of North America that allows easy north and south movement of air masses, and the Gulf of Mexico that serves as a primary source of moisture for the eastern portion of the state (Runkle, 2022).

The Texas climate is characterized by long, hot summers and mild to cool winters. For most of the state, evaporation exceeds precipitation, resulting in a semi-arid to arid climate. The exception is the wetter, eastern quarter, known as the Pineywoods region, that is subtropical humid. The average annual temperature gradually increases from 51 degrees Fahrenheit in the northern Panhandle to 76 degrees Fahrenheit in the Lower Rio Grande Valley (Figure 5). Precipitation patterns vary significantly across the state. Average annual precipitation decreases from 60 inches in Beaumont to less than 10 inches in El Paso. Rainfall is the predominant form of precipitation, though small amounts of ice and snow can occur toward the north and west.

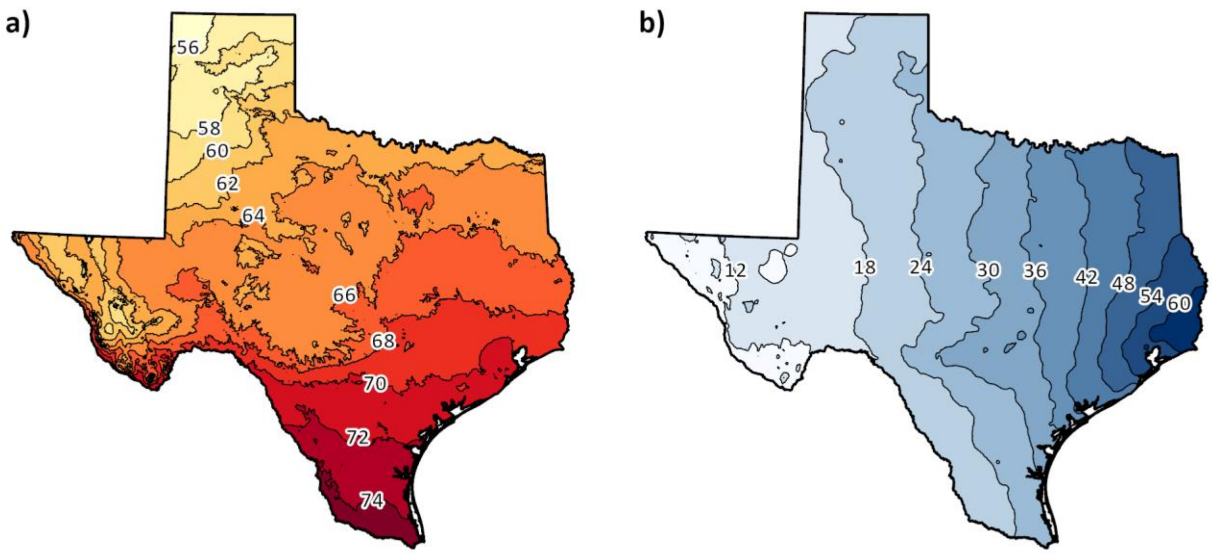


Figure 5. a) Texas average annual temperature (degrees Fahrenheit) and b) precipitation (inches), based on PRISM Climate Group 30-year normals for 1991-2020

Dewpoints across the state are diverse and seasonal fluctuations are typical. Dewpoint is the temperature the air needs to reach to achieve saturation (i.e., 100% relative humidity). The higher the dewpoint, the greater the amount of moisture in the air. Coastal regions have higher dewpoints due to proximity to the Gulf of Mexico, compared to far West Texas and the Panhandle where the dewpoint is typically lower (Figure 6).

Wind and wind-storm events are a common occurrence in Texas. Average annual wind speed ranges from 23 miles per hour in the Texas High Plains to 11 miles per hour in southeast Texas (Figure 6). Texas ranks first in the nation in tornado occurrence with an average of 139 per year, occurring predominantly from April through June, and most frequently in North Texas and the Panhandle. Additionally, Texas's position at the northwestern end of the Gulf of Mexico makes it vulnerable to hurricanes and associated tropical storm level winds in inland areas.

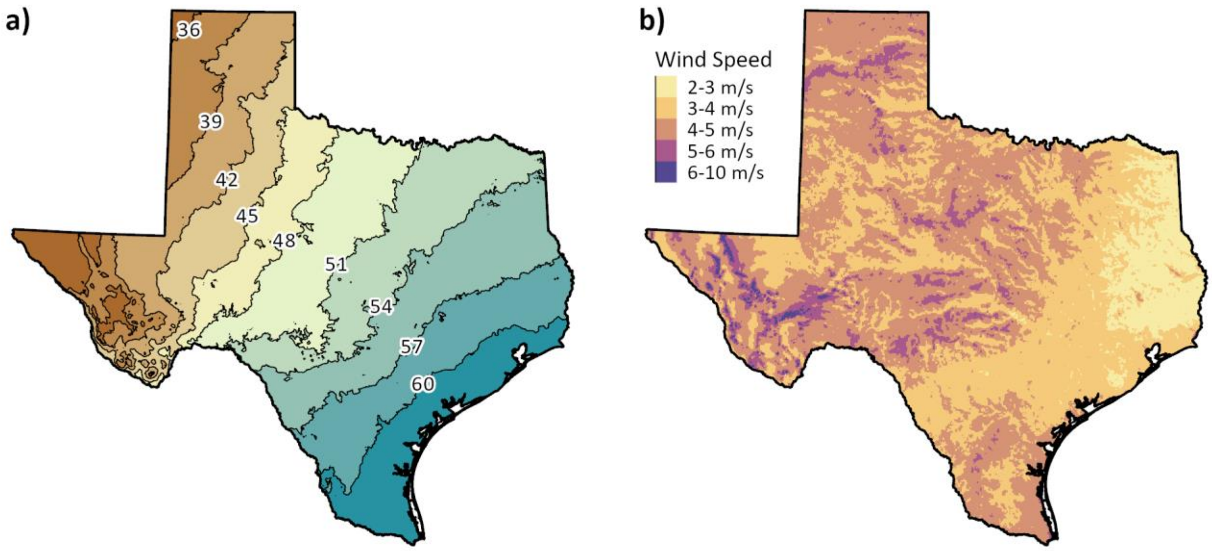


Figure 6. a) Average annual dewpoint (degrees Fahrenheit), based on PRISM Climate Group 30-year normals for 1991-2020, and b) wind speed at 10 meters above the surface (meters per second), based on NREL WIND Toolkit data for 2007-2013

How Climate and Weather Impact Wildfires

Climate and weather influence wildfire occurrence, behavior, and suppression. High temperatures, characteristic of Texas summers, dry out plant-based fuels, increasing the likelihood of ignition and promoting rapid wildfire spread. Low dewpoints work in a similar manner, further drying out fuels, especially leaves and small branches that can become highly flammable. High, sustained and gusty winds can cause wildfires to spread quickly, supplying additional oxygen to the fire, preheating nearby fuels, and transporting embers into unburned areas. Strong winds have also caused power lines to break and fall to the ground, creating sparks that can start wildfires. Prolonged periods of drought, particularly in the central and western part of the state, result in drier conditions, leading to higher fire risk. Thunderstorms can also cause lightning strikes that reach the ground, resulting in wildfires. Conversely, higher dewpoint, low temperatures, low wind speeds, and seasonal precipitation all work to lower wildfire risk.

El Niño and La Niña Climate patterns are based on Pacific Ocean water temperatures and atmospheric circulations that can impact temperature and precipitation trends. La Niña climate cycles often result in conditions that are warmer and drier in Texas and produce increased frequency of weather conditions conducive to fire during the winter and spring months. Some of the state’s most impactful fire seasons, such as 2006, 2011, 2018, and 2022, occurred during La Niña climate patterns.

Texas A&M Forest Service maintains a network of weather stations to support short and long-term forecasts of wildfire risk across the state. This information is used to assist state and local governmental entities in preparing for and responding to periods of elevated fire danger. On forecasted high fire danger days, Texas A&M Forest Service mobilizes and pre-positions resources to aid in wildfire response.

One extremely dangerous fire weather phenomenon that is closely monitored is the Southern Plains Wildfire Outbreak (SPWO). First discovered in 2006 by the National Weather Service, SPWOs are typically characterized by dry vegetation and dry west-southwest winds across an area with low relative humidity, above average surface temperatures, an unstable atmosphere, and clear, sunny skies. Historically, SPWO events occur more often during La Niña years, which causes Texas to experience warmer and drier conditions during the winter and spring months. Since 2005, SPWO fires have accounted for 3% of reported wildfires but are responsible for 49% of the acres burned.

Another major weather discovery occurred in 1999. Texas A&M Forest Service, by analyzing weather data from the past 100 years, identified a distinctive drought cycle occurring in Texas. Three separate 25- to 30-year drought periods were recognized, with the current drought cycle beginning around 1998 to 2000. During a drought cycle, rainfall and wet periods continue to occur; however, drought and extremely dry conditions occur with greater frequency and intensity. Drought becomes the “normal” pattern rather than the exception. The more frequent and intense droughts result in dryer vegetation that is more likely to ignite and will burn more readily, increasing fire occurrence, intensity, and size.

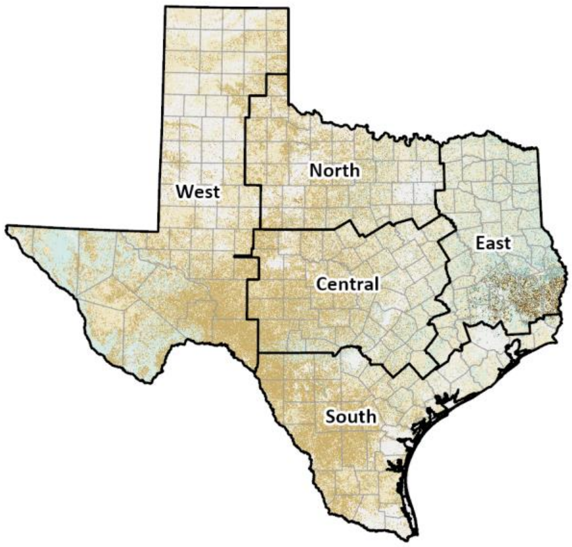
Future Weather Outlook

Based on review of historical weather data, the State Climatologist predicts that Texas will experience more extreme weather in the coming years (Nielsen-Gammon *et al*, 2024). This includes increased precipitation and more frequent heat waves, droughts, flooding, and wildfires. While these trends represent climatological expectations; the actual weather from year to year is heavily influenced by natural variability which is largely unpredictable. From a wildfire perspective, higher temperatures will continue to favor wildfires, while the overall trend will be sensitive to whether or not the trend toward increased precipitation continues.

Regional Vegetation and Fuel Sources

Texas is a large state with exceptional diversity in climate, geography, and land management. The combination of these three factors determines the vegetation, and therefore the wildland fuel present on the landscape. Wildland fuel can be described as an association or community of vegetative species with distinctive size, arrangement, amount, or other characteristics that produce predictable fire behavior when subjected to specified weather conditions.

Considering the number of diverse ecoregions within Texas and the land use objectives of the private landowners who own 95% of the land, the combinations could lead to identifying hundreds — if not thousands — of different fuels across the state. Instead, this assessment focused on vegetation and wildland fuels across five broad geographic regions: *East, North, West, Central*, and *South Texas*. Wildland fuels are grouped into fuel types based on the primary fuel that carries the fire. These include grass, grass-shrub, shrub, timber-understory, and timber litter (Figure 7). Slash-blowdown, debris following events such as hurricanes and other storms, also contributes to wildland fuel. Fire behavior is the final determining factor when assigning fuel types; some sparsely vegetated areas of West Texas in low desert are best represented by the timber litter fuel type because it has more representative rates of spread.



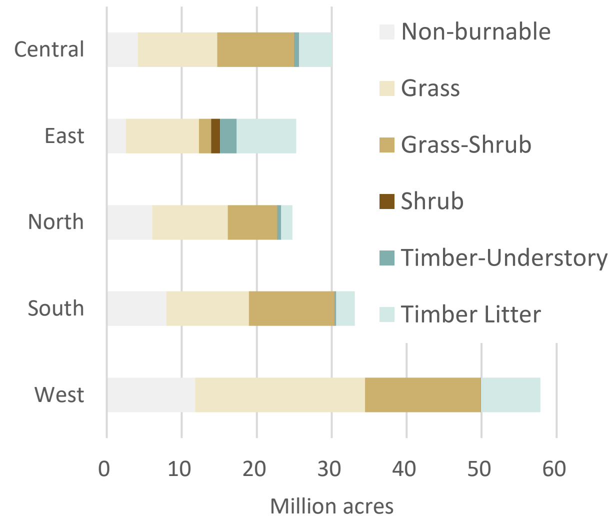


Figure 7. Map of surface fuels with chart showing area in each class by region

Fire is driven within these regions by varying levels of grass and herbaceous growth, shrubs and brush, and trees or timber. Even with the State's incredible diversity, common trends exist. A marked decrease in precipitation from east to west results in more rapid vegetation growth, a greater abundance of trees, and a faster accumulation of wildland fuels in the eastern part of the state. Moving west across the state, flat or rolling terrain often supports more grasses, whereas hilly and rocky terrain usually has more brush and trees. Widespread land management activities such as logging, grazing, and prescribed burning reduce or alter the composition of fuels, whereas smaller, less intensively managed tracts often have a greater accumulation of combustible vegetation. Careful study of these factors can help fire managers as well as the general public understand potential fire risk and behavior in a given area.

East Texas

The climate and soils of East Texas support a wide variety of plant communities, most notably expansive pine and hardwood forests of the Pineywoods. Annual rainfall ranging from 40–50 inches, a 7–8 month growing season, and deep sandy or loamy soils support a commercial timber industry, livestock production, farming, and abundant recreational opportunities. This diversity in land use objectives along with subtle changes in climate and soils creates a complex fuel environment that is constantly changing. Frequent low intensity surface fires every 2-4 years historically would have prevented the heavy accumulation of fuels and resultant large high intensity wildfires. During the 19th and 20th century timber production was a driving factor in moderating fuel loads; however, a decrease in logging and increase in residential or recreational properties in recent years has led to a subsequent increase in fuel loads across the region.

In most of East Texas there is an abundance of timber litter. Timber litter refers to debris on the forest floor that was shed or dropped from the trees of the forest. This debris can include pine needles, hardwood leaves, pinecones, and branches. Surface fire intensities increase as the amount of timber litter increases. Deep litter layers that contain a high percentage of dead branches will burn more intensely due to the higher fuel loading. Long needle or large leaf litter that is uniform across the surface and not compacted will produce higher rates of spread than compacted short needle or small leaf litter. Leftover dried residue or "slash" from logging operations or blowdown as a result of strong winds can create a thick continuous fuel bed which can be difficult to fight fire in.

Grass fuels are not a dominant fuel type in East Texas, but they do play an important role. Grass fuels, when cured, act as a bridge between areas of timber fuels, and can also provide a receptive fuel bed for ignitions. Many wildfires start in grass fuels along roads or near homes and then spread into timber or brush fuels. Improved grasses in pastures acts as a bridge for a fire to reach other timber or brush fuel types. Grasses can also mix in with shrub and brush fuels. The result is increased continuity in the fuel bed which allows for more efficient spread of fire.

Brushy fuels can be found growing in a number of different circumstances and different vegetative communities. Three common brush fuel types found in East Texas include: understory brush found growing underneath a timber overstory, young stands of pine regeneration, and vegetation growing in the open 2 to 6 years after a timber harvest. Yaupon, one of the most common brush species in the region, has a chemical content that promotes active burning.

Figure 8. Typical East Texas Pineywoods stand with relatively open pine canopy and well-developed broadleaved understory layer.

The common denominator for high-risk fuel beds in East Texas is the presence of pine trees. Loblolly pine is the most common native pine species and is favored for commercial forest production, however all pine species play a role in the fire environment. Two of the highest risk situations or configurations of pine fuel beds are: closed canopy pine plantations (usually 8-15 years old), and managed pine with a dense understory. Both configurations produce high fire intensity and have a high potential to support crown fire when fuel dryness and fire weather thresholds are met. When the pine canopy is opened during thinning, the brush underneath the pine canopy responds to the added sunlight that now reaches the forest floor. This brush can act as a ladder fuel and help to transition a surface fire to single tree torching or running crown fire. In these events long flame lengths and embers carried through the air will rapidly spread the fire long distances, increasing fire intensity and potentially resulting in complete stand mortality.

North Texas

North Texas is composed of three general ecoregions: Blackland Prairies, Cross Timbers, and the Rolling Plains. Changes in soil, topography, and average rainfall gradient from 40 inches per year in the east to 20 inches per year in the west define the varied vegetative communities found here.

Within the prairies in the east part of this region cultivated farmland frequently creates a barrier to fire spread. Some of the highest population densities in the state can be found near the Dallas/Fort Worth metroplex and surrounding counties in this region. Increasing development and modest property ownership sizes have a direct impact on the type and expanse of vegetation across this landscape. Smaller property sizes combined with varied land use creates a patchwork of vegetative communities or fuel types with increasing heterogeneity within proximity to large cities. Population densities decrease as you move west across North Texas into the Cross Timbers and eventually into the Rolling Plains. As the population decreases there is a trend towards larger expanses of similar fuel types.

The Cross Timbers region of North Texas, just to the west of the Dallas/Fort Worth metroplex, supports a variety of hardwood tree species. Most notable among these tree species is post oak, which is often found in sandy soils and on rocky slopes in rough, broken terrain. The post oak is a medium sized tree that produces a large leaf. These leaves form a deep loosely packed leaf litter which provides a continuous receptive fuel bed for surface fire spread. Timber stands in the Cross Timbers region can also be found in the deeper soils of the prairies. The mix of grass and moderately sized timber stands adds a level of complexity to wildland fires occurring here. The timber fuels add intensity and topography impacts accessibility while the grass provides fuel continuity between the stands of timber.


Figure 9. Vegetation characteristic of North Texas and the Rolling Plains

Grasses are an abundant type of vegetation across North Texas. As such, the grass fuel component generally determines the amount of fire activity in the region at any given time. While wildland fire does not carry well through well hydrated growing grass, dried grasses provide a receptive fuel bed for fire ignitions and spread. Freeze cured grasses are present from late fall through early spring, while drought cured grasses are often present during the late summer. Above normal loading of grass fuels will generally occur when above normal rainfall occurs during the May through September growing season. This thick, continuous arrangement of grass fuel increases the resistance to control of any wildfire burning in this region.

A combination of grass and brush is the fuel type that has consistently produced the highest impact wildfires in this region over recent years. Ashe juniper and redberry juniper (cedars) are two of the most common evergreen plants within this fuel type. During wet times juniper is resistant to combustion, however the canopies of juniper will readily burn after extended dry periods. Fire can carry rapidly through the quick drying grass and ignite the low hanging juniper canopies. The amount and distribution of grass and brush will determine how fast a wildfire will spread, or how intense it will burn. Rate of fire spread increases as the grass component of the ground vegetation increases. An increase in the brush component will generally slow the rate of spread but increase the fire intensities and prolong the burn time.

West Texas

West Texas stretches from the generally level terrain of the High Plains to the rugged mountains and basins of the Chihuahuan Desert borderlands. The driving factor for vegetation growth is the presence, or more often absence of moisture. Lower elevations are often dominated by grasses, but as elevation increases, brush communities appear and eventually transition to timber communities in the mountain ranges with higher elevations. Vegetation growth is driven by the North American monsoonal pattern typical of the southwestern United States. The 10–25 inches of annual rainfall is mostly observed from June through September. This seasonal rainfall will green the grass, greatly reducing the wildland fire potential. The peak season for fire activity is mid-February through mid-May which coincides with peak frontal passage activity.

Throughout the High Plains and Panhandle the dominant fuel source is grass. As in other regions, the amount of grass will influence the type and severity of fires that occur on the landscape. Wildland fires spread faster and are more resistant to control when there is more grass present . Much of the area from north of Amarillo to south of Lubbock is currently in crop production or has been in the past. In areas under crop production or where heavy grazing is occurring fire can have difficulty spreading through the resultant sparser fuels. Although grass driven fires may be relatively shorter lived and lack the intensity of those in timber and brush, they can have devastating impacts on lives and property.

One very common grass-brush fuel type includes mesquite as the dominant brush species. Mesquite has a relatively sparse canopy that will add some intensity to a grass fire but does not support as intense of a canopy fire as many evergreen species like juniper and pine. Mesquite is generally found growing in deeper soils associated with flatter terrain.

A mixture of low brush and grasses can be found on the lower slopes of some of the drier mountain ranges of the Trans Pecos region, and along canyons and river breaks in the High Plains. These arid, rocky slopes will not support as much grass loading as occurs on the flatter High Plains and higher elevation mountains. The brush in these areas contributes to fire intensity, but the desert brush height is much shorter than in other areas. In many lower elevation parts of the Big Bend region of West Texas, precipitation is so low that there is little to no grass. In these areas sporadic cacti and brush are the only fuel source. In these situations, the wide spacing between vegetation results in very few wildfires.

High-risk fuels on the High Plains and lower elevations of the Trans-Pecos include grass mixed with small amounts of brush. The common characteristic shared by historical high-impact wildfires in this region is the extreme rate of spread they exhibit in grass fuels due to high winds that accompany the frequent frontal passages during the spring fire season.

Figure 10. The Davis Mountains of West Texas

The grass and brush fuels associated with the rugged terrain of the Trans-Pecos mountains can support long duration wildfires that are highly resistant to control. The ratio of brush to grass generally increases with increasing elevation. Grass is more abundant at the lower elevations and west facing slopes. Brush species such as juniper, pinyon pine, and shrub-oaks are more a in the higher elevations and northeast facing slopes. The highest locations of select mountain ranges will include large western timber species such as ponderosa pine and Douglas-fir. The mountainous terrain that supports these fuel associations contributes to a wildfire's resistance to control, but can also help to protect pockets of vegetation from ignition creating a mosaic of burned and unburned areas.

Central Texas

The central region includes all or parts of the Edwards Plateau, Blackland Prairie, and Post Oak Savanna ecoregions. The most dominant features of Central Texas are the limestone hills of the Hill Country. Central Texas is also home to the Lost Pines area east of Austin, and the densely populated zone commonly referred to as the I-35 corridor that traverses from Waco to San Antonio.

As with all regions in Texas topography and decreasing precipitation moving east to west dictates a change in fuel within the region. Starting in the east deep prairie soils support mainly grasses with interspersed bands of trees and forests such as the Lost Pines near Bastrop. Upon entering the Edwards Plateau a distinctive band of timber known as the Balcones Escarpment wraps around the leading edge of the Hill Country. Moving west, the timber density declines and is replaced with a brush component. Eventually, grasses become the dominant component on the western extent of the Central Texas region.

There are normally two periods of increased fire activity in Central Texas. The winter/spring period is dependent on freeze cured grasses being present. Most of the winter/spring fire activity will occur in the more western half of the region where more grass is present on the landscape. The second period of increased fire activity can occur during the late summer/early fall drying season. This activity occurs most often in the timber and brush dominated eastern half of Central Texas.

Much of the Hill Country supports an oak savanna or woodland. Vegetation in this region is a combination of grass, brush, and trees in varying levels. As vegetation drives fire behavior, configurations that have a higher percentage of grass tend to support higher rates of spread. Configurations that include a greater brush component tend to spread slower but burn more intensely. The presence of heavy timber and large brush species can generate large fires that are difficult to control, especially if the fire is able to enter the canopy of the woodland and spread tree-to-tree as a crown fire. Fire will burn readily through this relatively open flat terrain. North-facing canyons and hillsides are usually cooler shadier environments with less grass and more large trees such as oaks and maples. While fire can penetrate these environments, it does so with much less frequency.

Figure 11. The Hill Country of Central Texas

Usually, above-normal late summer grass growth from the preceding year can readily carry fire through this environment. Under average conditions, common brush species such as Ashe juniper are relatively resistant to ignition and will help to slow a fire's spread. However, when coupled with extremely low moisture levels during times of drought, the plant's foliage can become highly volatile. Drought can play an important role in altering the composition of these fuel types by changing the percentages of brush, grass, and timber within a fuel type and by altering the ratio of live and dead fuel. The resulting standing dead brush and trees add a readily combustible element on the landscape. It also opens the canopy allowing more sunshine to the ground surface which will promote an increase in grass production.

The most destructive wildfire in Texas history, the September 2011 Bastrop County Complex fire, was in the Lost Pines region of Central Texas. This fire was able to spread rapidly with devastating effect through the area's dry pine timber overstory and the yaupon-rich mixed brush understory. Vegetation in this sub-region is reminiscent of East Texas, often with even less active management, less moisture, and even more intensive population pressure. Models suggest that fires would have historically burned through this forest every 1-2 years maintaining an open understory very different from what is seen today.

South Texas

The South Texas region as defined here encompasses a number of unique ecosystems. The Rio Grande Valley at the southern extent of the region has a subtropical climate with hot summers and mild winters with only occasional freezes. There is also a distinct maritime region along the Gulf Coast with almost 9.5 million acres of coastal prairies and marshes. South Texas is probably best known for the large expanse of plains often referred to as the brush country. The brush country has long been used for grazing and is known for expansive ranches. Recently, hunting of white-tailed deer and exotic game has become a major industry for the region driving land management practices. The Rio Grande Valley is the most densely populated area in the region with a large but shrinking amount of crop land. Land ownership sizes are smaller and do not support large expanses of unbroken wildland fuels. Wildfires here are also smaller on average, but due to the dense population can have a high impact on property.

There are generally two separate periods of increased fire activity in South Texas. The most active period is the winter season when grasses have turned brown from frost or drought. Strong winds from passing cold fronts can push these fires to immense sizes. The second period of wildfire activity is during the late summer or early fall when 100-degree days and little to no rainfall can cure the grass fuels. The late summer fires tend to be smaller in size but burn with higher intensities as they burn in heavier brush and some timber fuels.

Figure 12. South Texas brush country Photo: Abel Riojas, American Forests

The mixed grass/brush fuel type is widespread across the South Texas plains and has produced the largest and most damaging wildfires in this region. There are numerous configurations of this fuel type that include a variety of different brush species along with different ratios of grass to brush. Mesquite, blackbrush, lotebush, and white brush are a few common brush species. Even though the terrain is mostly flat, the dense, thorny, thicket forming nature of this brush can make access extremely difficult.

The deeper, clay-based soils of the eastern Coastal Plains generally support more grass with less brush. What brush does exist is not as receptive to fire as its western counterparts. Fire spreads through the grass here and underneath the brush without the brush adding much to overall fire intensity. One of the most fire-prone grasses in the region is cordgrass. The density and arrangement of this marsh grass facilitates fire spread. Cordgrass contains a chemical that not only increases fire intensity when it burns but also enables it to ignite under high humidity conditions when most other grasses will not.

There are only limited amounts of timber fuels that can be found along the rivers and near some of the coastal areas. This includes live oak with a brush understory that has the potential to support wildfire activity, especially during the late summer drying season. Fires that become established in this fuel type can be very resistant to control. In areas where dense stands of mesquite grow in tree-like form, the closed canopy shades the ground surface which inhibits the growth of sun-loving grasses. Low intensity and slow-moving fires are typical in these conditions.

Population Growth, Land Use, and Development

The population of Texas has increased every decade since Texas became a state, with recent population growth exceeding that of all other states in the nation. The state's population is projected to exceed 40 million by 2050, an increase of over 40% from the 2020 Census. While few new communities have been created, many communities and cities are rapidly expanding into undeveloped wildland areas.

For Texas wildland fires, this continued population growth is associated with both an increase in the number of fires and an increased population at risk once a wildfire starts. Wildfire occurrence statistics in Texas show that over 90% of all wildfires are caused by human activity and that approximately 86% of all the wildfires in Texas occur within two miles of an established Texas community. Additionally, the property analytics company CoreLogic, in their Wildfire Risk Report, identified Texas as having a high concentration of homes with a significant reconstruction cost value that are at risk from wildfire (CoreLogic, 2023). According to the report there are 233,434 homes in Texas at high risk from wildfire with a total reconstruction cost value of $85.5 billion.

Land use patterns are also being impacted by expansion of urban, suburban, and rural communities. One example is the town of Cross Plains, located in Callahan County (North Central Texas), which was devastated by the Cross Plains Fire in December of 2005. Immediately after the fire, a Texas A&M Forest Service Post Fire Assessment Team concluded that early 1900s cultivation practices that centered on cotton production in Callahan County resulted in little to no vegetation remaining around the homes, farms, and ranches in the community. As agriculture practices in Callahan County shifted away from cotton to forage hay and cattle raising by 2005, the landscape adjacent to Cross Plains changed from having low vegetation to high levels of grass. The devastating fast-moving fire claimed two lives and destroyed 116 homes.

Along with accumulation of fuels and more communities near wildfire-prone areas, several major factors are driving the Texas wildland urban interface fire problem. These factors include:

- Shortage of fuel management programs and community design standards that promote fire-resistant homes and property
- Lack of awareness by homeowners
- Inadequate community wildfire hazard planning and preparedness

Fires in the wildland-urban interface present major fire suppression challenges to emergency services. A keen example of this is the Bastrop County Complex fire. This fast-moving wildfire burned through multiple residential areas, resulting in the unfortunate loss of two lives and over 1,600 homes—most in the first 48 hours of the fire. Fire embers produced from burning wildland fuels were able to ignite vulnerable structures causing structure-to-structure fire spread.

The wildfires impacting the communities of Cross Plains and Bastrop are examples of what happens when a community experiences a wildfire, and the community was subject to land use changes in the wildland-urban interface. Unfortunately, these are not isolated examples. Across Texas, 6.7 million homes are exposed to potential wildfire through direct flame contact or ember loading. Nearly 22.6 million acres of Texas land have the potential to loft embers that reach buildings if a fire were to occur.

The greatest number of homes with exposure to potential wildfire is in South Texas (1.25 million), with the least in West Texas (670,000). However, West Texas has a greater mean burn probability in burnable areas and areas with exposure (0.74%) compared with South Texas (0.20%), meaning that although there are fewer homes in West Texas, on average those homes have a higher chance of experiencing wildfire (Table 3). In East Texas, 94% of the homes are exposed to potential wildfire, whereas fewer than half the homes in North and South Texas are exposed.

Table 3. Number of homes (in millions) exposed to wildfire by region

Region	Mean Burn Probability	Number of Exposed Homes	Percent of Total Homes
Central	0.29%	1.40	80%
East	0.16%	1.25	94%
North	0.55%	1.47	46%
South	0.20%	1.93	44%
West	0.74%	0.67	71%

Estimated Economic Losses Due to Wildfires

In 2023, the United States Congressional Joint Economic Committee (JEC) estimated the total cost of wildfires in the United States is between $394 billion to $893 billion each year. This is significantly higher than previous wildfire cost estimates. The National Institute of Standards and Technology conducted a literature review of costs and losses associated with wildfires, estimating the annual nationwide economic burden ranges from $87.4 billion to $427.8 billion, adjusted to 2022 dollar values (Thomas *et al*, 2017).

While both of these studies yield very high nationwide economic damage estimates, researchers believe they are still likely conservative estimates. Other costs that are not yet fully quantified due to their complexity include secondary disasters, wildfire rehabilitation costs, and even the costs of evacuation when certain areas become too dangerous for residents to remain in their homes.

Methodology

This assessment is based on the findings of the 2023 JEC report, which is the most recent and comprehensive analysis of wildfire cost in the United States. Nine primary damage categories associated with wildfires were assessed and are described below:

- *Diminished Real Estate Value* – wildfire occurrence and risk can result in property depreciation and reduction in property tax revenue for local governments.

- *Exposure to Wildfire Smoke* – exposure to smoke can result in significant public health issues, including cardiovascular diseases, respiratory illnesses, and even premature death.

- *Income Loss* – labor and employment can be impacted by wildfires through business closures, delayed openings, and the inability to get to work.

- *Watershed* – erosion and sedimentation following wildfires can pollute water supplies, causing increased water treatment costs, need for alternative supply, and reduced reservoir storage capacity.

- *Insurance Payouts* – claims resulting from damages to insured property and equipment.

- *Timber Loss* – commercial forests that are severely damaged and destroyed by wildfire have reduced and often limited or no value for utilization.

- *Property Damage* – homes, businesses, and infrastructure can all be damaged by wildfire and even exposure to smoke.

- *Electricity* – costs associated with damages to the state's electrical grid, mitigation measures to protect power infrastructure, and increased utility costs resulting from wildfires.

- *Other* – includes costs associated with evacuations, wildfire suppression, death and injuries, insurance premium increases, learning loss, tourism loss, and psychological costs.

Damage values and rates for each category were obtained from the literature, reviewed and adjusted to minimize overlap between categories, and converted to 2022 US dollars. National estimates in this report were scaled down to the state and regional level by comparing the number of wildfires and total acres burned in Texas to national statistics since 2005. Data were obtained from Texas A&M Forest Service and the National Interagency Fire Center.

During this time period, over 18% of the reported wildfires and 9.3% of the acres burned across the country occurred in Texas. A conservative proportion of acres burned in Texas was applied to the nationwide wildfire damage estimate to calculate the total wildfire cost estimate for Texas. Estimates for each wildfire risk region were then calculated from the statewide estimate using the same methodology.

Costs associated with Texas wildfires

The total cost of wildfires in Texas is estimated to be between $37 billion and $83 billion each year (Tables 4 and 5). Overwhelmingly, the primary damage categories that comprise the majority of the total in this range are diminished property value, exposure to wildfire smoke, and income loss resulting from wildfires, accounting for 84% of the total estimated annual costs (Figure 13).

Table 4. Annual national and state wildfire cost ranges (in billions of dollars) by damage category

Damage Category	National Value Minimum	National Value Maximum	Texas Value Minimum	Texas Value Maximum
Diminished Real Estate Value	67.5	337.5	6.3	31.4
Exposure to Wildfire Smoke	117.5	202.5	10.9	18.8
Income Loss	147.5	147.5	13.7	13.7
Watershed Costs	14.7	146.9	1.4	13.7
Insurance Payouts	8.0	14.8	0.7	1.4
Timber Loss	7.1	12.0	0.7	1.1
Property Damage	10.2	10.2	0.9	0.9
Electricity Costs	10.0	10.0	0.9	0.9
Other	11.6	11.6	1.1	1.1
Total			**36.7**	**83.0**

Table 5. Estimated wildfire cost ranges (in billions of dollars) by region

Region	Estimated Value Minimum	Estimated Value Maximum
Central	3.9	8.8
East	1.8	4.2
North	7.5	16.9
South	2.9	6.5
West	20.6	46.7
Total	**36.7**	**83.0**

Wildfire location and intensity are primary factors when estimating economic damages. As expected, an intense wildfire in the wildland-urban interface has the potential to result in significant losses to homes and structures, damage to high-value properties and critical infrastructure, and public health impacts from exposure to smoke to larger populations. These fires are also costlier to control due to the greater complexity of suppression activities, higher value infrastructure at risk of loss and the inherent intricacy of working around people and the built environment.

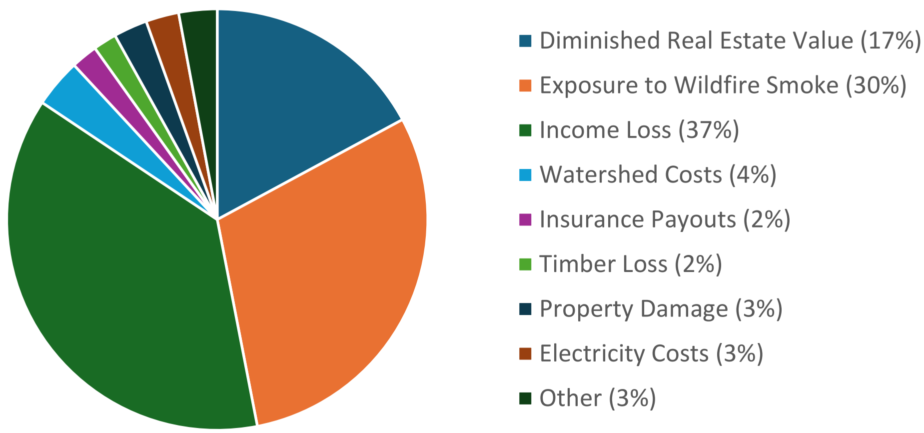


Figure 13. Proportion of Texas minimum wildfire costs by damage category

Environmental Risk and Impacts

Wildfires can cause environmental impacts that result in direct and indirect economic losses. Smoke produced from large and intense wildfires often contains high concentrations of toxic pollutants, especially when wildfires burn in populated areas. This has the potential to negatively impact air quality hundreds or even thousands of miles away. The Air Quality Index (AQI), measured by a network of air quality monitoring stations across the country, ranges from 0 to 500 and uses a color-coded system to warn the public when air pollution is dangerous. The Los Angeles wildfires that burned in January 2025 had an AQI of 401 or higher, indicating a hazardous level of concern and warning people to avoid all outdoor physical activity.

The most concerning pollutant in wildfire smoke to public health is fine particulate matter, or PM2.5. This type of pollutant is so small in size that it can travel through the respiratory system to the lungs and even enter the bloodstream. PM2.5 causes eye, nose, and throat irritation and has been known to increase the risk of respiratory disease, heart attack, and stroke.

Wildfires also release carbon dioxide previously stored in vegetation, back into the atmosphere. In early 2024, an estimated 3.4 million metric tons of carbon dioxide was released from Texas wildfires, most of which resulted from the Smokehouse Creek wildfire (Hirji, 2024). While this represents a fraction of Texas overall annual carbon dioxide emissions, it is a substantial amount from the EPA Greenhouse Gas Inventory Data Explorer category titled *land use, land use change, and forestry* (U.S. EPA, 2023).

Landscapes that have experienced significant wildfires are often denuded of vegetation, putting them at greater risk of post-fire damage from soil erosion and sedimentation. Wildfires that occur in close proximity to drinking water reservoirs can cause catastrophic damage not only to water quality but also reservoir storage capacity due to an influx of sediment and debris. This can result in a substantial increase in drinking water production costs, especially if alternative water supplies are needed in the interim.

In addition to reservoirs, stormwater runoff and resulting flooding can threaten other down-slope infrastructure, like roads, homes, and recreational facilities. Soil erosion following wildfires reduces agricultural productivity and increases restoration and recovery costs, especially when the colonizing vegetation is primarily invasive or otherwise undesirable.

Wildfires also have the potential to impact wildlife populations. In some cases, large and intense wildfires spread so quickly, wildlife are unable to get out of the way in time. In other cases, alterations to their habitat affect their cover and/or food supply, displacing them to other locations until restoration occurs. Toxic air emissions, as well as ash and sediment deposition in waterways, can have negative effects on wildlife. However, temporary ecosystem changes resulting from wildfires, like newly created openings in previously dense forests, can provide benefits to some wildlife species, promoting ecosystem recovery.

Past Texas Wildfire Damage Assessments

In mid-2024, the Investigative Committee on the Panhandle Wildfires estimated the preliminary economic loss to the Texas Panhandle from the Smokehouse Creek wildfire could exceed $1 billion (King et al, 2024). This estimate includes economic damages resulting primarily from home, structure, and capital equipment losses, and agricultural related damages, which include impacts to ranch infrastructure, fencing, cattle, grazing lands, and lost hunting revenue. While not specifically quantified, the report also discusses impacts from income loss, environmental damages including tree mortality and erosion, and changes to the aesthetic value of the Texas Panhandle. Additionally, these losses do not specifically account for the indirect and induced economic impacts that local and regional economies will face.

Texas A&M Forest Service works with Texas Division of Emergency Management to estimate economic damages resulting from wildfires in order to help state, local, and tribal governments qualify for FEMA Fire Management Assistance Grants. Texas A&M Forest Service tracks homes and structures that are lost to wildfires as well as those saved by suppression efforts. This metric is quantified using the median home value by county to estimate saved/lost economic values.

During the 2011 wildfire season, the agency conducted timber damage assessments from several major wildfires that occurred in the eastern portion of the state. Damage estimates were compared to Forest Inventory and Analysis (FIA) data collected prior to the wildfires to estimate the amount of wood volume by forest product class impacted and then related to current timber price data to quantify financial losses to timber. These assessments were done not only to provide a measure of timber losses, but also to assess the potential for salvage and cost of recovery.

These assessments estimated that over $97 million in standing timber value was lost due to wildfires. The total wood volume represented by this estimate could have produced $1.6 billion worth of value-added forest products, resulting in a $3.4 billion total economic impact in East Texas. In 2023, the agency started calculating annual, per acre delivered timber values by county to support rapid timber damage assessments following wildfires.

As noted in the Investigative Committee's report, ecosystem services can also be impacted due to wildfires. These critical services can be extremely difficult to quantify. In 2013, Texas A&M Forest Service released the *Statewide Assessment of Forest Ecosystem Services*. This comprehensive assessment estimated the annual value of the cultural and ecosystem services provided by Texas forests and woodlands in rural areas to be $90.5 billion, or $1,464.54 per acre. This assessment, and the companion *Forest Ecosystem Values* web application (Texas A&M Forest Service, 2025), could be used to spatially quantify wildfire impacts on the landscape. However, these estimates will likely still be conservative in nature since the original assessment did not quantify ecosystem services on non-forested lands.

Potential Costs Associated with Texas Wildfires

The potential cost of Texas wildfires was assessed for each region using the probability to burn dataset previously discussed and the statewide average wildfire cost per acre. In each region, the average burn probability was multiplied by the total number of acres within the region to obtain an estimate of potential burned area for a given year. The resulting acreage was multiplied by the average minimum and maximum cost per acre to produce a per-region cost estimate range. Estimated potential costs range from $38.9 billion to $88.1 billion statewide (Table 6). This is in line with current cost estimates. However, if Texas were to experience a catastrophic wildfire year, with actual wildfire occurrence exceeding probabilities, much higher costs would be incurred. For example, if all the area with at least 3% burn probability — 2.2 million acres — were to burn in a single year, the expected associated costs would be $116 billion to $263 billion.

Table 6. Estimated potential costs (in billions of dollars) of wildfire in Texas for a given year based on past estimated costs and burn probability.

Region	Estimated Cost Minimum	Estimated Cost Maximum
Central	4.5	10.2
East	2.0	4.6
North	6.8	15.5
South	3.1	6.9
West	22.5	50.9
Total	**38.9**	**88.1**

As high-intensity wildfires cost more in suppression and have higher economic and environmental impacts, fewer high-intensity fires in the future could help lower annual costs. Applying appropriate land stewardship practices, including wildfire mitigation measures, can help reduce the proportion of high-intensity fires.

Wildfire Mitigation Measures

Successful wildfire mitigation measures are guided by the National Cohesive Wildland Fire Management Strategy (USDA; DOI, 2014). The National Strategy is the result of a collaborative effort by Federal, state, local, and tribal governments and nongovernmental partners and public stakeholders, in conjunction with scientific data analysis. Key on-the-ground actions include restoring and maintaining landscapes through vegetation management and reducing risk to homes and communities.

Vegetation Management of Wildlands to Reduce Wildfire Risk

Wildfire behavior is influenced by topography, weather, vegetation and man-made structures. At some level, all vegetation is combustible, however stressed vegetation is more susceptible. Because a healthy ecosystem is a resilient ecosystem, vegetation management is a good way to reduce wildfire intensity risk.

Mechanical and chemical treatments help maintain optimal forest and rangeland brush density and when used appropriately, can help reduce the spread of wildfire. Application of mechanical activities are a necessary practice when lands have been converted from production to another use and left to grow unmanaged. Sometimes this is complete removal while other times it is fuel reduction, including creating shaded fuel breaks that remove understory vegetation that acts as ladder fuels. Ladder fuels are live or dead vegetation that allow wildfires to spread vertically from the ground to the treetops or homes. Clearing vegetation along roadways improves the effectiveness of a road as a firebreak and creating additional firebreaks in and around vulnerable areas helps slow wildfire advancement and supports containment.

When conducted on a regular basis, prescribed burning can accomplish many of the functions summarized above. In addition to reducing hazardous fuel loads and subsequent high-intensity fires, prescribed fire can reduce the spread of insects and diseases, reduce invasive species, improve habitat for species of concern, stimulate forage production for wildlife, and help maintain the biological diversity of fire-dependent ecosystems. Prescribed burning helps to create and maintain a more resilient ecosystem. Historically, the majority of Texas consisted of a frequent fire regime. Prescribed burning that is performed for specific purposes, can mimic historic fire regimes. The Texas Potential Prescribed Fire Benefit technical report (Texas A&M Forest Service, 2024) notes that 88 million acres of forest, shrub, and grass lands could potentially benefit from the application of fire or other fuel management activity. Prescribed burning works well in wildlands, but requires specific training and insurance coverage to conduct as well as sufficient land area, making it generally unavailable to exurban homeowners.

Community Wildfire Mitigation

Contained in the National Cohesive Wildland Fire Management Strategy is the concept of fire-adapted communities. According to these guidelines, a fire-adapted community is *"...a human community consisting of informed and prepared citizens collaboratively planning and taking action to safety co-exist with wildland fire."* The aim for a fire-adapted community is that homes and community infrastructure survive wildfire with minimum damage and any required recovery occurs with minimal social and economic disruption.

Addressing wildfire risk at the community level is completed through the implementation of a Community Wildfire Protection Plan (CWPP). This is completed at the county or municipal government level through coordination with the Texas A&M Forest Service. A CWPP is a unique, flexible, and living document that takes a collaborative approach to wildfire mitigation. CWPP identifies and assesses high-risk areas of the municipality or areas within the county, identifies barriers to wildfire risk reduction, and develops a prioritized action plan that addresses reducing hazardous fuel, treating structural ignitability, establishing regulatory approaches, deploying local planning tactics and implementing outreach programs.

*Effective fire-adapted community programs focus on educating citizens on ways to mitigate wildfire risk to homes and structures, and include concepts such as the home ignition zone, home hardening, and *Ready, Set, Go!* These empower people to reduce risk at the individual home level, which is critical to the success of mitigation efforts. Landscape management in the home ignition zone is designed to create a buffer between a house and vegetation that surrounds the house. Home hardening reduces the vulnerability of homes to embers and heat that accompany wildfires. Through *Ready, Set, Go!*, citizens learn how to complete a wildfire preparedness plan based on a risk assessment of their home and property.

Homeowners can implement certain practices on their property and the surrounding landscape that increase the survivability of their home and reduce damage caused by wildfire. Ignition resistant building materials and construction techniques, along with vegetation and debris removal, play a vital role during wildfires. The home ignition zone is comprised of three distinct zones that stretch from 0 to 200 feet from the home (Figure 14). Beyond 200 feet is considered wildland vegetation if it is not in some type of developed state.

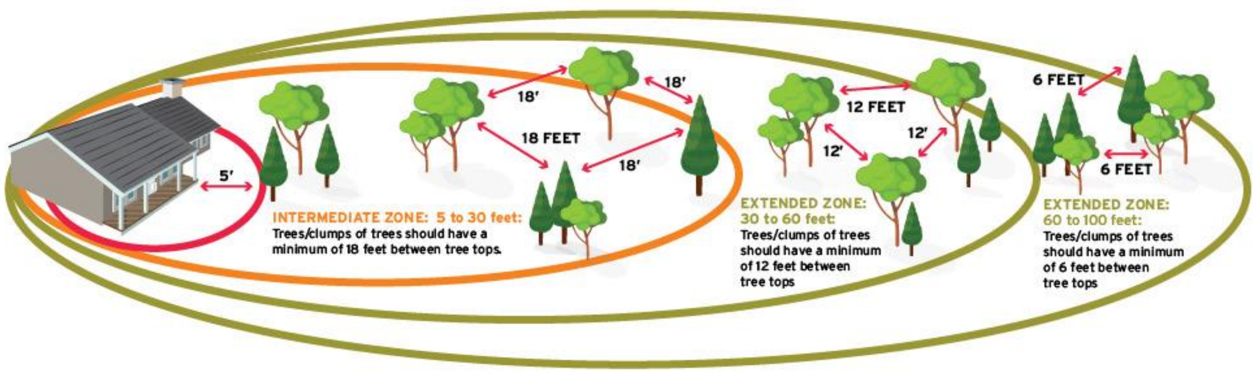


Figure 14. Home Ignition Zones

Research from the Insurance Institute for Business and Home Safety (IBHS) shows that the immediate zone (0 to 5 feet) has the greatest impact on risk to home from wildfire. IBHS and the National Fire Protection Association® recommend keeping this zone well-maintained and clear of combustible materials to reduce the potential that embers landing near a building will ignite fuels and expose the area around a home to a direct flame. The International Code Council maintains the International Wildland-Urban Interface Code (IWUIC) with recommendations for home hardening and fire-resistant construction (UpCodes, 2021).

The Firewise USA® program is a joint effort between the National Fire Protection Association and state forestry agencies. It is a fire-adapted community program aimed at addressing wildfire risk at the neighborhood level. Priority actions are reducing fuels within the home ignition zone. Once the neighborhood achieves the Firewise USA® standards, it becomes a recognized site. Nationally, Firewise USA® sites are recognized by insurance companies and residents are typically offered insurance discounts, or in certain high-risk areas, allowed to maintain coverage from the insurance company.

Current Wildfire Challenges

*Wildland firefighting in Texas faces a growing set of challenges as the state contends with increasing wildfire frequency, population growth, and resource limitations. Key challenges include:

1. **Urbanization and Fragmentation:** The rapid pace of urbanization and land subdivision in Texas has led to a fragmentation of landscapes that once had similar management goals and practices. Development in previously wild areas not only increases the risk of fires starting near homes and infrastructure, but also creates barriers to effective land management practices, such as prescribed burns, timber harvesting, and grazing which are essential for reducing fuel loads. Unfortunately, many property owners within these areas are not adequately prepared for the wildfire threats they face, increasing vulnerability and complicating evacuation and firefighting efforts.

2. **Increasing Wildfire Frequency and Intensity:** Volatile weather and shifting precipitation patterns in Texas contribute to longer fire seasons and more intense wildfires. Prolonged periods of heat and dryness make vegetation highly flammable, particularly in areas prone to seasonal drought, limiting prescribed burn windows that can reduce fuel loading. The accumulation of dry, combustible material in forests and rangelands exacerbates the risk, making it easier for fires to ignite and spread.

3. **Resource Limitations:** A shortage of personnel, equipment, and financial resources hampers both wildfire response and prevention efforts in Texas. Many rural communities, which are often the first to face wildfire threats, rely on volunteer firefighters. However, the number of volunteers has been steadily declining, exacerbating the strain on firefighting capacity. Effective management of wildfire risk requires coordination among various local, state, and federal agencies, as well as private landowners. Without sufficient resources and a strong network of collaboration, wildfire prevention and response efforts may be delayed or ineffective.

4. **Funding for Wildfire Mitigation and Preparedness:** Adequate funding for wildfire mitigation and firefighter preparedness is crucial but remains a significant challenge. Federal, state, and local financial resources are often stretched thin due to competing priorities. The need for ongoing investment in fire mitigation strategies, such as prescribed burns and vegetation management, exceeds available funding, leaving large portions of the landscape vulnerable to wildfire. Additionally, wildfire response requires specialized skills. As the severity and frequency of wildfires rise, so does the demand for better-equipped and better-trained firefighters.

5. **Fire in the Wildland-Urban Interface is a Structure-Ignition and Community Fire-Spread Problem:** To address structure-ignition from wildfire, mitigation efforts must be completed holistically at the local government level. Assessments following large Texas wildfires clearly show that home loss was the result of exposure to embers, surface fires, and structure-to-structure fire spread. Many Texas municipalities and counties lack expertise and resources to mitigate wildfire risk at the community level.

6. **Human Caused Wildfires:** Outdoor debris burning is a leading cause of wildfires in Texas. When fire conditions worsen, counties enact burn bans to limit potential wildfire ignitions. Violators can be fined and held liable for damages. While this is an effective strategy, human-caused wildfires

can still occur, making targeted wildfire prevention messaging critical. In order to maximize effectiveness, messaging needs to be deployed through a variety of media platforms and in multiple languages, which often exceeds the capacity of state and local government to adequately perform.

7. **Prescribed Burn Certification Inconsistencies and Limitations**: National Wildfire Coordinating Group (NWCG)-qualified burn bosses have the highest level of required training and experience which exceeds state training requirements, yet that qualification is not recognized as licensure for the Texas Department of Agriculture Certified and Insured Burn Manager (CIPBM). There are few CIPBM training opportunities in the state; one to two per year compared to over fifty TDA pesticide/herbicide applicator license training events. Additionally, insurance for prescribed burning has been identified as a constraint in Texas and Nationally (National Prescribed Fire Act, introduced 2024).

Recommendations and Considerations

Addressing the wildfire challenges in Texas requires a comprehensive needs assessment to identify and address gaps in resources, planning, and community preparedness. By enhancing firefighting resources, improving prevention and mitigation strategies, increasing community awareness, and fostering coordination among stakeholders, Texas can better manage wildfire risks and reduce the potential impacts on its environment, economy, and communities. Effective implementation of these needs will enhance the state's resilience to wildfires and support long-term sustainability and safety. At minimum, the following should be considered:

- ***Vegetation Management***
  Informed land management and proper stewardship practices that include regular maintenance of vegetation, including forest thinning, and clearing of dead and down woody materials, can lower the risk of wildfires, particularly when implementing defensible space around properties, above ground utility lines, and other critical infrastructure.

- ***Prescribed Fire***
  Conducting prescribed burns reduces fuel loads and slows the spread of wildfires, while supporting a resilient ecosystem. Ensuring rigorous training and reducing the barriers in maintaining prescribed fire certification, such as the availability of liability insurance, will ensure more and better trained professionals are available to practice. Developing more effective and consistent prescribed fire regulations in Texas could greatly increase the number of acres protected annually.

- ***Effective Response Coordination***
  Strengthening coordination among local, state, and federal agencies is vital for effective wildfire response and management. Interagency agreements and protocols can minimize confusion on roles and responsibilities. Communication system interoperability ensures that real time information is shared with all responders and officials, improving public safety and overall response during wildfire events.

- ***Advanced Firefighting Equipment and Technology***
  Investments in advanced firefighting equipment and technology aid response efforts and reduce losses. Wildfire forecasting and modeling systems support planning and pre-positioning of resources. Early detection systems, including satellite monitoring and remote sensing technology, can alert responders, reducing losses to life and property. Updated firefighting equipment, including engines, hoses, and protective gear, enhance firefighter safety and effectiveness of suppression efforts.

- ***Training and Recruitment***
  Increase the number of trained wildfire responders and enhance ongoing training programs to address the growing challenges and complexity of wildfires in Texas. Conduct joint training exercises and simulations with emergency responders to improve coordination and response effectiveness.

- ***Community Preparedness***
  Public education programs on wildfire prevention and preparedness enhance community resilience. Local stakeholders, including community organizations, businesses, NGOs, and landowners, need to be engaged in wildfire mitigation and preparedness efforts. Developing and practicing evacuation plans are essential for protecting lives and property.

- ***Increase Funding***
  Increase funding at local, state, and federal levels for land stewardship assistance, wildfire prevention, mitigation, response, and recovery.

Wildfires in Texas result in significant economic, environmental, and social losses. The costs associated with the loss of life, destruction of property, agricultural losses, emergency response, and long-term recovery can be substantial. Additionally, the environmental impacts, including habitat destruction and air quality deterioration, have lasting effects on ecosystems and public health.

Addressing these challenges requires ongoing investment in land stewardship, wildfire prevention, mitigation, response, and recovery efforts, increased coordination across all levels of government, effective policy and regulations, and enhanced community engagement. These strategies will help mitigate the impact of future wildfires and enhance community resilience.

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