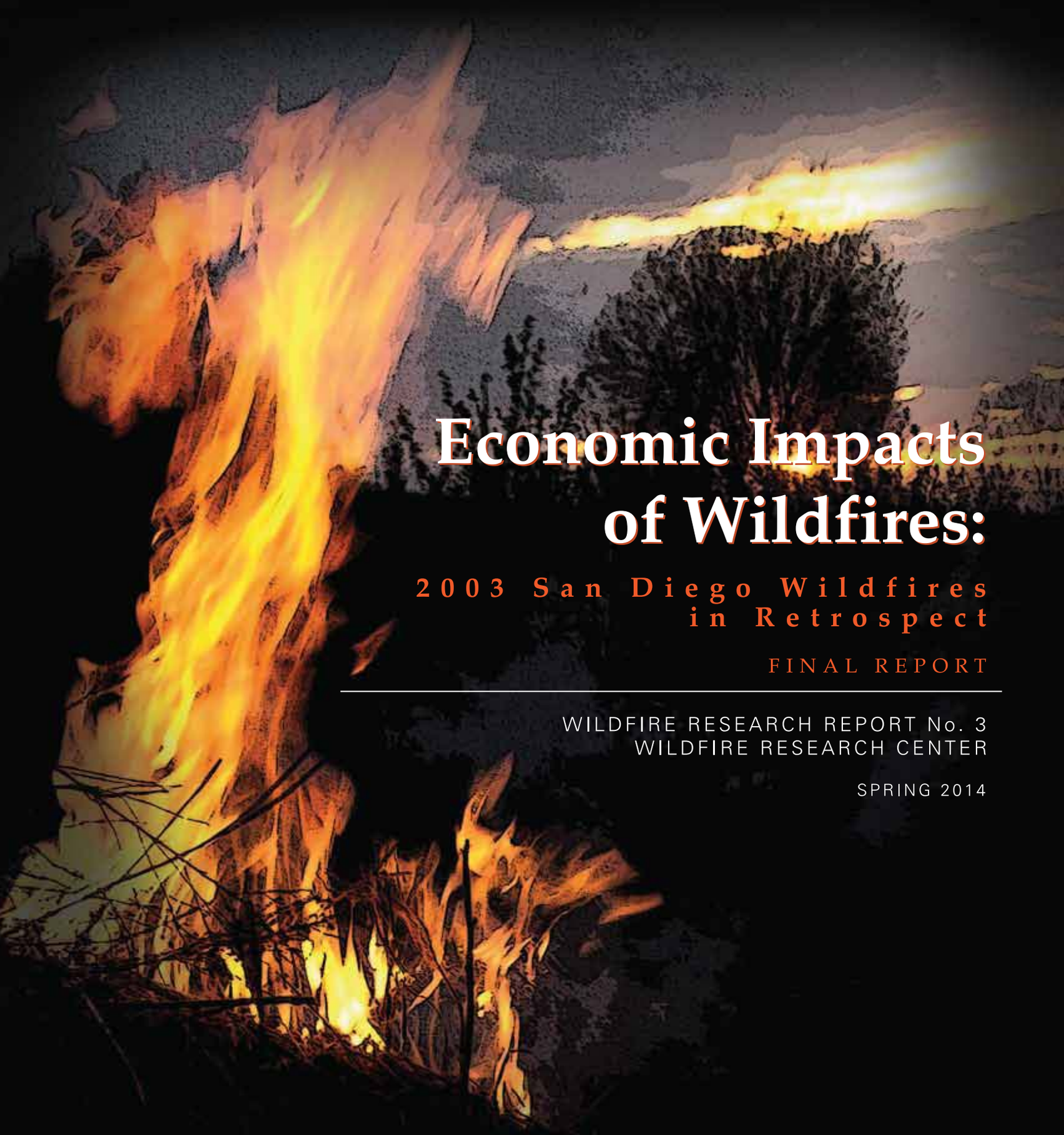

Economic Impacts of Wildfires:

2003 San Diego Wildfires in Retrospect

FINAL REPORT

WILDFIRE RESEARCH REPORT No. 3
WILDFIRE RESEARCH CENTER

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Wildfire Impact Analysis

CONTENTS

Introduction

Wildfire History

The term 'wildland fire' has become somewhat of a misnomer in the United States. What were once isolated fires in wildland areas that threatened rangelands, forests, and open space are now large incidents that frequently include homes, businesses and lives. Further intensifying the situation, a new paradigm is emerging: we are witnessing a dramatic shift in the frequency and intensity of wildfires due to a variety of factors, most of which are human-caused. As our population grows, decisions on developing and managing wildlands and the wildland urban interface (WUI) will determine our vulnerability and the risks imposed on our communities and our firefighters.

Since 1970, the US has witnessed an increase from three million to an overwhelming seven million acres burned each year with further increases projected. Today, there are in excess of 46 million homes in 70,000 communities in the WUI, with the annual cost of fires exceeding $14 billion. Local fire departments respond to more than 330,000 wildfires each year with over 900 occurring each day. The statistics are staggering: only 4% of wildfires are natural events; one in six engulfs transportation infrastructure; and one in ten includes structures (about 3,000 homes are lost each year). Emphasis has shifted from "traditional wildland firefighting" to structure defense in the WUI where over 40% of homes in this country are located. It is predicted that large fires (defined as 500 acres or more) will increase nearly 35% by 2050, and a shocking 55% by the end of this century. Future decisions on development and management of the WUI are critical in determining future vulnerability and risks

One of the most alarming trends is in California where half of the twenty largest wildfires in California's recorded history have occurred in the past ten years. Many of these events have had an unprecedented physical and financial impact to the state. The 2008 lightning-caused wildfires in northern California burned over 1.2 million acres, destroyed over 500 structures, and killed 15 people. Last year, the 2013 Rim Fire that engulfed in excess of four hundred square miles, threatening Yosemite National Park and affecting the water supply for the Bay Area. Indeed, this trend is not isolated just to California: in 2011 Texas WUI fires burned over 1,600 homes with an estimated total loss of $2 billion.

In this updated report, we provide a comprehensive assessment for the 2003 wildfire event that consumed much of San Diego County, costing the region nearly $2.5 billion in total loss. Typically, the cost of a fire is reported as the cost of suppression (staff, equipment, and supplies). However, these costs represent a mere fraction of the actual economic impact associated with many of our larger wildfires. The goal of this report is to evaluate the 2003 San Diego wildfires (including the Cedar, Paradise, and Otay Fires), and provide an estimate of the overall economic impact that wildfires have on our community, businesses, infrastructure, and natural areas. This report provides detailed insight into the costs and benefits of fire suppression, staffing, and resources. It also provides guidance for policy makers, and a model for future risk assessments and management decisions.

ASSESSMENT METHODS:

ASSESSING ECONOMIC IMPACTS FROM WILDFIRES IN SAN DIEGO COUNTY

Limited and dispersed information hinders the ability to conduct simple, and rapid economic assessments of wildfire impacts. The data collected in this report includes the basic information available and necessary to conduct a thorough economic impact analysis. Gaps in information and lack of suitable data are identified where appropriate.

Large wildfires cause dramatic ecological and economic impacts, warranting special attention and analysis. Typically, an economic assessment of wildfires focuses on only the more obvious variables, such as acreage burned and number of personnel, with often inadequate temporal and spatial perspectives. Historic reporting highlights suppression costs, federal assistance, or loss of structures. Unfortunately, this does not adequately capture the total economic impact from a wildfire event. The analysis provided herein attempts to rectify the disparity between suppression costs and the total economic impact from a wildfire.

Selecting Indicators for Economic Analysis

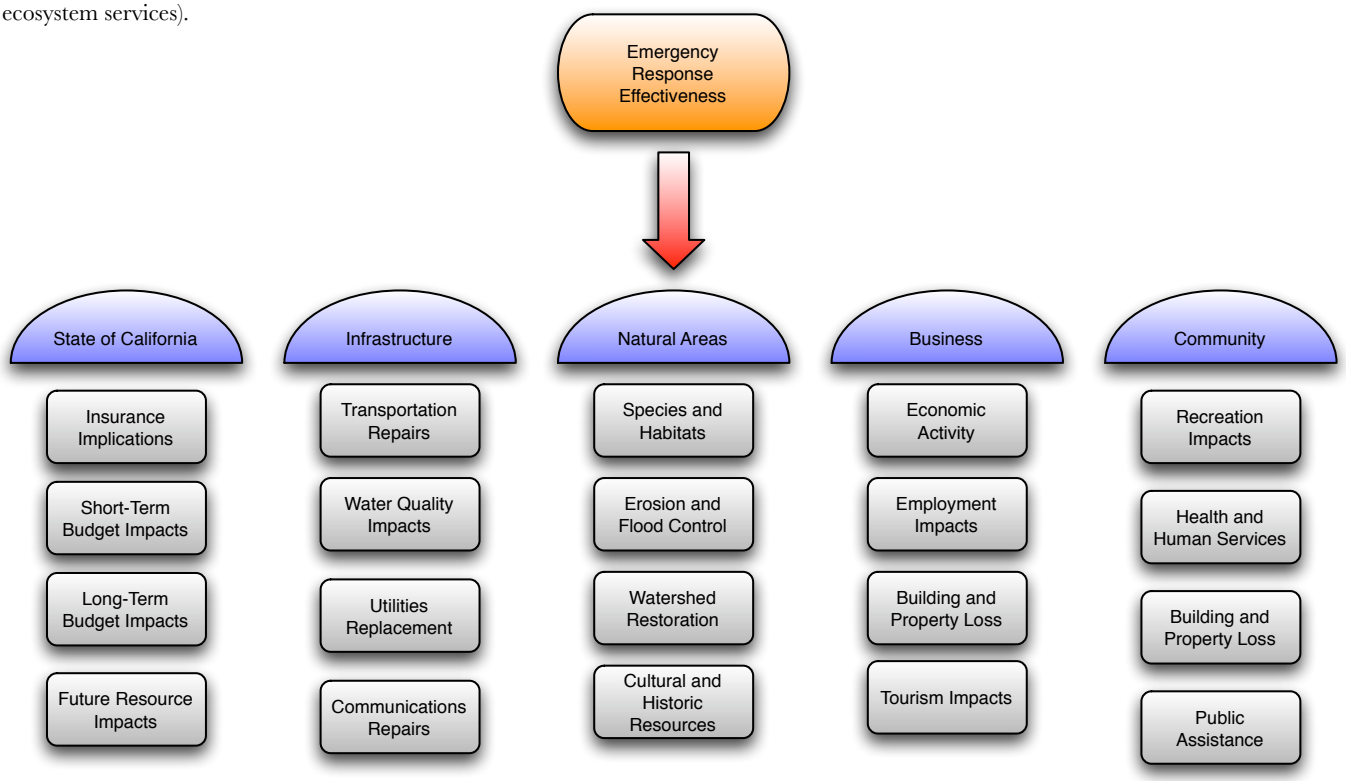
Framework for Data Collection

The first step in developing an economic impact analysis is selecting suitable indicators. These indicators will identify the chief categories of overall economic loss. We focused on five main areas of economic losses: state/agency, infrastructure, natural areas, businesses, and community. These five categories include both tangible items (loss of buildings) and intangible items (loss of ecosystem services).

Case Study of Economic Loss from Wildfires

San Diego County

Based on its recent history of severe and intense wildfires, it made immediate sense to conduct this economic analysis on the 2003 wildfires in San Diego County, with supplemental supporting information from the 2007 fire season. This report assesses data from federal, state, and local jurisdictions. The majority of the analysis is based on actual recorded economic losses published by the agencies and authorities within the region. However, a significant limitation to an economic analysis of this scale is access to suitable information and a lack of concrete data. Consequently, conservative estimates are provided for categories lacking actual data. While this report is comprehensive we recognize that not all information could be captured in this analysis. We ultimately provide recommendations for future wildfires to support the collection of adequate comprehensive information for improved economic impact analyses.



SAN DIEGO COUNTY

WILDFIRE HISTORY

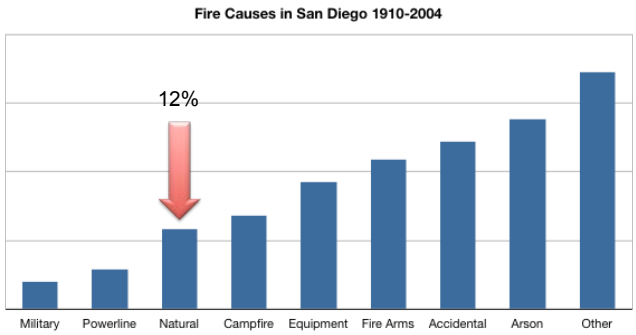
Wildfires have been a significant part of the southern California landscape, helping shape our ecosystems.

The San Diego region is located in one of the top twenty biodiversity hotspots in the world, hosting many endemic and rare species. The County also hosts the highest number of federally listed endangered species in the United States.

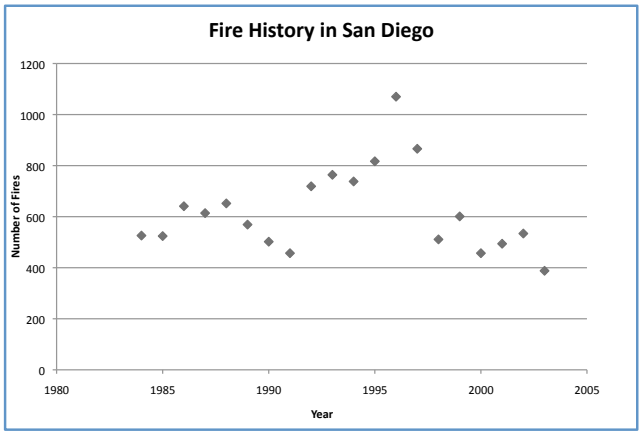
The uniqueness of the region poses a significant challenge in balancing urban growth and habitat conservation. This conflict is intensified by the urban-wildland interface, and increases in fire frequency and intensity.

Although San Diego County has experienced extraordinary urban growth, vast areas of land still contain native habitat, including grasslands, coastal sage scrub, chaparral, and forests. Much of this area is protected under regional multi-species habitat conservation plans, harboring some of the most sensitive and endangered species in the country. Historically, these ecosystems experienced periodic fires, likely caused by natural events (like lightening strikes). However, recent fire events have been intensified by human activity and growth. San Diego now experiences severe fire events caused by human vagary, accidents, and mismanagement. Only 12 percent of our fires in the past century were started by natural causes.

Causes of wildfires in San Diego County since 1910



While the total number of annual fires has fluctuated in the past 20 years, the San Diego region has been experiencing larger and more intense wildfires as evidenced by the fire events from 2003 and 2007. Predictions of climate change suggest that future temperatures, precipitation, and El Niño events may likely intensify the wildfire risk. Wildfire responders and land managers must be able to anticipate these changes and modify existing protocols and procedures accordingly.



Chaparral and coastal sage scrublands dominate much of the region. There is continuing debate whether such massive fires are natural but infrequent events or are a result of modern fire suppression and land management practices.[7] While the 2003 fires were unprecedented in their scale, they were not necessarily unique, and they were predicted to occur again. Unfortunately, consistent with the risk, just four years later and under similar conditions, San Diego experienced another devastating fire event in 2007. Many lessons were learned between these two fire seasons, and our understanding and response to wildfires in this environment has drastically improved.

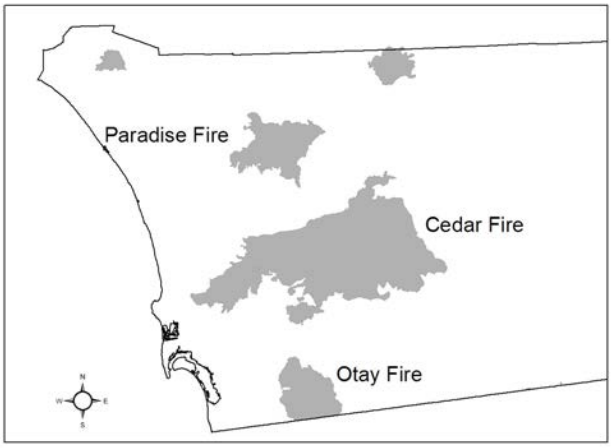
2003 WILDFIRES

SUMMARY REPORT

In late October of 2003, a series of wildfires began burning through the dense, dry brush and forest ecosystems of southern California. Fueled by drought conditions and Santa-Ana winds, the 2003 firestorm devastated southern California, becoming the largest fire in California's recorded history.

> *"Never in California's history were so many homes and lives in danger by fire at one moment. By the time the 14 major fires were extinguished; 24 lives were lost, 3,710 homes were destroyed and 750,043 acres were blackened."*
>
> *"California Fire Siege 2003:The Story"*

2003 San Diego Fire Map



Historically, the response to wildfires focused on establishing and defending a perimeter to control the fire. As the urban-wildland interface has increased, modern efforts are now focused on protecting our residential communities. In 2003, the unprecedented fire season pushed the limits of our capabilities, and showed us how vulnerable we really are. Three main fires were concurrently burning in San Diego County: Cedar, Paradise, and Otay.

Total Fire Impact

A total of 375, 917 acres were burned in San Diego County, 3,241 homes were lost, and sadly 16 people lost their lives, including one firefighter. At the peak of the fires, 6,635 crew were fighting the blazes.

Cedar Fire: October 25 - November 4

The Cedar Fire began at dusk on October 25th. It became the largest fire in California's history.

- Total Acres: **273,246**
- Suppression Cost: **$29,880,826**
- Firefighters at Peak: **4,275**
- Homes Lost: **2,232**
- Commercial Buildings Lost: **22**
- Other Buildings Lost: **566**
- Lives Lost: **14**
- Cause: **Human**

Paradise Fire: October 26 - November 4

The Paradise fire began on October 26. It was listed as the third highest priority during the fire siege.

- Total Acres: **56,700**
- Suppression Cost: **$13,000,000**
- Firefighters at Peak: **2,222**
- Homes Lost: **221**
- Commercial Buildings Lost: **2**
- Other Buildings Lost: **192**
- Lives Lost: **2**
- Cause: **Human**

Otay Fire: October 26 - October 28

The Otay Fire started the same day as the Paradise fire. Although this fire burned a substantial area, the total suppression cost and structures lost was minimal.

- Total Acres: **45,971**
- Suppression Cost: **$350,000**
- Firefighters at Peak: **138**
- Homes Lost: **1**
- Commercial Buildings Lost: **0**
- Other Buildings Lost: **5**
- Lives Lost: **0**
- Cause: **Undetermined**

ECONOMIC IMPACT ANALYSIS

FIVE INDICATORS OF FIRE IMPACTS:

As described by the figure on page 2, we selected five indicators of economic impact from wildfires:

- **state/agency**
- **infrastructure**
- **natural areas**
- **businesses**
- **community**

The impact analysis is based on actual data obtained from various agencies and conservative estimates from economic experts and organizations.

Economic Impact Analysis

Following major wildfire events, considerable scrutiny is placed on the agencies responsible for control and suppression. The focus is usually on the number of acres burned and homes lost. Often there is a rush to blame existing policy and procedures, and recommend changes to response protocol. Sadly, these hyper-critical, post-fire analyses focus on the wrong factors. To truly understand a fire event, it is crucial to provide a thorough review of the overall economic loss and the benefits and "saves" associated with fire protection.

An economic loss analysis for natural disasters is only as good as the quality and quantity of data used. The results are strongly influenced by the scope of the categories used in the evaluation, with a specific sensitivity to the spatial scale (geographic area), temporal scale (time span used to assess impacts), and sectoral scale (economic sectors included).[8]

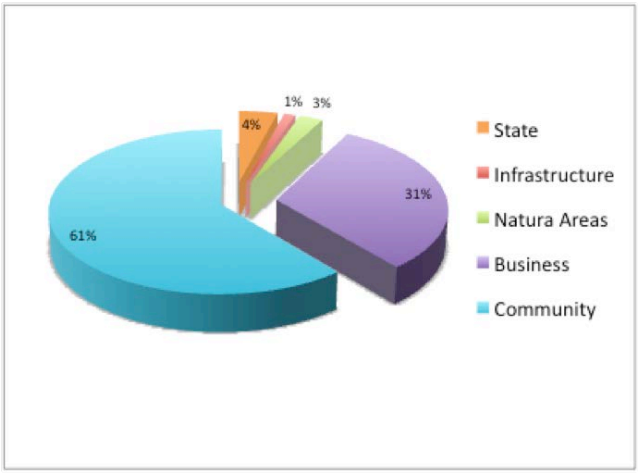
Certain losses caused by wildfires require additional research to ensure a consistent and reliable estimation of loss. Often, the types of data available are severely limited, and many key agencies and organizations have not yet considered undertaking a post-fire economic assessment. Also, many of the losses and impacts from certain sources take significant time to estimate, and may not be fully understood in a reasonable timeframe (e.g. water quality impacts and habitat restoration costs).

This assessment follows a global method of calculating the total costs, losses, and impacts of wildfires. The purpose of the assessment is to use the 2003 San Diego wildfires as a case study to provide a framework for developing a consistent and reliable method for assessing the economic impact from these disasters.

Summary Results

In the following sections, we discuss the indicators of costs and losses detailing the economic analysis conducted for each category, and the source of data and information used. This assessment corroborates other estimates provided in the media, agency reports, and at subsequent meetings and conferences.[9,10,11] However, this report is based on actual data and information to provide a more accurate, and justified estimate of the economic loss.

The total economic impact of the 2003 wildfires in San Diego County is estimated at **$2,450,016,476**. This equates to a cost of over **$6,500 per acre**. The total suppression costs amount to *less than* **2 percent** of the entire economic impact; a relatively negligible cost in contrast to the overall loss. A complete description of the economic loss is provided in subsequent sections, and summary table provided in Appendix A



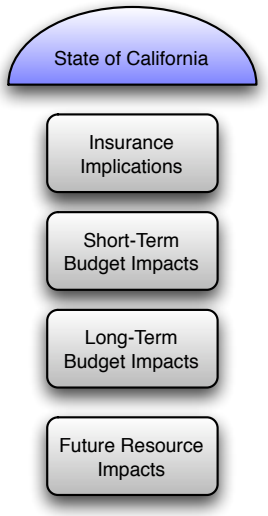
CALIFORNIA'S ECONOMIC IMPACT

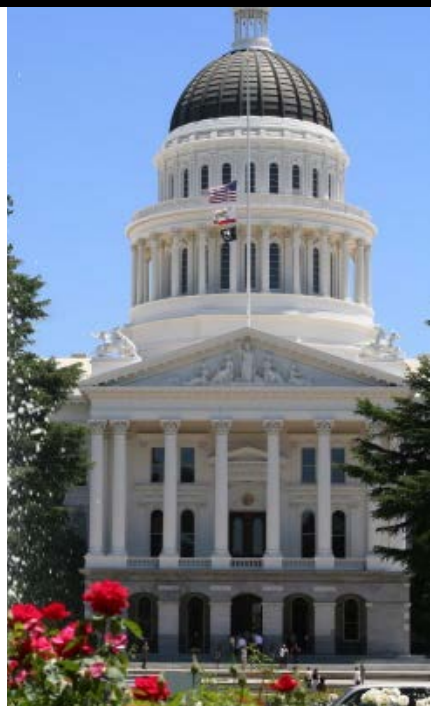
AGENCY EXPENDITURES

The State of California is feeling the lingering impacts of a serious financial crisis that could be a decade long. However, our obligation to ensure public safety and land stewardship cannot be neglected. The social and economic losses would only exacerbate the problem

According to budget reports and committee analysis, CAL FIRE is threatened each year with cuts that will result in losses in personnel and infrastructure, spreading the remaining resources thin. For example, in 2008, the State cut $10 million from its fire service budget in Southern California. This forced the San Diego Unit Chief to cut 16 jobs, spreading the remaining resources even thinner.

> *"If we don't have resources ready to jump on these fires when they are small, we will have another major wildfire in the county,"*
> *Supervisor Dianne Jacob*





Short-Term Budget Impacts

The short-term budget impact to the State includes the costs for fire suppression, staff, overtime, equipment, and supplies. This also incorporates the considerable costs of transportation and mobilization. The total cost of fire suppression was over $43 million, roughly 1.8% of the total economic loss estimated. The suppression estimates are typically very accurate in capturing the actual costs of this activity. In an economic analysis, this information is critical because it provides a perspective of how much is invested in staffing and equipment, and how even moderate increases in resources (in comparison to the total loss) can have a positive impact on the outcome of a fire event. Fortunately, this data is relatively easy to collect and has a high degree of consistency and reliability between fire events.

Long-Term Budget Impacts

Depending on the severity and location of a wildfire, post-disaster recovery can come with a considerable price. Factors that impact the budget in the long-term include watershed and water quality mitigation, sensitive species and habitat restoration, and loss of facilities and concomitant infrastructure. These data are typically not easily calculated or readily available.

Insurance Implications

The state often covers losses to infrastructure, facilities, and other resource obligations after a fire event. After the 2003 San Diego fires, the California Department of Transportation estimated their total loss at roughly $15 million. Furthermore, the total loss to San Diego Gas and Electric was a staggering $71.1 million loss in infrastructure. State tax-payers reimbursed the utility company more than half its total loss in a Catastrophic Event Memorandum Account (wildfire account), totaling $39.5 million.

Additional costs may be incurred by the state under unemployment insurance claims. While no report was provided for 2003, a comparative assessment was provided from the 2007 wildfires. The County of San Diego experienced 4,692 "fire-related" unemployment insurance claims, including 479 disaster related unemployment claims.[10] This loss is covered in greater detail below.

Future Resource Impacts

In response to large wildfires, the state often incurs additional costs in bond measures, local assistance grants, and investments in additional equipment or fire response staff. These costs are not well understood or estimated, but they are undoubtedly in the millions of dollars, and are felt in budgets as varied as our transportation and watershed protection funds. There's an old firefighters chestnut: "no matter where the fires are burning, all fires are local."

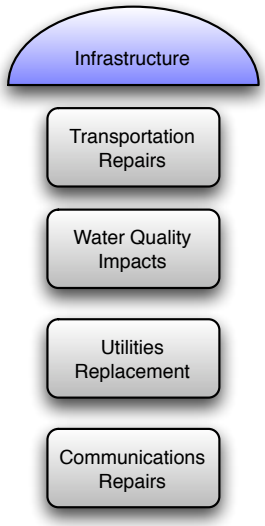
Total Economic Loss

The total economic loss to the State of California was estimated at nearly **$100 million**. This estimate is substantially lower than the total experienced by the state. For example, there were additional losses experienced by resource agencies (California Department of Fish and Game), local Universities (San Diego State University and UC San Diego), and other state agencies when they were closed during the peak fire event. Also, unemployment insurance costs (discussed below) could also be included in this section.

INFRASTRUCTURE ECONOMIC IMPACT

REPLACEMENT COSTS

Wildfires frequently damage our fragile infrastructure, including highways, communication facilities, power lines, and water delivery systems. Restoring basic services is a top priority, with many agencies and organizations incurring significant costs.



The 2003 wildfires resulted in daunting impacts to San Diego's infrastructure. Restoring these services post fire was critical to the recovery and restoration efforts. Fortunately, many of these costs have been well documented. The total economic loss to infrastructure was approximately **$147.3 million**. Some of these costs were included under the economic impact to the State of California (discussed above), and the economic impact to natural areas (discussed below).

Transportation Repairs

The California Department of Transportation incurred approximately $15 million in damage to existing infrastructure. This was the total cost of repair and rebuilding of the road and highway infrastructure under the purview of CalTrans. This effort included the cost of maintenance and damage assessment teams, field data collection, and replacement or repair of roads, guardrails, signage, electrical supply, culverts, landscaping, etc. This value tracks closely with the $17 million costs projected for the 2007 San Diego wildfire impacts.

The initial effort is focused primarily on safety concerns. Therefore, this cost estimate is fairly conservative, since it does not consider the long-term costs associated with restoring transportation to pre-fire conditions. For example, the long-term costs of habitat or landscaping restoration, erosion control, and maintenance of culverts (in response to inevitable mud slides and debris buildup).

Water Quality Impacts

Assessing water quality impacts is one of the most difficult components to calculate. Direct impacts to our municipal water supply occurred through contamination of ash and debris, and the flooding/mud slides that follow in the rainy season. Municipal water managers must address water supply impacts, and the potential substantial costs associated with changes in quantity and quality. Currently, data are not available to estimate this accurately.

However, while not exclusively used for water quality and infrastructure recovery, FEMA contributed $14 million in hazard mitigation efforts. Part of these funds were used to restore and protect sensitive habitat and watershed functioning (discussed below).

Utilities Replacement

Approximately 3,200 power poles, 400 miles of wire, 400 transformers and more than 100 other pieces of related equipment were damaged by the fire and needed to be replaced by San Diego Gas and Electric. In total, SDG&E spent $71.1 million to replace lost equipment and restore services. Every tax payer felt the squeeze, since approximately 55.6 percent of this loss was reimbursed by the State of California.

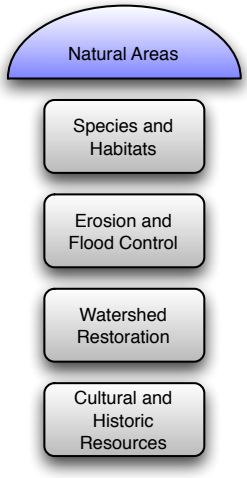
Communications Repairs

Given the diversity of communication carriers, and vast infrastructure associated with digital, wireless, and hard-line communication, estimates were difficult to obtain. This estimate does not include the total loss associated with communication infrastructure losses, including cell phone towers, communication relay stations, cable lines, phone lines, and poles. This loss was not adequately measured in 2003, but based on discussions with several prominent companies we can conservatively estimate the loss at several million dollars county-wide.

NATURAL AREAS ECONOMIC IMPACT

SPECIES, HABITATS, AND ECOSYSTEM SERVICES

A considerable ongoing research effort has been focused on appropriate and effective fire management practices, balancing the multitude of concerns such as endangered species, invasive species, defensible space, and fuel reductions. Despite our best intentions to manage our ecosystems, current and historic practices may both improve and worsen the risk of fire and the economic impacts.



Southern California's fire-adapted ecosystem has a well-documented history of large, catastrophic fires, yet integrating this risk into regional management strategies had not generally occurred prior to the fires in 2003. Pre- and post-disaster planning should aim to decrease the chances of catastrophes occurring while increasing the chances of maintaining the environment and enhancing post-catastrophe recovery.

The San Diego fires and their aftermath dramatically illustrate the need for change in natural lands management. Management must explicitly take into account the probability, direct and indirect impacts, and potential cumulative effects of stochastic (random) environmental events, anthropogenic (man-made) disasters, non-native species, disease, and other threats. Exotic invasive plants represent the main threat to post-fire succession; many non-native grasses, such as rye grass, reduce native species diversity and biomass. Furthermore, rapid establishment of exotic species promotes more frequent fires, resulting in conversion of chaparral shrublands into exotic grasslands.

Just as emergency services have learned how to better protect human life and resources with well-planned responses, land managers can also plan ahead to better conserve natural resources in the face of catastrophes. In general, disaster planning for natural systems should include strategies that: 1) minimize the risk of catastrophic events; 2) increase the chance of surviving a catastrophe; and 3) enhancing post-catastrophe recovery. Responses to catastrophes should focus on maintaining population viability, community structure, and ecological processes.

Unfortunately, this is probably the poorest documented economic impact, but it may actually represent one of the largest economic losses in wildfire events. Including these damage and restoration estimates is problematic due to questionable methods in creating models and high variability in their assumptions. A thorough assessment requires both estimates of the impacts on ecosystem structure and function, an estimate of the loss in ecosystem services, and the cost for restoration.

Species and Habitats

The question of who is responsible for financing and implementing post-catastrophe management was uncertain. The two multiple species habitat conservation plans include take permits for approximately 100 species. This makes the San Diego fires perhaps one of the most complex financial and legal issues for a conservation program to address after a catastrophe. No suitable estimates were available for this category.

Erosion and Flood Control

FEMA provided $47,183,333 in watershed restoration funding, and $14 million in hazard mitigation efforts. Portions of these funds were used to restore habitat and control the potential impact of erosion and floods in the following winter. It will never be clear how much funding private landowners, tribes, and municipal entities spent on erosion and flood control measures, but we know this expenditure is extraordinary.

Watershed Restoration

The County of San Diego reported the estimated total cost for fuels treatment in the three most impacted areas at $1.1 billion, with $250 million needed to reduce fuels along roads and in parks alone.[11] By 2009, we confirmed only $47,183,333 allocated, coming from three US Department of Agriculture Programs providing the County with $39.575 million, with matching funds from the County ($5 million) and SDG&E ($2,608,333). These funds have been used for restoration and post-fire fuel treatment.

While not adequately understood or supported, a loss of ecosystem services could potentially be included in the total economic loss (though not included in this report). An estimate of increased storm water runoff containment and air pollution reductions by vegetation (formerly taken care of through natural processes) could cost $25,349,000 and $798,000 respectively.[12]

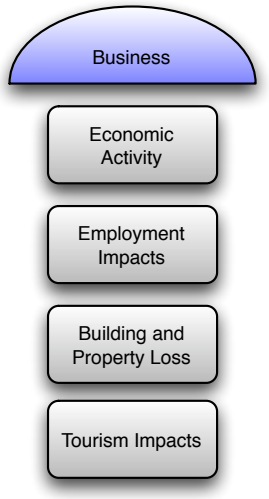
Cultural and Historic Resources

The San Diego region is rich in diverse cultural and historic resources. Unfortunately, no records or an assessment of economic losses associated with these resources has been completed.

BUSINESS ECONOMIC IMPACT

DELAY, PRODUCTIVITY, AND LOSS

San Diego's economy was once dominated by the military (now the city's second largest economic sector). Manufacturing, technology and trade are now the major industries. In 2002, manufacturing contributed $25 billion to the county's economy, with international trade accounting for 37 percent this value. In 2001, goods moving through San Diego customs totaled $33.6 billion, with the border between San Diego and Tijuana being the busiest in the world.



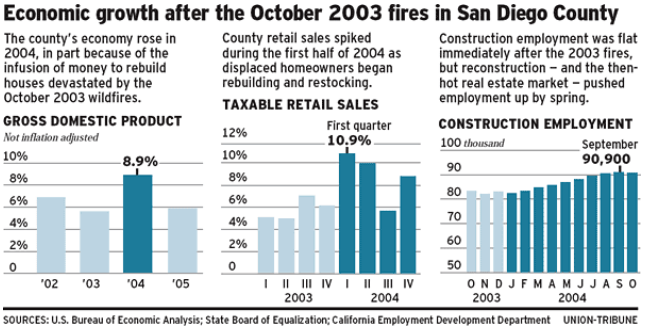
Determining the total economic loss and impact of the wildfires to the region is challenging. While many of the local businesses experienced impacts to facilities, shipping delays, and employee productivity, few of them actually estimated this loss. Without this information, we relied on economic indicators and estimations. For example, Qualcomm, a leader in San Diego's high tech industry, remained open for business during the wildfires, but incurred costs from replacing air filters, and maintaining equipment. Similarly, the military experienced not only a loss in activity, but also a loss of habitat and infrastructure at Miramar. Although this value was not tracked during the 2003 wildfires, the Navy estimated a total economic loss of $1.5 million during the 2007 wildfires.

Economic Activity

The lost economic activity in the San Diego Region was calculated by dividing San Diego's estimates 2003 Gross Metropolitan Product (GMP) of $133.4 billion by one day or $365.5 million. This loss is based on a ten-day long fire siege, and a conservative estimated loss of 10% in gross productivity, manufacturing, employees not working, and curtailed spending. Other losses captured by this estimate include impacts to shipping and distribution, tax revenue, and air transportation (Greater San Diego Chamber of Commerce).

For example, the wildfires led to nine separate airlines experiencing significant economic and operational impacts: 47 cancelled flights and 37 flight delays occurred as a result of decreased visibility on October 26, 2003. As a comparison, the San Diego Institute for Policy Research used similar (but more liberal) methods in estimating the loss in economic productivity during the 2007 wildfires ($893 million). While some of this economic loss can be (and probably was) recouped in later months, lost productivity and missed opportunity costs cannot be recovered.

Even though there may be economic growth after large wildfire events, this is still considered an overall loss; the boost in the economy is not a result of true economic growth, but rather a response to large-scale economic and infrastructure losses.



Employment Impacts

As stated above, business and the State may incur additional losses under unemployment insurance claims. While no report was provided for 2003, in 2007, the County of San Diego experienced 4,692 "fire-related" unemployment insurance claims. The 2007 "preliminary potential fire-affected loss of employment and wages" for San Diego County exceeded $400 million.[10] Equivalent losses are expected from the more devastating fires in 2003. In the future, it is vital to capture accurate data for this economic loss.

Building and Property Loss

A total of 24 commercial buildings were lost during the fire events, along with significant stocks of materials, merchandise, and equipment. Unfortunately, this total economic loss was not directly calculated for the 2003 events, but was likely in the millions of dollars.

Tourism Impacts

According to the San Diego Convention and Visitors Bureau, visitor spending dropped by $32.5 million in comparison to the month of November, and decreased by 1.3% in comparison to 2002 statistics (or a decrease in approximately $4.4 million). While neither of these values accurately captures the true decrease in visitor spending, there is no doubt that the wildfires had an economic impact. Similarly, the San Diego County "Index of Visitor Activity" showed a 1.4% decrease in October 2003, and a total decrease of 8.7% when compared to the same period for 2002.

COMMUNITY ECONOMIC IMPACT

LIVES, HEALTH, HOMES, AND QUALITY OF LIFE

The San Diego region was devastated by the 2003 wildfires. The extreme loss of homes and employment is the largest loss of the five economic indicators.

Recreation Impacts

Short- and long-term impacts netted by recreational activity are challenging to quantify. Closures of areas often eliminate recreational activity, while interest in post-fire impacts on the wildlands may actually attract new visitors. Mission Trails Regional Park lost 2,800 acres to the wildfires. Large portions of the Park were closed to the public, to minimize further disturbance, and allow natural succession and species responses to occur. During that time, Park staff and volunteers worked on clearing the park of dead animals, hazardous debris, and installing erosion control measures. By April, 2004, majority of the Park was open to the public, but some areas are still considered extremely sensitive, even six years later. Similar stories can be told for many of the other recreational areas impacted by the fires.

Health and Human Services

It is impossible to place a value on the loss of human life. Tragically 16 lives were lost in the wildfires, including one firefighter. It is however possible to calculate the economic impact from injuries and health impacts from the wildfires.

Donations received by the Red Cross increased by 200% over the previous year's activity, receiving $7.5 million earmarked for post-disaster support. A force of 4,500 volunteers and 100 paid staff established 12 shelters across San Diego and Imperial Counties to care for over 6,000 people displaced by the wildfires. The Red Cross provided 122,034 meals, cots and blankets, comfort kits, baby supplies, and counseling.

Concrete data are not available for estimating total health impacts from wildfire programs, but it has been estimated at over $10 million. The Council of Community Clinics reported that clinics outside the fire area experienced losses up to $20,000, while those providing more extensive services reported losses up to $35,000. Those clinics directly impacted by the fires reported maximum losses of over $80,000. These losses included personnel, overtime, supplies, equipment, and lost revenue from regular patient visits.[13] A similar report was provided for the 2007 wildfires, estimating the total loss at $1.5 million.

During the Cedar Fire in 2003, hospitals experienced significantly higher than average numbers of complaints for illnesses plausibly associated with exposure to fire or smoke such as asthma, burns, and respiratory distress. There was also an increase in potentially related complaints such as altered neurological function, cardiac-related chest pain, and palpitations (County of San Diego HHSA, EMS QA Net MICN records, 2003).

Buildings and Property Loss

The Insurance Service Organization (ISO) gathers data from all insurance companies. The ISO estimated the total insurance settlements for the Cedar Fire at $1.06 billion. This single fire destroyed 2,232 residential buildings. Using the same formula for the Paradise fire (average settlements of $474,910), San Diego County experienced a potential total insurance settlement of $1.165 billion. This estimate correlates with similar loss estimates from late 2003 as reported by city and county officials (before all insurance settlements were settled), and the estimates from the losses in 2007 (projected at $1.1 billion; San Diego Institute for Policy Research).

Private Assistance

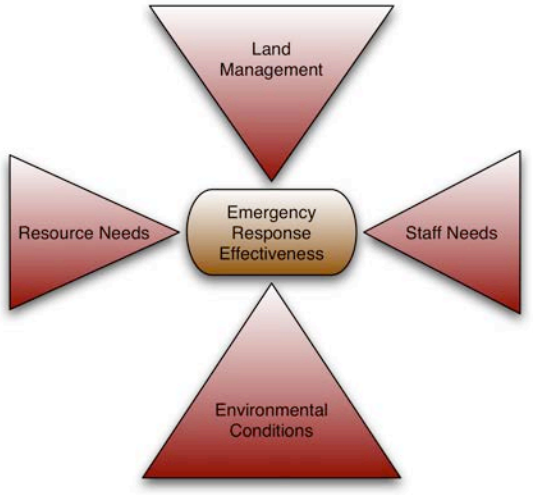
In response to the 2003 wildfires, charity donations and grant funding surged. The San Diego Foundation is San Diego's leading resource for information on charitable giving and community needs, managing $3,273,560 in donations and grants. FEMA assistance provided financial relief for individuals and households ($32.9 million), supplemental assistance ($1.4 million), disaster loans ($170 million), and public assistance ($103.2 million).

CONCLUSIONS

MAKING A DIFFERENCE

The focus of this study has been on documenting the staggering losses that occur in California every year due to major wildfire events. The 2003 San Diego wildfire event was a staggering $2.45 billion economic loss. Suppression costs were only 1.8%, with the vast majority of the loss borne by the taxpayers and citizens of California.

"The term 'wildland fire' has become a misnomer for most of California... Top priority has been shifted to the protection of the millions of citizens who have moved to the wildland/ urban interface"



As increasing development, urbanization, climate change, and invasive species alter the landscape of California, we will certainly experience more extreme fire events. A true accounting of the economic impact and loss due to wildfires is an important tool for resource and regulatory agencies. This can help plan for future fire events, identify key areas for protection, and highlight areas for reducing economic impacts.

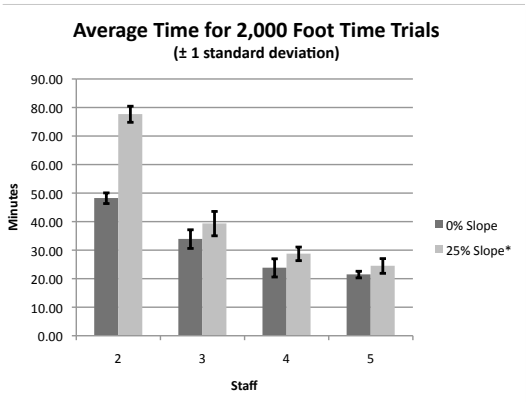
There are four main factors that influence the outcome of a wildfire: land management, environmental conditions, resource needs, and staff needs. Emergency response effectiveness is influenced by the existing land management practices. Stewardship and sustainable management of our natural areas requires a delicate balance between protecting our community and the natural ecosystems in our backyards. It was estimated that the total cost of fuel reduction for San Diego County is $1.1 billion. This is a significant and potentially insurmountable investment. The second factor involved in emergency response effectiveness is environmental conditions. Unfortunately, there is not much that can be done to manage drought conditions, electrical storms, or Santa-Ana winds. Under extreme weather events, these factors can significantly influence the outcome of a wildfire.

Finally, emergency response effectiveness is strongly influenced by the availability of adequate resources (engines, aircraft, equipment, and supplies). It is also influenced by adequate staffing levels and the number (and location) of fire stations. Therefore, reducing the total acreage lost in a wildfire is strongly correlated with reducing the overall economic loss. Increasing resources and staffing can successfully accomplish this objective. This has been demonstrated in subsequent studies, primarily through a staffing study conducted by Rahn (2010).[14] Rahn found that when comparing an engine staffed with three versus four firefighters, there was a significant difference in initial attack effectiveness and firefighter health and safety. On a standard 2,000 foot hoselay, our research study found:

- A 3-0 staffed engine operates up to 50% less efficiently than a 4-0 engine
- Firefighters on a 3-0 engine exhibited peak heart rates of over 220 beats per minute
- Firefighters on a 3-0 engine will travel nearly ½ a mile farther than a 4-0 engine (because they have to work harder to retrieve 100' sections of hose)
- During the hoselay experiment, a 3-0 engine had one firefighter working at the nozzle by themselves 65% of the time
- A 3-0 engine experienced 21% more errors/delays than a 4-0 staffed engine.

Likewise, increasing staffing to 4 persons per engine resulted in substantial savings in the state's emergency fund (estimated at $41 million per year as compared to previous staffing levels of 3 persons).[15] These same staffing levels also accounted for an increase in the total number of fires that were held to less then ten acres (1.7% and 3.9% increase in 2001 and 2002 respectively).[15]

The benefits of increasing the number of firefighters on a single engine cannot be overstated. For example, if a fire takes 12 personnel to fight it, this can be achieved by only sending three engines to the scene, rather than four, leaving behind one engine and enough resources to stay and protect the local area. During the 2003 wildfire events, 100% of the CAL FIRE staff for San Diego County were committed to the incident. However, over two-thirds of **all** statewide CAL FIRE resources were pulled into southern California, leaving some regions at risk. For example, the Humboldt-Del Norte and Lassen-Modoc districts committed 100% of their resources to assist southern California, leaving their areas at risk. On average, only one third of the state had any remaining staff during the 2003 fire siege. This is a necessary, yet risky solution to responding to large wildfire events. Increasing staffing and resources would significantly decrease this risk.



There is a significant difference between a 3-0 and 4-0 staffed engine. Note: a 3 or 4 person engine results in only 2 or 3 firefighters (respectively) actively engaged in fighting the fire while the company officer is responsible for operating the engine/pumps, providing command and control of the incident, and firefighter safety.

Emergency Response Effectiveness

The proposed annual budget for fire protection by CAL FIRE for the 2009-2010 fiscal year is $103,484,500, which is less than **1 percent** of the total state budget (and only **4% of the total economic loss of the 2003 San Diego County wildfires**). The benefits of a well-funded and staffed fire agency cannot be overstated. The ability to control wildfires can significantly reduce the resulting financial burden to the state of California. Additional staffing, training, and equipment, can lead to significant reductions in the total fire perimeter, resulting in dramatic reductions in the overall economic impact.

If the emergency response effectiveness was aided by additional staffing, even moderate reductions in the total fire perimeters of **1%** would have led to a potential savings of **$24.6 million** (over half the suppression cost), while a reduction of **10%** would have saved **$245 million**.

Percent Reduction	Revised Costs	Costs Savings
1%	$2,425,352,578	$24,663,898
5%	$2,327,358,535	$122,657,941
10%	$2,204,865,980	$245,150,496
25%	$1,837,388,317	$612,628,159
50%	$1,224,925,545	$1,225,090,932
75%	$612,462,772	$1,837,553,704

RECOMMENDATIONS

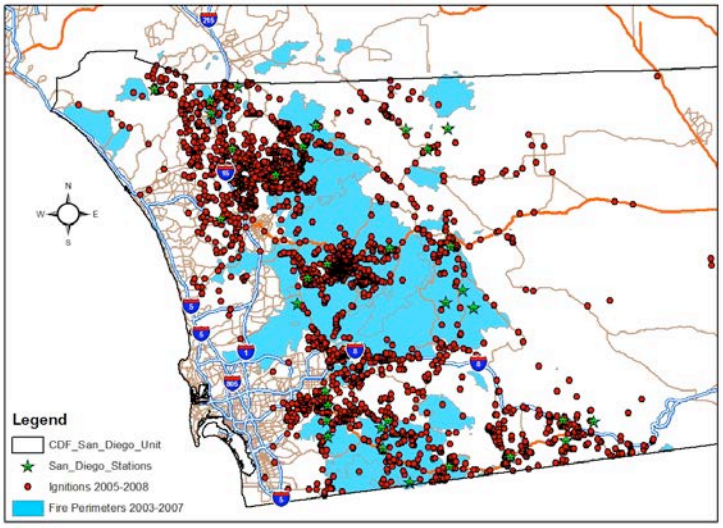
IMPROVING THE FUTURE

The focus on economic losses highlights the regional impact that wildfires can have. The impacts can span vast temporal and spatial scales, and the estimate provided may have still grossly underestimated the actual impact. Standardizing data collection, improving cooperation, and communication can lead to improved assessments in the future.

The focus on economic losses highlights the statewide impact that wildfires can have. The impacts can span vast temporal and spatial scales, and the estimates provided may have still grossly underestimated the actual economic impact. By standardizing data collection, improving cooperation, and increasing communication, we can improve assessments and effectiveness in the future. This report is limited to the data available, and our ability to create conservative and valid estimates of loss (in the absence of actual data). As we begin to ponder the future of data collection and economic impact analyses, we acknowledge that there are many more categories that we have not included, instead focusing on the largest and most obvious impacted areas. The following recommendations are intended to improve this process in the future:

- Conduct future economic assessments promptly, to avoid loss of data or institutional memory
- Develop a rigorous, statistically valid, and standardized protocol for future assessments
- Create a GIS based platform for data collection in the field, with an integrated GIS platform and mobile capabilities
- Establish a coordinator during and after major wildfires, to oversee reliable and accurate data collection
- Develop a protocol for estimating the economic "saves" associated with fire suppression, to document the annual value and benefit of firefighting services statewide
- Establish communication and data sharing with insurance companies, to insure accurate data collection
- Conduct research on the impacts associated with wildfires on natural areas, sensitive species/habitats, watersheds and losses in ecosystem services
- Review location of stations in relation to ignition points and fire perimeter maps to ensure adequate placement and volume of fire stations.
- Develop a strategy for assessing impacts to cultural and historic resources
- Review and improve reserve design and management strategies to effectively prepare natural systems for a catastrophe
- Ensure proper staffing and resource needs to ensure effective response and control for wildfires
- Evaluate the number and location of fire stations in relation to existing wildlands, ignition sites, and fire risk.

San Diego Fire Map



APPENDIX A.

Economic Impact Analysis Preliminary Results

Cost Type	Total Estimated Cost	Cost Per acre	Percent of Total
Fire Supression and Emergency Response	$43,230,826	$115	1.8%
CalTrans	$15,000,000	$40	0.6%
San Diego Gas and Electric	$71,100,000	$189	2.9%
FEMA - Hazard Mitigation	$14,000,000	$37	0.6%
Watershed Protection	$47,183,333	$126	1.9%
Estimate of Lost Business Economic Activity	$365,500,000	$972	14.9%
Unenployment Insurance	$400,000,000	$1,064	16.3%
FEMA - Disaster Loans	$170,000,000	$452	6.9%
FEMA - Individuals and Households Program	$32,900,000	$88	1.3%
FEMA - Supplemental Assistance	$1,400,000	$4	0.1%
FEMA - Public Assistance	$103,200,000	$275	4.2%
Foundation/Grant Programs	$3,273,560	$9	0.1%
American Red Cross	$7,500,000	$20	0.3%
Home, Business and Property Loss	$1,164,955,197	$3,099	47.5%
Medical Costs	$10,773,560	$29	0.4%
TOTAL	**$2,450,016,476**		

Appendix B

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