Case Study of the 2015 Hidden Pines Wildland-Urban Interface Fire in Bastrop, Texas

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Contents

Dedications:

This case study is dedicated to all of the families and citizens of Bastrop County that were impacted by the events of the Hidden Pines Fire. Their strength and courage during this challenging event allows the community as a whole to promote the resolve and determination of this county, despite overwhelming circumstances.

Acknowledgements:

A special note of appreciate goes out to all the first responders, sheriff's offices, emergency management services, county officials and Texas Forest Service. Their dedication and work prevented the loss of human lives and minimal structure damage and loss.

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Bastrop County First Responders
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Bastrop Police Department
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Texas Animal Health Commission
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Texas Department of Transportation
Texas Commission on Environmental Quality
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Abstract:

This case study was commissioned by Bastrop County as a way to document events and impacts from the Hidden Pines Fire and to capture lessons learned from the event.

The study focuses on Idle Acres, Spring Hollow and Turkey Run subdivisions (IASHTR) in Bastrop, effected during the Hidden Pine Fires on October 13, 2015. There were 504 structures (refers to Homestead/Year Round or Non-Homestead/Vacation per Bastrop County Appraisal District BCAD) that were within these communities impacted by road closures or home loss. Of these, 64 structures were completely destroyed and two had confirmed partial damage. Only 30% of the homeowner's impact would be covered by insurance. Other impacts to the neighborhoods would include debris clearance, road or bridge repairs, and public utility systems throughout the area. Overall, approximately 4,582 acres would be impacted by the wildfire. Approximately, 2,162 acres within the burn scar of the Bastrop Complex Fire (September 2011) and the remaining 2,420 acres outside the footprint of the Bastrop Complex Fire. The area outside the Bastrop Complex fire burn scar would be impacted the greatest with the majority of the homes lost located in heavy unburned vegetation. Map Figure 1 shows the location of the Hidden Pines Fire in relationship to the Bastrop Complex and Wilderness Ridge Fire (February 2009) within the county.

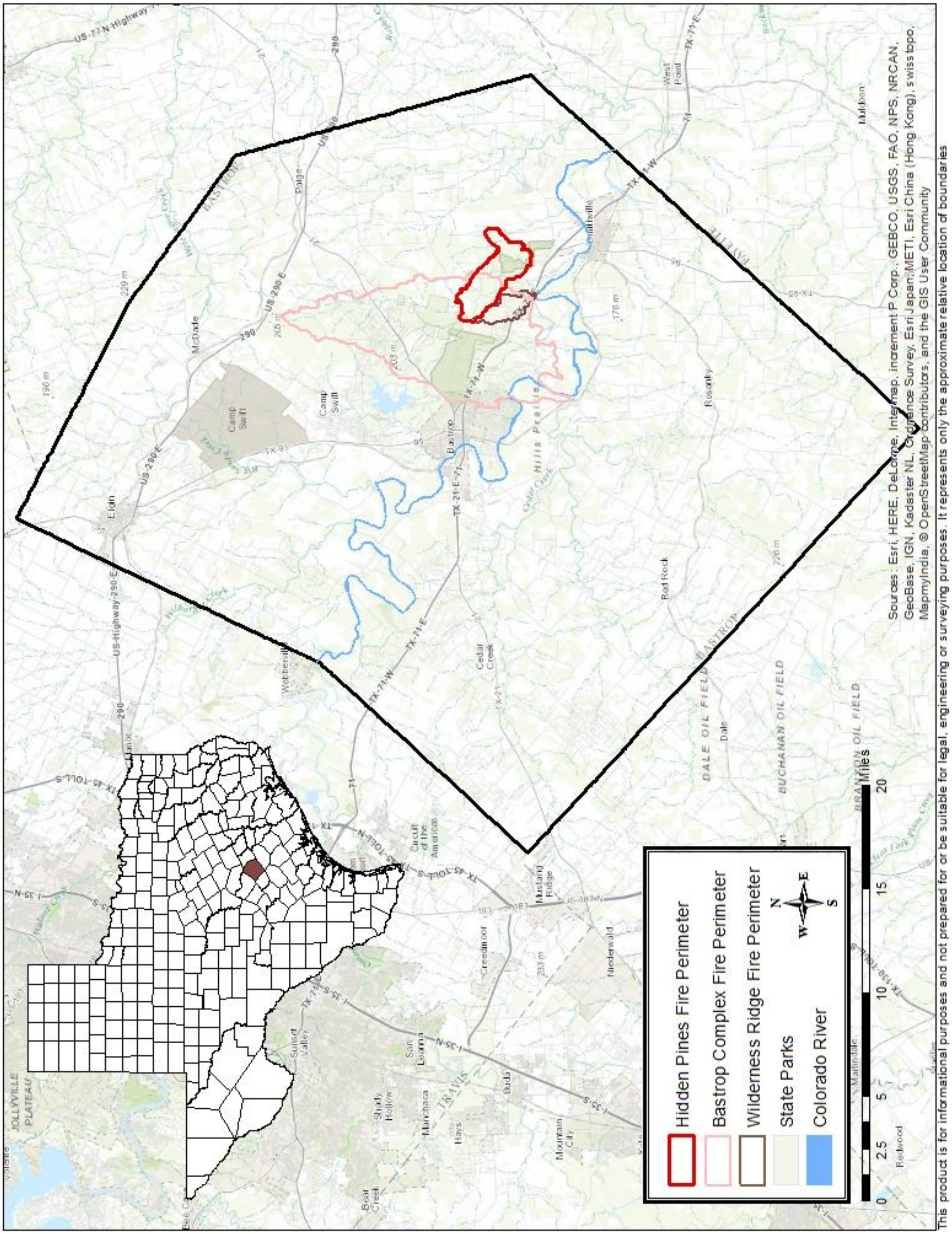
It needs to be made clear, due to misunderstanding by the public, that all emergency management entities within the county were prepared; resources were available and on standby, with constant communication among local and state emergency management agencies due to the forecasted fire weather conditions on October 13, 2015. Prior to the tone at 12:37 for the Hidden Pines Fire, resources would already be engaged in two active fires, one in Paige and the other in Cedar Creek, making these fire department resources unavailable. Bastrop County Sheriff's Office 911 operators would answer 560 calls during the first 24 hours of the fire with 100% of the calls answered within 20 seconds. The location of the fire and the visible column initiated an immediate response by the Bastrop County Office of Emergency Management (BCOEM) and Texas A&M Forest Service (TAMFS). On arrival, and based on initial potential of the fire, a unified command was established between Smithville Volunteer Fire Department, BCOEM and TAMFS. As the fire evolved, a Delegation of Authority to manage the fire was signed between Smithville Volunteer Fire Department and BCOEM. Unified command was maintained throughout the incident with representation from BCOEM – Mike Fisher, Disaster District Chairman – Captain Paul Schultze and the National Southern Area Type 1 Incident Management Blue Team under commander Mark Morales.

An alert was issued on Tuesday, October 13, 2015, at 12:37 for Smithville Fire Department to respond to a fire reported 1 mile past Buescher State Park off FM 153. Additional alerts would go out for mutual aid from Bastrop Fire Department, Heart of the Pines Volunteer Fire Department, and Texas Forest Service and Winchester Volunteer Fire Department within the first 15 minutes of the initial 911 call. The fire would progress southwest impacting M.D. Anderson Cancer Center Science Park at approximately 4:00 pm and would be held along Park Road 1C and Old Antioch Road throughout the night. Sometime around 10:00 am on Wednesday, October 14, due to a wind shift, the fire would begin producing heavy ember showers, (dangerous fuel elements of burning firebrands that fall like snow and can be carried by the wind for great distances downwind) over the containment lines. The fire

progression would switch to a northwest movement throughout the remainder of the afternoon, resulting in the loss of homes in the IASHTR area. The Origin and Cause Investigation report prepared by the Texas Forest Service would state the fire was accidental caused by equipment use.

This report on the Hidden Pines Fire addresses the event timeline reconstruction methods and defensive actions taken by local volunteer fire departments, state, and national resources during the first 48 hours of the event, during which time homes were impacted by the fire. Development of the fire timeline required the use of images, videos taken during the fire by witnesses, and technical discussions with first responders. This report focuses on the ignition timeline for primary structures and the associated defensive actions.

Since the Bastrop Complex Fire, the county has been working on a project to support the counties wildfire planning and mitigation programs. The information generated from this case study can provide input to best practices for fuel reduction programs and research for a new concept coined a “fire plain”. A “fire plain” is an area of land defined by specific topographical and vegetation categories that may experience significant fire behavior during periods of high fire danger if an ignition occurs.



Map Figure 1 Shows relationship of other fire in the county to Hidden Pines Fire. Map created by Karen Jackson

Section 1: Introduction

Destruction of homes and businesses from Wildland Urban Interface (WUI) fires have been steadily escalating, as have the fire suppression costs associated with them. Since 2000, in the U.S., over 3000 homes on average per year are lost to WUI fire. This was compared to about 900 homes per year in the 1990's and 400 homes per year in the 1970's. In 2011, in Texas alone, over 2000 homes were destroyed from WUI fires. The WUI fire problem affects both existing and new communities. In Colorado, from June 2012 to June 2013, three fires, the Waldo Canyon, the High Park and the Black Forest destroyed 1103 homes and burned 119,811 acres. In the U.S, the problem is most acute in the western and southern states; however, WUI fires recently have destroyed homes in the Mid-Atlantic States and the Pacific Northwest. WUI community construction codes and standards, test methods and best practices are in their technical infancy. While some codes address radiant heat fluxes, the science necessary to harden structures against ember assaults is very limited in part because quantifiable ember exposure data from wildfires and WUI fires is almost non-existent. Guidance on the effective deployment of firefighting resources in the WUI, as well as the effectiveness of fuel treatments, is also limited. Additionally, there is limited information on the effectiveness of defensive actions during WUI fires. Finally, the effectiveness of WUI mitigation strategies in varying exposure conditions is not well understood.[1]

The Hidden Pines Fire posed a significant challenge to first responders on October 13 in order the protect MD Anderson Cancer Research Center. The task of controlling the fire on October 14 would continue with wind shift earlier in the day changing the direction and fire behavior and producing heavy spotting. The fire would move rapidly through the community from 1:00 - 5:00 pm impacting an estimated 125 structures during this four hour time period, this was approximately one home every two minutes. The effectiveness of wildland firefighting has significant limitations when structures are located in heavily fueled areas within close proximity, where very rapid deployment of resources might be necessary to limit fire spread and structural losses.[1]

Case studies of this nature are intended to provide researchers with data that will allow for improved modeling and understanding of various fire exposures, fuels and home construction types across the country and combined impacts leading to home loss.

Initiated for the first time in a wildfire event within the county at the request of the Incident Commander of the Hidden Pines Fire, on October 15 a Citizens Services Branch was organized under the Operations Section. By initiating these activities in the Response phase prevented any lag time during the Recovery to get these functions up and running. This Branch was responsible for overseeing four distinct activities: Displaced Family Services, Registration/Needs/Donations, Sheltering, and Volunteer Coordination. The request for this Branch to stand up early in the Response phase of the incident was unusual, but very significant as the incident progressed into Recovery. Normally, these citizen activities are mobilized during the Recovery phase of an incident. However, getting this Branch active in the Response phase allowed for a much smoother transition into recovery for the individuals impacted by the fires. The Displaced Family Services function was to address immediate needs of those impacted; food, clothing, short-term housing, transportation, emotional and spiritual assistance, etc. The Registration/Needs/Donations division registered individuals and families right away; not knowing what their future needs might be, as the fire was still quite active, but at the start of Response it allowed us to seamlessly get to these individuals with prior knowledge of their pertinent information. Sheltering was immediately available for those needing a place to stay as areas were evacuated. Additionally, the shelter allowed staged re-entry and was a dynamic daily resource. The Volunteer Coordination division started coordinating state and local volunteer efforts to be immediately available at the first notice of complete re-entry. These four divisions under Citizens Services Branch worked together closely to close any gaps in addressing the needs of impacted individuals.

The Hidden Pines Fire affected the homes shown in Map Figure 2. The focus of the report will be on the impact of the fire to these homes.

Section 1 introduces background surrounding the events of October 13, 2015 and the initiation of the Citizens Services Branch operating to assist individuals within the county impacted by the Hidden Pines Fire.

Section 2 presents the weather overview leading up to and the day of the fire. While issuances of Red Flag Warnings are helpful to fire mitigation planners in the re-allocation of resources, sometimes-extreme fire conditions and events occur without a Red Flag Warning. The Hidden Pines fire would occur below defined Red Flag criteria for central Texas. Conversely, local weather conditions can behave much differently than landscape-scale predictions.

Section 3 describes the fuels and fire behavior indices associated with problematic fire behavior associated with the vegetation located within the fire area.

Section 4 will address defensive actions taken by first responders. A fire progression timeline was created and mapped to show movement of the fire through the impacted communities based on post-fire events.

Section 5 provides the timeline of command and control operations in regards to acquiring resources and incorporating them into the incident. The need to follow the incident command system (ICS) by all resources on the fire ground will be addressed.

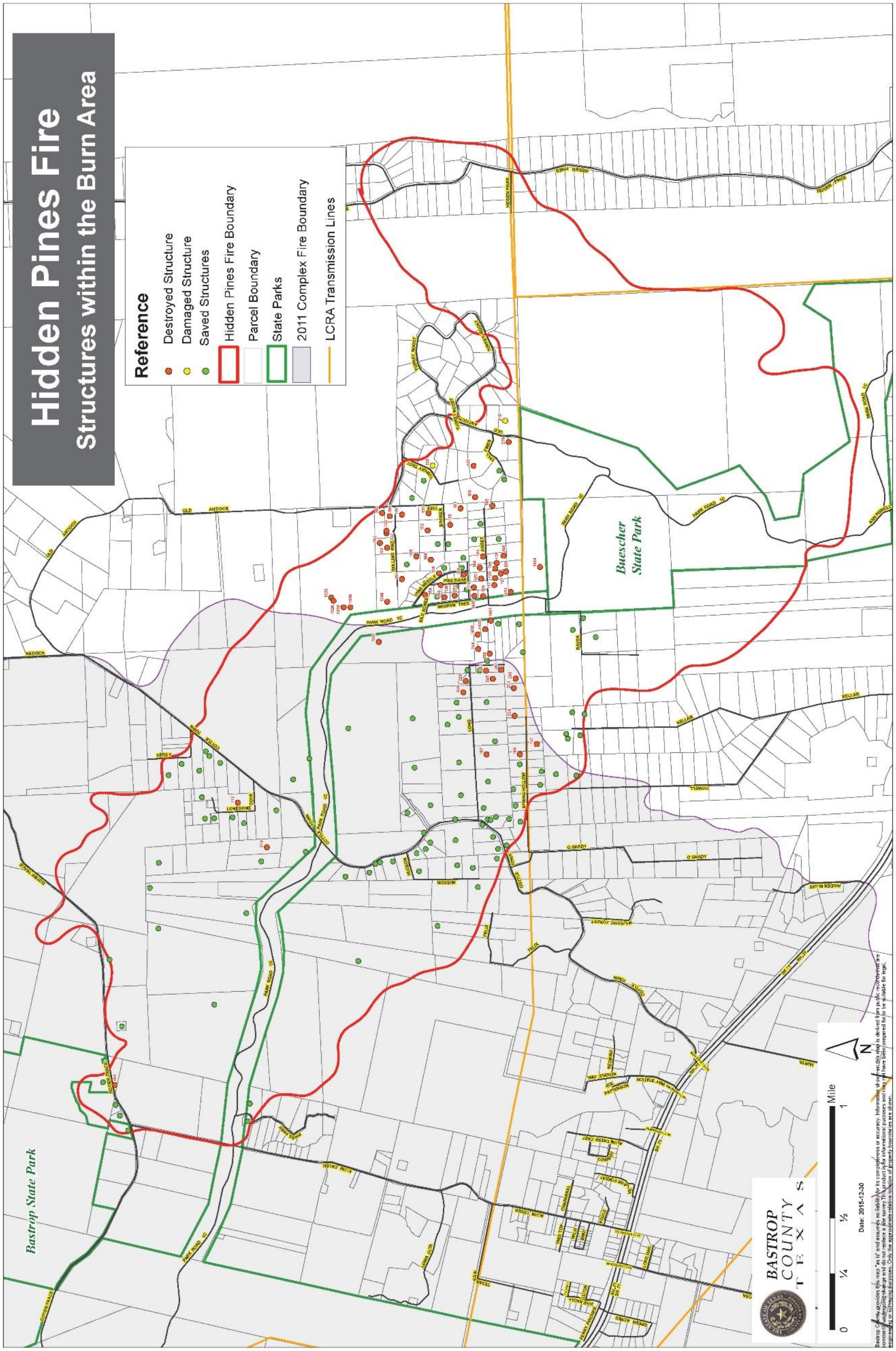
Section 6 will provide an analysis of homes lost based on available tax data and on site evaluations, along with recommendations for homes in WUI areas. This study focused on destroyed homes; statistical inferences regarding defended structures was not possible due to limited data. The creation of defensible space around structures has been discussed in the literature for over 35 years. Homeowners are given specific guidelines and requirements, but there is little realistic evidence to suggest how much vegetation modification is actually needed.

Section 7 will examine the current thoughts and misconceptions regarding the term Defensible Space.

Impacts to the State Park's work, both current and previous restoration following the Bastrop Complex Fire in 2011, are discussed in Section 8. Both the 2011 and 2015 fires impacted most of the Park Road 1C corridor. These areas are once again vulnerable and prone to erosion. Signs of erosion are already being recorded with the 2015 heavy rain events.

Section 9 will introduce the "Fire Plain" concept and its influence on possible future development within the county. The model presented in this section is a non-tactical model.

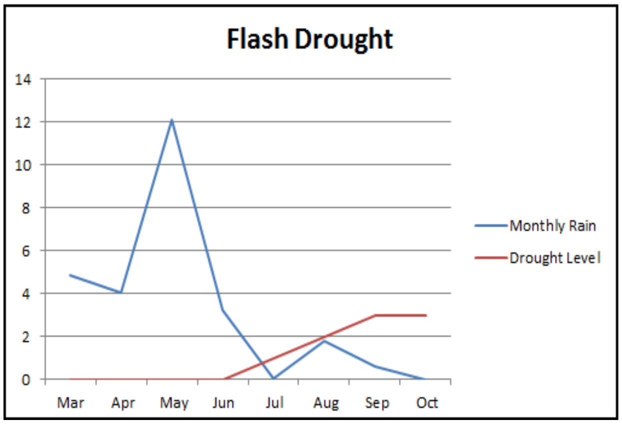
Finally, in Section 10 the report concludes and findings are summarized.



Map Figure 2 Homes impacted by Hidden Pines Fire. Map created by Sean Greszler with Bastrop County GIS and Addressing

Section 2: Weather Summary

The 2015 Texas summer fire season was unusually active and an analog to the summer fire season of 1998, a common backdrop; El Nino. Texas typically experiences some of the most active fire seasons within a La Nina backdrop, but that is for winter seasons. However, the conditions leading up to the possibility of active summer or winter fire seasons are similar; a pattern favorable for rain prior to the upcoming season resulting in the build-up of fuels, followed by abrupt drying. During the months of Apr-Jun in 2015 Texas was soaked with frequent periods of widespread heavy rain, followed by abrupt drying, and characterized as a “flash drought[i]”. The summer heat in Texas lingered into early fall and post fall equinox record high temperatures were broken in south central Texas. On October 12, the high temperature climbed to 99° in the Austin area, the highest recorded temperature that late in the season. The “flash drought” intensified too, the Bastrop RAWS station reported .25”of rain from September 12 - October 12.



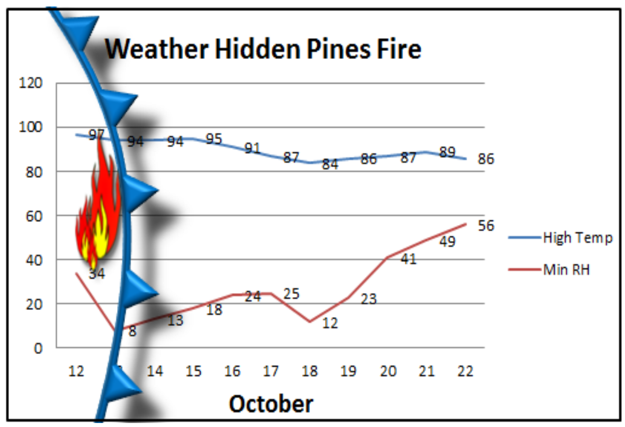


Diagram represents arriving front

One of the last large summer fires started on October 13 northwest of Smithville, Texas. The fire started within a post-frontal air-mass, a noted critical weather pattern for south central Texas. The day prior to the fire was an unseasonably hot 97°, but was accompanied with a relatively high minimum relative humidity of 34%. As the cold front passed Tuesday morning, the winds increased to 8 mph gusting to 16 mph and with the wind shift to the northeast a much drier air-mass overspread the area, the minimum relative humidity fell to 8%. Over the night, the relative humidity would have a low recovery, keeping live fuel moistures low and receptive to burning. On the 14. the wind shifted back to the southeast with gusts as high as 17 mph, however, moisture was limited and the relative humidity fell to 13% and the high temperature was an unseasonably hot 94°. Relative humidity that low was thought to be in the lowest 1% of all observed values for the month of October 2015. The following few days the relative humidity moderated between 18-25% and temperatures remained unseasonably hot ranging between 87°-95°.

[i] Massive heat waves bring about extreme heat during spring and early summer, turbocharging the process of evaporating water out of soils and plants, and leading to what meteorologists call a "flash drought." There is currently no recognized definition of “flash drought.”

Recorded weather data from the Bastrop Remote Automatic Weather Stations (RAWS) located approximately 12 miles northwest of the fire event are listed in Table 1. While onsite weather conditions can significantly affect the local fire behavior, the RAWS data was provided as a common weather source for general comparison with the events of the day. The winds were predominately from the north until 10:08 on October 14th then shifted to a southerly direction, this wind shift would be also be reported in technical discussion with fire responders. This shift in wind direction would influence the movement of the fire into an area west of Buescher state park populated with multiple subdivisions.

Table 1 Highlights in yellow the time period at 10:08 when wind shift occurred from northerly direction to more southerly direction

Date	Temperature ° F	Relative Humidty %	Winds mph	Wind Gust mph	Wind Direction °	Fuel Temperature ° F	Fuel Moisture gm
10/14/2015 0:08	59	57	0	1	35	53	10
10/14/2015 1:08	58	60	0	3	350	52	11
10/14/2015 2:08	56	68	0	2	350	50	12
10/14/2015 3:08	55	64	0	1	325	49	13
10/14/2015 4:08	54	74	0	2	325	48	14
10/14/2015 5:08	54	70	0	2	28	48	15
10/14/2015 6:08	52	77	0	2	353	48	17
10/14/2015 7:08	53	71	0	1	353	47	17
10/14/2015 8:08	56	70	0	0	353	54	20
10/14/2015 9:08	69	41	0	2	304	78	10
10/14/2015 10:08	82	26	2	5	134	95	6
10/14/2015 11:08	87	19	6	10	183	109	3
10/14/2015 12:08	90	16	5	12	178	109	3
10/14/2015 13:08	91	14	7	11	105	115	2
10/14/2015 14:08	94	13	7	14	162	116	2
10/14/2015 15:08	93	13	7	17	180	113	2
10/14/2015 16:08	93	13	7	11	164	104	2
10/14/2015 17:08	87	18	3	12	161	84	3
10/14/2015 18:08	83	24	0	4	148	78	4
10/14/2015 19:08	82	24	3	4	113	73	5
10/14/2015 20:08	78	25	3	6	102	68	6
10/14/2015 21:08	76	28	3	5	111	66	7
10/14/2015 22:08	78	25	5	9	128	69	7
10/14/2015 23:08	77	35	7	12	163	70	7

Since 2009 the Hidden Pines region has been plagued with three devastating fires; the 2009 Wilderness Ridge Fire (WRF), 2011 Bastrop Complex Fire (BCF), and 2015 Hidden Pines Fire (HPF). All three fires where anthropogenic and occurred within known critical fire weather patterns; post-frontal (WRF/HPF) and periphery of an inland falling tropical cyclone (BCF). Although the Hidden Pines fire occurred in a known critical fire pattern (post-frontal) the magnitude of the sustained wind speed was below defined Red Flag criteria[ii] (15 mph). This suggests the degree of fuel dryness was such that stronger winds were not needed to hamper control efforts.

[ii] The National Weather Service (NWS) issues Red Flag Warnings & Fire Weather Watches to alert land management agencies about the onset, or possible onset, of critical weather and fuel moisture conditions that could lead to rapid or dramatic increases in wildfire activity. This could be due to low relative humidity, strong winds, dry fuels, or any combination thereof.

The largest fires (BCF/HP) not only occurred during the summer fire season, but near the end or at the end of the season. The cool season WRF was the smallest fire and occurred on a much cooler day, but also near the end of the cool fire season. Inference could be made that the larger/destructive fires are favored toward the end of the season when the fuels may be driest.

All three fires occurred within a drought designation of at least "extreme", were preceded by wet periods, and associated build-up of fuels. El Niño in the summer does not necessarily imply rain as the development of the subtropical ridge (high pressure aloft) can still dominate. Furthermore, during El Niño summers tropical activity is less likely. As in the case of 2011 BCF, which was a La Niña summer, location with respect to the land-falling tropical cyclone is very important. It was noted that even though the post-frontal and tropical cyclone patterns differ they both serve to bring much drier continental air south. Figure 1 compares all three fires regarding the drought status for the state and Bastrop County.

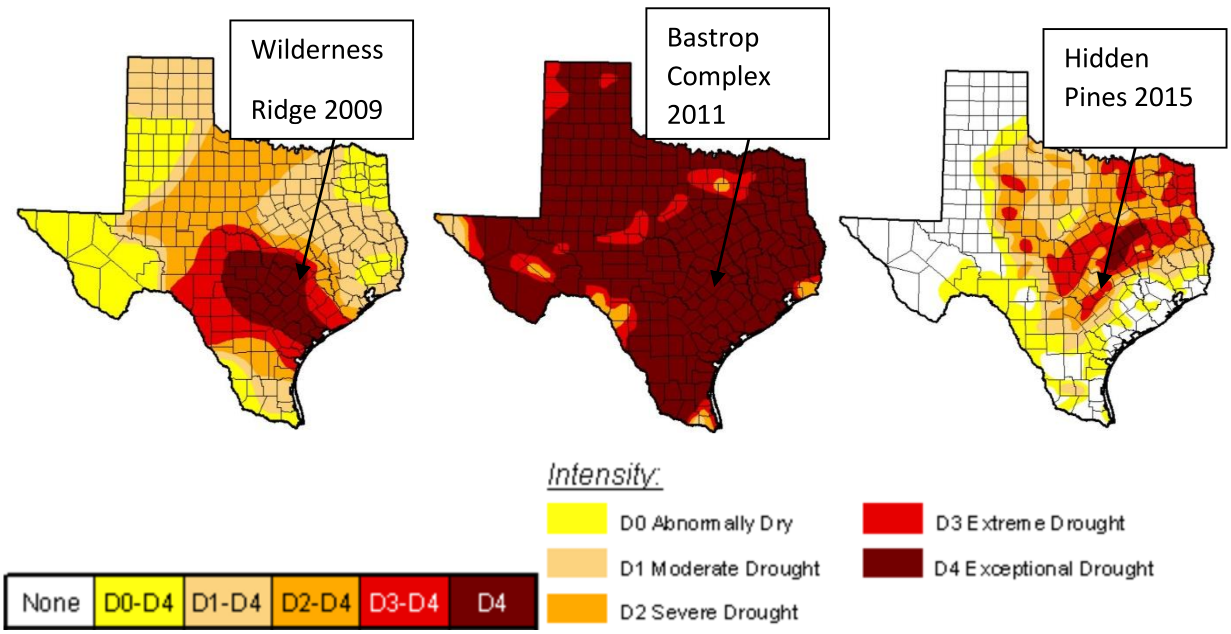


Figure 1 Comparision of drought conditions for three largest fires in Bastrop County

Section 3: Fuels and Fire Behavior Indices

Live Fuel Moistures

Live fuel moistures are typically lowest in September through November due to seasonal patterns of becoming dormant. For the Hidden Pines fire, the live fuel moistures were points lower than average lows due to lack of rainfall and growing season. This augmented by the “flash” drought conditions within the Bastrop area mimicked a long-term drought for live fuels. There was a time lag rate for fuels to gain or lose moisture due to changes in the environment. This gain or loss does not occur at a constant rate and fuels are classified according to their time lag.

Fine “flashy” fuels, which consists of vegetation less than a quarter inch in diameter generally have a time lag of 1 hour to change based on factors such as temperature, rain, and humidity. Fine 1-hour fuels includes vegetation types such as grass and pine needles. Fine 1-hour fuels are key to fire spread.

Larger fuels, which comprise vegetation three to eight inches in diameter generally, have a time lag of 1000 hours to respond to changes in environmental factors. Large 1000-hour fuels include vegetation types such as brush piles and deadfalls. Larger 1000-hour fuels contribute to fire intensity and prolonged residual burning.

The National Fuel Moisture Database - NFMD is a web-based query system that enables users to view sampled and measured live- and dead-fuel moisture information. The system utilizes a database that is routinely updated by fuels specialists who monitor, sample and calculate fuel moisture data. The understanding of the percentiles and thresholds associated with live and dead vegetation fuels are key to educating homeowners, and first responders about the changing local enviromental factors that can impact fire behavior. Percentiles are based on a scale of 0 – 100. Thresholds are the actual values of an indice that mark changes from one category to another. At the low end of the scale in the green and blues we see normal to below normal conditions. Initial attack on fires with fuels having these indices should be successful with few complexities. At the upper end of the scale in the orange and reds we see unusual or rare conditions and we would expect to see complex fires where initial attack may often fail. Table 2 shows comparision of critical threshold values for live fuel moistures for Central Texas.

Table 2 Central Texas Critical Thresholds for Live Fuel Moisture

	Percentiles				
	97+	90-96	75-89	50-74	0-49
Pine	105	106-120	121-130	131-150	151-300
Oak	75	76-90	89-100	101-125	126-300
Juniper	70	71-80	81-90	91-110	111-300

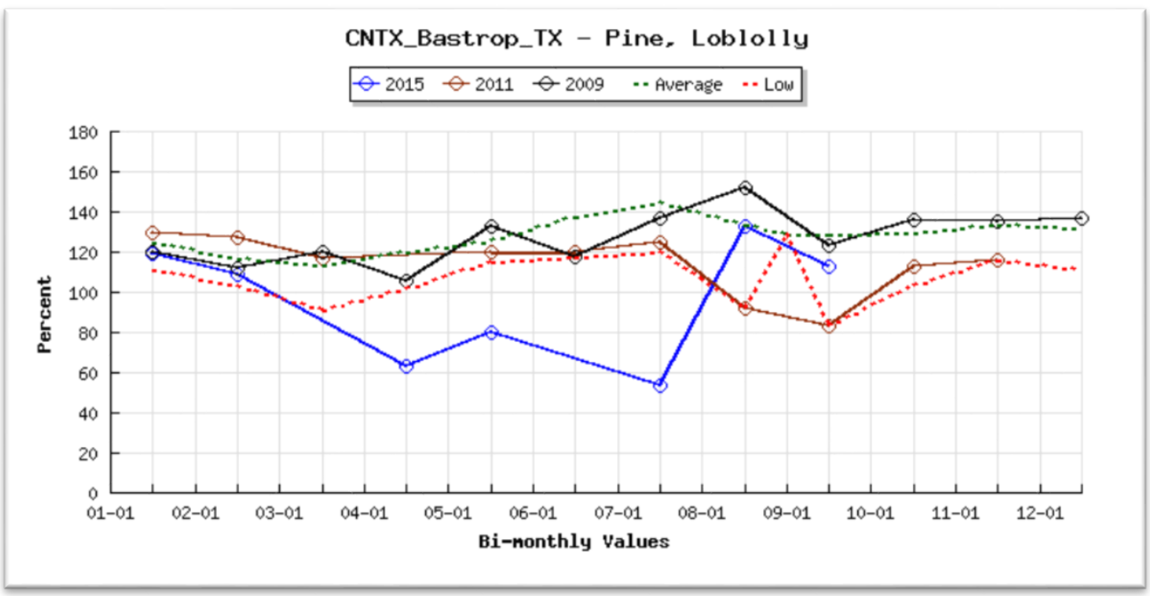
Critical live fuel moistures are key to understanding when fire behavior will increase and make control more difficult in large fire events. Graphs 1-3 below are a comparision of Loblolly Pine (*Pinus taeda*), Eastern redcedar (*Juniperus virginiana*) and yaupon (*Ilex vomitoria*) for the three major fires within the county: Wilderness Ridge Fire February 28, 2009; Bastrop Complex Fire September 4 2011; and Hidden Pines Fire October 13 2015. In 2011 cedar, pine, and yaupon were tracking low due to an all-time historic low in both live and dead fuel moisutres due to exceptional drought conditions across the state. While in February 2009, a continuation of the rainfall deficits that began in September 2007 were measured in similiar fuels. The live fuel moistures were trending down due to lack of rainfall and vegetation entering or already in dormacy growth state.

Under high moisture regimes, the pines will respond slower due to deep root systems and begin to hit critical live fuel mositure thresholds after short rooted and finer vegetation; while midstory vegetaion will respond quicker as moisture events reduce. In pine dominated ecosystems seeing critical thresholds in the 90 percentiles for live fuel moistures in understory species such as cedar and yaupon, allows for fire to be driven into the canopy due to drape needles from the pines. Live fuel moisture content is measured in percantages based on stages of vegetative development related to moisture content percentiles ranging from 30-300%.

- 300% - Fresh foilage, annuals developing early in the growing cycle
- 200% - Maturing foliage, still developing, with full turgor
- 100% - Mature foilage, new growth complete and comparable to older perennial foliage
- 50% - Entering dormacy, coloration starting, some leaves may have dropped from stem
- 30% - Completely cured, treat as dead fuel

Critical thresolds in central Texas, for active burning, are typically reached when Eastern red cedar achieves values below 80% and yaupon below 100%.

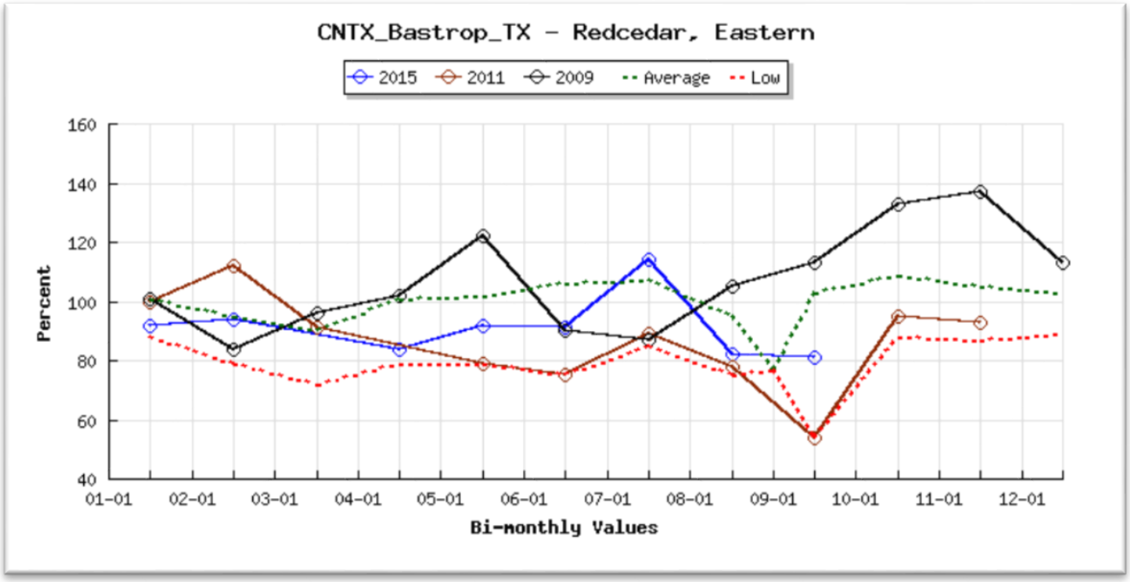
Graph 1 and Table 3 Bi-monthly live fuel moistures for Loblolly pine for Bastrop 2015 compared to 2009 and 2011 fires.



Pine, Loblolly

	01-15	02-15	03-15	04-15	05-15	06-15	07-15	08-15	09-15	10-15	11-15	12-15
2015	119	109		63	80		54	133	113			
2011	130	127	117		120	120	125	92	83	113	116	
2009	120	112	120	106	133	118	137	152	123	136	135	137

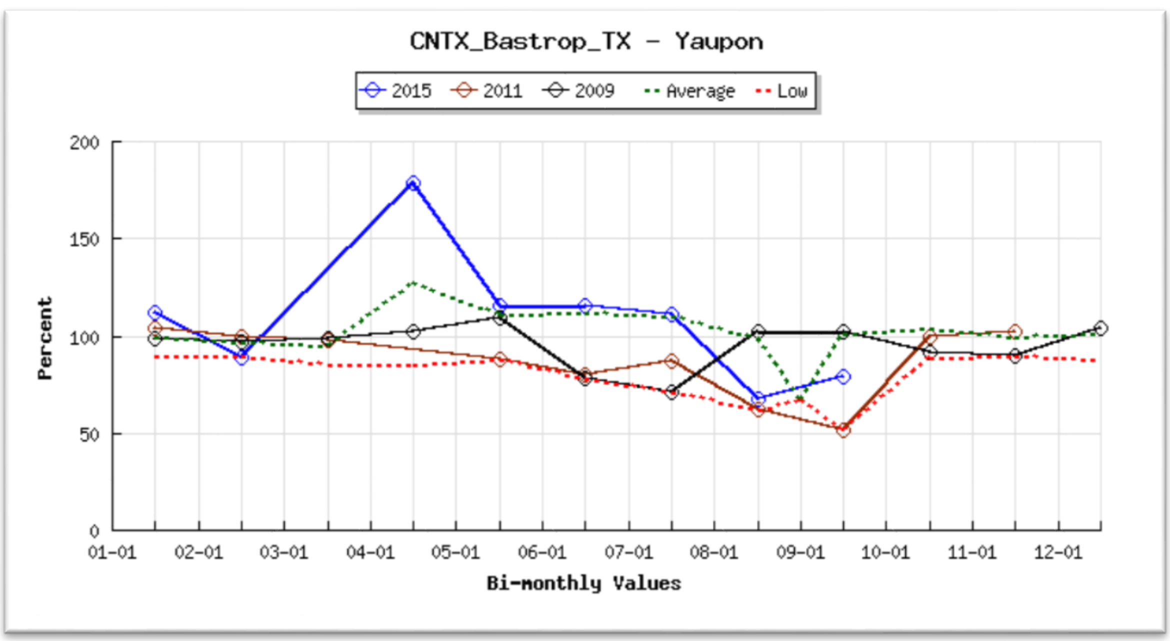
Graph 2 and Table 4 Bi-monthly live fuel moistures for Eastern Redcedar for Bastrop 2015 compared to 2009 and 2011 fires.



Red Cedar, Eastern

	01-15	02-15	03-15	04-15	05-15	06-15	07-15	08-15	08-29	09-15	10-15	11-15	12-15
2015	92	94		84	92	91	114	82		81			
2011	100	112	91		79	75	89	78		54	95	93	
2009	101	84	96	102	122	90	87	105		113	133	137	113

Graph 3 and Table 5 Bi-monthly live fuel moistures for Texas Yaupon for Bastrop 2015 compared to 2009 and 2011 fires.



Texas, Yaupon

	01-15	02-15	03-15	04-15	05-15	06-15	07-15	08-15	08-29	09-15	10-15	11-15	12-15
2015	112	89		179	116	116	111	68		79			
2011	104	100	98		88	80	87	62		52	100	102	
2009	99	97	99	102	109	78	71	102		102	92	90	104

Examination of the large fires within the county, over the last 6 years, has shown the fires to be fuel driven; two of which had a start date that occurred only a month apart , based on a calendar year. These fires were associated with either long-term drought or problematic drought conditions. This allowed the correlate of problematic fire years with some ***parameters to monitor*** involving fuels and weather moving mid-August to October through the winter season:

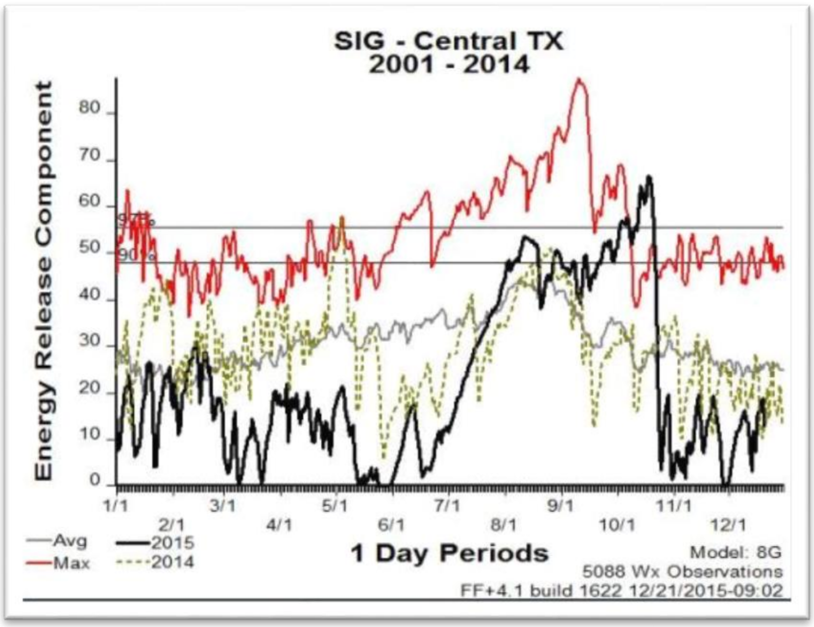
- Live fuel moistures based on seasonal drying as they line up with flash droughts or long-term drought conditions across the county
- The number of days since last rain during dormant vegetation seasons as it effects pine, yaupon and cedar
- The presence of dead brush and trees left over from the severe drought and the 2011wildfire; fine fuels can carry fire into areas where dead trees are still present, allowing them to ignite and burn
- The instability in the atmosphere leading tospotting, of receptive fuels with heavy needle drape

ERC and KBDI - Indicators of Problematic Fire Behavior

The Energy Release Component (ERC) is a National Fire Danger Rating System (NFDRS) index related to how hot a fire could burn. ERC are specific to Predictive Service Areas (PSA) that represent areas of the state where the weather reporting stations (RAW) tend to react similarly to daily weather regimes and exhibit similar fluctuations in fire danger and climate. The state of Texas is divided into seven PSA areas. Central Texas PSA will be the focus of this report. ERC is directly related to the 24-hour, potential worst case, total available energy (BTUs) per unit area (in square feet) within the flaming front at the head of a fire. Tracking the ERC and other NFDRS components through the season and on a daily basis will increase the situational awareness of wildland firefighters. Daily variations in ERC are due to changes in moisture content of the various fuels present, both live and dead. Since this number represents the potential “heat release” per unit area in the flaming zone, it can provide guidance to several important fire activities. The ERC is a cumulative or “buildup” type of index. As live fuels cure and dead fuels dry, the ERC values get higher thus, providing a good reflection of drought conditions. The scale is open-ended or unlimited and, as with other NFDRS components, is relative. Conditions producing an ERC value of 24 represent a potential heat release twice that of conditions resulting in an ERC value of 12.

Graph 4 is the seasonal graph for Central Texas; it provides a good view of the current ERC trends and allows for comparisons of recent years or significant fire years to the current year. In this graph, the plot starts on January 1 and ends on December 30. Each tic mark represents 3 days. In this example, years 2015 (solid black) and 2014 (dashed green) are displayed. The average is displayed in gray and is based on all ERC collected from years of data collection. The red line represents the maximum value recorded on each date over the data record. For this example, on September 1, the highest ERC value from 2001 to present was recorded. On October 13, the ERC would exceed the 97% percentiles at a value of 58. ERC in 90th percentile or above is an indicator of very dry environments making management of all fuels difficult and accounting for problematic fire behavior. Figure Map 3 shows ERC percentiles recorded for central Texas.

- Maximum (Max) - highest energy release component by day from 2004 - 2013
- Average (Avg) - shows peak fire season over 10 years (1839 observations)
- 90th Percentile - only 10% of the 1839 days from 2004 - 2013 had an Energy Release Component (ERC) above 47
- 97th Percentile – only 3% of the ERC recorded reached this level
- ERC gives seasonal trends calculated from 2 pm temperature, humidity, daily temperature and relative humidity ranges, and precipitation durations.



Graph 4 shows seasonal trends for ERC in Central Texas from 2001-2014

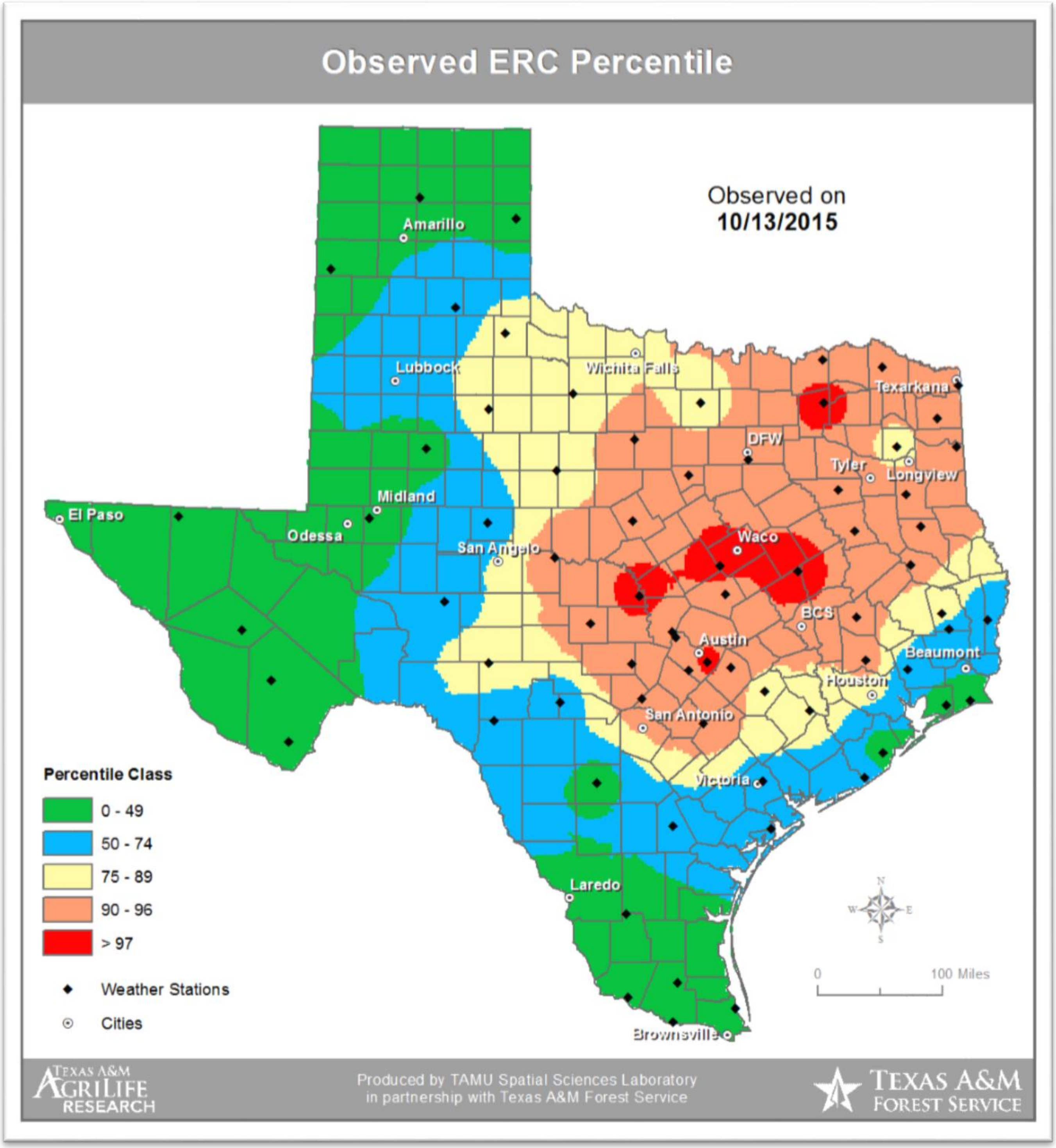


Figure Map 3 Shows statewide observed ERC values for October 13 2015. The actual recorded value for Bastrop on this day would be 58 ERC. Map prepared by TAMU Spatial Sciences Laboratory

John L. Keetch and George Byram designed a drought index specifically for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground. The Keetch-Byram Drought Index (KBDI) attempts to measure the amount of precipitation necessary to return the soil to full field capacity. It is a closed system ranging from 0 to 800 units and represents a moisture regime from 0 to 8 inches of water through the soil layer. At 8 inches of water, the KBDI assumes saturation. Zero is the point of no moisture deficiency and 800 is the maximum drought that is possible. KBDI is a good indicator of problematic fire during growing season fires. Values ranging from 600 – 800 are often associated with more severe drought with increased wildfire occurrence. Intense, deep-burning fires with extreme intensities can be expected. Live fuels can also be expected to burn actively at these levels

Table 6 Compares the KBDI values between the three large Bastrop Fires showing averages, maximums and minimums. Flash drought conditions would proceed the Hidden Pines fire with record rainfall on Memorial Day throughout Central Texas. While in 2011 historical long-term drought, conditions would be recorded with intermittent rain events leading up to the Bastrop Complex Fire. Despite hurricanes in late 2008 the area would experience drought conditions by February prior to the Wilderness Ridge Fire. The actual recorded KBDI for October 13, the start day of the fire, would be 748.

Table 6 compares KBDI for large fires in Bastrop County

Year	KBDI Average	KBDI Maximum	KBDI Minimum
2015	**740**	**767**	**684**
2011	**789**	**792**	**779**
2009	**693**	**745**	**587**

The Texas Weather Connection http://twc.tamu.edu/ is a site available to the public that is a collection of weather products derived from real-time weather data, which are generated through the use of remote sensing, geographic information systems (GIS), global positioning systems (GPS), and internet mapping server (IMS) technologies. The site provides daily and archived fuel dryness, ERC, Forecasted Fire Danger, KBDI and numerous other indices to keep both first responders and the public informed about current conditions. Knowledge and understanding of these indices by homeowners can aid in preparing property and homes during high fire danger periods throughout the year.

Section 4: Timeline of Fire Progression

The following fire progression time line and map are not a prediction fire progression map, but based only on post-fire events. Exact boundaries and time stamps are approximations using best-verified data possible.

There is a critical and necessary synergy among technical discussions, radio logs, during-fire images; GPS track logs, pre-fire and post-fire aerial imagery, and other pertinent data sets. It is only by integrating the different data sets that a precise and accurate reconstruction of the event may be developed. The integration of data also allows for assessment of the data quality as well. Each data set on its own can provide limited and potentially very misleading information.

This report focuses on the fire progression timeline based on post-fire events as it moved through the neighborhoods. The technical discussions did not result in precise time estimates of burning features to allow adequate reconstruction of the fire's timeline as it impacted specific structures. Defensive actions did help in many cases to prevent ignition of homes and the technical discussions were the only way to associate defensive actions with specific properties or primary structures. No images were available to portray the full extent of defensive actions taken. The data gathered for assessment of the Hidden Pines Fire and used in this report can be classified into the following categories:

- **Field Data**: data gathered in the field during and after the Hidden Pines Fire. The data gathered for the igntion timeline progression were assimilated in an Enviromental Systems Research Institue (ESRI) File Geodatabase. Field data used in this report are shown in Table 7.

- **Other Spatial Data**: data stored in GIS datasets used in this report are shown in Table 8.

Table 7 Field Data used for Hidden Pines Fire report

Data Type	Source
Technical Discussions	First Responders
Call Sheet Report	Bastrop County Sheriff's Office
911 Calls	Bastrop County Sheriff's Office
Radio Calls	Bastrop County Sheriff's Office
Radio Calls	Smithville County Sheriff's Office
Videos	Bastrop County Sheriff's Office

Table 8 Other Spatial data used for Hidden Pines Fire report

Data Type	Source
Address Points	Bastrop County 911/Addressing
Destroyed Structures	Bastrop County 911/Addressing
Hidden Pines Fire Boundary	Texas Forest Service
Parcels	Bastrop County 911/Addressing
Roads	Bastrop County 911/Addressing

Technical discussions with first responders provided onsite observation and time stamps necessary to create the fire progression maps and provide an understanding of fire behavior and defensive actions taken by fire departments and state resources to prepare, protect and save homes impacted by the fire.

Seven local and state agencies were involved in the technical discussions. Events as related to the first 48 hours of the fire were manually recorded. Images and videos taken by first responders were sent via email for archiving and validation of location along with time stamps.
Defensive actions included pre-fire mitigation and post-ignition activities to save structures. Pre-fire actions included pre-wetting or vegetation removal. When fire was present, defensive actions included fire extinguishment and follow-up for re-ignitions around structures. Individual properties might have seen multiple actions repeated throughout the fire event; while other structures would receive no defensive actions due to involvement of structure beyond saving or safety of first responders. Actions were immediately aimed at containing the fire. Re-ignition scenarios where extinguishment was originally thought to be effective by first responders, but ultimately required additional actions to extinguish or contain, were reviewed during technical discussions. Only partial information is known about the homes defended. Technical discussions only identified 89 of the total structures within the fire perimeter, received some sort of defensive actions at some point during the fire. It should be noted, not all types of defensive actions were taken on every structure.

Pre-fire mitigation actions taken by first responders included:

- Raking pine needles off structure
- Pull flammable materials away from structure
- Pre-wet structure and area
- Hand-lines constructed to contain or redirect fire spread
- Dozer lines constructed
- Air drops
- Noted by first responders numerous homeowners left sprinklers running in yards and on structures

Post-ignition actions taken by first responders included:

- Re-establishment or direction of existing dozer and hand lines
- Fire extinguishment on or around structures
- Remove decks and/or fences on fire
- Re-engagement of fire on structures once initial fire front passed
- Vegetation removal and extinguished
- Prevention of structure-to-structure ignitions
- Re-ignitions, suppression, and mop-up around structures

Fire Progression Timeline and Map

The fire progression map shown in Map Figure 4 presents the movement of the fire from the general point of ignition on October 13 through the evening of October 14 based on post-fire events. The focus of the Hidden Pines Fire progression data collection included technical discussions with first responders, photos/videos, 911 calls, and radio logs. The time accuracies are relative based on operational events. The development of the fire progression map involved the placement of the observed fire location data points by integrating all data in a Geographic Information Systems (GIS) using latitude and longitude with associated timestamp value. Outliers, such as points from dash cam video that were recorded outside the final burn perimeter or pictures/video going back into areas already impacted were removed. Only points that could be tied to an absolute location within the burn area were used. For reference, the observed fire points were overlaid on three fire perimeters collected by flights on 10/13/2015, 10/14/2015 and 10/17/2015 along with aerial imagery. Referencing the time stamp values, progression polygons were created by connecting each point and interpolating general shape and area within the observed fire perimeters for time intervals between the points using the three aforementioned fire perimeters as boundaries. Resulting polygons were merged into a single layer, and then symbolized by Time/Date fields. The GIS review and integration process was believed to have corrected major errors, but it is likely errors still exist.

This was not a wind driven surface fire**.** Surface and 20-foot winds would remain light through the morning hours at 5 mph or less. By the afternoon, winds would pick up to 5 to 8 mph with maximum gusts 10 mph from the southeast. These sporadic and isolated gusts would not include fire-induced winds. Spotting, in the direction of winds, into heavy receptive fuels loads would quickly grow in size. High intensity heat pulses associated with slow rate of spread in sheltered fuels would result in much higher BTU outputs in heavy fuels correlated to areas not burned during the 2011 wildfires. As the fire reached the burn scar of the 2011 Bastrop Complex Fire, rates of spread would increase in unsheltered fuels associated with lower fire behavior due to reduced fuel loads. It would be noted by fire fighters that ember washes into combustible landscape areas around homes or (the Home Ignition Zone as defined by NFPA- Firewise) would burn together in and around structures within 15 -30 minutes. Map Figure 5 shows key road locations mentioned throughout the report and specifically the fire progression timeline.

October 13 Timeline (the following are relative times as accurately possible during an operational event of this nature)

12:27 PM - Call comes in stating fire is in progress off Hidden Pines Drive on the property just off of FM 153 (address is commonly referred to as the Leucke property).

12:33 PM -Tone goes out to Heart of Pine VFD, Smithville VFD and Winchester VFD to respond to brush fire

12:48 PM - Office of Emergency Management request Star Flight for water drops

1:03 PM - Texas Forest Service, Smithville Volunteer Fire Department and Emergency Management Coordinator all arrive on scene. Figure 2 shows smoke column upon arrival

Figure 2 1:03 p.m. Smoke column as units approach fire from south ©Steven Moore – Texas Forest Service

1:58 PM - Air assets are requested and in route to fire

2:02 PM - MD Anderson Cancer Research Center begins evacuations

2:17 PM – Air assets are on scene and making drops on fire

2:21 PM - Fire leaves the Luecke property on to MD Anderson property along the transmission line shown in Figure 3

Figure 3 2:21 p.m. Fire leaving Luecke property along transmission line ©Jayson May – Texas Parks and Wildlife

3:06 PM - Begin evacuations of State Park. Air attack did multiple retardant drops to try and stop fire front. Air attack reported spot fires 1/8 mile in front of head fire.

4:07 PM - Fire has reached MD Anderson Property close to power lines. Multiple spot fires were reported into the complex prior to the head fire reaching the southeast corner of MD Anderson Center.

5:52 PM - Start evacuations along Ann Powell Road with Reverse 911 activated

10:31PM - Texas Forest Service and Texas Parks and Wildlife conducted burn out operations along Park Road 1C by MD Anderson to control the fire. Figure 4 shows burn out operations.

Figure 4 10:30 p.m. Fire along Park Road 1C ©Steven Moore – Texas Forest Service

2:11 AM - Fire behavior north of MDA entrance on Park Road 1C would produce heavy spotting into the night as seen in Figure 5.

Figure 5 2:11 a.m. Fire spotting along Park Road 1C north of entrance to MDA ©Jayson May – Texas Parks and Wildlife

Fire Departments continue to patrol along Park Road 1C and make necessary evacuations throughout the night on Turkey Trot lane, Tall Pines, and Old Antioch Road.

October 14 Timeline

06:17 AM - Reverse 911 goes out to Agget Road, Raven Road, and Idle Acres as an alert for residents to evacuate. Unconfirmed reports indicate that the first home would be lost in this neighborhood hours later.

11:57 AM - Fire activity increases and wind shifts from north to southerly direction. Long distance spotting across Park Road 1C as seen in Figure 6.

Figure 6 11:57 a.m. Fire along Park Road 1C ©Steven Moore – Texas Forest Service

1:30 PM - Active fire behind homes on Raven Road, fire fighters were cut off due to one way egress. Figure 7 shows fire behavior on Raven Road. Due to adequate defensible space around the homes on Raven Road no first responders were injured, and were able to shelter in safety zone. At which time they re-engaged the fire and followed-up on defending homes exposed to the passing fire front.

Figure 7 1:30 p.m. Fire behind home on Raven Road ©Rich Gray – Texas Forest Service

3:15 PM - Fire is now north and south of Park Road 1C where the high lines cross.

3:22 PM - Begin structure protection on Kellar Road

3: 35 PM - Spot fires are reported all around Idle Acres, several structures are burning, no defensible space around homes for fire fighters to retreat for safety.

3:36 PM - A report from fire fighters state that no structures have been lost on Tall Pines at this time.

3:39 PM - Fire is now behind homes on Kellar Road

3:41 PM - Homes are reported on fire on both Long Trail and Spring Hollow. All homeowners have been evacuated. Heavy fire is reported east, south and north of Long Trail with fire moving in what appears to be a due north direction. Figure 8 shows home lost from fire.

4:04 PM - Fire is at Camp Wilderness Ridge

4:11 PM - Spot fires and active fire at Camp Wilderness Ridge are too big to do any structure protection at this time

4:21 PM - Heavy fire behind 180 Spring Hollow fire fighters are knocking down grass fire around home.

4:59 PM - Fire jumps Cottle Town Road at Fire Station

7:20 PM - Head fire is at Alum Creek Road and Gotier Trace Road

Figure 8 5:30 p.m. Home lost earlier in day ©Steven Moore – Texas Forest Service

Lessons learned and improvements to the data collection methodology have been identified during other cases studies by National Institute of Standards and Technology (NIST) and were utilized during technical discussions[1].

1. Images and video taken by first responders are critical in developing the event timeline and in reconstructing the defensive actions. Images and video taken by first responders should be collected before or during technical discussions.

2. First responder recollection of events in space and time is critical in developing the event timeline and in reconstructing the defensive actions.

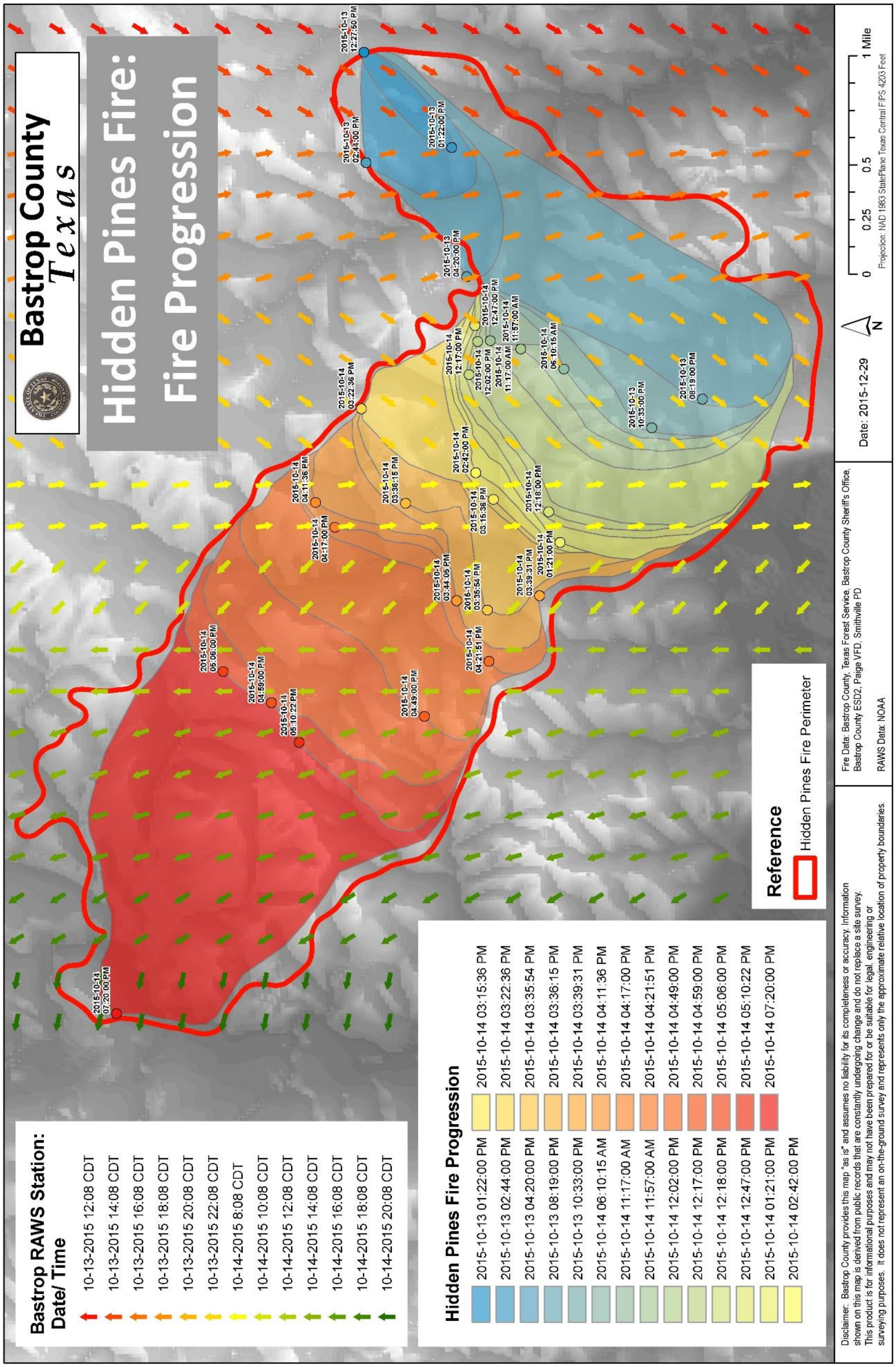
3. The focus of the technical discussion process should be on observations related to actions taken by the first responders. Anecdotal accounts and observations of burning features as first responders drive between locations produced a lot of uncertainty and should not be the focus of data recording efforts.

4. Observations must take into account the point of view of the observer. An image of no burning does not mean the feature was not ignited if only viewed from one angle.

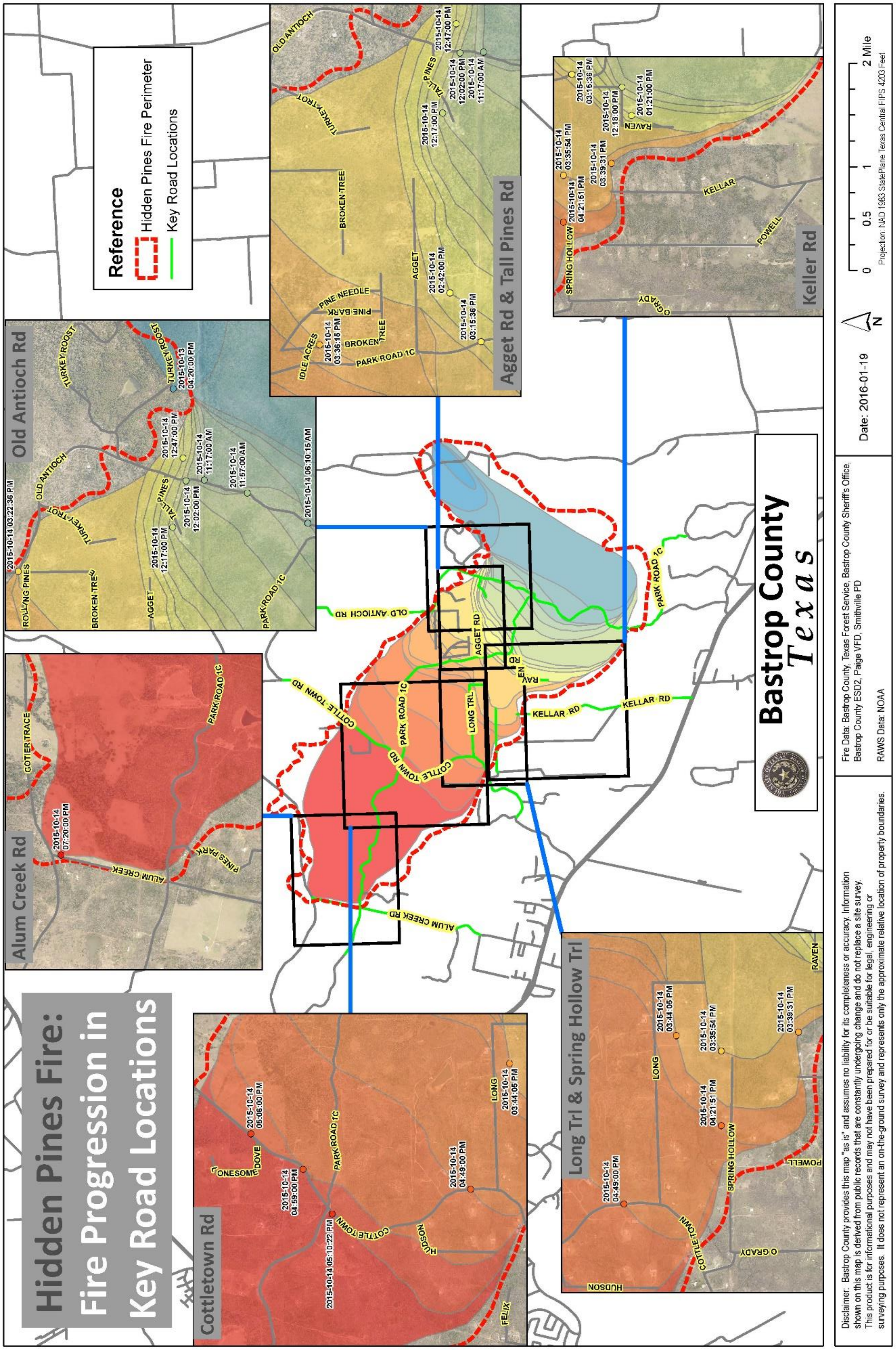
5. Technical discussions must not begin before a solid and open-minded understanding of the incident is obtained from other sources, though it is acknowledged understandings might change after the technical discussion process. This implies obtaining a majority of the pre-fire, during-fire and post-fire imagery maps for the incident, along with a complete damage assessment and weather data during the event.

6. It needs to be noted that the effectiveness of the reverse 911 calls only connected to approximately 31% of the residents in the area. Highlighting the need for citizens to register cell phones with the county.

7. Re-engaging the fire and follow-up on defending homes exposed to the passing fire front is crucial in saving homes. Emergency response personnel need to train with this methodology, rehearse and put into practice during WUI fires.



Map Figure 4 Fire progression associated with overlaying wind vectors based on Bastrop RAW data. Map created by Sean Greszler with Bastrop County GIS and Addressing



Map Figure 5 Shows key road locations within the perimeter of the Hidden Pines fire. Map created by Sean Greszler with Bastrop County GIS and Addressing

Section 5: Concept of Operation - Command and Control:

The **Incident Command System** (**ICS**) is a system designed to enable effective management when organizing both near-term and long-term field-level operations for a broad spectrum of emergencies, from small to complex incidents, both natural and manmade. ICS is used by all levels of government—Federal, State, local, and tribal—as well as by many private sector and nongovernmental organizations. Response problems are far more likely to result from inadequate incident management than from any other single reason and it is crucial that all resources follow this ICS organization structure. In particular, volunteer fire departments must not freelance just because an event is within their local jurisdiction or the level of their involvement warrants a perceived need to create their own independent command structure. Such action creates risk and threatens all involved both on and off the fire grounds.

The process of moving responsibility for an incident from one Incident Commander (IC) to another was referred to as "transfer of command". The basic framework for moving from one stage to the next is as follows:

- IC type 5 - least complex incident, initial attack, short duration
- IC type 4- normally limited to one operational period (12 hours), involves multiple local fire departments
- IC type 3- requires multiple resource disciplines (i.e. local and state), extends into next operational period
- IC type 2- large number of resources, base camp is established, significant logistical support is required
- IC type 1- most complex incident, multi-agency and national resources, large number of personnel and equipment, extended over days even weeks.

The following is a summary of events and activities that precede the actual arrival of responders to the Hidden Pines fire. This summary is compiled from interviews and other information presented in " Origin and Cause Investigation Report" published by the Texas A&M Forest Service Law Enforcement Department and from audio recordings of radio traffic on the Bastrop County 800 MHz radio system.

On Tuesday, October 13, 2015, an employee of the Luecke Ranch was operating a shredder on the ranch near Smithville. The employee was working by himself. After a lunch break at 11:30 am the employee returned to work and noticed a grass fire that he assumed had been ignited by his shredder. After an unsuccessful attempt to extinguish the fire, he returned to his truck and used his radio to inform the ranch headquarters of the fire. The ranch headquarters, which is located in Lee County, called 9-1-1 and was connected to the Lee County Sheriff's Department. After another unsuccessful attempt to extinguish the grass fire the employee drove to the ranch gate on FM 153 in order to have the gate unlocked for the fire department. The employee stated that he waited for about 20 to 25 minutes at the gate for the first fire department vehicle to arrive.

Radio traffic from Smithville indicates that the Smithville FD was alerted about the fire at 12:37 and again at 12:43 but did not have a specific location. On both tone outs, the location given was somewhere on FM 153 about one mile past the Buescher State Park entrance. Several Smithville fire units checked in route at 12:42. The recorded radio traffic from 12:42 through12:50 centers around the responding units being uncertain as to the exact location of the fire. It is suspected that information passed on from another county to our dispatchers resulted in insufficient detail on size, severity and location of the incident and thus delayed the initial response. The first fire unit located and arrived at the fire at 12:54.

Based upon this information, several assumptions can be made regarding the response to this fire;

1) The fire began in a grass pasture and likely burned for as long as one hour before any fire department arrived.

2) The 9-1-1 call made from the ranch office went to the Lee County dispatcher rather than the Bastrop County dispatcher, resulting in a delay in alerting the appropriate response.

3) Since the location of the fire origin is only about five miles from the Lee/Bastrop/Fayette County lines, an exact location was not immediately determined for emergency dispatch purposes.

4) During the hour or so that the grass fire burned prior to fire department arrival, the weather conditions (i.e. relative humidity, fuel temperature, solar radiation and wind) had worsened which created very active fire spotting into a nearby pine stand and became a crowning fire.

The following information outlines the establishment of command/control and the assembly of resources utilized throughout the Hidden Pines Fire. All times are approximates based on available data sets.

First Initial Hours of the Fire Event on <u>13 October 12:30 pm – 6:00 pm</u>

- The shortage of local resources was apparent going into the Hidden Pines fire event due to multiple active fires already established within the county. ESD 1 was engaged in a wildfire in the Southwest part of the County and ESD 2 was engaged in a hay bale fire near Paige.
- Smithville and Winchester Volunteer Fire Departments (VFD), Office of Emergency Management (OEM) and Texas A&M Forest Service (TFS) responders all arrive on scene within 30 minutes of initial call
- Realizing the event was quickly evolving beyond a type 5 incident Smithville VFD delegated the authority to manage the fire to the Bastrop county OEM. Within the first 15 minutes, the fire became type 3 complexity and was assigned a type 3 Incident Commander, Mike Fisher, who then went into unified command with TFS Type 3 IC Richard Gray to manage the fire.
- OEM Type 3 Incident Commander ordered a Type 2 helicopter from STARFlight through Travis County, while in route to the fire. The initial helicopter arrived within the first 45 minutes of request.
- Once in unified command, the unified commander from Texas Forest Service ordered an air attack platform and two single engine air tankers from Fredericksburg and two from Abilene. The air assets began to arrive within an hour of the request.
- To support air tanker operations, Smithville and Giddings Volunteer Fire Departments were tasked with setting up support at their local airports.
- Due to the imminent threat from aggressive fire behavior and direction of spread, evacuations were ordered at around 2:00 PM for MD Anderson Cancer Research Center and Buescher State Park. Structure protection resources were deployed to those areas as well as along Ann Powell Road, KLBJ Road and Kellar Road.
- Local and state Unified Commanders established an on-scene, Incident Command Post (ICP) and began ordering extended attack operational resources and management personnel.

Overnight 6:00 pm **<u>October 13 - 6:00 am October 14</u>**

- Because daytime operations were successful in defending MD Anderson Cancer Research Center and Buescher State Park overnight operations would focus on stopping forward progression of fire into residential neighborhoods.
- Based on forecast for Wednesday October 14th, night operations strategies prioritized gaining containment of the south side of the fire along Park Road 1C as well as keeping the fire east of Old Antioch Road.
- Emergency Service District 1 (ESD1) resources would transition with present volunteer fire department day resources and would take over night shift for patrol and strengthening fire lines. Texas Parks and Wildlife (TPWD) resources would continue to support containment along Park Road 1C and TFS continued to construct and improve lines along Old Antioch, Park Road 1C, and the east flank with dozer and engine operations.
- Fire behavior remained active through 1 am with spotting across containment lines at Old Antioch and Park Road 1C.
- Precautionary evacuations begin on Turkey Trot, Turkey Roost, Tall Pine, Old Antioch, Kellar, Ann Powell and Powell Road
- Several spot fires were contained throughout the night
- All resources worked through the night. By 6:00 am all spot fires were suppressed and all containment lines tied in with the exception of the east flank.

Day of **<u>October 14 – 6:00 am – 12:00 pm</u>**

- Incident Command Post was established in Buescher State Park and operational briefings were conducted
- Operational strategies for the day were to strengthen the containment lines and complete dozer lines along the east flank to Park Road 1C
- Capital Area Incident Management Team Type 3 team was ordered to support the Planning Section of incident
- OEM Type 3 IC develops and implemented strategies to address shelters, public information, briefing of local and elected officials, assigning fire management personnel and planning for recovery.
- TFS Type 3 IC continued to coordinate fire ground operations and requesting additional resources for future operational periods.
- Aerial mapping of the fire is requested via Department of Public Safety (DPS) helicopter
- Air attack is over the fire at 10:00 am coordinating two black hawk helicopters that were working the southwest corner of the fire
- Ground operations continued to strengthen lines with heavy equipment and engine apparatus. Additional dozers were requested through TFS dispatch.
- Type 3 organization was adjusted to maintain unified command to include OEM Type 3 IC and the Disaster District Chairman (DPS Captain Schuelze) as the state IC and TFS IC 3 was re-assigned to Operations Section Chief.

Early afternoon of October 14 12:00 pm – 6:00 pm

- Fire behavior picks up dramatically as multiple spot fires result across old Antioch road and Park Road 1C
- The scope of evacuations was expanded to areas west of Old Antioch and Park Road 1C
- Operation strategies were now focused on individual structure protection utilizing dozers, TIFMAS engines and aviation assets.
- Additional resources are ordered through Texas Intrastate Fire Mutual Aid System (TIFMAS) to include five strike teams of engines as well as through TFS for additional strike teams of dozers, aviation resources, and operational overhead.
- By mid-afternoon, due to extreme fire behavior, homes and other outbuildings are being reported as lost to the wildfire. The number of homes threatened by the fire front and downwind ember wash exceeds the capacity of available fire forces. Fire crews began street-by-street triage for structure protection intervention.
- Fire continues aggressive spread to the northwest.
- Evacuations, structure protection and fire line construction continue as operational priorities

Evening of October 14 6:00 pm – 6:00 am October 15

- The complexity of the expanding incident is determined to have progressed into a Type 1 Incident and an order is placed for a National Type 1 Management Team
- Scope of evacuations continues to enlarge westward along Alum Creek to Harmon Road.
- Additional TIFMAS strike teams arrive and are assigned to structure protection in conjunction with local fire departments and other state resources
- Line construction with heavy equipment continues throughout the night with only the section from Cottletown to Alum Creek not completed.
- During this period, the fire had moved into or near the area affected by the 2011 wildfire. The fire had now become active outside the Smithville VFD territory and into the territory served by the Heart of the Pines VFD (HOP). During this transition, HOP announced that they would break from the established management structure and initiate their own command system. They announced that an ICP would become active at the HOP fire station. However, there is no direct evidence that this decision resulted in property loss, but clearly compromised the safety of HOP and other firefighters assigned to the leading front.

October 15

- The American Red Cross was reporting preliminary damage assessments and members of an assessment team from the Texas Forest Service. Initial reports were conflicting and were not in agreement with reports from fire field supervisors.

- Type I Southern Area Blue Team arrives and begins transition with local forces. Unified command was expanded to include the local and State commanders with Mark Morales, Blue Team IC as the federal management component.
- A Citizens Services Branch was established within the Operations Section to coordinate the immediate needs of evacuees, monitor public health issues and organize resources for short and long-term recovery.
- The Agency Administrator (County Judge Paul Pape) establishes procedures for continued information flow to the public through social media and regularly scheduled public meetings.

October 16

- County takes over the coordination for determining valid structure damage and losses due to conflicting and anecdotal information. Accurate information was needed to provide loss information to homeowners and public officials. The County IC assigned Karen Ridenour Jackson to implement the same damage assessment protocols that she followed for the 2011 Complex wildfire; based on NIST post-fire assessment methodology. Sean Gretzler, Bastrop County GIS specialist was assigned to support the assessment. A complete and accurate damage assessment would later be provided to the County Officials.
- Blue Team begins management of fire ground operations with objectives of protecting completed containment lines and interior control activities in support of re-entry procedures.

Section 6: Home Loss Analysis

Park Road 1C from Turkey Trot to Ann Powell Road would be monitored throughout the evening of Tuesday October 13 to contain the fire to Park Road 1C. Backing fires would be conducted throughout the evening off Park Road 1C to get some containment of the wildfire and burn off heavy fuels. At approximately 11:30 am on October 14, radio traffic would indicate increased fire activity along Park Road 1C at Old Antioch Road with request for airdrops from resources on the ground. The fire would continue to spot across the length of Park Road 1C resulting in the need to evacuate homeowners and firefighting resources.

The primary fire activity would begin to affect multiple communities west of Buescher State Park at approximately 11:48 am Wednesday, October 14. Bastrop radio traffic would indicate that 210 Old Antioch Road would be the first structure impacted by the fire at 11:53 am as it jumped Old Antioch Road. Local fire departments, Texas Forest Service and aircraft with a combination of hand crews, engines, bulldozers and fire retardant airdrops would actively defend homes. Throughout the fire event heavy fuel loads, 1/8 mile spotting, direct fire exposure, unseasonal warm weather conditions, limited defensible space and neighborhoods with only one way in and out would hamper firefighting efforts.

Post-fire wildland-urban interface (WUI) assessments are an important identified requirement in a recent National Fire Research Foundation (NFRF) funded study on fire prevention at the WUI.[2] WUI post-fire assessments increase knowledge of WUI environments and thereby provide better protection of life and property in these environments. The availability and scale of assessments are as wide-ranging as the agencies utilizing them. Agencies and individuals in the field of WUI study need to move towards consistent standardization protocols allowing for improved data, which in turn will aid in the understanding of structure ignition vulnerabilities, development of codes and standards and finally reduce risk to first responders. The National Institute of Standards and Technology breaks down assessments of post-fire WUI environments into the following four categories:

- **WUI 0/1**: These assessments occur at WUI incidents where structures are damaged or destroyed. The goal of these assessments is to respond to the incident both during, to facilitate allocation of resources, and to allow for safe re-entry into the community. Many protocols are used to perform WUI 0/1 assessments.
- **WUI 2**: These assessments attempt to characterize fire behavior in the WUI, qualify/quantify exposure and assess structure response given the early nature of the study of the WUI and the state of the art of the measurement science. These assessments are data and labor intensive and suffer from a lack of available information to characterize the entire Fire Disturbance Continuum.[3]
- **Rapid Assessments**: These types of assessments typically require limited resources and are a result of larger scale (in terms of life and property) WUI disasters, which receive public attention or locally large disasters. These assessments attempt to go beyond identification of damage and destruction conducted in a WUI 0/1 assessment. The limited resources also do not allow for gathering a statistically representative sample for assessment.

- **Black Swan Assessment**: This type of assessment is introduced in this report and follows the belief put forth by Popper [3] which held that science cannot be founded on universal statements such as “all swans are white” (or “no additional research [to address the problem of wildland fire in the interface] was needed”).[4] Rather a falsification solution is proposed by Popper where a single universal observation such as “all swans are white” can be disproven by the identification of one swan that is not white as it would be impossible to observe every swan in nature.[iii] This type of assessment holds value in the WUI given the impossible task of proving the effectiveness of current mitigation strategies. WUI post-fire assessments that take a critical approach to potential shortcomings and can lead research and development in relevant directions applicable to the identified problems and hold value for improving knowledge of the WUI.

[iii] Falsification as applied to WUI mitigation advice needs to be assessed in the context of exposure for an understanding of the conditions under which the respective mitigation advice failed and to ultimately understand the relative probability of such exposure conditions to exist in other WUI environments.

A WUI 0/1 post-fire assessment was initiated on October 17th 2014, four days after the fire reached Gotier Trace and the fire was considered contained. The following findings for the Hidden Pines Fire home loss analysis were based on post-fire damage assessments and utilizing Bastrop County tax appraisal records. Home loss analysis for all destroyed structures can be found in Appendix D.

Findings:

- Based on the current tax appraisal cards and post-fire damage assessments, the data indicates that of the 64 structures lost 13 were mobile home and 51 were single-family house with 66% of all the houses constructed on pier-and-beam or cinder block foundations. It is hypothesized, that years of debris and leaf litter accumulation allows the fire to burn under homes, smolder and cause ignitions. Figure 9 shows the count of various foundation types for destroyed structures.

- Of the 51 single-family homes, 59% were constructed with wood siding. It is hypothesized that this number could be higher due to the 26 additional structures with an unknown exterior building material. Similar to 100-hour fuels, the wood siding dries out making the building material mimic dried vegetation, which as the potential to ignite after decades of drought and drying conditions. Figure 10 shows the count of various siding materials on destroyed structures.

- Roofing material consisted of non-combustible materials of composite shingle or metal for 42 of the destroyed structures. Homes with undetermined roofing types can be hypothesized to have been wooden or combustible materials since no roofing materials were located during on-site visits. Even with non-combustible roofing materials, fire can start at the eves and proceed to the roof and possibly into the attic due to the ignition of combustibles on the roof (e.g. pine needles). Figure 11 shows the types of roofing materials on destroyed structures.

- Of the 64 homes lost, 50% were identified as having attached wooden porches or decks, ignitable fuel sources and can mimic kindling. During technical discussions with first responders, it would be noted that on multiple cases decks would be removed in attempts to save the structure. High ember production was noted in technical discussions. Embers landing on or under the top surface, accumulation in re-entrant corners, combustible items on the decks and vegetation underneath decks all contributed as ignition potentials in advance of the fire front.

- Of the 51 single-family homes, 50% were built before 1990 ranging from 26-74 years old in construction. Pre-planning of defensive actions by homeowners is vital in older homes. Weathering of building materials, single pane windows, along with the accumulation of decades of debris in attics and under foundations influence the behavior of fires around the structure.

- Stated throughout technical discussions by first responders that some areas within the fire perimeter had extreme overgrowth of vegetation. In many cases emergency response vehicles were unable to make entry down driveways and privately maintained roads without vegetation hindering vehicle access. This correlated with the high loss of homes outside of the 2011 Bastrop Complex Fire perimeter that were located within unburned heavy fuels loads associated with the lost pines ecosystem.

- Of the total number of homes within the operational area of the fire event 64 (13%) of the homes were destroyed while 440 (87%) were saved by mitigation actions of fire departments or were not impacted by the fire.

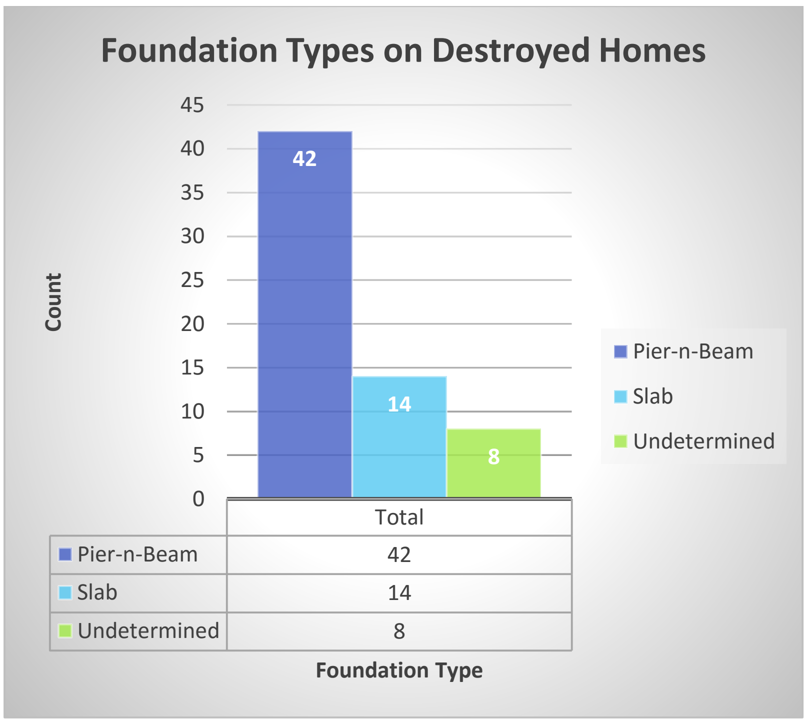


Figure 9 shows the foundation types of the 64 structures destroyed

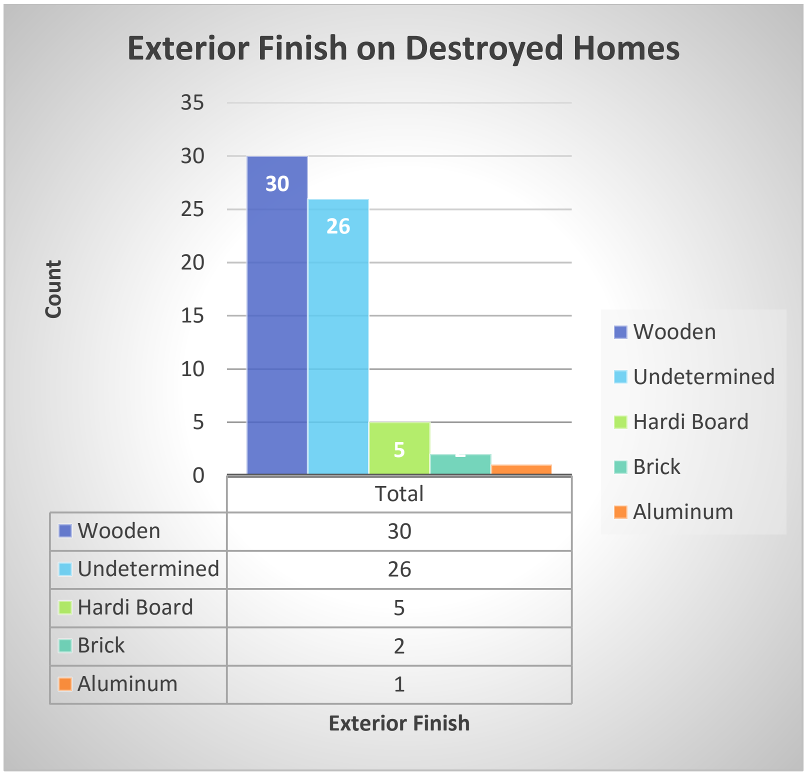


Figure 10 shows the exterior siding types of the 64 structures destroyed

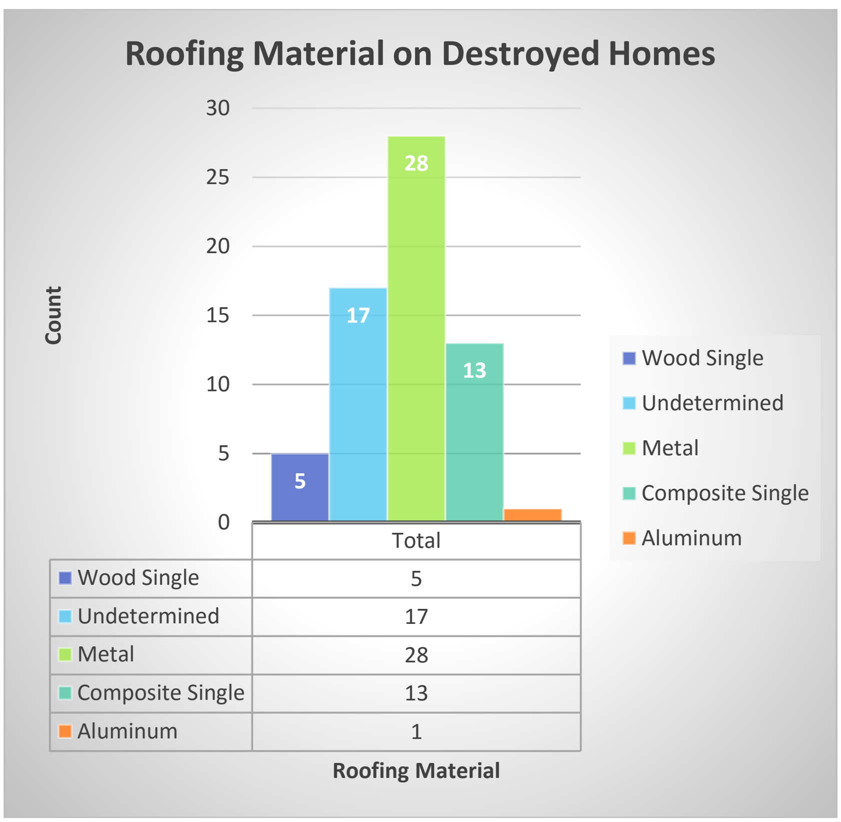


Figure 11 shows the roofing materials of the 64 structures destroyed

Section 7: Defensible Space Discussion

Oakland Hills WUI fire issues, 1923

California's first wildland-urban interface fire occurred in the Oakland Hills of Berkeley, Calif., in 1923. This fire destroyed 584 structures. In the past 80 years, there have been 14 large-scale fires in the Oakland Hills, eight of them in the same parkland canyon, including the 1991 Oakland firestorm. After the 1923 fire, a committee was formed to identify the factors that contributed to the structure loss in an effort to prevent future losses in wildland fires.

The committee identified six major factors. In order of significance they were:
1. Flammable roofing materials
2. Inadequate clearance between combustible vegetation and structures
3. Extreme wind conditions
4. Inadequate access – narrow winding roads
5. Inadequate water supplies
6. Lack of modern firefighting equipment

San Diego County WUI fire issues

The 1970 Laguna Fire was the most deadly and destructive wildland urban interface fire in San Diego County history. The fire burned 190,000 acres over seven days, killing five people and destroying 382 homes. The more recent 1996 Harmony Grove Fire also was also extremely destructive. The fire injured many firefighters and took the life of one resident. It burned 8,600 acres, destroyed 122 residences and damaged an additional 142 residences in less than eight hours.

Task force members agreed that the major reasons for structure loss in both of these fires and other recent fires were:
1. Flammable roofing materials
2. Inadequate clearance between combustible vegetation and structures
3. Extreme wind conditions
4. Inadequate access – narrow winding roads
5. Inadequate water supplies
6. Improper structure design

Comparing the preceding lists with current research, most of the major factors for home loss have remained the same over the last 80-plus-year period. The list remains the same, yet homes still are being lost – prompting researchers to ask, "What have we missed? What is the perceived risk from a wildfire to structures by homeowners, neighborhoods and communities?" "Firewise" concepts work but only if fully implemented and maintained around a structure. A key analogy: A four-way intersection is designed with four stop signs to keep all vehicles moving safely on the roads. However, if even one vehicle fails to fully implement a stop, vehicles are damaged or destroyed. The "human factor" is the missing component.

Firewise and defensible space are not cookie-cutter concepts that apply equally to every structure in a community. Every structure has to be viewed and managed with its construction components as part of the surrounding and adjoining vegetation in mind to reduce vulnerability from wildfires. When homes are placed within the vegetation environment, they become merged as part of the wildland fuels and can no longer be considered "standalone" structures. The wood deck is just like a log that dried out from the sun and heat and will burn like a dead log on the ground." Researchers and fire officials have an obligation to the community to produce sound suggestions regarding home loss in the WUI. If the whole story were not fully known, it would be irresponsible to make educated suggestions or provide supported results. The public depends on quality scientific research so educated decisions can be made regarding building codes and home design. There are many variables in the wildland, which challenge the provisions of an all-encompassing value for homes.

One of the biggest misconceptions is the idea of ***"defensible space".*** The objective of defensible space is to stop movement of the fire to the house under varying wildfire conditions with or without active defense. Defensible space has nothing to do with whether a house will burn, but whether it can be defended by interventions from fire resources from an approaching fire front. During a WUI fire there will never be enough resource to match the number of structures threatened. Difficult decisions during triage of structures will result in some homes not to be defended due to heavy fuel loads and unsafe conditions for fire fighters. Even with quality fuel reduction around a structure ember intrusion can result in a home ignition…this has nothing to do with defensible space…this is now just a structure fire.

Currently established recommendations may have organizational benefits but do not recognize real wildfire threats not researched and confuse homeowners with mixed messages. Documents date back to the early 1980 is regarding creating defensible space around a structure to break up the vegetation within close proximity to a home. What is the magic number?

Homeowners are advised to create a defensible space of 30 feet around their house and use 'fire safe" construction materials in order to protect a home from wildfires as recommended by National Fire Protection Agency (NFPA) [5]. Despite these specific guidelines on how to create defensible space, there is little scientific evidence to support the amount and location of vegetation modification that is actually effective at providing significant benefits. Most spacing guidelines and laws are based on 'expert opinion' or recommendations from older publications that lack scientific reference or rationale.[6] Over time the idea of defensible space has evolved and changed using terms like inner and outer protection areas, Zones 1-3, I Zone and home ignition zone (HIZ). These methods are an attempt to simplify complex concepts of defensible space and seek a one-size-fits-all answer. The result has caused homeowners to misunderstand the true intent of defensible space. It is not a cookie cutter one-size-fits-all number value identical for every structure. When we talk about defensible space, homeowners and developers need to understand that it requires adjustments based on the footprint of the structure and location on the topography with correct implementation and maintenance of the created space unique to that structure and property. The objective for defensible space is to stop movement of the fire to the house in conjunction with modified fire behavior to allow for safe suppression actions to protect structures. Any materials, vegetation or manmade, that allow the fire to progress to the structure within the initial area, even over several days and unattended, is not defensible space.

Defensible space is a house by house scenario with homeowners taking into account the environment within 30 feet of structure (*this is an industry standard and is NOT an absolute number) as well as hazards present beyond these arbitrary distances. High-density primary structure areas adjacent to wildlands with topographic features that can increase fire and ember exposure are not considered in current concepts of defensible space. A particular location can be defensible from ember attack yet not defensible from direct fire spread[1]. Homeowners need to create defensible space that is appropriate for their specific structure. Defensible space has nothing to do with whether a house will burn only whether or can be defended

The practice of advocating 30 feet of defensible space has implications are far reaching regarding this number. Case in point, Bastrop County was awarded a FEMA grant for fuel reduction throughout the county. One stipulation of the grant was that vegetation would only be cleared up to a home within 30 feet, due to the established recommended, unsubstantiated, 30 feet of defensible space value. The county has reached out to ESD1 to do the remaining clearing around designated homes within their jurisdictional area. Every volunteer fire department in the county needs to be working with homeowners to develop strategies to actively assist in removing vegetation around homes. Due to the limitations of the current state of knowledge, defensible space definitions do not consider defensibility from structure to structure fire spread, defensibility from dangerous configurations of topographic, or fuels beyond the initial structure footprint. All these components need to be considered when mitigating around structures[1].

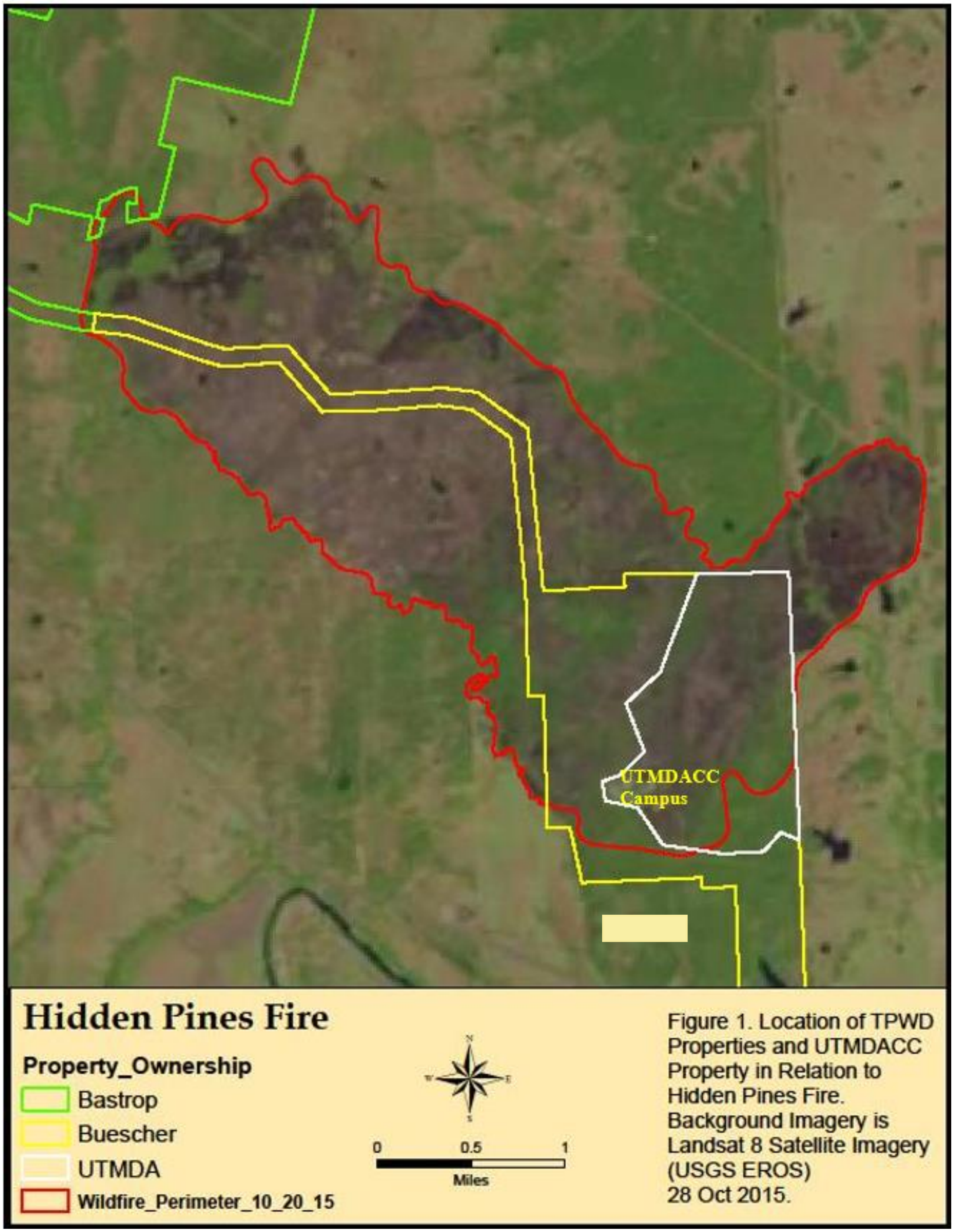
Section 8: Impacts to the State Park

The Hidden Pines Fire burned through Buescher State Park, adjacent University of Texas M. D. Anderson Cancer Center (UTMDACC) property, the Bastrop-Buescher State Parks corridor (herein corridor), and into the southeastern portion of Bastrop State Park from October 13 to October 15, 2015 (Map Figure 6). The aim of these post-fire data collections by the park service were to perform post-fire assessments within all established vegetation monitoring plots that were burned and map burn severity classifications across the entire burn area within state property, including adjacent UTMDACC property. This study is a part of an ongoing effort by the State Parks Natural Resources Program of Texas Parks and Wildlife Department (TPWD) to acquire baseline floral data and conduct long-term monitoring within all State Parks. Data and information obtained from implementation of this program are used to develop resource management plans that guide management and restoration of natural habitats. This study follows the protocols and guidelines established by TPWD for quantitative vegetation studies on Texas State Parks.[7] This project was funded in part through a State Wildlife Grant from U.S. Fish and Wildlife Service.

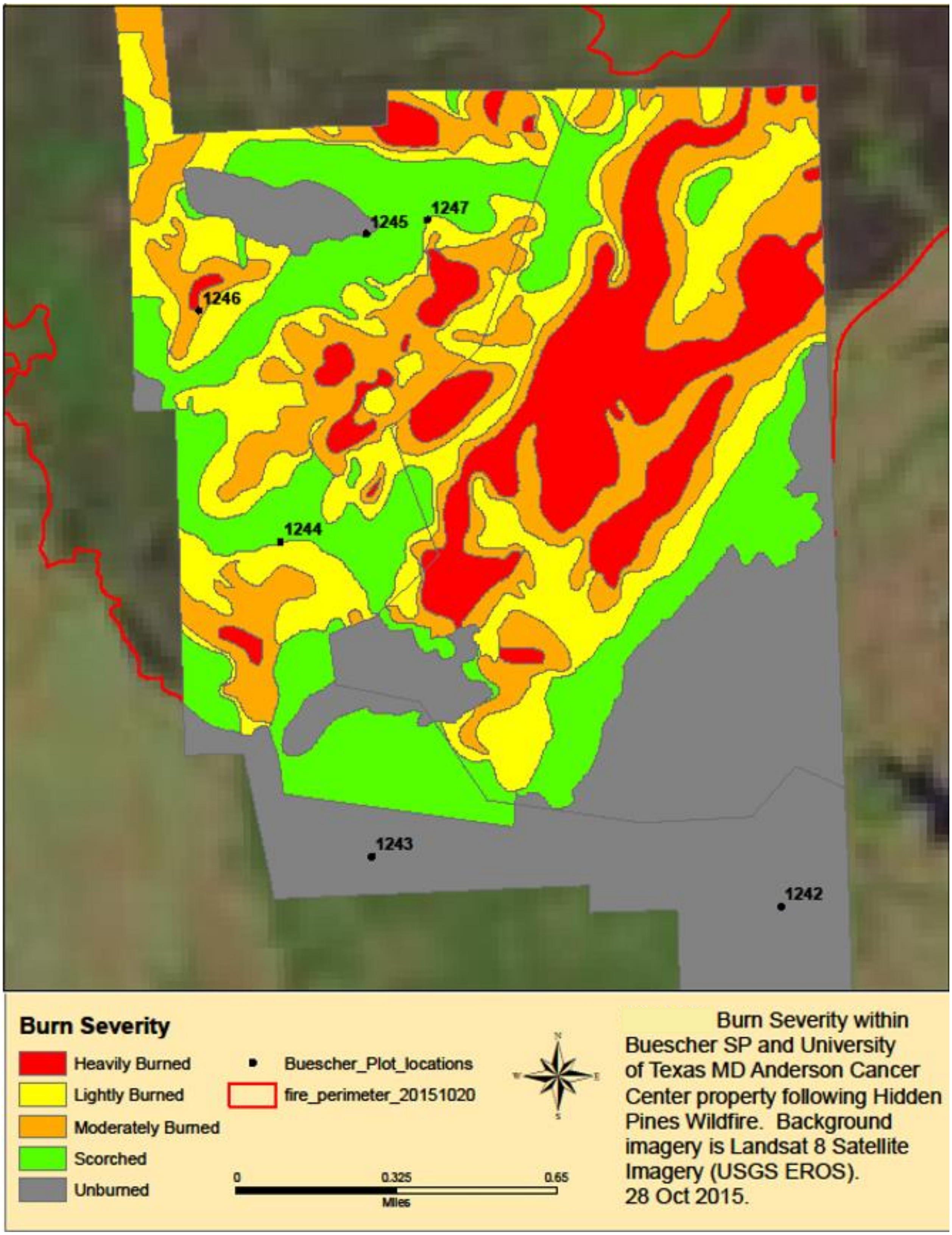
Bastrop and Buescher State Parks are located in the Oak Woods and Prairies Natural Region according to Diamond; Post Oak Savannah Vegetation Area according to Diggs; or the Bastrop Lost Pines Sub-region of the East Central Texas Plains Ecoregion according to Griffith.[8] Several large wildfires have occurred in the Lost Pines since 2008 with slightly more than 50% of this sub-region being burned during the historic 2011 Bastrop Complex Fire, including most of Bastrop State Park and the corridor.[9] This devastating fire consumed over 34,000 acres, 1,645 homes and 38 commercial buildings.[10] The incident occurred during the region's worst drought in recorded history, which began in 2008 and continues to a slightly lesser extent, into 2015.[11] There were slight reprieves from below average rainfall during fall/winter of 2009/2010, winter/spring of 2012 and winter/spring of 2015.[12] However, from mid-June to mid-October 2015, monthly rainfall totals were substantially below average, and central to southeastern Bastrop County was experiencing exceptional drought at the time of the fire.[12 13 14] This fire consumed 4,582 acres, 64 homes. Approximately 2,162 acres or 45% of the total acreage of the fire burned within the footprint of the 2011 Bastrop County Fire including most of the corridor as seen in Map Figure 7.

Methods

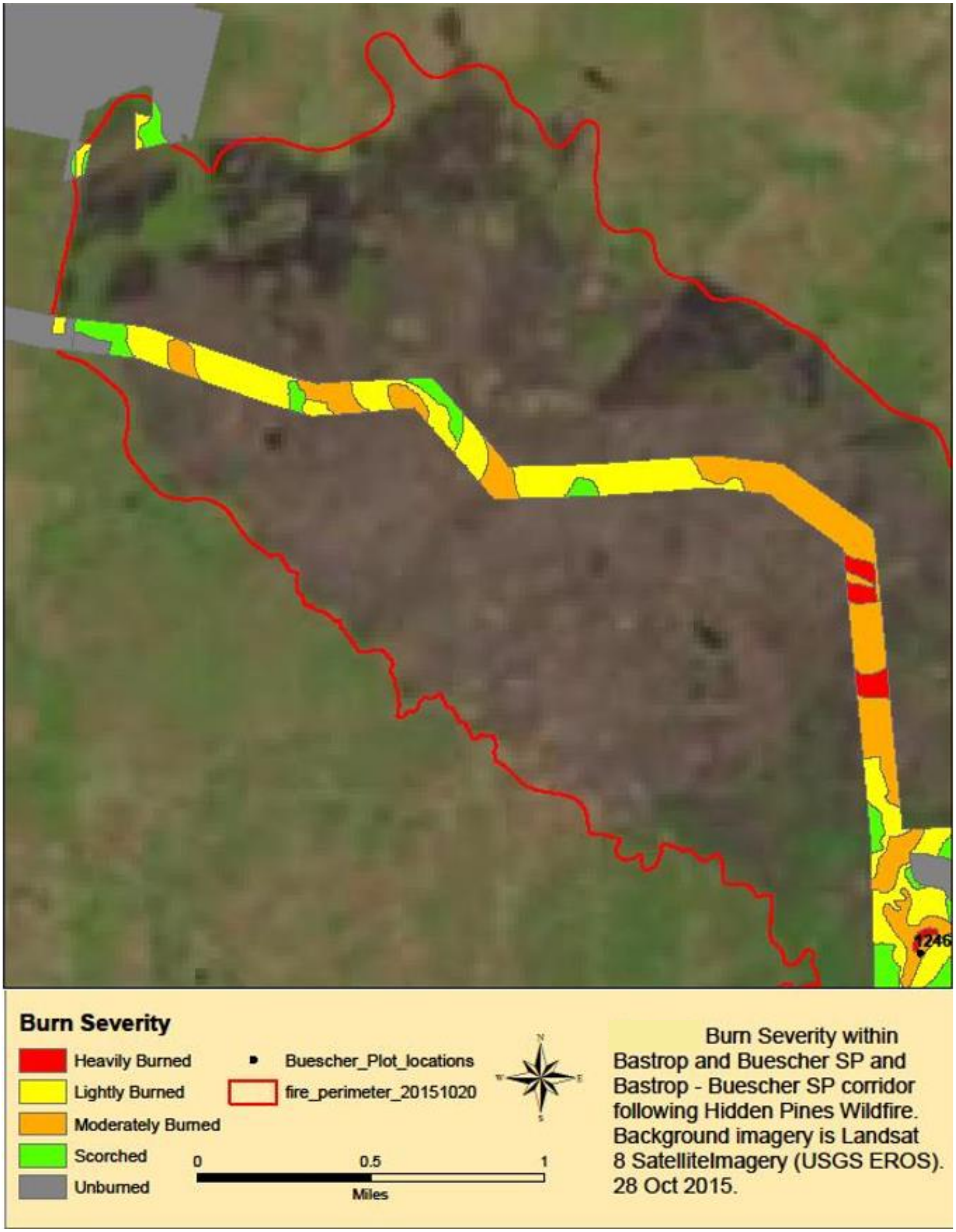
The Hidden Pines fire entered Buescher State Park and UTMDACC property on October 13, 2015, expanded into the corridor (and adjacent private property) on October 14 and into Bastrop State Park on October 15, burning intermittently until October 21, 2015 (TFS 2015, personal observation). Post–fire assessments were completed in four Fire Monitoring Handbook (FMH) vegetation monitoring plots using Tree Post-burn Assessment Data Sheets (FMH-20) and Burn Severity Data Sheets (FMH -21 & FMH-22) as shown in tables 9 &10.[14], these assessments were completed October 21, 2015. Photos of each plot were taken according to protocols outlined in USDI monitoring handbook.[14] Figures 11-18 illustrate examples of each burn severity rating in plots before and after the fire. Following the identification of burn severity classifications at each FMH plot, burn severity maps, Map Figures 7 & 8, for all properties assessed were created using Landsat 8 Satellite Imagery (USGS EROS -101715) and walking random transects to determine the size and extent of associated severity classes. TPWD Natural Resources Program Planning and Geospatial Resources (PGR) Lab. provided property boundaries and infrastructure shapefiles.



Map Figure 6 Areas burned within the state parks during the Hidden Pines fire @Texas Parks and Wildlife. The location of the Texas Park Wildlife Department (TPWD) and University of Texas M.D. Anderson Cancer Center (UTMDACC) properties are indicated on map.



Map Figure 7 Burn severity within Buescher State Park (SP) and University of Texas MD Anderson Cancer Center @Texas Parks and Wildlife



Map Figure 8 Burn severity along the Bastrop and Buescher State Park corridor @Texas Parks and Wildlife

Results and Discussion

Throughout the park, control plots have been established for research and have experienced no fire whether natural or prescribed in decades. Understory woody vegetation in these sampling plots are classified has "extreme high fuel loads", specifically yaupon with a density averaging 1,174 stems/acre for heights ranging from 0.5- 3.0 meters. These numbers are highly variable due to plot locations. In areas of the park with regular prescribed burning yaupon density averages <50 stems/acre. Additionally, surface fuel densities in control plots with no recorded fire, including all size classes, in this pine oak woodland have measured values of approximately 5 tons/acre. These values fluctuate over time in plot areas where regrowth occurs between burn periods.

This study was conducted to monitor fire intensities within Buescher and Bastrop State Parks following the Hidden Pines Fire. Descriptions of plot severity data are found in USDI[14] and listed in Appendix E. Of the four plots sampled for burn severity, no plots were heavily burned, one plot was moderately burned (1246) (partially heavily burned), one plot was lightly burned (1247), and two plots were scorched (1244 and 1245). Figures 11 – 18 show burn severity of these plots before and after the Hidden Pines fire. Plot 1245 was partially unburned due to a fire suppression line being installed through middle of the plot running east to west. Plots 1244, 1245 and 1247 appear to have burned at night with low fire intensities. Plot 1246 was burned with intense fire behavior and all trees within the plot were recorded as dead.

Fire effects to trees generally follow burn severity data values are listed in Tables 9-13. Most, if not all, overstory trees in the three lightly burned or scorched plots (1244, 1245, and 1247) will likely survive based on the amount of leaf scorch and char height on the boles of the trees. Across the burn area, most trees within scorched areas will probably survive as reflected in the plot data. However, in lightly burned areas, overstory trees will probably experience some mortality (approximately 30-50%) based on previous observations and depending on future rainfall amounts. In areas that were heavily to moderately burned, mature trees were scorched at or near 100% and will most likely not survive.

The previous plot sampling occurred in 2010 and many overstory trees had succumbed to drought prior to the fire. Only trees considered alive before the fire were counted in this study, therefore, total live trees recorded during this study were substantially fewer than the number recorded in the previous sampling in 2010.

Complete acreage totals according to burn severity by ownership are summarized in Tables 12 and 13. Acreage and percentage totals for Buescher State Park include the Bastrop – Buescher State Parks corridor. Approximately 425 acres or 39% of Buescher State Park was unburned. These unburned areas include the southern portion of the park where the fire was suppressed, south of the UTMDACC campus, 25 acres in the northern portion of the park south of Park Road 1C (where a fire suppression line was installed), and small areas that were suppressed with aerial fire retardant Map Figure 7). In total, approximately 30% of the canopy trees within the Park will be lost based on the burn severity data and tree post-burn assessment data. This estimate was based on the likelihood that most trees in the unburned (39% of park) and scorched (20% of park) areas and over half of the canopy trees in the lightly burned areas (20% of park) will survive. All of the trees in the heavily burned areas have already been lost and most, if not all, of the trees in the moderately burned areas have died or will ultimately die in the near future. It was estimated almost half of the understory vegetation in the park was top-killed or completely eliminated. All understory vegetation was top-killed in the heavily burned, moderately burned and lightly burned areas. A much smaller percentage was top-killed within the scorched areas. It is likely that a certain percentage of understory vegetation was completely killed within heavily burned and moderately burned areas. The only areas in the park where soil was visibly altered were within the heavily burned areas. The soil in these areas was generally powdery and a charred orange color. Approximately 8 acres were burned within Bastrop State Park including 3 acres being lightly burned and 5 acres being scorched.

The northwestern portion of the Hidden Pines Fire burned into the footprint of the Bastrop Complex Fire including a small portion of Bastrop State Park and most of the corridor.[8] Because of very low humidity and drought conditions, fire behavior was very intense in this area, which burned on the third day of the wildfire on October 15 (personal observation) shown in Figure 7. Because this area burned previously in 2011, fuel loads were primarily a combination of grass and young woody species (Fuel Model GS2),[16] these lower fuel loads were mostly responsible for the lower burn intensities despite the intense fire behavior.

Table 9. Average Burn Severity of substrate and vegetation in Plots 1244-1247 at Buescher State Park, Bastrop County, Texas (USDI 2003, FMH 21 & FMH-22) Lower values indicate higher burn severity.

Burn Severity	Substrate Severity (Avg.)	Vegetation Severity (Avg.)
Moderately Burned (n*=1) (1.5 - 2.5)	1.77	1.57
Lightly Burned (n=1) (2.5 - 3.5)	3.3	3.27
Scorched (n=2)(3.5 - 4.99)	4.15	4.18

Table 10. Average Tree Post-burn Assessment Data for Plots 1244-1247 at Buescher State Park, Bastrop County, Texas (USDI 2003, FMH-20).

Burn Severity	Average Scorch (%)	Avg. Scorch Height (m)	Avg. Char Height (m)
Moderately Burned (n=1))	100	10.9	9.3
Lightly Burned (n=1)	56.6	6.6	0.6
Scorched (n=2)	30.8	5.9	0.5

***In statistics "n" is the number of observations or measurements taken during data collection. The values represented are not significant for analysis but for preserving field data purposes only.**

Table 11 Summary of Canopy Tree Losses According to Burn Severity Following October 2015 Hidden Pines Fire at Buescher State Park, Bastrop County, Texas. Burn Severity ratings from USDI[12].

Overstory Trees (>15-cm, DBH) Pre-fire	Moderately Burned (n=1)	Lightly Burned (n=1)	Scorched (n=2)	Total	
Pinus taeda - Loblolly Pine	3	2	12	17	
Quercus margarettae - Sand Post Oak			27	27	
Quercus marilandica - Blackjack	5		5	10	
Quercus stellata - Post Oak	1	14		15	
Juniperus virginiana -Red Cedar			1	1	
Total (Pre-fire)	**9**	**16**	**45**	**70**	
Overstory Trees (>15-cm, DBH) Post-fire	**Moderately Burned (n=1)**	**Lightly Burned (n=1)**	**Scorched (n=2)**	**Total**	**% Change by Species**
Pinus taeda		2	12	14	-17.6
Quercus margarettae			27	27	0.0
Quercus marilandica			5	5	-50.0
Quercus stellata		14		14	-6.7
Juniperus virginiana			1	1	0.0
Total (Post-fire)	**0**	**16**	**45**	**61**	**-12.9**
% Change	**-100.0**	**0.0**	**0.0**	**-12.9**	

Table 12. Burn Severity Acreages and Percentages Burned Following October 2015 Hidden Pines at Buescher State Park, Bastrop County, Texas. Percentage values include Bastrop – Buescher State Parks corridor

Burn Severity	Acres	% of Park
Heavily Burned	37	3
Moderately Burned	199	18
Lightly Burned	222	20
Scorched	218	20
Unburned	425	39

Table 13. Burn Severity Acreages and Percentages Burned Following October 2015 Hidden Pines on University of Texas M.D. Anderson Cancer Center Property, Bastrop County, Texas

Burn Severity	Acres	% of UTMDACC
Heavily Burned	164	23
Moderately Burned	146	20
Lightly Burned	125	18
Scorched	99	14
Unburned	181	25

Figure 11 Heavily Burned portion of Plot 1246 (50P-0P) Prior to Wildfire taken on September 2, 2010 at Buescher State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Figure 12. Heavily Burned portion of Plot 1246 (50P-0P) Following Wildfire taken on October 21, 2015 at Buescher State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Figure 13 Moderately Burned portion of Plot 1246 (P2-Origin) Prior to Wildfire taken on September 2, 2010 at Buescher State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Figure 14 Moderately Burned portion of Plot 1246 (P2-Origin) Following Wildfire taken on October 21, 2015 at Buescher State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Figure 15 Lightly Burned Plot (Plot 1247: P2-Origin) Prior to Wildfire taken on September 1, 2010 at Buescher State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Figure 16 Lightly Burned Plot (Plot 1247: P2-Origin) Following Wildfire taken on October 21, 2015 at Bastrop State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Figure 17 Scorched Plot (Plot 1245: 0P-50P) Prior to Wildfire taken on September 1, 2010 at Buescher State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Figure 18 Scorched Plot (Plot 1245: 0P-50P) Following Wildfire taken on October 21, 2015 at Buescher State Park, Bastrop County, Texas. @Texas Parks and Wildlife

Recommendations

Following decades of fire suppression in this fire-dependent habitat, extremely high fuel loads (primarily yaupon and pine needles) existed within most areas of the Park and adjacent properties. These high fuel loads along with the weather conditions during the time of the wildfire led to extreme fire behavior that was difficult to suppress. Without frequent fire, a similar fire event is likely to occur in the future. In heavily burned areas of the Park, a unique opportunity has presented itself to begin to restore the upland areas to open herbaceous and less fire-suppressed forests that most likely occurred prior to European settlement. A habitat management strategy should now be designed to guide early- successional habitats to the desired future condition. While this strategy is quite different from the pre-wildfire strategy of managing late successional habitats, the objective of restoring the natural structure and composition of the Lost Pines forest remains the same.

While some salvage logging may be necessary, wholesale clear-cutting of the heavily burned areas was not recommended. From previous experience, heavy ground disturbance related to timber harvests increases the abundance of weedy, early successional plant species and woody shrubs. These quick-growing species commonly out-compete native herbaceous species adapted to frequent fire. With that being said, there are also habitat restoration challenges associated with accumulated logs and dead woody debris within non-harvested areas. Large amounts of remaining slash will complicate potential replanting operations and the ability to protect pine regeneration, while simultaneously reducing competition by non-desirable vegetation. The expected positive and negative effects of all post-wildfire management practices must be carefully considered prior to implementation.

Where salvage harvesting is deemed necessary, planting of native species (i.e. pine seedlings, little bluestem, etc.) and frequent prescribed fires and/or mechanical treatments may negate some of these anticipated negative effects. Any loblolly pine trees used for replanting should originate from seed sources in the "Lost Pines" area because of these trees' adaptability to drought. Close monitoring of recolonizing species in heavily burned areas (and throughout the park) should be implemented and restoration efforts should be adjusted according to which treatments are meeting restoration goals. Some replanting of pine seedlings, as well as native herbaceous species, even outside of timber harvest areas will probably be necessary to increase chances of restoration success.

There are multiple types of fuel reduction treatments including and not limited to mastication, herbicides, browsing and biological treatments. In this event for the county and park service, going forward, the only way to prevent a similar catastrophic fire is frequent (as frequently as annual) prescribed fires. By deliberately burning wildland fuels in either their natural or modified state and under specified environmental conditions, aids in controlling the fire, produces lower fireline intensity and rates of spread during an actual wildfire event.

Section 9: Fire Plain

As for all natural hazards, there are many sources of uncertainty inherent in wildfire hazard and risk research. There are two primary types of uncertainty: aleatory (statistical) uncertainty is irreducible, and pertains to natural ***randomness*** in a process, epistemic (scientific) uncertainty in a process, due to ***limited data and knowledge***. In risk assessment, it is important to attempt to quantify these uncertainties to enable informed decision-making and make risk managers aware of the limitations of the science.

For process-based wildfire models, uncertainties arise due to the accuracy and resolution (both temporal and spatial) of measurements of independent variables, e.g. topography used to model the slope and dynamics of the fire. Model structural uncertainty is also critical here-how accurately are the physical and chemical processes of combustion represented? This is something that is very difficult to quantify. There are also uncertainties associated with model parameterization (e.g. the combustion temperature of a given type of vegetation), and methods of data assimilation[17].

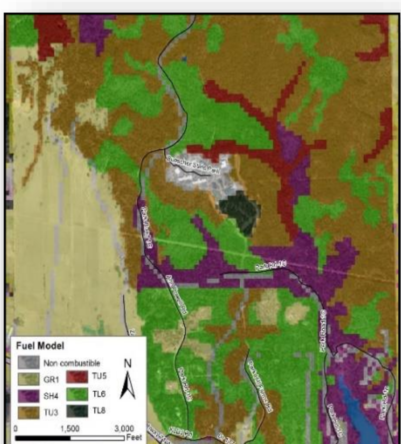
Fire behavior models with well-qualified data and generated outputs with known uncertainties in the field of fire science are in their infancy. The following data presented represents an attempt by the county to help improve these uncertainties of these type of tools. In addition, the county can provide data to improve fire models that potentially could be utilized by Bastrop County. This is not a tactical model for firefighting during wildfires. The model under a range of thresholds (fuel and weather) can produce possible outcomes that could occur.

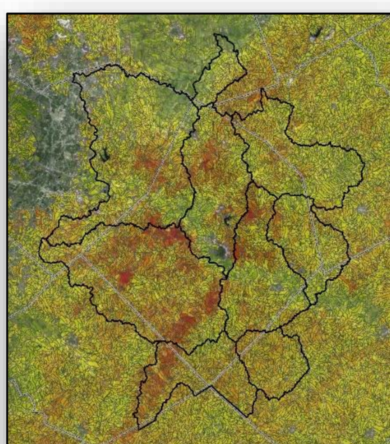
Anchor Point Group, a private-sector company that applies state-of-the-art fire science to wildfire mitigation, planning, municipal codes and insurance issues, were contracted by Bastrop County in 2015. Anchor Point Group conducted a three-tiered project to support the counties wildfire planning and mitigation programs. The project encompassed detailed vegetation mapping for accurate fire behavior predictions, assessing and prioritizing the county landscape and coalescing all the data into a user based tool for trained county and fire responder personnel. Deliverables included:

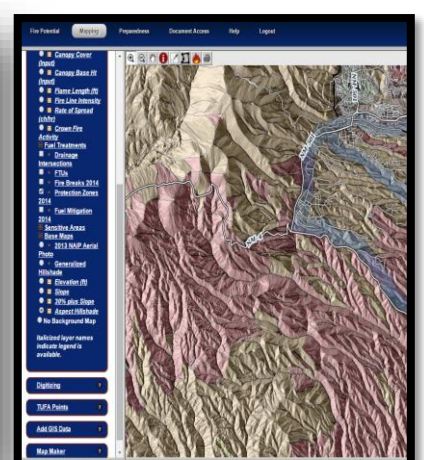
Fuels Project Support
Decision Support for Wildfire Mitigation

Assessment/Prioritization
Multi-Functional Fire Plain Maps

Custom Web Map Interface
Custom reports, maps and analytics on demand







Robust fire science generated these maps and analysis. Remote satellite imagery in combination with field inspection provided detailed vegetation map or fuels map in wildfire terms. This in depth information supported fire behavior modeling which produced predictions for how fast a fire would advance, how intense it would be and if it would generate crown fire or fire in the tree tops (one of the most destructive fire behaviors).

To analyze the county, it was divided into Fire Plains. Fire Plains are conceptually similar to floodplains but are smaller and provide definable planning units within the county. Custom Fire Plain map layers with hazard and risk at the parcel level were generated. These maps have the potential to be used for:

- Support for sustainable communities
- Support long-term resiliency
- Define vulnerability to critical infrastructure
- Clear identification of the wildland urban interface
- Prioritization of treatment areas to ensure high cost benefit
- Educating all citizens on their vulnerability to wildfire

The foundation of this effort takes place in detailed and accurate fire behavior modeling, which the county will be supporting by providing historical fire data.

Fire behavior modeling

Fire behavior modeling consists of making predictions across a landscape of what type of fire would occur given a set of topography, fuel and weather information as shown in Figure 19

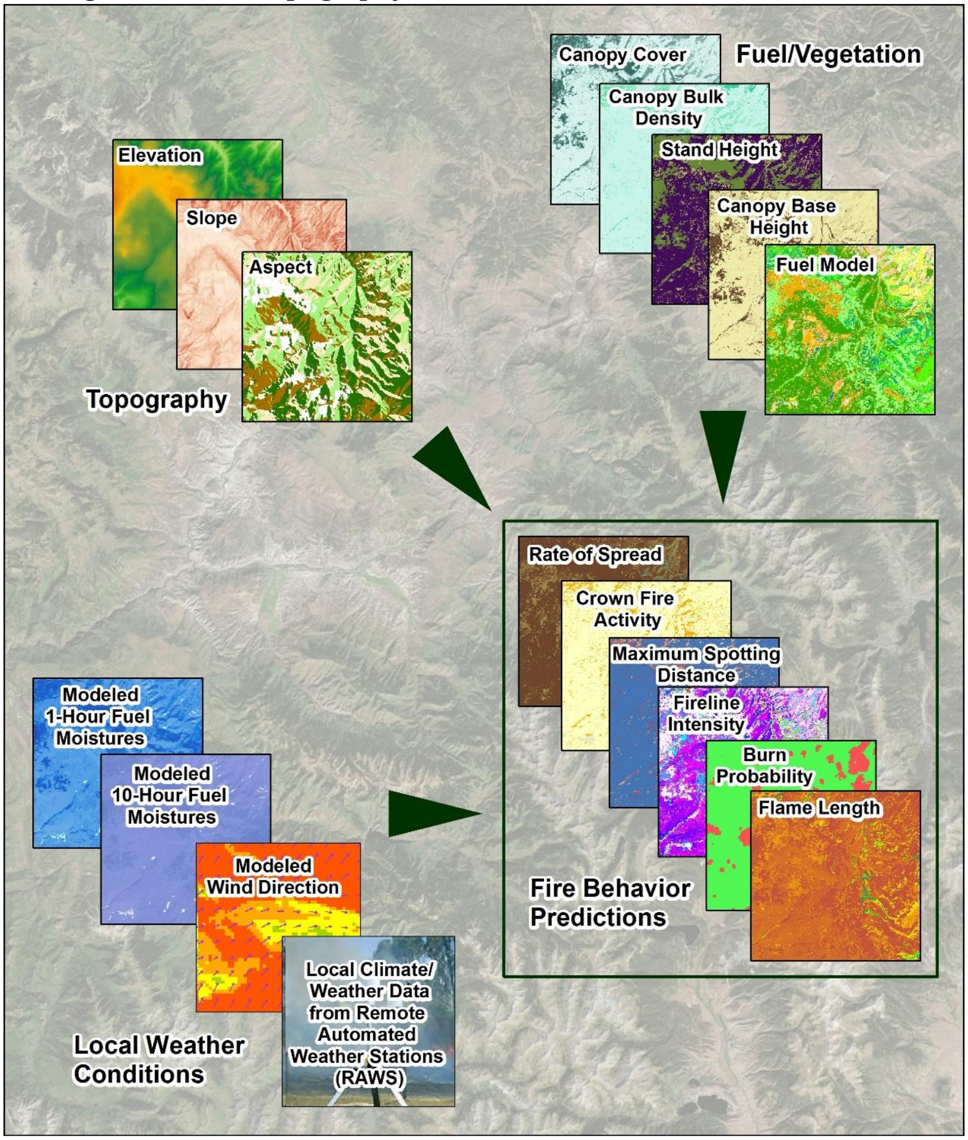


Figure 19 Flow chart of the fire behavior modeling process @Anchor Point Group LLC

Topography is the changing elevation of a landscape and was captured in the modeling by elevation, slope and aspect layers. Examples of topographic impacts on fire behavior predictions include fires traveling more quickly up steeper slopes and fuels on south-facing slopes drying out more during the afternoon hours.

Weather conditions are incorporated using data from a series of Remote Automated Weather Systems (RAWS). The weather can be sorted by various values (fuel moistures, wind speed and direction, maximum daily temperature, relative humidity, etc.) and fire behavior predictions can be made for weather of increasing rarity until only the worst fire days are captured. This allows a large degree of flexibility in the type of scenario a user may want to plan. Average weather conditions can be modeled or the conditions for day of the worst fire on record can be used. There are applications for fire behavior modeling using both types of weather scenarios.

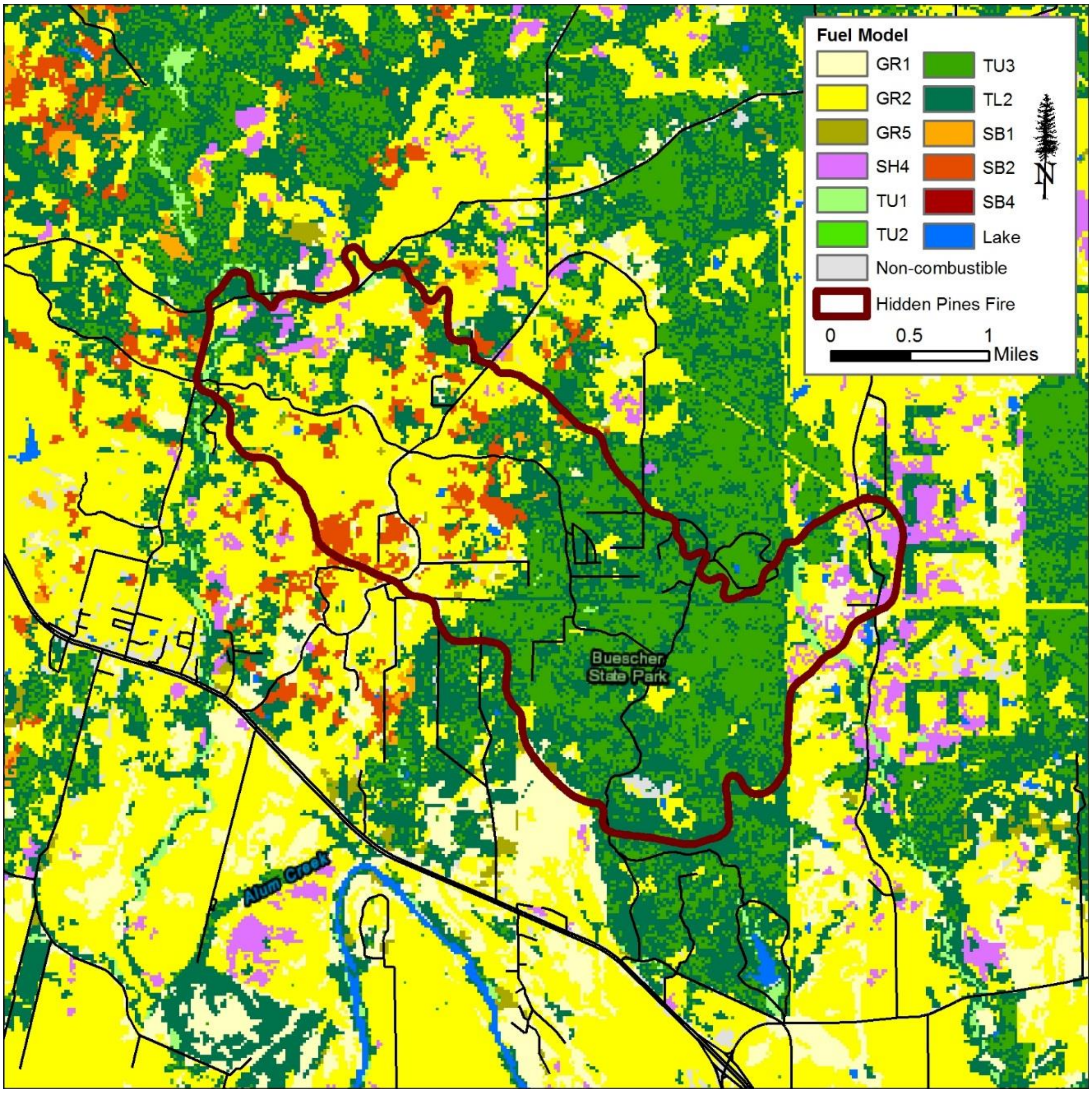
Table 14 compares the weather on the day of the Hidden Pines Fire (10/13/15) with the two weather scenarios Anchor Point used to model predicted fire behavior during the Bastrop wildfire project.

Table 14 Weather inputs for different scenarios

Parameter	Hidden Pines Fire Day (2015)	90th Percentile Scenario	Bastrop Complex Fire Day (2011)
1-hour Fuel Moisture	1	6	3
10-hour Fuel Moisture	3	7	4
100-hour Fuel Moisture	10	14	10
Herbaceous Fuel Moisture	30	47	13
Woody Fuel Moisture	106	103	83
Wind Speed	8	8	12
Wind Direction	From the North	From the SSE	From the North

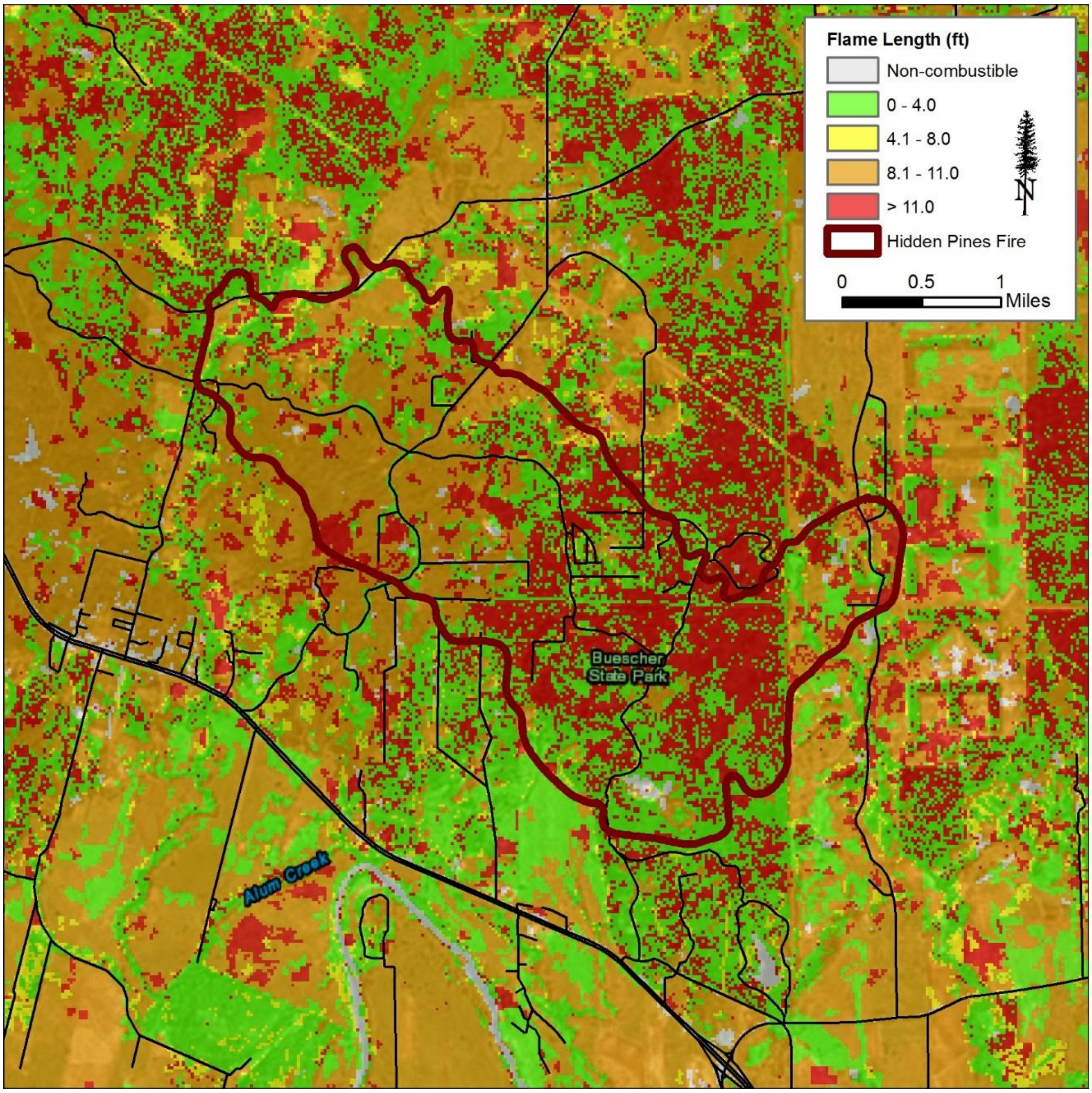
As Table 14 shows, the weather values for the Hidden Pines fire were extreme and are even more severe than those experienced during the worst of the Bastrop Complex Fire. Fuel moistures were historically low, especially in the lighter (1-hour and 10-hour) fuels. These are the fuels that contribute to rapid ignition and to the rate at which the fire moves (the rate of spread). Winds and Woody Fuel Moistures were not as severe during the Hidden Pines fire. The low woody fuel moisture values recorded on the day the Bastrop Complex Fire started were the result of a long drought running up to the day of the fire. The winds also contributed to the massive rates of spread and extreme fire behavior experienced on that day.

Fuels are the final input for fire behavior modeling. Inputs for the modeling in this category include fuel type, canopy cover, canopy base height, canopy bulk density and stand height. This component of the Bastrop County project was especially robust given that fuels were custom-sampled using remote sensing and field-based sampling techniques. The fuel model and canopy cover inputs were all custom-generated for this project are shown in Map Figure 9.



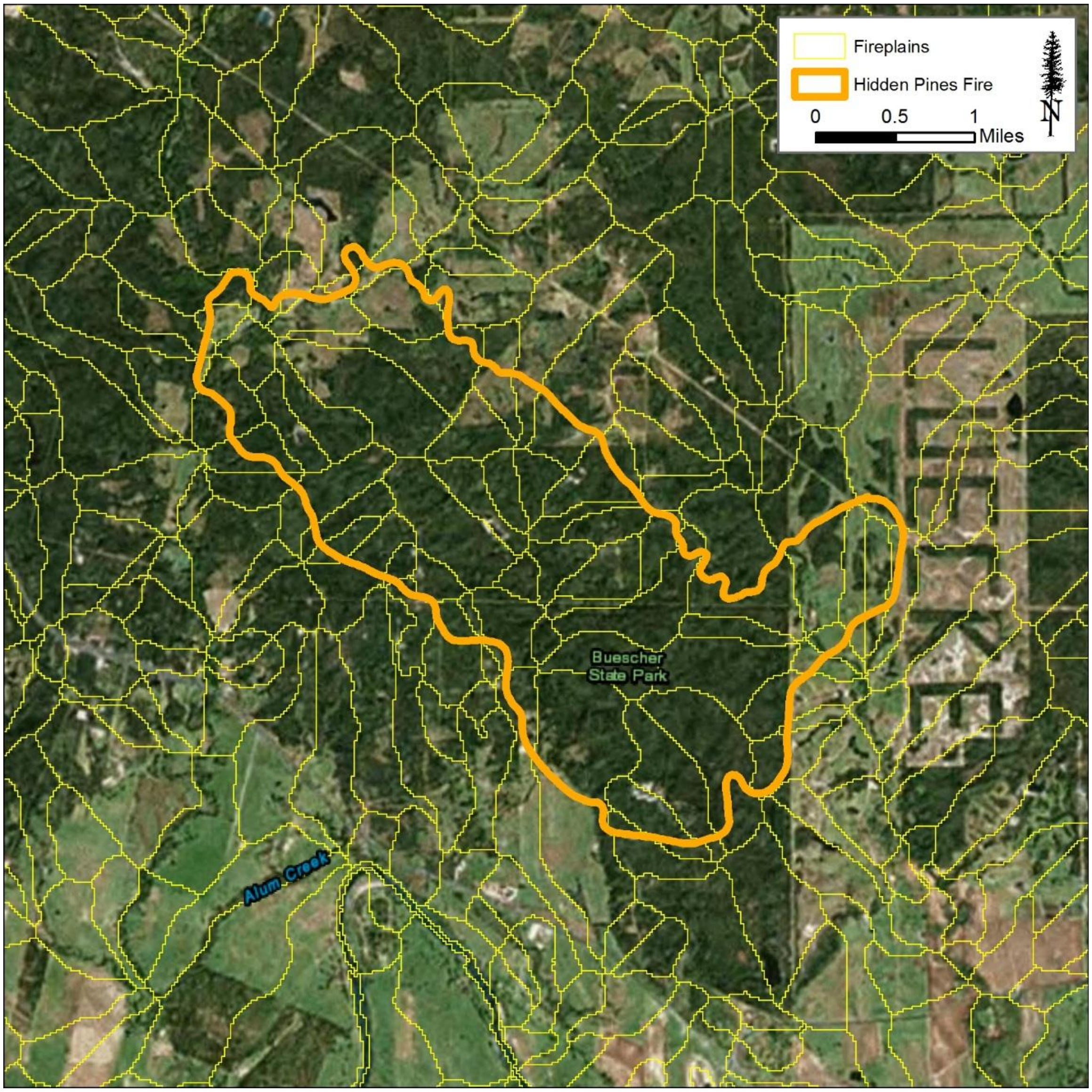
Map Figure 9 Custom fuel modeling incorporating remote sensing and field techniques. @Anchor Point Group LLC

As can be seen in the examples of inputs and outputs in fire behavior modeling for Map Figure 10, the results are quite raw in appearance and can be difficult to interpret for pre-planning purposes. The 30m squares (pixels) can have widely differing fire behavior predictions in areas immediately adjacent to each other, which can make analysis at fine scales difficult.



Map Figure 10 Example of fire behavior modeling outputs (flame length in feet). @Anchor Point Group LLC

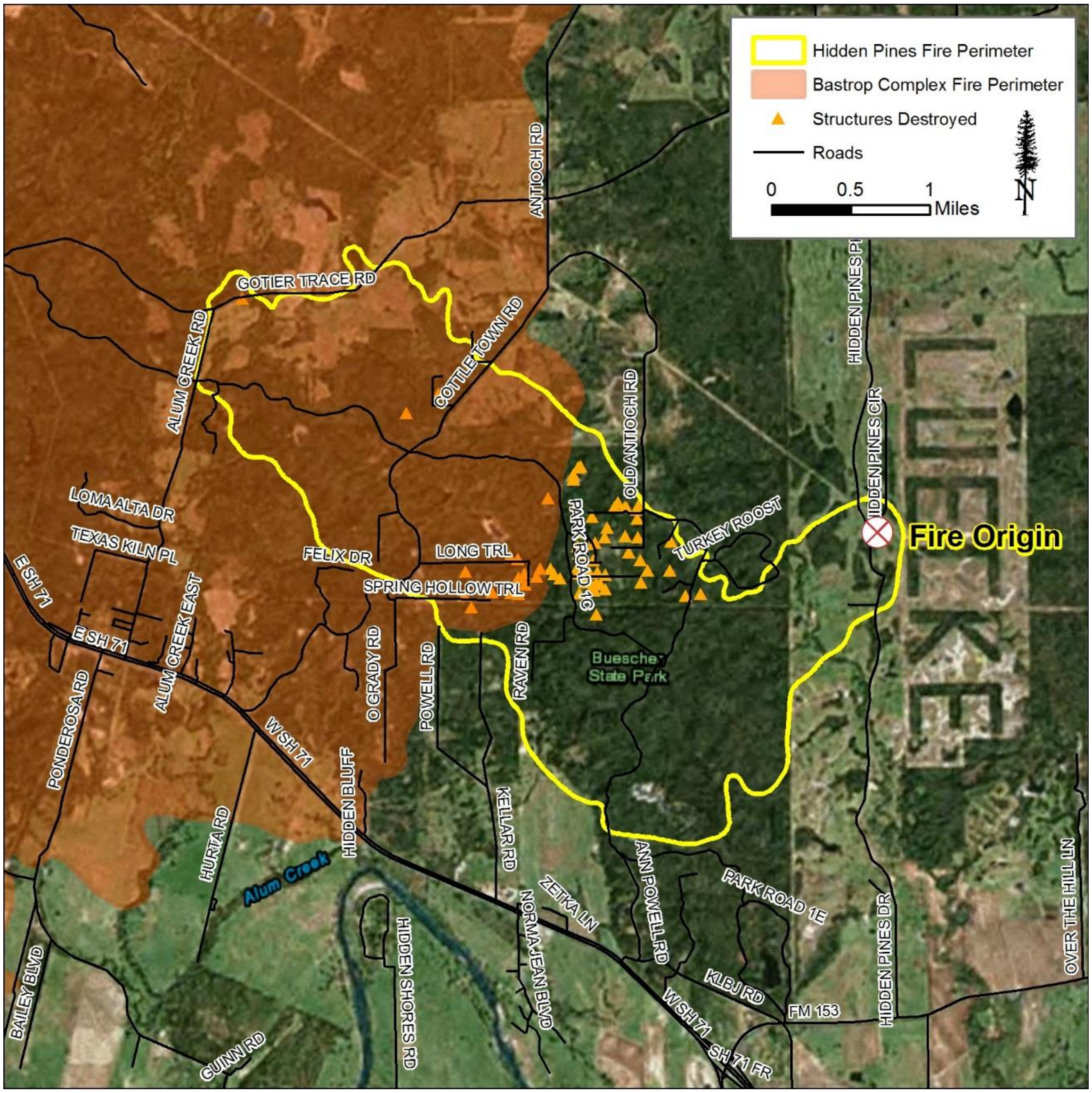
Anchor Point along with Bastrop County created the fireplain concept in order to aggregate individual pixels into a more easily understood spatial context as shown in Map Figure 11. Fireplains are segments of the landscape created using the topography of the area. The goal in creating them is to focus on one side of a drainage where the aspect is somewhat standard. These units also tend to group natural vegetation better than squares and other ways to divide the landscape.



Map Figure 11 Example of fireplains created specifically for Bastrop County, Texas. @Anchor Point Group LLC

The Hidden Pines Fire

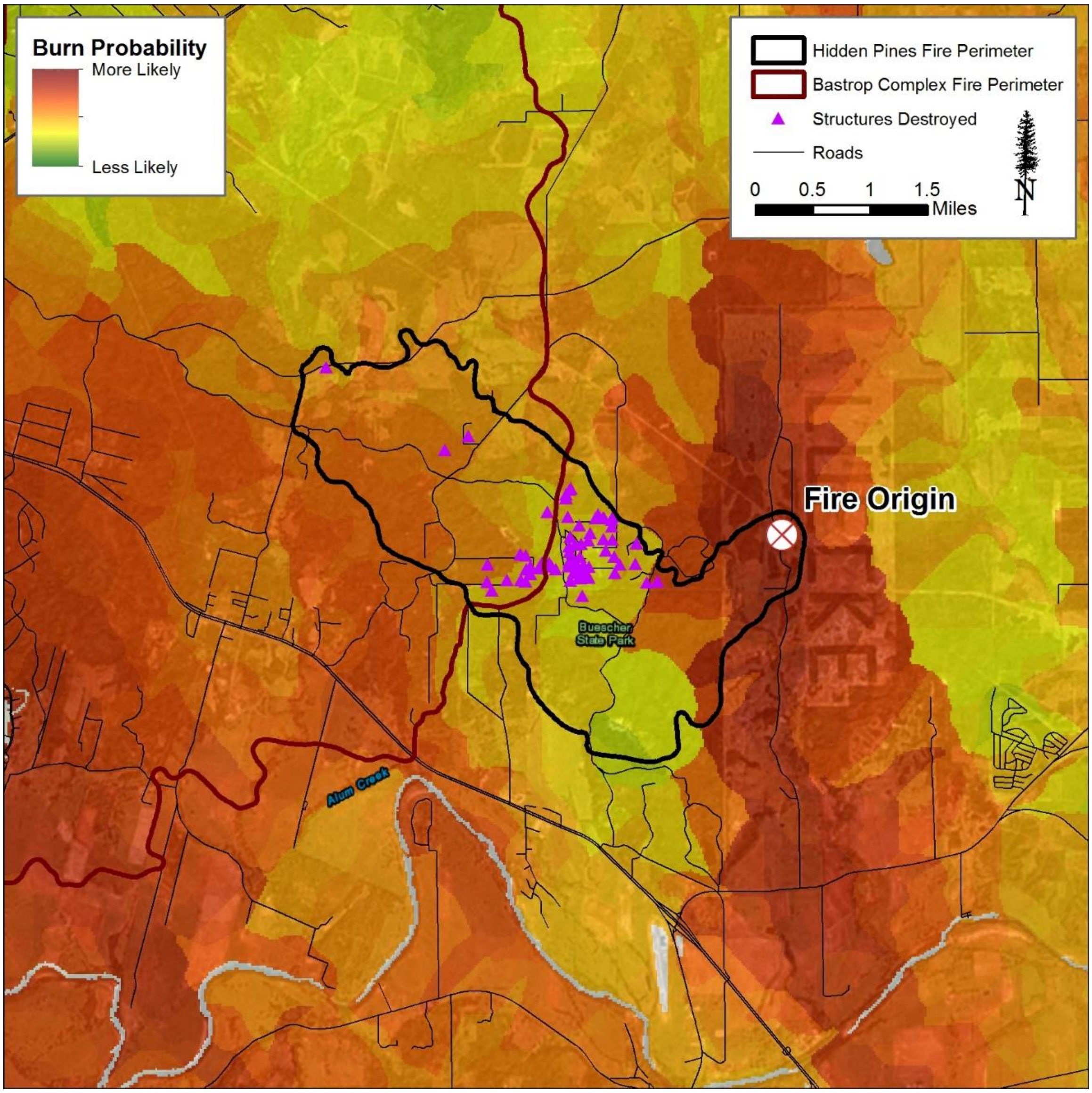
The fire started on the northwestern edge of the LUEKE property and was blown by wind toward the southwest shown in the general reference Map Figure 12. Later, the fire expanded greatly and moved in a northwest direction. It was during the second day when changes in winds (toward the northwest) resulted in intense fire behavior in heavy fuels and loss of structures.



Map Figure 12 General reference map of the Hidden Pines fire. @Anchor Point Group LLC

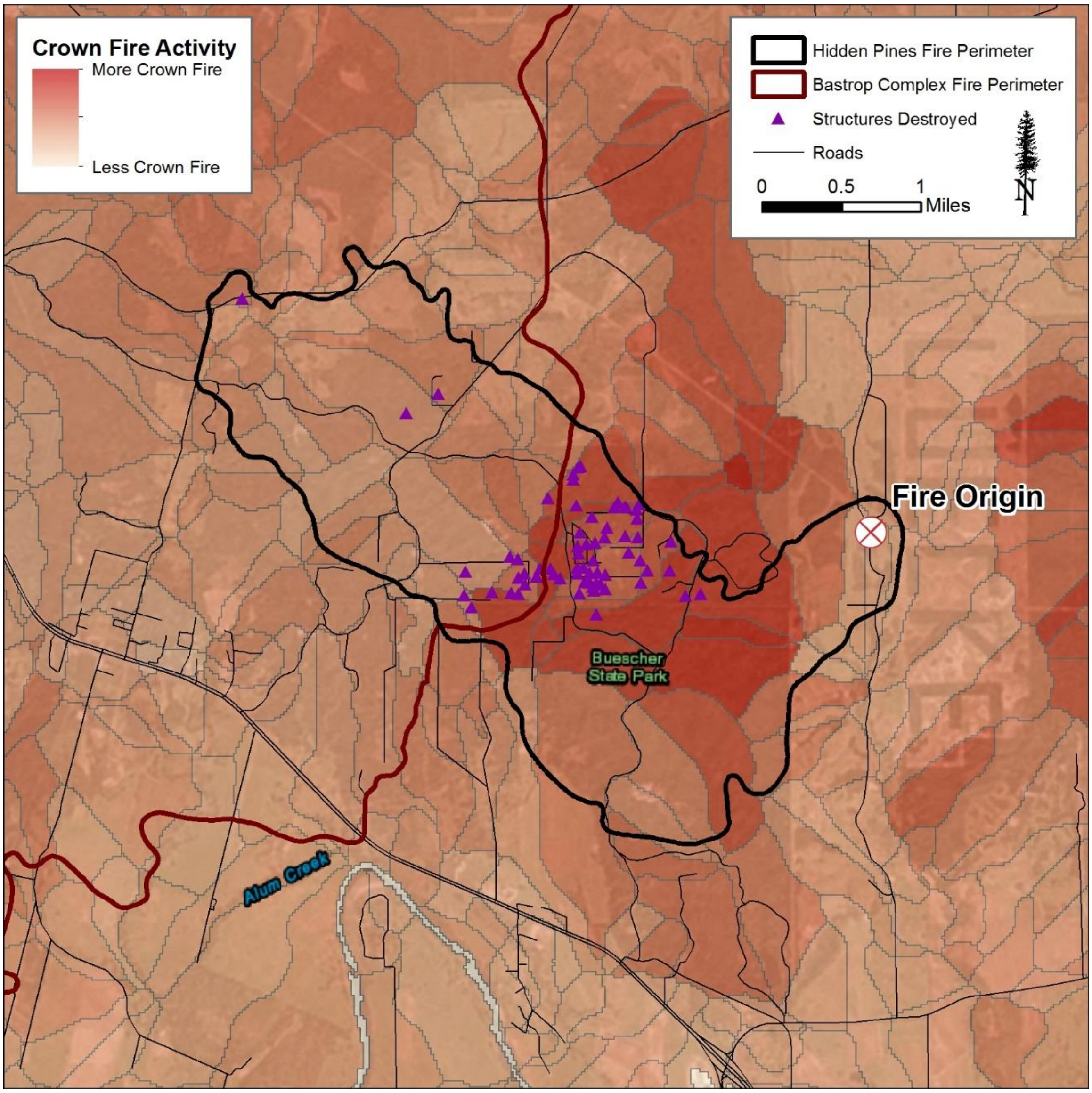
During the fire behavior modeling process, simulated ignitions were started randomly; fires started by those ignitions were allowed to burn using prevailing weather conditions inputted into the model. Any areas within each simulated fire were recorded as burned each time it was within a simulated fire perimeter. After an estimated 70,000 of simulated fires with random ignition locations, the number of times each location on the landscape was burned was recorded. Areas prone to burning were those that burned the largest number of times in the simulations.

The models examination of burning probability across the landscape was shown in Map Figure 13. The darker red areas were predicted to be the most likely locations to burn, regardless of where a fire might have started. The Hidden Pines fire started in one of the areas likely to burn frequently (according to Anchor Point modeling utilizing Fireplains).



Map Figure 13 Results of burn frequency modeling utilizing Fireplains. @Anchor Point Group LLC

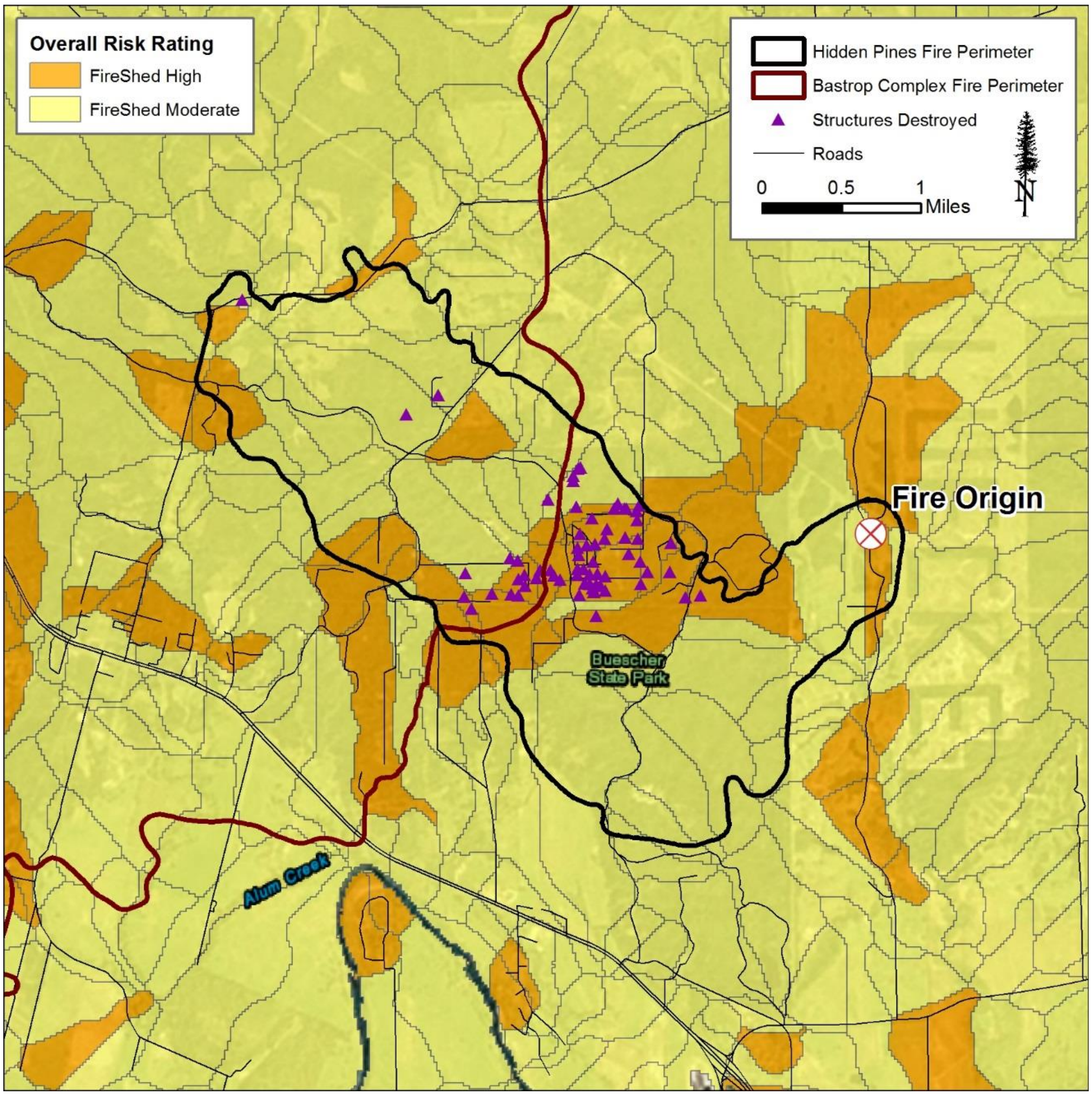
Once the fire started, the phase of the fire where burn frequency matters is over. At that point, predicted behavior of the burning fire is most important. Two-fire behavior layers are useful for assessing where a burning fire will be most dangerous – flame length and crown fire activity. Flame length is a prediction of the length of the flame from base to tip and crown fire activity reflects whether a fire was predicted to burn into the crowns or tops of the trees. Extreme values in either one of these layers will represent a significant threat to structures, but crown fire is a special danger. As seen in Map Figure 14, the majority of the structures lost were in areas predicted to have significant crown fire, due to heavy fuel loads.



Map Figure 14 Results of crown fire modeling utilizing Fireplains. @Anchor Point Group LLC

Anchor Point's National Hazard and Risk Model (No-HARM)

Anchor Point's National Hazard and Risk Model (No-HARM) is a combination of all of the factors discussed above. It combines fire behavior predictions (aggregated by fireplains), fire frequency modeling, information about the built environment such as parcel and road density and susceptibility to flame impingement, ember cast and smoke. This combination produces a Map Figure 15, which shows where on the landscape structures might be susceptible to wildfire. The map shows high values around the fire origin associated with the burn frequency and high values around the structures destroyed that are associated with fire behavior once a fire was ignited. The combination of approaches shows locations on the landscape that are more likely to threaten structures.



Map Figure 15 National Hazard and Risk Model (No-HARM) results for the areas around the Hidden Pines fire. @Anchor Point Group LLC

Bastrop County Wildfire Web Mapping Portal

Data sets such as No-HARM are extremely valuable to the planning process, but without the ability to view and interact with them, they will sit on a hard drive collecting virtual dust.

Anchor Point modeled to identify areas that are prone to supporting fire starts under various weather scenarios. Areas that displayed a propensity to burn often were identified as "high burn probability" areas. For much of the county this identified grassy areas vs dense timber areas as its easier to start fires in grass than timber (a spark might start a grass fire but the same spark wouldn't start a fire if it landed on a tree trunk) The model is simulating ignitions in vegetation and the ignitions are computer based, and does not discern between lightening, equipment etc. The model tries to identify areas that have a propensity to burn most frequently. Once a real fire happens, this portion of the model is no longer needed and modelers would turn to rate of spread, fireline intensity and other modeled fire behavior to predict areas that might burn severely enough to impact or damage homes and infrastructure.
For the Hidden Pines Fire, the ignition occurred in an area we predicted to have a high propensity to burn, and the majority of the structure loss occurred in an area we predicted to have significant fire behavior resulting in impact to structures.

As a part of the Bastrop County wildfire pre-planning project, a web map interface (Figure) was developed that allows the user to look at the various data produced as part of the project. The interface combines No-HARM data with data already in possession of the County and allows the user to ask spatial questions of the data. Questions would include: Which portions of the county are most likely to experience wildfire ignitions? Where is crown fire the most prevalent? Which areas of the county are furthest from a fire station? Which of two potential development sites would require the least investment in mitigation for wildfire? What is the fire threat in my neighborhood? The Portal incorporates sophisticated tools that allow the trained user to explore the many data sets generated as part of the project.

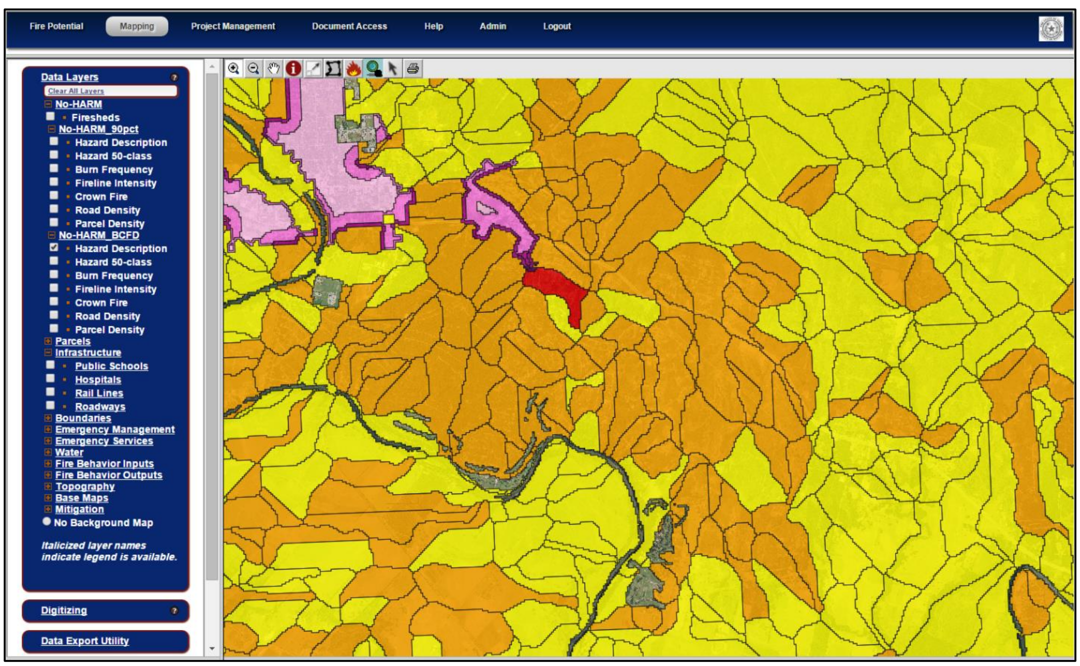


Figure 20 the Bastrop County Wildfire Web Mapping Interface Portal. @Anchor Point Group LLC

Section 10: Conclusions and Recommendations

Technical discussions with fire fighters, dash camera videos and radio traffic captured the spatial extent of the spread of the fire and actions taken to protect structures. The data collected and analyzed indicates that first responders would identify numerous primary structures where defensive actions were taken. The majority of impact to structures would take place during a 4-hour period. Overall, the first responders were effective in saving 440 structures despite extreme fire behavior in heavy unburned fuel loads. For every eight homes, lost or damaged 55 homes were defended or were not directly impact from the fire.

It should also be recognized that the most important statistic is ZERO:

Number of fatalities - ZERO

Number of serious injuries - ZERO

Wildland Urban Interface

Unfortunately, this has not been the first large home loss fire within the county. Conversations involving defensive actions have been presented to the community in the past. Homeowners, community leaders and first responders need to start recognizing that fire spread and behavior during a WUI fire, and the subsequent losses, involves the interaction of multiple factors including pre-fire mitigation technologies, fire and ember exposure during the fire, and defensive actions; measures need to be taken by all parties involved.[1]

Characterizing fire behavior, quantifying structure response, assessing exposure conditions and developing efficient and effective WUI mitigation strategies are in their infancy. It was thought that post-fire assessments alone, particularly given the current state of the art will never be able to individually successfully perform the above characterizations, quantifications, and assessments. Integrated laboratory and field experiments, coupled with physics based fire modeling and innovations are needed. The National Institute of Standards and Technologies continues to do research in all these areas of WUI fire. The following are recommendations are aimed at creating an overall paradigm shift in responding to WUI fires[1]:

- Develop, plan, train and practice SOPs, based on better understanding of exposure and structure vulnerabilities, to enable rapid fire department response to WUI fires. SOPs need to account for responding, in the event of a specific WUI scenario, to both high and low exposure areas.

- A response time threshold for WUI fire situations needs to be developed based on increased understanding of exposure and structure vulnerabilities, the same way city fire departments have response thresholds for responding to building fires.
- Structure spatial arrangements in WUI areas where defensive actions are ineffective or unsafe need to be identified.
- Mitigation plans for high density WUI areas, with the objective of fire not reaching these areas, need to be designed and implemented. Long-term solutions should be planned for continuation of grant-funded projects such as the ongoing FEMA mitigation project for wildfire fuel reduction.
- Defensible space definitions need to be updated to emphasize that the main desired result is the ability for first responders to defend locations and recognize hazards of primary structures and dangerous configurations of topography and fuels outside the home ignition zone (HIZ).
- Hazards at the WUI, factoring in fuels, topography, and local weather need to be quantified. Fuels need to include wildland fuels and structural/residential fuels such as wood roofs, fences and combustible decks.
- Wildland fuel treatment standards to quantify exposure reduction for different topographical and weather conditions need to be developed.
- Construction standards and test methods need to be up-dated to capture representative fire and ember exposures from fuel treatments.
- Due to complexities associated with timeline reconstruction, exposure characterization and defensive actions, rapid post fire need to identify/count destroyed homes, and focus on documenting damage and destruction to the WUI environment, using current technology and comprehensive methods for documentation.
- Protocols for collection of ground and aerial imagery for pre-fire, during-fire and post-fire situations need to be developed.
- Consistent protocols for collection of damage information in a WUI environment need to be developed.

The above activities would require integration of post-fire assessment data in the WUI and wildlands with lab and field experiments, coupled with validated computational fluid dynamics (CFD) fire models to gain a better understanding of exposure, structure vulnerabilities and fire behavior.

Commonalities of the Hidden Pine fire related to previous fires in Bastrop County:

- Drought Conditions - preceding all fires extreme drought conditions were present in the county.
- Extreme Fire Behavior - spotting, torching and changing fire behavior in burned and unburned fuels.
- Problematic Fuel Loads - in heavy pine with thick understory and needle drape.
- Initial shortage of available resources - local fire, law enforcement and support agency resources and personnel, though well-equipped and trained for day to day service, are not able to provide adequate resources in quantities required for a major event and must rely on assets obtained through mutual aid and inter-local agreements with regional, state and federal agencies.
- Property loss - destruction of homes/contents, outbuildings, vehicles and businesses
- Safety - extreme threat to the safety of the public and responders.

- Rapid evacuation - of neighborhoods took precedence over fire suppression efforts. Law enforcement personnel and fire fighters were exposed to extreme danger in completing evacuation assignments.
- Triage – Fire fighters were required to triage home sites in making decisions regarding the potential for protecting structures. In some cases, lack of pre-fire preparation, access issues or non-existent defensible features resulted in greater risk to safety than could be justified in aggressive protection tactics.

Recommendations

Citizens of Bastrop County

- Continual mitigation around homes throughout the year is necessary. Homeowners often voice the desire to live in the woods for its aesthetic beauty and privacy. Steps can be taken reduce vegetation which makes structures vulnerable during wildfires and still allow for the nature lifestyle.
    - Removing lower branches and pulling vegetation away from a structure. When fuels accumulate, they allow fires to burn hotter, faster and with higher flame lengths. Areas of continuous mid-story vegetation can burn as "ladder fuels" and may quickly move from a ground fire into a crown fire
    - Keeping roofs and gutters clean of debris reduces the exposure threat from embers
    - Pier and beam platform construction increase accumulation of debris under structures which requires removal to prevent movement of fire under a structure and skirting to prevent accumulation.
    - By breaking up the continuity of vegetation on larger land tracts homeowners can still maintain a forested feel while reducing fuel loads that will alter fire behavior
- Homeowners need to understand and be aware when critical thresholds for fire weather and fuels are being reached - low relative humidity and windy conditions require monitoring while heeding warnings and advice given by officials.
- No two fires are alike and homeowners need to understand that regardless of the number of resources, there will be fire events that exceed suppression efforts and homes will be lost.
- Homeowners must comply with building codes and restrictions established within the county and should be adequately insured against structure and content loss.
- Residents and businesses should have plans to evacuate or seek suitable shelter when advised. Such plans should include travel safety, preservations of records and documents, medical needs, pet and animal care.

County and State Agencies

- County and state cannot come onto private lands without permission to mitigate fuels, so landowners need to be willing to cooperate with local authorities. Agencies need to develop ad provide incentives to these landowners to conduct fuel reduction projects.
- Continue fuel reduction projects on public lands including mechanical treatment, prescribed burning, herbicides and re-introduction of desirable native vegetation.
- Mapping of hazards within and around a community has begun by the county; this together with preplanning for rapid and targeted deployment within the community, can improve firefighter safety and in many cases reduce structural losses.
- The Hidden Pines fire was preceded by heavy rains and flooding and within 90 days the area was in drought conditions. Local agencies must pay attention to rapidly changing weather conditions and be situationally aware of rapidly developing fire conditions.
- Building codes and development within the county need to be examined and discussed.
- State agencies with wildfire responsibilities should monitor regional fire conditions and pre-position firefighting assets in Bastrop County when fire risk escalates locally and in Central Texas. County officials with wildfire responsibilities should assist the prepositioning of State assets through pre-event agreements for staging areas and logistical support systems.
- All agencies must be prepared to provide timely and accurate emergency information, both internally and externally. All information, announcements and advice should be made in cooperation with other agencies.
- Agencies should continue with building shelter facilities and fashion plans for support and sustainability of those shelters.

Responders

In this context, responders include emergency response agencies, utilities, schools, public works, recovery units, logistical support units, financial personnel and volunteer agencies.

- Responders should provide training for new and current individuals to adequately perform within command and management structures for type 3 events and non-traditional response/recovery roles.
- Maintain situational awareness prior to, during and after an incident. Responding agencies should increase/decrease readiness levels commensurate with hazard threat potential.
- Responders must follow the Incident Command System (ICS) to insure safety of personnel and the public. Agencies must assure that personnel assigned tasks are fully trained and equipped before accepting those assignments. Agencies should train and exercise emergency response techniques regularly.
- Responder agencies with shelter or donations management responsibilities should collaborate on planning for operations and support of new shelter facilities built in Bastrop, Elgin and Smithville.
- Every volunteer fire department in the county needs to be working with homeowners to develop strategies to actively assist in removing vegetation around homes.

Emergency Management

- The Bastrop County Office of Emergency Management (BCOEM) should continue to update and keep current planning documents, protocols, inventories of resource availability and training.
- BCOEM should remain prepared to provide ICS command and general staff roles on type 3 or higher incidents and/or as directed by the County Judge, as the Director of Emergency Management.
- BCOEM should assure that recovery planning is initiated early in an incident that has involved evacuation, sheltering or significant loss of property. When reasonable, recovery tactics should be developed within an appropriate function of the incident's operation section. The recovery functions mobilized during the response phase can then be later transitioned into the long-term recovery need.
- BCOEM should coordinate partnership(s) with the business community to focus on disaster preparedness, response and recovery. A system or functional group could be modeled after the very successful Bastrop County Long Term Recovery Team, which provides for the individual citizen recovery. Such a group could then be integrated into the County's EOC activations to minimize economic impacts caused by disasters.
- BCOEM should develop precise protocols for rapid and detailed damage assessment.
- BCOEM should provide resources, coordination support and progress tracking of all recommendations discussed in this report that may be accepted or adopted by other partnering agencies.

Appendix

Appendix A - Fire Statistics

Started: October 13th
Acreage: 4,582
Ignition Cause: Equipment
Homes Saved: Total of 440 homes saved within the operational area
Homes Lost: Total of 64 homes lost within the operational area
Total Value of Structures Loss: $3,365,827 *based on available tax records
Total Value Private Land Loss: $2,490,692
Under Burn Ban: Yes
Fire Occurred on Private Property: Yes
Class: F Size Fire (1000-4999 acres)
Financial Assistance: Fire Management Assistance Grant
Total Hazard Trees Removed: 1004
Total Hazard Trees to be Removed: 3000

State Agencies:

Texas Forest Service

- 10 Dozers
- 3 Engines
  - 2 - Type 6
  - 1 - Type 7

Texas Intrastate Fire Mutual Aid System

- 25 Engines
  - 4 - Type 1
  - 9 - Type 3
  - 1 - Type 4
  - 11 - Type 6
- 4 Water Tenders
- 2 Saw Modules (14 sawyers)

Texas Parks and Wildlife Division

- 7 Engines
  - 1 - Type 4
  - 3 - Type 6
  - 3 - Type 7

Florida Department of Forestry

- 10 Tractor Plows

Total State Resources:

- **20 - Dozers**
- **35 - Engines**
- **14 - Sawyers**
- **10 - Tractor Plow**
- **4 - Water Tenders**

Aviation: Suppression (State Resources)

1 - Very Large Air Tanker (VLAT)
2 (TYPE 2) Air Tankers
4 Single Engine Air Tankers
8 (TYPE 1) helicopter - State Agencies

- 1118 Bucket Drops
- 1,226,980 Gallons of Water/Retardant

1 (TYPE 2) helicopter - Travis County
1 (TYPE 3) helicopter - Travis County

Volunteer Fire Departments:

Emergency Service District (ESD) 1
4 – Type 6 Engines
1 – Type 1 Engine
1 – Type 3 Tender
18 - Personnel

Emergency Service District (ESD) 2
7 – Type 6 Engines
1 – Type 1 Engine
1 – Type 3 Tender
1 – Type 7 Ranger with Skid Unit
28 – Personnel

Elgin VFD
1 – Type 6 Engine
1 – Type 1 Engine
12 – Personnel

Heart of Pines VFD
2 – Structural Engines
2 – Type 6 Engines
1 – Mini Pumper
1 – Tender
18 – Personnel

Winchester VFD
3 – Type 6 Engines
1 – Type 2 Engine
1 – Tanker
14 – Personnel

Appendix B - Declaration of Disaster

WHEREAS, the County of Bastrop the 14th day of October, 2015, is in imminent threat of widespread or severe damage, injury, or loss of life or property resulting from

Wild fire and wind, and

WHEREAS, as the County Judge of Bastrop County, I have determined that extraordinary measures must be taken to alleviate the suffering of people and to protect or rehabilitate property,

NOW, THEREFORE, BE IT PROCLAIMED BY THE HONORABLE PAUL PAPE, COUNTY JUDGE OF BASTROP COUNTY:

1. The state of disaster shall continue for a period of not more than seven days from the date of this declaration unless continued or renewed by the Commissioner Court of Bastrop County.
2. This declaration of a local state of disaster shall be given prompt and general publicity and shall be filed promptly with the Bastrop County Clerk.
3. This declaration of a local state of disaster activates the county emergency management plan.
4. That this proclamation shall take effect immediately from and after its issuance.

Ordered this 14th day of October, 2015.

Paul Pape

Paul Pape
Bastrop County Judge

FILED
OCT 14 2015 3:00 pm
Rose Pietsch
Bastrop County Clerk

Appendix C - Response from State

TEXAS DEPARTMENT OF PUBLIC SAFETY

5805 N LAMAR BLVD • BOX 4087 • AUSTIN, TEXAS 78773-0001
512/424-2000
www.dps.texas.gov

STEVEN C. McCRAW
DIRECTOR
DAVID G. BAKER
ROBERT J. BODISCH, SR.
DEPUTY DIRECTORS

COMMISSION
A. CYNTHIA LEON, CHAIR
MANNY FLORES
FAITH JOHNSON
STEVEN P. MACH
RANDY WATSON

November 3, 2015

The Honorable Paul Pape
County Judge
Bastrop County
Bastrop, Texas

Dear Judge Pape:

This is in response to your letter dated October 30, 2015, to request federal assistance in Bastrop County as a result of wildfires started on October 13, 2015. I would like to personally and professionally thank you for your leadership and continuous attention to the citizens of Bastrop County and the state of Texas. Through your leadership, lives and property have been saved.

On October 14, 2015, the state requested a Fire Management Assistance Grant (FMAG) that was quickly approved by the Federal Emergency Management Agency (FEMA) to support mitigation, management, and control of the wildfires. In addition, as Bastrop County qualified for the Small Business Administration (SBA) Disaster Loan Program, Governor Abbott is requesting an SBA declaration to assist the county and jurisdictions within the county.

It is unfortunate that I must inform you, as catastrophic as this fire was to the residents of Bastrop County, the severity of the damage did not meet federal criteria for public and individual assistance required for these programs. As mitigation money from the FMAG becomes available, I look forward to working with you and your team to apply this federal resource to protect Bastrop County.

We understand the disruption, damage, and impact, wildfires can inflict and we remain supportive of the residents and businesses in your county as you move through the long-term recovery process.

Please contact me with any questions at 512-424-2436.

Sincerely,

W. Nim Kidd, CEM®
Assistant Director
Texas Department of Public Safety
Chief
Texas Division of Emergency Management

cc: Senator Kirk Watson
Representative John Cyrier
Tom Polonis
Mike Miller
Traci Brasher

Enclosure

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Appendix D - Home Loss Data

House ID	Year Built	Foundation	Exterior Finish	Roof	Deck	Improved Value Loss	Land Value Loss
1	1941	Pier-n-Beam	Hardi Board	Metal	No	$55,364.00	$49,500.00
2	1958	Slab	Wooden	Metal	Undetermined	$38,465.00	$215,169.00
3	1974	Pier-n-Beam	wooden	Metal	Undetermined	$25,610.00	$76,793.00
4	1975	Pier-n-Beam	Wooden	Composite Single	Yes	$61,492.00	$17,070.00
5	1976	Slab	Wooden	Metal	Undetermined	$109,162.00	$40,261.00
6	1977	Pier-n-Beam	Wooden	Wood Single	Yes	$228,852.00	$96,615.00
7	1978	Pier-n-Beam	Wooden	Metal	Yes	$14,867.00	$32,923.00
8	1978	Pier-n-Beam	Wooden	Metal	Yes	$23,690.00	$46,591.00
9	1978	Pier-n-Beam	Wooden	Metal	Yes	$62,808.00	$44,550.00
10	1978	Pier-n-Beam	Wooden	Metal	Yes	$72,031.00	$18,140.00
11	1979	Pier-n-Beam	Wooden	Metal	Undetermined	$23,815.00	$50,754.00
12	1979	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$64,213.00	$52,328.00
13	1979	Pier-n-Beam	Wooden	Composite Single	Undetermined	$56,755.00	$32,414.00
14	1980	Pier-n-Beam	Wooden	Metal	Yes	$17,733.00	$29,846.00
15	1980	Undetermined	Undetermined	Undetermined	Yes	$0.00	$0.00
16	1980	Undetermined	Undetermined	Undetermined	Yes	$88,831.00	$52,371.00
17	1981	Pier-n-Beam	Wooden	Metal	Yes	$161,059.00	$13,204.00
18	1982	Pier-n-Beam	Wooden	Metal	Yes	$49,343.00	$21,394.00
19	1982	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$0.00	$0.00
20	1983	Pier-n-Beam	Undetermined	Composite Single	Yes	$64,510.00	$19,604.00
21	1986	Pier-n-Beam	Undetermined	Metal	Yes	$76,028.00	$68,285.00
22	1986	Pier-n-Beam	Undetermined	Undetermined	Yes	$21,832.00	$42,061.00
23	1986	Slab	Brick	Composite Single	Yes	$76,997.00	$58,888.00
24	1987	Undetermined	Undetermined	Undetermined	Undetermined	$10,571.00	$48,124.00
25	1988	Slab	Hardi Board	Metal	Yes	$24,360.00	$18,200.00
26	1989	Slab	Wooden	Metal	Yes	$61,310.00	$30,055.00
27	1994	Pier-n-Beam	Wooden	Metal	Undetermined	$64,716.00	$16,664.00
28	1996	Pier-n-Beam	Wooden	Metal	Yes	$63,061.00	$50,898.00
29	1996	Pier-n-Beam	Undetermined	Composite Single	Undetermined	$85,824.00	$30,263.00
30	1997	Pier-n-Beam	Undetermined	Metal	Yes	$3,778.00	$30,000.00
31	1999	Slab	Brick	Composite Single	Yes	$179,065.00	$31,508.00
32	2004	Pier-n-Beam	Hardi Board	Composite Single	Yes	$0.00	$0.00
33	2005	Slab	Wooden	Composite Single	Yes	$189,109.00	$73,505.00
34	2005	Slab	Wooden	Metal	Undetermined	$125,930.00	$40,000.00
35	2008	Pier-n-Beam		Undetermined	Undetermined	$0.00	$0.00
36	2009	Undetermined	Wooden	Metal	Yes	$4,704.00	$0.00
37	2009	Pier-n-Beam	Undetermined	Composite Single	Undetermined	$80,888.00	$0.00
38	2009	Slab	Wooden	Wood Single	Yes	$299,096.00	$483,319.00
39	2009	Slab	Wooden	Wood Single	Yes	$69,283.00	$0.00
40	2009	Slab	Wooden	Wood Single	Yes	$26,587.00	$0.00
41	2009	Slab	Wooden	Wood Single	Yes	$75,651.00	$0.00
42	2009	Pier-n-Beam	Wooden	Metal	Yes	$139,060.00	$32,212.00
43	2009	Slab	Wooden	Metal	Yes	$70,711.00	$31,133.00
44	2009	Pier-n-Beam	Undetermined	Metal	Undetermined	$6,312.00	$40,251.00
45	2009	Undetermined	Undetermined	Undetermined	Undetermined	$23,440.00	$0.00
46	2009	Pier-n-Beam	Wooden	Composite Single	Undetermined	$50,162.00	$21,384.00
47	2012	Pier-n-Beam	Wooden	Metal	Yes	$32,620.00	$70,416.00
48	2013	Pier-n-Beam	Wooden	Composite Single	Undetermined	$47,868.00	$0.00
49	2013	Slab	Wooden	Metal	Undetermined	$211,566.00	$42,384.00
50	2013	Undetermined	Undetermined	Undetermined	Undetermined	$6,048.00	$69,566.00
51	2015	Pier-n-Beam	Hardi Board	Composite Single	Yes	$0.00	$0.00
52	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	$0.00	$0.00
53	Undetermined	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$0.00	$0.00
54	Undetermined	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$0.00	$0.00
55	Undetermined	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$12,040.00	$41,960.00
56	Undetermined	Pier-n-Beam	Undetermined	Metal	Undetermined	$0.00	$0.00
57	Undetermined	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$0.00	$0.00
58	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	$8,610.00	$210,089.00
59	Undetermined	Pier-n-Beam	Undetermined	Metal	Undetermined	$0.00	$0.00
60	Undetermined	Pier-n-Beam	Undetermined	Metal	Undetermined	$0.00	$0.00
61	Undetermined	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$0.00	$0.00
62	Undetermined	Pier-n-Beam	Hardi Board	Composite Single	Undetermined	$0.00	$0.00
63	Undetermined	Pier-n-Beam	Undetermined	Undetermined	Undetermined	$0.00	$0.00
64	Undetermined	Pier-n-Beam	Aluminum	Aluminum	Yes	$0.00	$0.00
					Total Loss	**$3,365,827.00**	**$2,490,692.00**

Appendix D Home Loss Data for Hidden Pines Fire

Appendix E - Texas Parks and Wildlife Tree Assessment Tables

Burn Severity Table for all plots sampled (1244-1247) at Buescher State Park, Bastrop County, Texas[13] Lower values indicate higher burn severity.

Plot	Substrate Severity (Avg.)	Vegetation Severity (Avg.)	Overall Severity
1244	3.70	3.77	Scorched
1245	4.60	4.60	Scorched
1246	1.77	1.57	Moderately Burned
1247	3.30	3.27	Lightly Burned

Tree Post-burn Assessments for all plots sampled (1244-1247) at Buescher State Park, Bastrop County, Texas[13]

Plot	Avg. Scorch (%)	Avg. Scorch Height (m)	Avg. Char Height (m)	Fire Severity (FMH-21)
1244	59.5	7.0	0.7	Scorched
1245	2.1	4.7	0.3	Scorched
1246	100.0	10.9	9.3	Moderately Burned
1247	56.6	6.6	0.6	Lightly Burned

Overstory Tree Mortality by Species Following October 2015 Hidden Pines Fire at Buescher State Park, Bastrop County, Texas[13]

Plot	Species	Trees (Pre-fire)	Trees (Post-Fire)	% Change	Burn Severity
1244	Juniperus virginiana	1	1	0.0	Scorched
1244	Pinus taeda	1	1	0.0	Scorched
1244	Quercus margarettae	15	15	0.0	Scorched
1244	Quercus marilandica	4	4	0.0	Scorched
1245	Pinus taeda	11	11	0.0	Scorched
1245	Quercus margarettae	12	12	0.0	Scorched
1245	Quercus marilandica	1	1	0.0	Scorched
1246	Pinus taeda	3	0	-100.0	Moderately Burned
1246	Quercus margarettae	5	0	-100.0	Moderately Burned
1246	Quercus marilandica	1	0	-100.0	Moderately Burned
1247	Pinus taeda	2	2	0.0	Lightly Burned
1247	Quercus stellata	14	14	0.0	Lightly Burned
	Total	**70**	**61**	**-12.9**	

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