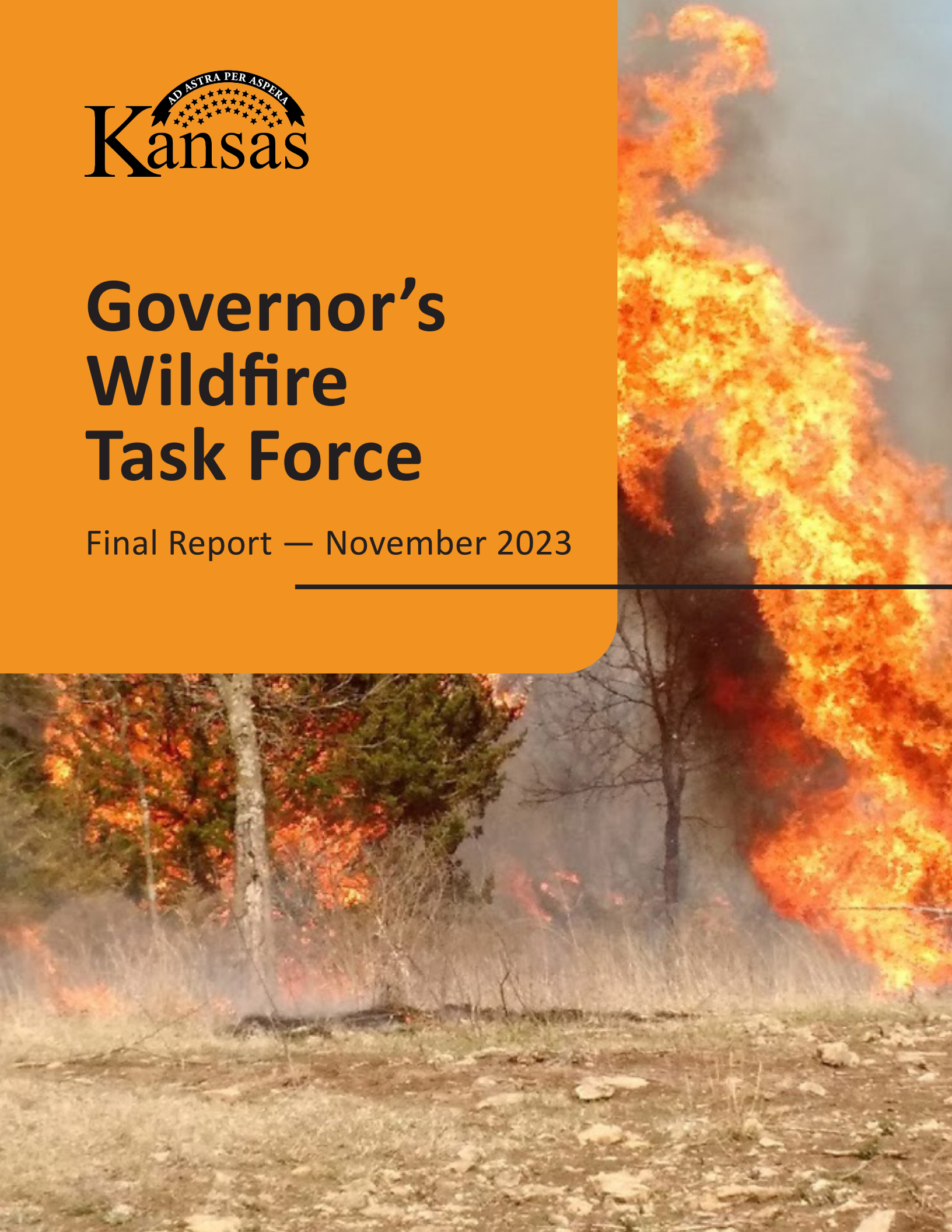
Kansas

Governor's Wildfire Task Force

Final Report — November 2023



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Letter from the Secretary

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Mike Beam, Secretary

Laura Kelly, Governor

Governor Laura Kelly
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Dear Governor Kelly,

It's an honor to serve as the coordinator of your Wildfire Task Force, created in the summer of 2022. It was humbling to learn about how much is done by first responders, firefighters, and community leaders across the state, many of whom are volunteers. The Task Force members represented many state and local agencies and organizations which are directly involved in wildfire mitigation, response and recovery, as well as private citizens who have experienced wildfire events in recent years.

I have appreciated the candid, yet cordial, exchange of concerns and suggestions among the Task Force members. It's obvious to me that these entities have enhanced their collaborations and partnerships in recent years in response to multiple large-scale wildfires since 2016.

Several legislators served on the Wildfire Task Force, and discussion at many meetings included specific suggestions that could serve as legislation to address some of the public concerns. It is anticipated legislation will be proposed and considered in 2024 addressing some recommendations within this report. In addition, many of these recommendations will take several years to consider and possibly implement. I'm confident many of the Task Force members welcome the opportunity to interact and engage in the near future upon request.

As you'll read in the report, the Task Force concluded that weather trends and increasing fuel loads will continue to create challenges for reducing the risks of future large-scale wildfires throughout the state of Kansas.

In closing, I want to thank Kansas Department of Agriculture staff who've assisted in organizing the Task Force meetings and preparing this report. I appreciate their willingness to support this initiative in addition to daily demands of their responsibilities at the Department. Please let me know if you have questions or recommendations going forward.

Sincerely,

Mike Beam
Kansas Secretary of Agriculture

Introduction

Wildfires have become an increasingly destructive threat in Kansas, with an impact that affects the lives and livelihoods of Kansans statewide. The causes of the wildfire crisis are complex, and the solutions to preventing, responding to, and recovering from these wildfires are equally challenging for communities across Kansas.

During the past 10 years, Kansans have experienced multiple large-scale wildfires that caused catastrophic financial losses from destroyed homes, buildings, vehicles, machinery, equipment and agricultural fencing, as well as livestock deaths and loss of feed inventories. Rather than respond following each specific fire, the 2022 Legislature set a permanent sales tax exemption for agricultural fencing.

In addition, these fires have jeopardized the lives of the state's residents and the safety of our firefighters and first responders — many of whom serve in a volunteer capacity. Addendum #1 includes highlights of the scope of eight of the recent large-scale, devastating fires in Kansas.

According to state officials, Kansas experiences at least 5,000 reported wildfires a year, which makes the state in the top five states for wildfire incidents, despite an estimate that 30% of the state's wildfires go unreported.

In 2022, Kansas Governor Laura Kelly declared that it was time for our state's leaders to take a comprehensive look at mitigating wildfire threats, review the role that local governments and state officials respond to such emergencies and address how these entities can and should provide more support to communities impacted by devastating wildfires. To address these issues and questions, Governor Kelly appointed a Wildfire Task Force in July 2022 to exchange thoughts and expertise on these questions and submit a report with their findings and recommendations. Addendum #2 is a list of the Task Force members.

This Task Force report contains those findings and recommendations, organized into three sections: Mitigation and Prevention, Response, and Recovery.

In the Mitigation and Prevention section, the Task Force examines the efforts in place to monitor fire risk, major contributors to the fire risk across the state, and work that is underway to mitigate that risk. The Response section examines the response plans and systems that are in place locally and statewide and how they could be strengthened. The Recovery section examines the plans for long-term recovery following a wildfire event.

Recommendations from the Task Force are incorporated into each section, and a full compilation of the recommendations is included at the end of the report. Addendums that follow the report provide additional background that was shared with the Task Force throughout the process. Addendum #3 specifically outlines the financial support that would be necessary to

put the recommendations into practice. For further reference, the Kansas Forest Service has provided a Glossary of Wildland Fire Terminology that can be found at agriculture.ks.gov/WildfireTaskForce.

Some of the conclusions and suggestions from the Wildfire Task Force mirror issues that were expressed in the report of the federal Wildland Fire Mitigation and Management Commission in September 2023. However, the Task Force was able to focus on concerns that are specific to the geography, demographics, and culture of Kansas.

The Task Force worked to take a comprehensive look at the role that local governments and state officials play in the prevention of and response to wildfires, and engaged in candid discussions to address how that role could be enriched and expanded through policy changes.

The threat of wildfire will continue, and the impact on Kansans could be devastating without collaborative efforts to reduce the risk and strengthen the response capabilities for our communities. The recommendations included in this report can serve as a strong first step in moving Kansas in the right direction to reduce the threat of wildfires and protect public safety.

Mitigation and Prevention

State Hazard Mitigation Plan (SHMP) for Kansas
The Kansas Division of Emergency Management is responsible for producing the State Hazard Mitigation Plan (SHMP). A Wildfire Risk section is included in the Risk Assessment Chapter, (Section 3.3.20). A Task Force member from KDEM briefed the Task Force on their efforts and plan to update this section. The SHMP rates the probability of future fire hazard events as "highly likely." The highest concerns noted in the risk assessment are the spread of Eastern redcedars, urban/wildland interface, and staffing of volunteer fire departments. The plan includes descriptions of recent large fires, crop insurance payouts as the result of wildfires, how much wildfires cost the state, the probability of future hazard events, drought and fire potential in Kansas and our surrounding states, and a hazard risk index. There is also a chart that shows counties most likely to have the highest losses. Community Wildfire Protection Plans and Firewise Communities are highlighted as mitigation programs.

The SHMP specifically states a Community Wildfire Protection Plan (CWPP) is one way communities can reduce their overall vulnerability to wildfire by identifying specific areas at risk and actions that can be taken to reduce risk. A CWPP is the most effective way to take advantage of various federal programs for assistance. As of June 2022, there were 15 approved plans in 15 counties, 3 plans pending, and 9 plans in progress. Since that time, several additional plans have been completed and more are in progress. The Kansas Forest Service has helped to coordinate most of the CWPPs and has plans to hire a consultant for help with additional CWPPs.

Firewise Communities is another program to help communities mitigate for wildfire risks. Thus far there is only one community with this designation in Kansas (University Park in Manhattan).

Kansas Wildfire Risk Assessment Portal
As noted earlier in this report, all areas of Kansas are at risk of wildfire impacts. Several risk assessment tools exist at various scales and that are based on various baseline data. A tool to assess risk at the state, county and local level — all the way down to the individual homeowner — that is based on Kansas-sourced data has not been available until recently. In October 2023, the Kansas Forest Service released its Kansas Wildfire Risk Assessment Portal which can be found at kansaswildfirerisk.org. This tool is now available to the public and should reduce the impacts of wildfires in several ways.

- Identify areas most prone to wildfire.
- Plan and prioritize fuel treatments (i.e., manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control).
- Define priorities and improve emergency response across jurisdictional boundaries.
- Increase communication with residents to address community needs and priorities.
- Identify areas where additional tactical planning may be needed, especially regarding mitigation projects and development of CWPPs.
- Provide robust data to support resource, budget and funding requests.

- Plan for response and wildfire suppression resource needs.

The Kansas Wildfire Risk Assessment Portal provides a consistent, comparable set of scientific results to be used as a foundation for wildfire mitigation and prevention planning in the state of Kansas. Results of an assessment can be used to help prioritize areas in the state where mitigation treatments, community interaction, education, or tactical analyses might be necessary to reduce risk from wildfires.

Weather and Fire Risk Monitoring
Kansas lacks unified fire weather and danger messaging, which critically complicates response and public interpretation. While the National Weather Service (NWS) provides essential information for fire weather decision making such as Fire Weather Watches and Red Flag Warnings, these are limited to weather — mostly humidity and wind information. The Kansas Mesonet provides real-time fire weather information for first responders essential for proper suppression, response, and public safety. Additionally, this vital Kansas State University 85 weather station network utilizes the National Fire Danger Rating System (NFDRS) to help responding agencies develop staffing, communication and response plans based upon fuel, fire and climatological data. This information assists agencies and departments to communicate uniformly throughout the state. Instead of varying decision information limited by political boundaries, the entire state of Kansas utilizes similar messaging and decision information as a result.

Through a Mesonet NFDRS forecast product utilizing the NWS forecast data, both the fire weather and fuel landscape can be predicted into the future. This combination provides a value added product that will greatly assist the NWS watch/warning process. It has established a unified platform for fire departments and state agencies to properly develop staffing and associated plans in advance of a fire event. This alone could decrease wildfires in the state and works to potentially minimize fire impacts with quicker suppression and less threat to life and property. Additionally, this will substantially aid media partners in effective messaging around higher fire potential days.

Recommendation:
- The Task Force supports the expansion of the Kansas Mesonet and recommends statewide support for use of the fire danger index based off the National Fire Danger Rating System using Mesonet data. It also suggests consideration for state funding to support the necessary maintenance to sustain accurate and quality future decision support data in the long term.

Mitigation Funding Sources for Kansas
Most of the Kansas landscape is privately owned. Therefore, the responsibility and burden for implementation of actions that mitigate wildfire risk falls primarily on private individuals who often need financial support to implement mitigation practices. Addendum #4 is a list of federal

grants available for landowners and communities seeking to mitigate fire hazards. The Task Force observed some of these programs are relatively new, such as the Community Wildfire Defense Grant program, and the public may not be aware of these resources. Unfortunately, many of these grants require a non-federal matching contribution that if not covered by a local, county or state government entity could be financially prohibitive for many private individuals to afford.

Recommendations:

- The Task Force acknowledges that woody species encroachment is a significant natural resource issue in Kansas and encourages state and federal agencies to make cost share funding a priority for controlling and reducing woody species on private lands.
- The Task Force encourages state and federal agencies that own or manage public lands to prioritize land management strategies that control and reduce woody species and/or invasive plant species encroachment on public lands in collaboration with adjacent private landowners. This should include rights of way along transportation corridors including interstates, highways and railways. Funding options should utilize state and federal financial assistance as available.
- The Task Force recommends additional funding to the Kansas Forest Service for a Community Wildfire Protection Plan coordinator and fuel reduction program.
- The Task Force encourages additional state support for technical assistance that enables additional communities to obtain the Firewise Community designation.
- The Kansas Legislature should create a dedicated fund that's available for matching grants or financial assistance for mitigation, prevention and recovery.

Invasive Trees and Woody Species as a Threat for Wildfires

Task Force members noted that over the last 20-plus years, the Kansas landscape has evolved in a manner that creates greater risks for wildfires that are almost impossible to contain during dry and windy conditions. One of these changes is encroachment of woody plant species in rangelands, on publicly owned wildlife and recreation areas, along roadsides, and on the edge of dense population areas.

A report by Dirac Twidwell, PhD, and others, titled "Wildfire Risk and Woody Plant Encroachment in Kansas" (Addendum #5), claims the "encroachment of volatile woody fuels has therefore been identified as a leading driver of increasing wildfire risk" in regions experiencing woody species encroachment. The 300,000 acre Anderson Creek Fire in 2016 and the 400,000+ acre Starbuck Fire in 2017, are examples of the magnitude that a wildfire can reach when it ignites or spreads to rangeland areas containing heavy Eastern redcedar infestations.

The importance of curtailing further encroachment of woody vegetation is amplified by the "Wildfire Risk and Woody Plant Encroachment in Kansas" report, which claims "the number and severity of wildfires are expected to increase unless actions are taken to halt the expansion of volatile woody fuels."

The trend of increasing woody species encroachment is not limited to rural areas in Kansas. One example of woody encroachment in suburban areas is in Reno County, where a 2022 wildfire, called the Cottonwood Fire Complex, was responsible for burning 6,180 acres, killing one person, and destroying 36 homes, 92 outbuildings, and 110 vehicles. This fire was difficult to contain or put out because of windy conditions and a large amount of fuel load from Eastern redcedar trees throughout this residential community. Since this fire, Reno County has assembled a local task force to help implement mitigation practices such as encouraging landowners and homeowners to reduce cedar trees, providing fire breaks and firefighting corridors, practicing prescribed fire 100 feet from roadways, and supporting educational efforts about helpful wildfire mitigation practices for private homeowners in high risk areas. Adequate local, state and federal funding for this mitigation project is challenging.

Other Environmental Factors Contributing to Fire
Emergency responders have also reported there have been large fires in recent years that surround lakes which have a significant infestation of phragmites (a perennial wetland grass), Eastern redcedar trees, and hardwood trees such as salt cedar, and these fires are difficult to control due to rough terrain.

Accumulations of driftwood following flood events often create suppression challenges around many Kansas reservoirs. These fuels ignite easily, burn intensely, and hold heat for days or longer, in some cases, causing repeated fire events in the same area over several weeks. While the Kansas Department of Wildlife and Parks (KDWP) has a management plan in place to address this concern, continued support from partner agencies is encouraged as well as appropriate driftwood management by federal entities on portions of public land not under KDWP management.

The increase in farming practices related to residue management — including no-till farming and other practices — have changed the Kansas fire environment. Kansas fire departments could once count on crop production ground as potential fire breaks to slow or stop the spread of wildfires. This is becoming less common across the state due to increased use of no-till/minimal till farming. There are unarguable benefits to these practices, including soil health, erosion control, and drought/water management, but the tradeoff of increased fire risk should not be ignored.

Mitigation of Eastern redcedar and these other fire environment factors is not a one-time project. True risk reduction will require continued and ongoing efforts at the private, local, county and state levels.

Recommendation:
- Proper brush pile management is crucial in reducing the risk of wildfires. Identifying and planning for multi-day, post ignition weather factors is vital. Having appropriate resources and manpower to monitor and manage burn piles should be a priority.

Kansas Prescribed Fire Council
The Task Force recognizes that prescribed fires — conducted safely by trained individuals — serve as an invaluable and highly effective tool for reducing fuel loads, especially woody species encroachments, that can lead to hard-to-control wildfire events. The Kansas Prescribed Fire Council (KPFC) was created in 2005 to promote safe and responsible prescribed fires as an important natural resource management tool. It was noted by a Task Force member the KPFC plans to focus more on fuel mitigation through prescribed fire training to help reduce wildfire threats. An employee of the Kansas Forest Service serves as the LPFC Coordinator.

Currently, there are about 18 local prescribed burn associations (PBA), which are typically a group of local landowners and land managers who help each other with prescribed burns on a voluntary basis. In many cases, the KPFC and/or neighboring PBAs help newly forming PBAs train private landowners on how to conduct prescribed burns safely and effectively. At times, PBAs may receive excess federal equipment and can also apply for community wildfire defense grants in areas with a current Community Wildfire Protection Plan.

To date, KPFC had limited funding though KDWP State wildlife grant program to hire a Regional Fire Coordinator who worked with producers in the northcentral Kansas area on prescribed fire planning and PBA formulation. Funding for this position expired October 2023. On a limited basis, KPFC has helped local PBAs to purchase fire equipment through non-governmental organizations.

KPFC partners with the Kansas Grazing Lands Coalition, K-State Research and Extension, Kansas Prescribed Burn Association and others to providing training for landowners and land managers. More such training and outreach could be accomplished with additional resources to the KPFC Coordinator and Kansas Forest Service.

Recommendation:
- The Task Force recommends additional state funding to the Kansas Forest Service to enhance training and equipment opportunities for prescribed burn associations (PBAs), firefighters, and others who desire to use prescribed fires as an effective management and mitigation tool.

Task Force Conclusion and Observation:
- The Task Force acknowledges prescribed fire is an important mitigation tool that should be encouraged when conducted by trained and knowledgeable individuals.

Power Lines as a Cause of Wildfires
Task Force members, during several meetings, discussed reports and concerns regarding unsafe conditions of some secondary power lines (non-utility owned) in rural areas, including lines to oil/gas fields that cross rangelands in rural Kansas. During high wind events, there is a considerable risk of these lines breaking or touching and causing an arc that ignites fires. While not all fires are investigated for cause and origin, there is a common belief that the conditions of

inferior secondary power lines have in fact contributed to wildfires in the state in recent years. One Task Force member provided photos of low hanging, sagging lines with leaning poles that cross grasslands which would easily spark a fire(s) in a high wind event. Landowners have reportedly informed the private owners of unsafe secondary power lines and the utility which provides electricity to these users. To date, there have been limited responses to such concerns. Furthermore, there is some confusion regarding the responsibility for ensuring that weak, unsafe secondary power lines are properly maintained.

One sample tariff that serves a contract between the utility and the customer was provided to the Task Force. It specifically and clearly stated that "any and all wiring, appliances, or equipment required to transform, control, regulate or utilize beyond the point of delivery the electric service supplied by the Company (utility) which are furnished, installed and maintained by the customer will be the sole responsibility of the Customer." Furthermore, a separate agreement specifically authorized the utility to refuse or discontinue service "immediately, without notice required, when an unsafe or dangerous condition exists on the Customer's property."

Task Force members discussed the merits and feasibility of empowering utility providers to shut off power during dangerous weather conditions, which include abnormally high winds during dry conditions. No recommendation on this issue was made by the Task Force.

Recommendations:

- To assure compliance with addressing unsafe secondary power lines, the Task Force recommends state legislation or regulation assigning responsibility for inspecting and regulating the safety and integrity of secondary and private (non-utility owned) electric lines to the Kansas Corporation Commission.
- The Task Force encourages local utility users and providers to collaborate with local emergency managers and fire chiefs to help aid in reducing fire risks associated with inferior secondary power lines.

Conservation Reserve Program Lands in Kansas

The USDA Conservation Reserve Program (CRP) has been a popular conservation program in Kansas since implemented by the 1985 federal Farm Bill. Landowners who participate agree to idle previously tilled farmland and plant these fields to a perennial cover, which is primarily warm-season, native grass species in Kansas. Of the nearly 2 million acres in Kansas, the western half of Kansas is where the predominant number of CRP enrolled acres are located.

While CRP lands are sometimes hayed or grazed (with limitations established by USDA) in late summer, in most years these enrolled lands go undisturbed during the growing season and CRP grass can exceed 3 feet in height of dry standing grass and create a significant fire risk during dry and windy periods of winter and early spring.

One of the impediments to mowing CRP is the USDA policy that prohibits haying and grazing

during the grassland bird nesting season. If this policy would change and allow for haying or grazing earlier in the growing season, there would likely be more participation and less fuel for wildfires.

In addition, there reportedly have been concerns or hesitation by local firefighters to disk fire breaks in CRP for fear the landowner would be penalized for a violation of their CRP contract.

Recommendations:

- The Task Force encourages local and state U.S. Department of Agriculture Farm Service Agency officials to provide outreach or expand communications with Conservation Reserve Program landowners, tenants, emergency responders and other stakeholders to clearly outline the wildfire mitigation practices allowable under existing Conservation Reserve Program regulations.
- The Task Force encourages U.S. Department of Agriculture to modify restrictions for the timing and frequency of haying and grazing under a Conservation Reserve Program contract to improve grass quality and reduce fuel load.
- The Task Force supports current efforts to provide cost share for fencing and water development early in the Conservation Reserve Program contract to provide more flexibility in managing Conservation Reserve Program grasslands and to reduce fuel load for wildfires.

Response

Kansas Response Plan
The Kansas Response Plan recognizes Kansas adheres to the National Incident Management System (NIMS), which is a standardized approach for responding to emergency/disaster incidents, including wildfires. NIMS was formally adopted by a 2005 Executive Order and is referenced in the updated 2022 Kansas Response Plan.

Local governments are charged with developing their local emergency operations plan. Under NIMS, responses to emergencies/disasters begin with local governments, which have ultimate control with support from the state and federal partners. The local incident commander is responsible for directing on-scene emergency management and maintaining command and control of the on-scene incident operations. County emergency management authorities may request outside assistance when necessary and may also recommend the county commission issue a county disaster declaration and make a formal request for state assistance to the Kansas Division of Emergency Management (KDEM). If warranted, the State's Emergency Operations Center (SEOC) is activated to support local and state responses.

The Kansas National Guard has trained personnel (many with Red Card certification) and large equipment units that are ready for deployment to wildfire events with a Governor's declaration. Response time may be delayed, but this layer of assistance could be beneficial for large-scale fires that need expanded response.

Fire Management Assistance Grant Program
When a wildfire represents a "threat of major disaster," the state can request a Fire Management Assistance Grant (FMAG) from the Federal Emergency Management Agency (FEMA) to support management of fires. The FMAG program declaration process is initiated when the Governor (or Governor's authorized representative) submits a verbal request for assistance to the FEMA regional administrator (or designated FEMA regional fire duty liaison) while the fire is burning uncontrolled and threatening such destruction as would constitute a major disaster.

FMAG provides a 75% federal cost share only reimbursement to the grantee for actual eligible costs of fighting the eligible fire.

The Task Force reviewed the requirements for securing a FMAG and noted it's difficult for a local incident commander — who is often involved in responding to the fire — to contact KDEM and supply information necessary for applying before the fire is extinguished. In addition, identifying the 25% match is often a high hurdle for rural communities.

Recently, the federal Wildland Fire Mitigation and Management Commission, created by Congress in 2021, released a report that recommended changes to FMAG. The Commission specifically recommended the program make emergency protective measures eligible beyond the

end date of the incident period and support proactive support for actions that reduce the long-term impacts of a wildfire.

Recommendation:

- The Task Force encourages Congress to amend the Fire Management Assistance Grant statute to allow applications immediately following the incident and to broaden the eligibility for use of Fire Management Assistance Grant funds for recovery and mitigation.

Mutual Aid System and Agreements

When local firefighters need additional assistance, they often rely on prearranged mutual aid agreements to pull support and assistance (manpower, equipment, etc.) from neighboring firefighting teams across jurisdictional boundaries. The Kansas Mutual Aid System is established by law and all political subdivisions are automatically included unless they exercise the statutory provision to withdraw.

To facilitate the call and rapid response for assistance, KDEM has developed a Comprehensive Resource Management and Credentialing System (CRMCS), which among several functions, provides information on availability of equipment and personnel during an emergency and the ability to track assets in use at the time of the incident. It was noted during the Task Force discussions that some fire departments are reluctant to designate their equipment as "deployable" for fear their equipment will be moved to a location outside their area in a time they are needed for prepositioning locally during fire danger conditions. They may be more willing to input data into the system if they feel reassured that they have the right to decline a request to loan out deployable equipment. When CRMCS is not updated, it affects local response as well as the statewide response if information is not current and accurate. In addition, it was also suggested CRMCS is utilized more by emergency management than fire chiefs.

Attention is also needed regarding mutual aid agreements. In the event of a fire, the first response is usually calling neighboring departments, so updating local mutual aid agreements should be a high priority.

Recommendations:

- Establish a better system of collaboration between emergency managers and fire chiefs to input information into Comprehensive Resource Management and Credentialing System and keep it updated to keep the system current and useful.
- Local fire departments should annually update current local mutual aid agreements and contact information with neighboring departments. In addition, the State Fire Marshal is encouraged to keep a current statewide list of local fire department contacts.

Mutual Aid Box Alarm System
Several states, and some Kansas counties, are adopting the Mutual Aid Box Alarm System (MABAS) for deploying support for firefighting and other emergency responses. MABAS, started in the late 1960s, is a structured, planned mutual aid system for multijurisdictional and/or multi-agency responses within a state. All MABAS agencies operate on a common radio frequency, Interagency Fire Emergency Radio Network, and are activated for response through pre-designed run cards each participating agency designs and tailors to meet their local risk need. According to one website, MABAS includes over 750 fire departments and spans the states of Illinois, Wisconsin, Indiana, Michigan, and parts of Missouri and Iowa. It was noted one or more Kansas counties are considering adopting this system as well.

Recommendations:
- The Task Force encourages local fire chiefs, emergency managers, and/or other appropriate local officials to research Mutual Aid Box Alarm System to consider it as a possible tool for their jurisdiction.
- The Task Force encourages Kansas Division of Emergency Management and the statewide emergency response associations/stakeholders to study Mutual Aid Box Alarm System as a possible statewide tool and/or ways to improve the acceptance of Comprehensive Resource Management and Credentialing System by local emergency jurisdictions.

Multiple Radio Frequencies Among Firefighters
Several Task Force members reported that local fire departments often use outdated radios that operate on differing frequencies than neighboring counties and/or state agencies, including the Kansas Forest Service, Kansas Department of Wildlife and Parks (KDWP), and the Kansas Department of Transportation (KDOT).

KDOT's Statewide Interoperability 800 MHz Radio System (KSICS) is available for law enforcement, emergency responders and firefighters. Presently this system has over 56,000 public safety users and is estimated to cover 80% of all public safety functions in Kansas. It's been recommended that firefighting districts and departments invest in P25 radios and join the Interoperability Radio System and have the radios programmed with the Interoperability template. Reprogramming the radios is costly and time consuming. Updating to this system may be a significant expense for firefighters, especially the volunteer rural fire districts with a limited budget.

The Kansas Field Operations Guide (produced by the KDEM Emergency Communications Section) that provides information for templates for the radios is outdated. The information is on an app, but limited service in some areas means that information is not always accessible so hard copies are preferred.

It was reported that several state agencies had applied for Kansas America Rescue Plan Act (ARPA) grant money to update and repair firefighting equipment, including new radios.

On October 6, 2023, Governor Kelly announced more than $6.2 million from the Local Safety and Security Equipment grant (from federal ARPA monies), was awarded to 72 law enforcement, fire, emergency medical services, and 911 communications agencies. Over 30 of these local agencies were rural and urban firefighting agencies, who reportedly used the funds to replace or repair damaged firefighting equipment and radios, and for other purposes.

Recommendations:

- The Kansas Division of Emergency Management's Emergency Communications Section should update and redistribute hard copies of the Kansas Field Operations Guide to all users statewide.
- The Task Force encourages elected officials to seek funding to update firefighters' communication equipment and consider joining the state system to allow communication with most local and state firefighting agencies.
- State officials should continue to seek other opportunities to utilize federal grant funds to support equipment for public safety assistance including communications or other needs.

Challenges for Recruiting, Retaining, and Training Volunteer Firefighters

The Task Force spent considerable time discussing the need to provide stronger support for fire districts operated by volunteer firefighters. In Kansas, there are about 640 fire fighting agencies and districts. According to the National Fire Incident Reporting System, nearly 80% of the firefighters in Kansas are volunteers, and another 15% are partially volunteer. Only 6.4% of the firefighters in Kansas are full career firefighters. Some of the Task Force concerns and observations included:

- Volunteer firefighters often report they don't always have adequate support of their employers, especially for taking leave for training. It was suggested it would be beneficial if volunteer firefighters had the support and acceptance that employees usually experience who are enlisted in the National Guard.
- Currently about 10% of all Kansas firefighters have and maintain full National Wildfire Coordinating Group training. These qualifications allow them to participate in and learn from national deployment. However, such deployments are uncommon during the peak season of Kansas wildfire risk (winter and early spring).
- Firefighting districts with limited resources often struggle to determine balancing their limited resources between training and equipment expenditures.
- Kansas is one of a few states that doesn't require minimum standards or training for volunteer firefighters. The Task Force recognizes while proper training of volunteers offers more protection for firefighters and enhances firefighting skills, requiring such training could deter recruiting efforts for new firefighters.
- The Task Force applauds KDWP for offering prescribed burns as opportunities for hands-on training.

Recommendations:

- The Task Force encourages the Kansas Legislature to support and fund a study (up to

$250,000) of strategies which the Governor and Legislature could consider offering, including:

- Data related to the capacity, motivation, and roadblocks of current and future trends of volunteer firefighter service across Kansas.
- Incentives for volunteer firefighters as well as their employers to encourage volunteer firefighting.
- Impact of standards and training for volunteer firefighters.

Reporting and Investigations

As with all fire reporting, wildfire reporting is utilized for a wide range of data which can benefit the fire departments submitting the reports. The data is used to analyze trends, to qualify for grant funding, and in determinations of risk such as the recently released Kansas Wildfire Risk Assessment Portal. Wildland fire reporting data can be used to implement public education programs, accurately explain equipment needs for departments, determine standards of cover information, and watch/identify trends. After identifying problems, a prevention program can be developed and utilized. Many prevention programs rely on up-to-date reporting to aid public safety. Our fire service data is only as accurate as the reporting.

Investigation of the cause and origin of wildfires have been limited in past years, and has only taken place upon request of local responders. However, it has become clear that the state would benefit from having an origin and cause investigation following all wildfires, no matter how small or large. Increased investigations could potentially help identify the cause of wildfires which could contribute to improved mitigation and prevention. For example, some recent investigations have led to determining arson as the cause of some fires.

Recommendation:

- The Task Force supports incentives to report wildfires and recommends adjusting (shortening) the time frame in which reporting is required. In addition, the Task Force recommends expanding the reporting form to add the option to request an investigation regarding the cause of the fire.


COUNTY

Recovery

State of Kansas Disaster Recovery Plan
In addition to the State's Mitigation Plan and Response Plan, the Kansas Division of Emergency Management is also statutorily charged with producing and administering the state's Disaster Recovery Plan. This plan is intended to align with the National Disaster Recovery Framework and provide tools and templates to facilitate coordination among federal, state, tribal, local, private sector, and non-governmental disaster recovery stakeholders. Wildfire recovery is one of the disasters that's covered in the state's Disaster Recovery Plan. One key assumption of the plan is recovery operations are led at a local level, supported at the state level, and assisted at the federal level.

Local Recovery Efforts
In several instances, local volunteers stepped forward to support the local emergency recovery efforts following large wildfires in rural Kansas. This was most obvious after the Anderson Creek, Starbuck, and Four County fires. These communities experienced overwhelming recovery challenges from the loss of housing, injured and dead livestock, loss of hay for feeding local livestock that survived the fire, damaged fences, and other devastating losses. Within hours of the fire's extinguishment, people from across the state and U.S. began asking where they could send supplies and money to help those impacted by the fires. In these situations, a local ad hoc committee did their best to assess who needed what resources and where to send supplies that were being transported to these communities.

In the areas impacted by recent large-scale wildfires across Kansas, local volunteer community leaders have stepped up to help their neighbors by organizing, collecting, and distributing valuable supplies and labor donated to help them, sometimes even while their own property needs attention. These leaders have had to start from scratch in developing and learning the best processes and procedures to manage these very complex and overwhelming shows of support nationwide. Many times, the lessons in managing these recoveries are unfortunately having to be relearned after every event. Developing a continually updated and thorough set of resources, management recommendations, and experienced contacts could help tremendously to ensure recovery efforts are carried out as quickly and efficiently as possible by learning from and sharing insight from previous experiences.

Recommendation:
- The Task Force encourages state and local officials to develop a recovery resource tool kit that will serve as a continually updated resource and guidance on recovery for emergency managers, local volunteers, and community members on the programs, processes, and procedures learned and used to manage the cleanup, donations, distribution of supplies, and rebuilding after a broadly impactful wildfire. The plan should include a clearly defined process for distribution of these resources to local entities when needed.

Recovery for Farmlands

As noted earlier, the use of no-till/minimum till farming in Kansas has resulted in many fields that retain fuel from crop residues after the growing season. There are times a wildfire will move through these fields and burn off all soil cover. The soil health of these fields is depleted significantly, and it may take many years for these fields to return to their yield capacity as it was prior to the fire. In addition, tilled fields without any cover will be especially prone to wind and water erosion until regrowth in the spring, which causes additional complications.

One landowner noted that technical assistance and financial support for addressing the impact of the soil damages from a recent wildfire were less readily available than similar resources related to livestock losses.

Recommendations:

- The Task Force encourages public and/or private research to help design protocols for restoring soil health following a fire that burns off all or most of the residual cover on tilled farmland.
- The Task Force encourages the U.S. Department of Agriculture and the Kansas Department of Agriculture Division of Conservation to adopt financial assistance programs to address these situations.

Complete List of Recommendations

Mitigation and Prevention

- The Task Force supports the expansion of the Kansas Mesonet and recommends statewide support for use of the fire danger index based off the National Fire Danger Rating System using Mesonet data. It also suggests consideration for state funding to support the necessary maintenance to sustain accurate and quality future decision support data in the long term.

- The Task Force acknowledges that woody species encroachment is a significant natural resource issue in Kansas and encourages state and federal agencies to make cost share funding a priority for controlling and reducing woody species on private lands.

- The Task Force encourages state and federal agencies that own or manage public lands to prioritize land management strategies that control and reduce woody species and/or invasive plant species encroachment on public lands in collaboration with adjacent private landowners. This should include rights of way along transportation corridors including interstates, highways and railways. Funding options should utilize state and federal financial assistance as available.

- The Task Force recommends additional funding to the Kansas Forest Service for a Community Wildfire Protection Plan coordinator and fuel reduction program.

- The Task Force encourages additional state support for technical assistance that enables additional communities to obtain the Firewise Community designation.

- The Kansas Legislature should create a dedicated fund that's available for matching grants or financial assistance for mitigation, prevention and recovery.

- Proper brush pile management is crucial in reducing the risk of wildfires. Identifying and planning for multi-day, post ignition weather factors is vital. Having appropriate resources and manpower to monitor and manage burn piles should be a priority.

- The Task Force recommends additional state funding to the Kansas Forest Service to enhance training and equipment opportunities for prescribed burn associations (PBAs), firefighters, and others who desire to use prescribed fires as an effective management and mitigation tool.

- To assure compliance with addressing unsafe secondary power lines, the Task Force recommends state legislation or regulation assigning responsibility for inspecting and

regulating the safety and integrity of secondary and private (non-utility owned) electric lines to the Kansas Corporation Commission.

- The Task Force encourages local utility users and providers to collaborate with local emergency managers and fire chiefs to help aid in reducing fire risks associated with inferior secondary power lines.

- The Task Force encourages local and state U.S. Department of Agriculture Farm Service Agency officials to provide outreach or expand communications with Conservation Reserve Program landowners, tenants, emergency responders and other stakeholders to clearly outline the wildfire mitigation practices allowable under existing Conservation Reserve Program regulations.

- The Task Force encourages U.S. Department of Agriculture to modify restrictions for the timing and frequency of haying and grazing under a Conservation Reserve Program contract to improve grass quality and reduce fuel load.

- The Task Force supports current efforts to provide cost share for fencing and water development early in the Conservation Reserve Program contract to provide more flexibility in managing Conservation Reserve Program grasslands and to reduce fuel load for wildfires.

Response

- The Task Force encourages Congress to amend the Fire Management Assistance Grant statute to allow applications immediately following the incident and to broaden the eligibility for use of Fire Management Assistance Grant funds for recovery and mitigation.

- Establish a better system of collaboration between emergency managers and fire chiefs to input information into Comprehensive Resource Management and Credentialing System and keep it updated to keep the system current and useful.

- Local fire departments should annually update current local mutual aid agreements and contact information with neighboring departments. In addition, the State Fire Marshal is encouraged to keep a current statewide list of local fire department contacts.

- The Task Force encourages local fire chiefs, emergency managers, and/or other appropriate local officials to research Mutual Aid Box Alarm System to consider it as a possible tool for

their jurisdiction.

- The Task Force encourages Kansas Division of Emergency Management and the statewide emergency response associations/stakeholders to study Mutual Aid Box Alarm System as a possible statewide tool and/or ways to improve the acceptance of Comprehensive Resource Management and Credentialing System by local emergency jurisdictions.

- The Kansas Division of Emergency Management's Emergency Communications Section should update and redistribute hard copies of the Kansas Field Operations Guide to all users statewide.

- The Task Force encourages elected officials to seek funding to update firefighters' communication equipment and consider joining the state system to allow communication with most local and state firefighting agencies.

- State officials should continue to seek other opportunities to utilize federal grant funds to support equipment for public safety assistance including communications or other needs.

- The Task Force encourages the Kansas Legislature to support and fund a study (up to $250,000) of strategies which the Governor and Legislature could consider offering, including:

    - Data related to the capacity, motivation, and roadblocks of current and future trends of volunteer firefighter service across Kansas.

    - Incentives for volunteer firefighters as well as their employers to encourage volunteer firefighting.

    - Impact of standards and training for volunteer firefighters.

- The Task Force supports incentives to report wildfires and recommends adjusting (shortening) the time frame in which reporting is required. In addition, the Task Force recommends expanding the reporting form to add the option to request an investigation regarding the cause of the fire.

Recovery

- The Task Force encourages state and local officials to develop a recovery resource tool kit that will serve as a continually updated resource and guidance on recovery for emergency managers, local volunteers, and community members on the programs, processes, and procedures learned and used to manage the cleanup, donations, distribution of supplies, and rebuilding after a broadly impactful wildfire. The plan should include a clearly defined process for distribution of these resources to local entities when needed.

- The Task Force encourages public and/or private research to help design protocols for restoring soil health following a fire that burns off all or most of the residual cover on tilled farmland.

- The Task Force encourages U.S. Department of Agriculture and the Kansas Department of Agriculture Division of Conservation to adopt financial assistance programs to address these situations.

Major Wildfires in Kansas

1. The 2016 (March) Anderson Creek Fire totaled nearly 300,000 acres in Comanche and Barber counties primarily in grass and some timber. Terrain made access extremely difficult resulting in multiple communities and structures threatened. Resources from across the state were called in to assist, including a Kansas Forest Service (KFS) Incident Management Team, an All-Hazard Incident Management Team, and Kansas National Guard Blackhawk helicopters.

2. The 2017 (March) Starbuck Fire totaled approximately 463,887 acres in Kansas primarily in Clark County but also impacted Meade and Comanche counties. Fuels, terrain, and weather conditions were very similar to Anderson Creek with access to many portions of the fire extremely difficult. Weather conditions and fire behavior resulted in multiple communities threatened and some, such as Englewood, the fire burned through. Resources from across the state and nation were called in to assist, including an All-Hazard Incident Management Team, strike teams of additional fire engines from surrounding states, Kansas National Guard Blackhawk helicopters, and out of state National Guard Chinook helicopters. Property damage estimates were more than $44 million. The local National Resources Conservation Service office received approximately $18 million to help build 1,600 miles of fence in Clark County alone. As of the date of this Task Force report, the Starbuck Fire remains the largest fire recorded in Kansas history.

3. The 2017 (April) Highlands Fire was a fire in Reno County that burned approximately 7,000 acres. This fire required numerous resources from across the state including an All-Hazard Incident Management Team, and a Rocky Mountain Type 2 Incident Management Team. This fire was the beginning of formalizing task forces in the state. High winds, a heavy grass and brush fuel load, and a wind shift made the fire very difficult to control and threatened hundreds of homes.

4. The 2019 (November) Cherry Creek Fire in Cheyenne County was approximately 10,000 acres, and was the first fire utilizing airtanker 95. Responding state resources from KFS assisted with operations as well as coordinating the aviation response with airtanker 95 and National Guard Blackhawks.

5. The 2021 (December) Four County Fire (Ellis, Russell, Osborne, Rooks) occurred during a very large wind event that required multiple operational periods of aviation support from Kansas Forest Service and Kansas National Guard. This response also included task force deployments, two SEAT aircraft, NWDFMO, AFMO Fuels. The extreme fire behavior in a predominately grass fuel type threatened hundreds of homes and posed a major threat to ranches, fences, and livestock. Unfortunately, this was not the only wildfire threat faced that day. According to the combined data gathered from the State Fire Marshal and the Kansas Forest Service, a total of 54 wildfires occurred on December 15, with ignitions in 34 counties spread from Greeley and Wichita counties in the west to Leavenworth and Cherokee counties

in the north and southeast.

6. The 2022 (April) Carlson Fire in Riley and Pottawatomie county burned around 1,500 acres of grassland in Riley County and was wind blown across a narrow area of the Blue River into Pottawatomie County where around 1,000 acres of rangeland was consumed. This fire included areas of the Tuttle Creek Reservoir conservation pool and flood-downed trees. Both counties had timber-filled drainages and hillside areas. The fire was able to be contained about 2 miles from the city limit of Olsburg; 8 stations from Riley County, 4 stations from Pottawatomie County and 3 Marshall County Fire Departments responded. Aviation was unavailable due to high winds. On day 2 of this incident the Johnson County task force and KFS Engine 64 assisted with felling and mop-up activities on the Riley County side.

7. The 2022 (October) Ness/Ellis County Fire started in Ness County and traveled northeast into a little of Trego County and then into Ellis County on October 23. It was estimated that just about 10,250 acres burned in Ellis County with about 14,000 overall. Fire crews were already responding to two other fires in eastern Ellis County when this fire was paged out. A local disaster declaration was declared, and assistance was requested through the SEOC. The KFS responded to assist that evening. There were no homes lost, only one farm structure and a piece of county public works equipment burned. Ness County determined the fire to have started near an oil tank battery in their county.

8. The 2023 (April) Bronco Complex in Chautauqua county included 6 fires totaling about 5,700 acres. This required a lot of resources to suppress due to the fires being in timber fuel model and threating structures and towns. In addition to local resources, assistance with this 7-day event included two state task forces, one SEAT aircraft, KFS SE DFMO, and KFS Staffed Engine 461.

Task Force Roster

Kansas Governor's Wildfire Task Force Roster

Secretary Mike Beam
Kansas Department of Agriculture

Chief Steve Beer
Hutchinson Fire Department

Senator Elaine Bowers
Kansas Legislature

David Braun
Agricultural Landowner
Kansas Livestock Association

Dennis Carlson
Kansas Prescribed Fire Council

Terry David
Kansas Association of Counties

Daryl Donohue
Kansas Association of Conservation Districts

Kathleen Fabrizius
Kansas Emergency Management Association

Stephanie Goodman
Kansas Division of Emergency Management

Jason Hartman, State Forester
Kansas Forest Service

Senator Tom Hawk
Kansas Legislature

Doug Jorgensen, State Fire Marshal
Office of the State Fire Marshal

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Dean Krehbiel
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Dennis McKinney, Director
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Darin Myers
Kansas State Association of Fire Chiefs

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Kansas Emergency Management Association

Representative Jason Probst
Kansas Legislature

David Redger
Kansas State Firefighters Association

Chip Redmond
K-State Research and Extension

Stuart Schrag
Kansas Department of Wildlife and Parks

Lee Tafanelli
Kansas Electric Cooperatives

Representative Troy Waymaster
Kansas Legislature

Brenden Wirth
Kansas Farm Bureau

Financial Recommendations

RECOMMENDATION	AGENCY	BREAKDOWN	EXPENSE
Support for the Kansas Mesonet	K-State Agronomy Department	Salary Maintenance Additional Stations	$180,000 $170,000 $20,000
Cost share fund for control/reduction of woody encroachment	State Agency TBD	Cost share fund for work on private lands	$500,000
CWPP and fuels reduction work and assistance	Kansas Forest Service	Salary Operations	$288,943 $21,000
Firewise promotion and technical assistance	Kansas Forest Service	Salary Operations	$76,000 $5,523

RECOMMENDATION	AGENCY	BREAKDOWN	EXPENSE
State funds to use as match	Kansas Forest Service	Matching funds for federal mitigation grants	$500,000
Prescribed fire assistance and training	Kansas Forest Service	Equipment donation management	$100,000
		Training and Educational Programs	$50,000
Leverage FMAG and other federal funds for recovery	State Finance Council	State Disaster Assistance	$10,000,000
Study on volunteer recruitment and retention	Office of the State Fire Marshal	Contracted Services	$250,000*

*One-Time Expense

Funding Resources

Funding Resources for Mitigation
This is a list of some of the available funding resources that could be utilized for wildfire prevention, mitigation, response or recovery, developed with the input of the Wildfire Task Force members. This is not a comprehensive list, but provides several options for funding that could benefit Kansas communities.

- The USDA Forest Service's funding is tied to their strategy of resilient landscapes, fire adaptive environments, and safe wildfire response. Kansas ranks in the top five states of wildfire occurrences, with only 70% of fires reported. We would rank even higher with higher reporting. In prescribed fire acres, we are in the top two states in the country. However, we aren't recognized as a fire state.

- The Volunteer Fire Assistance grant is funded by the USDA Forest Service and is passed through to fire departments to purchase communication devices, PPE, pumps, monitors, hand tools, and other necessary equipment.

- The Wildland Urban Interface Grant Program is a competitive grant in the western states. It is hard for Kansas to get this grant due to the matching requirements. It can be used to fund fuel reduction, information and education, assessment and planning, and monitoring. Projects must be tied to a Forest Action Plan and Community Wildfire Protection Plan.

- The Fire Management Assistance Grant (FMAG) can be used for mitigation, management and control of fires on public land and private forests and grassland. It is managed by the Kansas Division of Emergency Management. These grants are often post-fire grants and require local matching funds.

- The Joint Chiefs' Landscape Restoration Partnership funding avenue can be used to reduce wildfire threats, protect water quality and supply, and improve wildfire habitat for at-risk species. Kansas is already working on an application in preparation for next year. Joint Chiefs is a partnership grant between USDA Forest Service and USDA National Resources Conservation Service. The grant is focused on projects near or adjoining to state or federally owned lands.

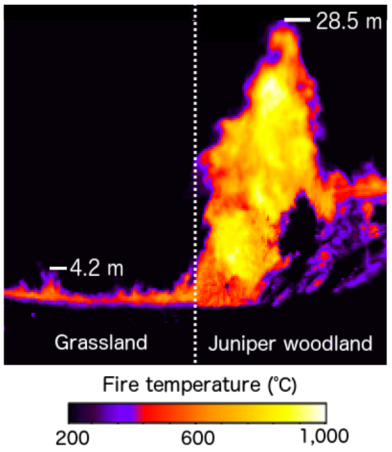
- The Community Wildfire Defense Grant program is $1 billion in funding over five years, but that includes federal administrative costs and it must be divided in half for the roof ordinance allocation, so the actual funding that ends up in local use can be significantly less. The funds can be used to develop a Community Wildfire Protection Plan or to implement projects in a current CWPP. In Kansas, few exist so we are working to get them developed. Three counties applied again in 2022 (Reno, Riley, and Wabaunsee), and six counties have indicated they are applying in 2023. Each plan will cost $60-80,000 to develop.

- The Recovering America's Wildlife Act includes $1.3 million that could be used for mitigation efforts on private land for cedar tree removal, fire guards, and water source facilities. Kansas' allocation is unknown. It is hard to know if Kansas would be able to make the match required. Kansas Department of Wildlife and Parks doesn't get any SGF funds for this function.

- The U.S. Department of Agriculture Natural Resources Conservation Service makes financial assistance available to agricultural producers to address natural resources concerns including mitigating against drought and increasing weather volatility. Specifically, increasing woody encroachment on our Kansas grasslands significantly increases wildfire risk. NRCS introduced the Great Plains Grassland Initiative (GPGI), part of USDA's Great Plains Grasslands Biome Framework, to address the major threat to our Kansas rangelands. GPGI set in motion an opportunity for private landowners and managers to address the woody plant encroachment that places much pressure on working rangelands.

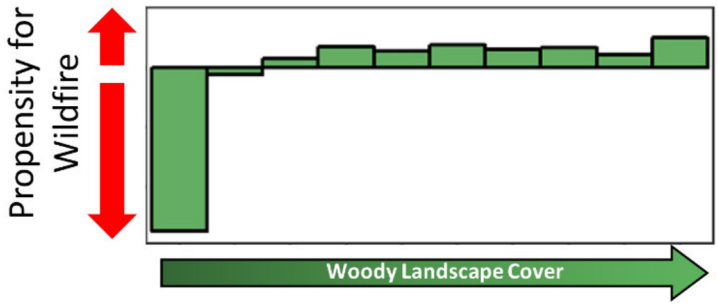
Wildfire Risk and Wood Plant Encroachment in Kansas

1. **Regions dominated by grasslands and croplands have lower wildfire risk and higher agricultural profitability.** Agricultural land uses of croplands and grasslands are either (i) unlikely to burn or (ii) lower fire intensities and wildfire danger than other land use types [1]. Encroachment of volatile woody fuels has therefore been identified as a leading driver of increasing wildfire risk while also negatively impacting livestock production and profitability for the region [1-2]. Volatile woody fuels like eastern redcedar increase volatile fuel loads, fire temperature, flame length, and spot-fire distance; all of which contribute to higher wildfire danger and reduced effectiveness of suppression tactics than croplands and grasslands [3–6].



Thermal fire imaging showing how volatile juniper woodlands increase wildfire danger and cause flame lengths above wildfire suppression thresholds compared to the same fire in a grassland vs. woodland [3].

2. **The number and severity of wildfires are expected to increase unless actions are taken to halt the expansion of volatile woody fuels**. The number and size of wildfires are increasing in the Great Plains, and the expansion of volatile woody fuels is a leading contributor [1, 5, 7]. Wildfires burn disproportionately more in woody vegetation than any other land-use type [1], and wildfires were more likely to occur when woody vegetation composes greater than 20% of the landscape [1]. The trend of larger and more intense wildfires is unlikely to change in Kansas and other Great Plains states without policy change that deals with the expansion of volatile woody fuels.

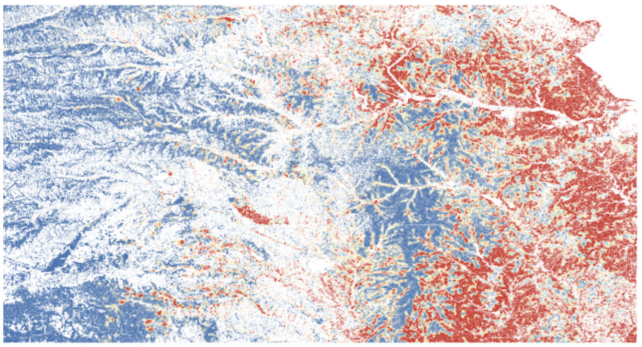


Analyses of all large wildfires in the Great Plains since 1985 show increased propensity for wildfire as woody cover increases and displaces grasslands [1].

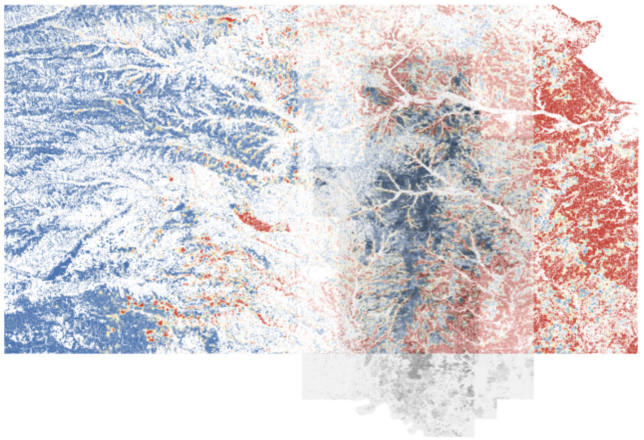
3. **Scientific monitoring platforms now exist to track the expansion of volatile woody fuels at the expense of agriculturally productive grasslands**. Kansas lost more than 1.5 million tons of forage production to woody encroachment in 2019, which is equivalent to the yearly forage need of 321,907 cows [2]. Tree cover increased in Kansas by 929,112 acres from 1990 to 2019, resulting in forage production losses in almost all Kansas counties (Please see Appendix 1; https://county-reports-dev.web.app/index.html). Without management action, increased grassland losses are expected due to woody encroachment [8], including losses in western Kansas where the initial stages of encroachment are happening now.

4. **Regions with a strong prescribed fire culture benefit both Kansas agriculture and wildfire prevention**. For example, the Kansas Flint Hills is among the most productive grassland regions in the United States and one of the only regions to prevent large-scale collapse from woody encroachment (see figure below; data from https://rangelands.app/), but the region requires more frequent fire applications today to deal with the pressures of woody encroachment than was required in previous decades [8-9]. Regional prescribed fire use is responsible for conserving the last regional-remnants of large-scale grasslands threatened by the expansion of volatile fuels, and therefore lowers wildfire risk than in landscapes that lack a regional prescribed fire culture [4, 10-11]. Other regions of Kansas that lack prescribed fire cultures are unlikely to replicate the resilience of the Flint Hills and sustain production or other management practices to prevent woody encroachment are unlikely to prevent increases in wildfire danger as woody encroachment expands westward and converts grasslands to woody-dominated landscapes.

Alternative grassland (blue) vs. woody (red) alternative ecological states in Kansas (without fire overlay)



Alternative grassland (blue) vs. woody (red) alternative ecological states in Kansas (with fire overlay; darker areas are burned annually whereas lighter colors are burned infrequently; data from Kansas Department of Energy and t Environment and Scholtz et al. 2020).



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APPENDIX

Net Acres Lost to Woody Plant Encroachment in US Great Plains States from 1991 to 2021 and the Cost to Treat Infested and Contaminated Areas Once. Acreages represent net acres lost or gained in each category between 1991 and 2021. Dollar amounts are cost estimates to treat the total area in each category one time in 2021 (based on NRCS payment scenarios for Kansas).

COUNTY	Intact	Contaminated	Infested	Woodland	Cost to Treat Contaminated and Infested Areas Once (USD)
	Acreage Change From 1991 to 2021	*Acreage Change from 1991 to 2021*	*Acreage Change from 1991 to 2021*	*Acreage Change from 1991 to 2021*	
Allen	-28,885	-19,181	+30,000	+18,067	$15,186,352
Anderson	-53,921	+10,992	+20,393	+22,537	$13,875,100
Atchison	-9,350	-10,750	+4,138	+15,962	$8,321,705
Barber	-181,127	+80,975	+90,444	+9,708	$29,594,353
Barton	-43,240	+31,264	+9,383	+2,593	$4,000,765
Bourbon	-32,517	-41,602	+25,893	+48,226	$26,153,446
Brown	-4,904	-5,454	+1,299	+9,059	$5,409,791
Butler	-297,717	+179,199	+97,070	+21,448	$31,756,514
Chase	-171,979	+141,531	+23,843	+6,605	$9,636,155
Chautauqua	-44,016	-20,635	-1,260	+65,911	$30,087,451
Cherokee	-8,656	-26,000	+7,627	+27,028	$14,670,745
Cheyenne	+5,451	-5,140	-316	+5	$540,564
Clark	-198,986	+173,247	+25,580	+159	$5,077,220
Clay	-30,319	+17,169	+8,474	+4,676	$8,123,006
Cloud	-70,549	+49,922	+14,578	+6,049	$8,636,766
Coffey	-62,938	+15,434	+27,669	+19,834	$14,368,755
Comanche	-220,845	+147,797	+70,593	+2,455	$14,154,889
Cowley	-163,824	+70,960	+65,571	+27,293	$28,238,621
Crawford	-17,302	-26,606	+17,443	+26,465	$16,428,363
Decatur	-12,620	+10,515	+2,084	+22	$1,334,922
Dickinson	-57,787	+35,057	+14,353	+8,377	$10,576,876
Doniphan	-1,965	-10,792	-2,547	+15,304	$5,924,756
Douglas	-29,959	-14,939	+12,749	+32,149	$12,341,289
Edwards	-40,792	+28,870	+11,272	+651	$2,915,946
Elk	-100,112	+20,465	+46,821	+32,826	$24,069,994
Ellis	-101,115	+85,146	+15,080	+889	$4,657,313
Ellsworth	-108,109	+81,443	+20,093	+6,573	$8,469,161
Finney	-89,043	+69,111	+19,922	+11	$3,314,436
Ford	-56,302	+46,748	+9,272	+282	$2,658,585
Franklin	-40,588	-5,827	+16,093	+30,322	$14,185,321
Geary	-54,821	+22,753	+17,514	+14,554	$11,293,084
Gove	-41,312	+37,414	+3,857	+40	$1,410,620
Graham	-45,700	+37,340	+8,187	+172	$2,622,849
Grant	-16,989	+14,194	+2,794	+1	$557,503
Gray	-28,301	+23,267	+5,028	+7	$938,908
Greeley	+973	-958	-16	+1	$57,026
Greenwood	-258,709	+156,201	+73,541	+28,968	$28,470,825
Hamilton	+5,168	-5,370	+201	+1	$349,134
Harper	-40,287	+10,515	+23,067	+6,705	$11,387,024

Harvey	-18,274	-4,628	+17,775	+5,126	$7,899,271
Haskell	-8,751	+5,880	+2,870	+1	$473,280
Hodgeman	-62,704	+54,976	+7,514	+215	$2,172,777
Jackson	-59,476	+361	+31,999	+27,116	$17,329,778
Jefferson	-26,514	-28,721	+12,943	+42,291	$14,909,858
Jewell	-63,478	+35,375	+17,754	+10,349	$15,186,352
Johnson	-11,468	-11,179	+3,938	+18,708	$13,875,100
Kearny	-16,922	+13,120	+3,802	0	$8,321,705
Kingman	-92,539	+36,521	+45,705	+10,313	$29,594,353
Kiowa	-138,354	+102,359	+34,901	+1,095	$4,000,765
Labette	-19,370	-32,111	+23,547	+27,934	$26,153,446
Lane	-33,518	+30,284	+3,198	+36	$5,409,791
Leavenworth	-18,610	-27,510	+9,345	+36,774	$31,756,514
Lincoln	-76,165	+62,615	+9,554	+3,996	$9,636,155
Linn	-14,857	-36,166	+7,065	+43,958	$30,087,451
Logan	-13,073	+11,982	+1,082	+8	$14,670,745
Lyon	-154,703	+93,709	+46,094	+14,900	$540,564
Marion	-90,744	+58,936	+25,542	+6,267	$5,077,220
Marshall	-42,209	+13,609	+14,967	+13,633	$8,123,006
McPherson	-56,219	+28,038	+20,357	+7,824	$8,636,766
Meade	-109,121	+98,247	+10,734	+141	$14,368,755
Miami	-21,798	-32,358	+18,157	+35,999	$14,154,889
Mitchell	-40,980	+31,223	+5,952	+3,805	$28,238,621
Montgomery	-15,692	-25,396	-5,658	+46,745	$16,428,363
Morris	-115,085	+79,390	+27,899	+7,796	$1,334,922
Morton	+12,161	-11,778	-384	+1	$10,576,876
Nemaha	-19,540	+2,704	+5,059	+11,778	$5,924,756
Neosho	-23,803	-26,183	+25,348	+24,637	$12,341,289
Ness	-48,427	+43,865	+4,454	+107	$2,915,946
Norton	-24,878	+18,493	+6,138	+247	$24,069,994
Osage	-84,173	+5,567	+43,307	+35,299	$4,657,313
Osborne	-98,630	+71,366	+21,982	+5,281	$8,469,161
Ottawa	-69,498	+51,182	+14,497	+3,819	$3,314,436
Pawnee	-25,632	+14,564	+10,054	+1,013	$2,658,585
Phillips	-57,685	+42,742	+13,448	+1,495	$14,185,321
Pottawatomie	-118,244	+48,670	+43,044	+26,530	$11,293,084
Pratt	-64,104	+39,689	+21,853	+2,563	$1,410,620
Rawlins	-33,449	+31,159	+2,268	+22	$2,622,849
Reno	-98,706	+20,611	+62,828	+15,267	$557,503
Republic	-32,739	+15,425	+12,438	+4,876	$938,908
Rice	-51,484	+23,827	+22,192	+5,465	$57,026
Riley	-52,143	+8,566	+22,860	+20,716	$28,470,825
Rooks	-95,628	+73,618	+20,635	+1,375	$349,134
Rush	-32,960	+27,786	+4,348	+826	$11,387,024
Russell	-153,421	+120,110	+29,391	+3,921	$7,899,271
Saline	-80,067	+58,082	+16,960	+5,025	$473,280
Scott	-13,871	+10,855	+3,011	+5	$2,172,777
Sedgwick	-26,837	-14,933	+29,808	+11,962	$17,329,778
Seward	-64,448	+57,312	+7,131	+4	$14,909,858
Shawnee	-43,716	-11,813	+25,789	+29,740	$15,186,352

Sheridan	-10,040	+8,681	+1,310	+49	$13,875,100
Sherman	+4,626	-4,473	-155	+2	$8,321,705
Smith	-54,433	+36,666	+13,909	+3,858	$29,594,353
Stafford	-67,230	+36,095	+26,630	+4,505	$4,000,765
Stanton	+4,590	-4,539	-52	0	$26,153,446
Stevens	-39,914	+35,295	+4,619	0	$5,409,791
Sumner	-10,551	-17,066	+14,307	+13,310	$31,756,514
Thomas	-1,726	+1,464	+260	+2	$9,636,155
Trego	-48,860	+42,681	+6,037	+143	$30,087,451
Wabaunsee	-163,906	+95,526	+51,671	+16,709	$14,670,745
Wallace	+1,731	-1,755	+13	+11	$540,564
Washington	-60,563	+27,926	+24,837	+7,800	$5,077,220
Wichita	-2,163	+1,786	+378	-1	$8,123,006
Wilson	-18,814	-21,937	+6,339	+34,412	$8,636,766
Woodson	-60,418	+17,446	+22,900	+20,072	$14,368,755
Wyandotte	-823	-5,483	-2,889	+9,195	$14,154,889