

**FEDERAL AND NONFEDERAL COLLABORATION,
INCLUDING THROUGH THE USE OF TECH-
NOLOGY, TO REDUCE WILDLAND FIRE RISK
TO COMMUNITIES AND ENHANCE FIRE-
FIGHTING SAFETY AND EFFECTIVENESS**

**HEARING
BEFORE THE
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE**

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

AUGUST 3, 2017



Printed for the use of the
Committee on Energy and Natural Resources

Available via the World Wide Web: <http://www.govinfo.gov>

U.S. GOVERNMENT PUBLISHING OFFICE

WASHINGTON : 2018

COMMITTEE ON ENERGY AND NATURAL RESOURCES

LISA MURKOWSKI, Alaska, *Chairman*

JOHN BARRASSO, Wyoming	MARIA CANTWELL, Washington
JAMES E. RISCH, Idaho	RON WYDEN, Oregon
MIKE LEE, Utah	BERNARD SANDERS, Vermont
JEFF FLAKE, Arizona	DEBBIE STABENOW, Michigan
STEVE DAINES, Montana	AL FRANKEN, Minnesota
CORY GARDNER, Colorado	JOE MANCHIN III, West Virginia
LAMAR ALEXANDER, Tennessee	MARTIN HEINRICH, New Mexico
JOHN HOEVEN, North Dakota	MAZIE K. HIRONO, Hawaii
BILL CASSIDY, Louisiana	ANGUS S. KING, JR., Maine
ROB PORTMAN, Ohio	TAMMY DUCKWORTH, Illinois
LUTHER STRANGE, Alabama	CATHERINE CORTEZ MASTO, Nevada

COLIN HAYES, *Staff Director*

PATRICK J. MCCORMICK III, *Chief Counsel*

LUCY MURFITT, *Senior Counsel and Public Lands & Natural Resources Policy Director*

ANGELA BECKER-DIPPMANN, *Democratic Staff Director*

SAM E. FOWLER, *Democratic Chief Counsel*

BRYAN PETIT, *Democratic Senior Professional Staff Member*

CONTENTS

OPENING STATEMENTS

	Page
Murkowski, Hon. Lisa, Chairman and a U.S. Senator from Alaska	1
Cantwell, Hon. Maria, Ranking Member and a U.S. Senator from Washington	3
Stabenow, Hon. Debbie, a U.S. Senator from Michigan	5

WITNESSES

Christiansen, Victoria C., Deputy Chief, State and Private Forestry, Forest Service, U.S. Department of Agriculture	5
Rice, Bryan, Director, Office of Wildland Fire, U.S. Department of the Interior	15
Maisch, John “Chris”, Alaska State Forester and Director, Division of Forestry, Alaska Department of Natural Resources	24
King, Steve, Economic Development Director, City of Wenatchee, Washington	36
Miller, Dr. Mary Ellen, Research Engineer, Michigan Tech Research Institute	44

ALPHABETICAL LISTING AND APPENDIX MATERIAL SUBMITTED

Cantwell, Hon. Maria:	
Opening Statement	3
USA Today article by Robin Will dated June 11, 2015 entitled “St. Marks Refuge staffer wins Fire Safety Award”	81
Map issued August 1, 2017 and produced by Predictive Services, National Interagency Fire Center entitled “Significant Wildland Fire Potential Outlook—August 2017”	83
Christiansen, Victoria C.:	
Opening Statement	5
Written Testimony	8
Responses to Questions for the Record	87
Daines, Hon. Steve:	
Map issued August 1, 2017 and produced by Predictive Services, National Interagency Fire Center entitled “Significant Wildland Fire Potential Outlook—September 2017”	61
King, Steve:	
Opening Statement	36
Written Testimony	39
Maisch, Chris:	
Opening Statement	24
Written Testimony	27

IV

	Page
Miller, Dr. Mary Ellen:	
Opening Statement	44
Written Testimony	46
Responses to Questions for the Record	98
Murkowski, Hon. Lisa:	
Opening Statement	1
Rice, Bryan:	
Opening Statement	15
Written Testimony	17
Responses to Questions for the Record	92
Stabenow, Hon. Debbie:	
Opening Statement	5
Wyden, Hon. Ron, et al.:	
Letter of Support for the Crapo/Brown Proposal	65

FEDERAL AND NONFEDERAL COLLABORATION, INCLUDING THROUGH THE USE OF TECHNOLOGY, TO REDUCE WILDLAND FIRE RISK TO COMMUNITIES AND ENHANCE FIREFIGHTING SAFETY AND EFFECTIVENESS

THURSDAY, AUGUST 3, 2017

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Committee met, pursuant to notice, at 10:03 a.m. in Room SD-366, Dirksen Senate Office Building, Hon. Lisa Murkowski, Chairman of the Committee, presiding.

**OPENING STATEMENT OF HON. LISA MURKOWSKI,
U.S. SENATOR FROM ALASKA**

The CHAIRMAN. Good morning. The Committee will come to order.

We are here today to take a look at wildfire, to examine our wild-fire management programs, the collaboration that is required to reduce risks to firefighters, communities, and resources and some of the emerging technologies that are changing the way that fires are managed.

We are now well into the 2017 fire season. It is certainly a very active one. My friend from Montana, I think, is going to share some of what is happening in his state this morning, and I think it is appropriate to recognize the heroic acts of the men and women who fight these fires throughout the season and to recognize the loss of a firefighter in Montana.

Senator Daines.

Senator DAINES. Madam Chair, thank you. I will talk about it in my remarks, but we lost a firefighter last night in Montana.

The CHAIRMAN. So I understand.

Senator DAINES. It is our second fatality in two weeks in Montana of firefighters.

The CHAIRMAN. Well, know that our hearts and our prayers are with the families, but again this speaks to the realities that we face with wildland fires and with fires around the country, that this is dangerous and unpredictable work. Again, our thoughts and our prayers are with those who are serving.

As of August 1st, nearly 39,000 fires have burned almost 5.5 million acres of land. For comparison's sake, this is an area about the

size of the State of New Hampshire. In Alaska, we have had a low fire year this year, we have had more than 300 fires burning about 630,000 acres. It is a lot of land, but it is below normal for us in Alaska, so we are certainly not complaining. Just two years ago, back in 2015, over 5 million acres burned in Alaska alone. Mr. Maisch, from the State of Alaska, certainly knows and understands this all too well. Nationally, 2015 was one of the worst seasons on record, stretching nearly all year and burning over 10 million acres in total.

This Committee has spent a lot of time, a lot of good work, working on legislation to address the consequences of wildfire. We will continue that work until we arrive at legislative solutions, hopefully sooner than later.

What we really need is a comprehensive solution that addresses both wildfire budgeting and forest management. We need to tackle both of those, at once, because we know the wildfire problem is not just a budgeting problem, it is also a management problem.

Last year, our Ranking Member, Senator Cantwell, along with Senators Wyden, Risch, and Crapo joined me in putting forward a comprehensive solution to address both challenges, we called this the "Wildfire Budgeting, Response and Forest Management Act." Our proposal included a fiscally responsible fix to permanently end the destructive practice of fire borrowing. We required Congress to provide resources to the agencies up front, enough to cover 100 percent of the average annual cost of firefighting over the previous 10 years, while allowing for a limited cap adjustment when we experience those truly catastrophic years. Our proposal took steps to address the hurdles that stand in the way of implementing the fuel treatments needed to mitigate wildfire risk, increase firefighter safety and make our forests more healthy and more resilient. We would have increased the use of technologies, such as drones and GPS trackers and fire risk mapping and made needed investments in community wildfire protection plans as well as "Firewise programs."

We know that our wildfire strategy needs to include all of these important pieces of the wildfire management puzzle, and we know that other members on our Committee also have good ideas that deserve to be considered.

While our hearing today is focused on oversight of wildfire management programs and the use of technologies, our goal is a good bill that will fix these problems so the President will be able to sign this into law.

We came up a little bit short in the last Congress but, as we will hear today, fires, again, are continuing to destroy our lands. There is a lot more that we can do, there is a lot more that we must do, from budgeting to new technologies to better management practices, to save them.

Again, I want to thank all of our witnesses for being here today, and I want to particularly extend my appreciation to Chris Maisch, Alaska's State Forester.

With that, I will turn to Ranking Member Cantwell for your opening remarks.

**STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON**

Senator CANTWELL. Thank you, Madam Chair, and thanks for holding this hearing.

Before I begin I, too, want to thank the over 35,000 men and women who fight fires everyday throughout our country. And our thoughts and prayers are with those in Montana who have lost lives and to the firefighters who are continuing to battle the blazes there.

These firefighters have been working tirelessly to save homes, communities, people and assure that they are always there to answer the call. Their diligent work has managed to save many hundreds of residents already this year.

The Chair mentioned our efforts in the last Congress to work diligently together in a bipartisan effort. I can assure all my colleagues here that there was no stone unturned, no late night not visited by she, myself, our staffs, the leadership in the United States Senate, to try to resolve the fire borrowing issue and to make a down payment on our fuel reduction strategies for the future. Unfortunately, we could not quite get there with our House colleagues. So any of you who think that you can help us get them to pay attention in a more serious way, we would be so grateful.

We have come together on a bipartisan solution in the United States Senate to end fire borrowing and to make investments for the future. I hope, I certainly hope, that we can get the attention of the House to reinvigorate those efforts and pass it when we return later after the summer session.

Today we are here to talk about what additional tools we can give firefighters. As of today, 50 percent more acres have already burned this year than average, and yesterday a forecast report was released that predicted the West is likely to experience above-normal wildfires over the next month. That shouldn't surprise people since we knew exactly what's been trending the last few years. While in the State of Washington, we have some fires, the rest of the country is seeing even more impact. So today's hearing is about the tools that we can give to help decrease the risks of firefighting.

I also want to thank Steve King for being here from Washington to talk about the innovative actions that the City of Wenatchee has been undertaking to mitigate these risks. We know all too well from the Thirtymile Fire, from the Carlton Complex, where over 100,000 acres have burned up in one afternoon, how fast these fires can move.

So we want to make sure that we are giving new tools to firefighters. If we are seeing a new normal, which I don't want to think that it is normal because it is very, very stressful for all our communities. But if we are seeing a new increase because of the dry conditions and the abilities for fires to spread in so many more places, more quickly, what can technology do to help us address this and make us safer for the future?

A couple of approaches that my colleague, Senator Gardner, and I have been working on, would make sure that we are using new technology and tools to help us deal with fires. That is use, for the first time ever, real-time wildfire mapping aircraft. That is the ability for aircraft to fly over these areas or use unmanned aerial vehi-

cles (UAVs) to generate real-time mapping, depicting where the fires are burning. We also should make GPS locators available to fire crews. *Wildfire Today* refers to the combination of crew locations and real-time fire maps as the Holy Grail of wildland firefighting because of how it would improve the safety for our firefighters.

This legislation we are proposing would also encourage federal agencies to take advantage of some of the tools that we have at NASA in order to speed up the planning that goes into effect to prevent after-the-fire flooding and erosion. These are important issues for us—to map these areas.

And I know, as we look every year at NIFC's information, working with the Forest Service, we know where our bad fire seasons are going to be. Not that other spots are not going to see an impact, because you never know where a fire is going to start, but it gives us information about where to cash and put resources so they are ready and available.

We also want to make sure that we do better with real-time weather forecasting information. In the State of Washington, we have a gap in the central part of our state. We do not want to have a region of our state less-protected because they don't have accurate weather forecasting information. We want to build on the state of the technology and to make sure that every community knows where and when it should not be sending firefighters out, given the weather forecast and the challenges that we face.

So I agree with the Chair, we need to work efficiently; we need to work together; we need to get, as I'm sure we are going to hear about, the "hasty response" approach that has been used in the central part of Washington—that is to have everybody ready. Given the outbreaks of fires in so many locations, we would be able to have a hasty response. We also need to have a hasty response in getting this legislation over the goal line with our House of Representatives.

So, Madam Chair, thank you for holding this important hearing. I thank our witnesses for being here. Again, our thoughts and prayers are with those families impacted by this fire season.

The CHAIRMAN. Thank you, Senator Cantwell.

Know that my commitment remains to help address this in a way that is going to be more than just, kind of, the herky jerky way it has been handled. The fire borrowing really limits the ability of our agencies to do the work that we need them to do, so having an approach that will yield enduring policy is, I think, what we are all looking for here.

I am pleased to be able to welcome the panel this morning. We will have good input, and I appreciate the time that you will spend with us.

We will be led off by Victoria Christiansen, who is the Deputy Chief for State and Private Forestry at the Forest Service at the Department of Agriculture. Welcome.

Mr. Bryan Rice is the Director for the Office of Wildland Fire at Department of the Interior.

I have mentioned my friend, Mr. Chris Maisch, who is a State Forester for the Alaska Department of Natural Resources. He is also here this morning wearing another hat on behalf of the Na-

tional Association of State Foresters. We appreciate your leadership there.

Mr. Steve King is the Economic Development Director for the City of Wenatchee, Washington. Welcome to you.

And I understand, Senator Stabenow, you would like to introduce Dr. Miller.

**STATEMENT OF DEBBIE STABENOW,
U.S. SENATOR FROM MICHIGAN**

Senator STABENOW. Thank you very much, Madam Chair.

I first want to thank both of you for an incredibly important hearing. As the Ranking Democrat on Agriculture and Nutrition and Forestry, I want to work closely with you so that we can resolve this so that when we are doing the next Farm bill and we have a forestry title to focus on prevention and management, all the money is not transferred over to fight fires. So thank you for holding this hearing.

We have tremendous expertise in Michigan. I want to introduce Dr. Mary Ellen Miller, who is a research engineer at Michigan Tech Research Institute in Ann Arbor. Michigan Tech is actually in the Upper Peninsula, as Senator Cantwell knows, way up in Houghton, Michigan, where I was not long ago meeting with them on these issues—a beautiful, beautiful place. But Michigan Tech is a leader in the use of information technology to solve security and infrastructure, earth science and environmental problems. With the help of NASA, Dr. Miller has used models and earth observations to predict erosion and runoff after wildfires in Colorado and California. Of course, not all of her work is high-tech. She also spends plenty of time out in the field with more low-tech tools like tipping bucket gauges and a bucket hat.

So thank you for being with us today, Dr. Miller. We look forward to hearing your unique, scientific insights on how watersheds are impacted by wildfires. Welcome.

Thank you.

The CHAIRMAN. Thank you, Senator Stabenow.

At this time, Ms. Christiansen, if you want to lead the panel off, we welcome your comments.

**STATEMENT OF VICTORIA C. CHRISTIANSEN, DEPUTY CHIEF,
STATE AND PRIVATE FORESTRY, FOREST SERVICE, U.S. DE-
PARTMENT OF AGRICULTURE**

Ms. CHRISTIANSEN. Madam Chairman and Ranking Member Cantwell and members of the Committee, thank you for the opportunity to discuss collaboration to reduce wildfire risk.

After the events of yesterday, a loss of one of our own, we're all, our hearts are heavy and we send our condolences to our whole community.

It's a very appropriate time for this discussion. Thank you.

My name is Vicki Christiansen, and I am the Deputy Chief of State and Private Forestry for the USDA Forest Service. My remarks today will be framed by the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy), an all-lands blueprint for building synergies to address the nation's growing wildfire challenges. The three goals of the Cohesive Strategy are restoring

and maintaining resilient landscapes, creating fire-adapted communities, and having an effective risk-based wildfire response. The Forest Service is committed to restoring and maintaining resilient landscapes across all jurisdictions.

On our national forests, we achieved over three million acres of hazardous fuels treatments last year. We also work across boundaries with our partners. In 2006, we provided financial support to carry out nearly 150,000 acres of treatment on non-federal lands.

Since 2006, we have assessed more than 3,000 fuel treatments. And when tested by wildfire, 90 percent of these fuel treatments have shown to reduce the impacts of wildfire. For example, in Arizona, the fuel treatments associated with the White Mountain Stewardship Project dramatically slowed the rate of spread of the Wallow Fire to allow firefighters to safely attack the fire and protect homes and property.

The Forest Service collaborates with state and local partners to help prepare communities to withstand a wildfire. This is challenging because of the increasing development in the Wildland-Urban Interface.

We work with state partners to assist communities in developing community wildfire protection plans. These plans bring community members together to address wildfire response, hazard mitigation and community preparedness.

As our risk assessment technology has developed, our capability to help communities reduce their risk to wildfire, has really evolved. For example, you will hear more from Mr. King about our community planning assistance for the wildfire program.

Wildfire prevention is a critical element to working collaboratively across land ownership boundaries. Nationally, nearly nine out of ten wildfires are caused by humans, including some of the most costly fires. If we prevent unwanted, human-caused fires, we can proactively use our resources to create resilient landscapes, improve our response, and help communities be prepared.

A long-standing example of federal and non-federal collaboration is Smokey Bear. His campaign is administered by the Forest Service, the National Association of State Foresters, and the Ad Council. Smokey will be 73 next week, and he is one of the world's most recognizable characters.

Our goal at the Forest Service is to work with partners to continuously improve our risk-based response to wildfire. No one agency has the capability or the surge capacity to respond to wildfire alone, so we have a collaborative approach in the U.S. It includes federal, state, tribal, city, county, contract, and volunteer firefighters.

We continue to work with our cooperators and industry on emerging technology to help respond to the challenges of fire. The Forest Service invests \$34 million each year in wildland fire information and technology systems, and we work very closely with the Department of the Interior to develop an integrated approach and prioritize our investments to be able to update our legacy systems.

The central platform is the Enterprise Geospatial Portal. The portal provides up-to-date wildland fire situational information to first responders, to fire managers and the public. Through our research and development branch, we continue to collaborate with

additional partners, such as NASA, on new and emerging technologies. We also partner and DOI takes the lead on interagency capability on unmanned aircraft operations in wildland fire management.

Although our missions and priorities among our partners are diverse, we are united with a common vision and set of goals defined by the Cohesive Strategy established to collectively address our nation's wildland fire challenges so we can redeem our responsibilities to the citizens of the U.S.

Thank you for the opportunity to discuss wildfire risk and collaboration. We look forward to working with the Committee on these important issues.

[The prepared statement of Ms. Christiansen follows:]

TESTIMONY of
VICTORIA C. CHRISTIANSEN, DEPUTY CHIEF, STATE AND PRIVATE FORESTRY
UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
BEFORE THE
UNITED STATES SENATE
ENERGY AND NATURAL RESOURCES COMMITTEE
August 3, 2017
Concerning
FEDERAL AND NON-FEDERAL COLLABORATION, INCLUDING THROUGH THE
USE OF TECHNOLOGY, TO REDUCE WILDLAND FIRE RISK TO COMMUNITIES
AND ENHANCE FIREFIGHTING SAFETY AND EFFECTIVENESS

Madam Chairman and Members of the Committee, thank you for the opportunity to appear before you today to discuss the important role prevention, restoration, community assistance and technology plays in wildland fire management. My testimony today focuses on how wildfire risk can be effectively reduced and mitigated.

Wildland Fire Management programs at U.S. Forest Service and the Department of the Interior seek to achieve both cost-efficient and a technically effective fire management that meets resource and safety objectives. The guiding principles and priorities, as outlined in the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy), are to safely and effectively respond to wildfires, promote fire-adapted communities, and create fire-resilient landscapes through direct program activities and strong Federal, State, tribal and local collaboration. Firefighter and public safety are the primary considerations for all operations.

State Foresters and local fire departments serve as first responders on almost 75 percent of wildfires. Fires on National Forest System lands, on average, represent 11 percent of the wildfires (and 25 percent of the acres) across all jurisdictions each year. The Forest Service provides critical national capacity to ensure that fire management assets, such as large airtankers, helicopters, hot shot crews and smokejumpers are available to support response operations on National Forest System lands, as well as other Federal, State, and private lands. In addition to wildfire response, the agency invests in planning, prevention, education, information technology development and decision support systems.

Fire Budget

While the Forest Service and its firefighting partners are able to suppress or manage 98 percent of fires during initial attack, a few escape initial attack and become catastrophically large fires that are extremely costly to contain. These large conflagrations account for 1 to 2 percent of total fires but result in 30 percent or more of fire expenditures. The ongoing erosion of the agency's non-fire budgets due to the increasing 10-year average cost of fire suppression, causes an ongoing shift in resources from land management to fire management. We are committed to working with Congress to develop a solution that addresses the growth of fire programs as a percent of the agency's budget, and also ends the practice of transferring funds from non-fire programs when suppression funds fall short before the end of the fiscal year.

Wildfire Prevention

Wildfire prevention is a critical element to working collaboratively across land ownership boundaries. The agency uses cooperative fire agreements to further the goals and implementation of the Cohesive Strategy. Nationally, nearly 9 out of 10 wildfires are caused by humans, including some of the most costly wildfires. If we prevent unwanted, human-caused fires from igniting, we can proactively use our resources to create resilient landscapes, improve our response to the other wildfires that need attention, and engage communities to be prepared for and live with wildfire.

The goal of wildfire prevention is to stop unwanted human-caused wildfires before they start and to reduce the negative effects of wildfires. Prevention occurs in three main areas:

- **Education** aimed at changing behavior through awareness and knowledge.
- **Engineering** designed to shield an ignition source or prevent wildfire from impacting something we value. Examples include clearing debris from around a house, installing spark arrestors on equipment, and utilizing well-designed campfire pits.
- **Enforcement** efforts to gain compliance with fire regulations and laws (primarily a State and local role). Elements of enforcement include detection to keep fires small, patrols to increase visibility and public awareness of fire danger, and public compliance with wildfire regulations.

Wildfire prevention education activities can reduce the number of human-caused wildfires and thus fire-related costs. A 2009 study on wildfire prevention education programs in the state of Florida found that the benefit to cost ratio could be as much as 35 to 1. That is, every additional dollar spent would have reduced wildfire related losses (e.g., home and timber losses, etc.) and suppression costs by 35 dollars. A more recent study on Tribal lands found that fire prevention education is highly effective, reducing the number of human-caused fires on one tribal unit by 93 percent.

Wildfire Prevention Education Teams are used to deliver messaging targeted to diverse audiences. These Teams have developed messages ranging from sage grouse habitat protection to how to reduce sparks from shooting, dragging chains and equipment, to properly extinguishing campfires and understanding restrictions. These are often interagency teams that help support the local agency's fire protection plan to reduce human-caused wildland fire risks, hazards, and losses through the development, use, and communication of prevention plans.

As Smokey Bear reaches 75 years in 2019, he is still the Ad Council's most successful Public Service Announcement. In fact, 8 out of 10 citizens can identify his face and slogan, and he continues to be loved by millions of people. Smokey's messages are particularly important as more people choose to live in and near the wildland urban interface and recreate in wildlands.

Restoring Forests

Many ecosystems are fire dependent, requiring fire as a critical process for maintaining health and resiliency. Yet, we are experiencing larger and more intense fires along with expanding development within our nation's forests. This scenario increases the negative impacts of wildfire. The Forest Service estimates a total of nearly 480 million acres (of which 94 million are within National Forests) remain at moderate to very high risk from uncharacteristically severe wildfires.

Restoring fire to these fire-dependent landscapes can reduce the frequency and the impact of severe wildfire events.

The agency's hazardous fuels management program continues to focus on wildfire risk through prescribed burns, timber sales and mechanical treatments that reduce the spread and severity of wildfire, and also promote resilient ecosystems. These activities also reduce potential impacts to communities and increase opportunities for wildland firefighters to safely and effectively engage wildfires. More than 3,000 fuel treatments have been assessed since 2006 and evidence suggests that these treatments can be effective in reducing the impacts of wildfire.

Nearly two million acres of hazardous fuel treatments are accomplished on National Forest Systems lands a year, including 700,000 acres of mechanical treatments. Timber sales account for 200,000 acres of the mechanically treated acres. So far this year, we have treated more than 1.2 million acres to reduce hazardous fuels and are on track to meet our target of 2.2 million acres. The majority of these treatments are in the wildland urban interface. These accomplishments include naturally-ignited wildfire acres that were assessed and determined to meet land management goals. Managing wildfires in favorable conditions continues to be an important method to reducing risk of catastrophic wildfire.

Wildfire risk reduction requires coordinated efforts across a given landscape by many landowners. Since 2014 we have placed special emphasis on hazardous fuels investment in cross-boundary efforts that engage in reducing landscape level risk and on working with partners to create resilient communities. For instance, the Joint Chiefs' Landscape Restoration Partnership aims to reduce wildfire threats to communities and landowners, protect water quality and supply, and improve wildlife habitat for at-risk species. This multi-year partnership between the Forest Service and the Natural Resources Conservation Service is a landscape-level initiative which directly funds work across all ownerships to improve the health and resiliency of forest ecosystems where public and private lands meet across the nation. The Forest Service is also a partner in the Department of the Interior's Wildland Fire Resilient Landscapes program, which is a landscape-level approach for creating fire-adapted ecosystems through joint fuels management work.

Since 2014, the Joint Chiefs' Landscape Restoration Partnership has carried out hazardous fuels treatments on over 236,000 acres of National Forest System lands. These activities have improved 200,000 acres of wildlife habitat, restored 29,000 acres of watersheds and improved aquatic habitat on 724 stream miles. The Joint Chiefs' Landscape Restoration Partnership has also drafted 2,200 contracts to support private landowners in implementing conservation activities on over 216,000 acres through the Environmental Quality Incentive Program and leveraged over \$14 million from partners to implement restoration projects.

The long-term value of fuel treatments far outweigh their costs. Our studies show that when tested by wildfire, 90 percent of fuel treatments assessed are effective in changing the fire behavior or helping with control of the wildfire. In case studies such as the Mokelumne Watershed Avoided Cost Analysis in the Sierra Nevada, estimates for avoided costs from fuel treatments range from 126 to 224 million dollars based on 68 million dollars of treatments, 2 to 3 times the costs of the hazardous fuel treatments. Avoided costs included structures saved,

suppression operations, infrastructure repair and reconstruction and impacts to municipal watersheds.

Capacity constraints due to the present approach to budgeting for wildfire continue to be the greatest impediment to further improving the health and resiliency of the nation's forests. Today, the agency spends over half of its budget in fire-management activities and has seen a corresponding decline in non-fire staffing of 39 percent since 1998. This has enormous implications for how the agency carries out its mission, including shifting resources from the very programs that help reduce the risk of catastrophic fire in the first place.

Protecting Homes and Helping Communities Adapt to Wildfire

During an average year, more than 73,000 wildfires burn about 7 million acres of Federal, Tribal, State, and private land and more than 2,600 structures. Growth, development and sprawl of homes and communities into America's wildland continues in or near wildlands. Wildfires also pose risk to utility infrastructure, municipal watersheds and recreation and wildlife values. The National Association of State Foresters has identified more than 70,000 communities at risk from wildfire. Approximately 11 percent of these communities are at reduced risk as a result of enacting mitigation and fire prevention ordinances, being recognized as a Firewise community, or reduction of high priority hazardous fuels identified in a Community Wildfire Protection Plan. Nationally, more than 20 percent of communities at risk have a Community Wildfire Protection Plan, while more than 80 percent of communities at risk in the west, where wildfire risk is highest, have such a Plan. The Forest Service works together with our Federal, State, local and NGO partners to help communities be prepared for wildfire.

State Fire Assistance Program

The State Fire Assistance program provides financial assistance through partnership agreements with State Foresters to support hazardous fuel mitigation projects, create defensible space near communities, plan and prepare for wildfire, , and obtain equipment to respond to and mitigate fire impact. This program maximizes cross-jurisdictional partnerships to help homeowners and communities in fire-prone areas take responsibility for fire protection. In 2016, program funding assisted nearly 14,000 communities, providing personnel, training, firefighting equipment, education programs and hazardous fuels treatments. State and local firefighting resources are important for community protection and often provide the quickest response to wildfires in the wildland urban interface.

Volunteer Fire Assistance Program

The Volunteer Fire Assistance program is focused on rural fire departments in communities of less than 10,000 people. This program supports local fire preparedness and suppression efforts and provides funding for equipment, training, and expansion of volunteer fire departments where little or no fire protection is available. There are over 26,000 rural and predominantly volunteer fire departments nationwide. In fiscal year 2016, Volunteer Fire Assistance funding assisted over 14,000 volunteer fire departments.

Fire Adapted Communities Coalition and Firewise

Working with other Federal agencies and professional and non-profit organizations, the Fire Adapted Communities Coalition is a partnership helping communities in the wildland urban

interface adapt to living with wildfire and increase their resilience against wildfire damage. The National Fire Protection Association's Firewise program, a key component of Fire Adapted Communities, encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes to withstand the risk of wildfire. Home ignitability during wildland fires depends on the characteristics of the home and its immediate surroundings. The placement and configuration of factors such as construction material, decks, firewood, rain gutters, wooden shingles, outdoor furniture, landscaping and vegetation can significantly affect the defensibility of a home or related structure. Firewise helps communities and home owners in the wildland urban interface understand their vulnerability and maintain defensible space around their homes.

Community Mitigation Assistance Teams

The Forest Service has used Community Mitigation Assistance Teams to collaborate with local communities on mitigation efforts soon after incidents occur. These Teams integrate the community fire adaptation and resilient landscapes concepts outlined in the National Cohesive Wildfire Management Strategy, and focus on building local capacity for sustainable mitigation programs to reduce risk.

Use of New Technologies in Fire Management Activities

The Forest Service is committed to working with the wildland fire community and the Committee to identify areas where we might adapt to keep pace with the increasing complexity in the wildland fire system. The following includes areas where the agency has invested in development of technologies to use in fire management activities.

Unmanned Aircraft Systems

The interagency wildfire community has made a commitment to using Unmanned Aircraft Systems technology in wildfire suppression operations. An interagency Fire Unmanned Aircraft Systems working group has been chartered to help identify procedures, assess risk and develop policy to safely integrate unmanned aircraft systems in wildfire suppression.

Wildfire suppression has used smaller aircraft systems available to ground crews for tactical decision making and fire managers for strategic planning. Recent unmanned aircraft systems deployments include:

North Fire: In 2016, the Forest Service utilized small unmanned aircraft systems to gather aerial imagery helpful in managing the North Fire on the Cibola National Forest in New Mexico. Two platforms were used. A fixed-wing platform gathered data used for strategic planning. A small quadcopter was also used by ground crews to gather real time situational awareness information to help guide their actions. These activities were done in coordination with the Department of the Interior.

National Aerial Supervision Training Academy: In early 2017, unmanned aircraft systems technology was used as part of a training event to introduce aerial firefighters to this technology, demonstrate and test launch procedures, test unmanned aircraft systems and visibility, and evaluate draft protocols and procedures for integration of this technology into suppression operations.

Boundary Fire: The Forest Service recently used unmanned aircraft systems to document pre-fire and post-fire effects in key biological areas of the Boundary Fire on the Kaibab

National Forest in Arizona. This information will be used to develop a rehabilitation and reforestation plan as part of the post fire restoration work. These activities were done in coordination with the Department of the Interior.

The agency will continue to look for opportunities to use unmanned aircraft systems in wildfire management to enhance fire fighter safety both on the ground and in the air.

Wildfire and Asset Monitoring Applications

A wildfire monitoring application prototype that provides real-time incident information to users is being tested. Similar to current weather forecasting and monitoring applications in use today, *Wildfires Near Me* monitors the landscape for wildfires and notifies the user if a wildfire is reported within the user's specified notification distance. Once the user begins "monitoring" a specific incident for information, the application alerts the user of any incident changes that occur via browser, emails and text-messages. This provides users of the application with an early warning system to raise awareness of fire activity, potential risks, and general information about management activities.

The agency recently deployed the *Automated Flight* following application which tracks, in real time, where all aviation assets are located across the nation. The application is web-based and enables managers to track aviation assets and provide real time situational awareness.

Mapping technologies

New technologies such as the Incident Management Team Collector can create, collect and share map information in near real time to support decision making. Firefighters and field personnel can relay incident data to the Incident Management Teams such as structural locations, hazards, and fire line location, etc. The decreased time in obtaining decision support information helps plan for operations and reduces redundant data collection efforts.

Early warning systems

To explore new opportunities in early warning systems, fire management staff have reviewed tweets about wildfires from Twitter with the goal of developing an early warning system for new and emerging wildfires. Utilizing the existing structure and concept of the *Threat News Explorer*, fire management staff are building a web app called *TwitterFire*. Every 15 minutes *TwitterFire* relies on a custom built search algorithm to examine an average of 5,250,000 tweets and narrow the data set down to only those likely to be talking about a wildfire in the United States. The tweets are then used to drive a notification system which sends emails and/or text messages to registered users when a threshold is met for a specific geographic location. The concept relies on the millions of Twitter users to spot wildfires and tweet about them; the results appear to be promising. The science of social media data mining is growing rapidly, and our ability to extract meaningful value from social media posts has improved greatly over the course of this project.

Automated telemetry units

The Forest Service is deploying automated telemetry units on all large airtankers that are utilized on fire operations to monitor the effectiveness of fire retardant. The information will help the agency better understand the conditions where retardant will best support firefighting objectives.

Research

Forest Service Research and Development is working to decrease the impacts of uncharacteristically high intensity wildland fires that damage natural resources, decrease ecosystem productivity, cause erosion and create high risk for flooding. Forest Service scientists are working on fuel assessments and treatments and other preparedness activities. They are also studying societal attitudes and developing decision-making processes for reducing risk and potential impacts to life and property.

We continue to work on developing risk-based methods for deciding the best strategies to mitigate the adverse impacts of fires in forest ecosystems and decrease the risk for communities. This research has directly supported the development of two major fire management decision support systems. The models estimate the probability of impact of an ongoing large fire. The agency is also conducting research related to fire spread and applications of fire behavior models for fire management decision support and actuarial risk assessment.

I would be happy to answer any questions the Committee may have.

The CHAIRMAN. Thank you, Ms. Christiansen.
Mr. Rice, welcome.

**STATEMENT OF BRYAN RICE, DIRECTOR, OFFICE OF
WILDLAND FIRE, U.S. DEPARTMENT OF THE INTERIOR**

Mr. RICE. Good morning.

Chairman Murkowski, Ranking Member Cantwell, members of the Committee, thank you for the opportunity to appear before you today and have this discussion. It's important. Thank you for the opportunity to talk about the Department of the Interior's Wildland Fire Program.

First, I'd like to start by saying that we in the Department are saddened by yesterday's news of the fatality in Montana. The Department of the Interior's (DOI/Department) heartfelt condolences go out to the family and friends and others that are affected by this situation.

Overall, we are seeing the cumulative impacts of climate variability, drought, and invasive species that are creating this situation that leads us to being more susceptible to large and devastating wildfires. So far this season, we've seen outbreaks across the country in numerous, if not all, of the geographic areas.

In working through this, the National Cohesive Strategy, which my partner here alluded to, is the backbone of the National Wildland Fire Management Policy and it's built on collaboration with federal, state, tribal, local, all the partners and represents a determined effort by the Federal Government to actively involve partners in planning and decision-making.

Fuels management work, active management work, either done collaboratively with our partners or done directly on Department lands managed through each of the Bureaus within the Department of the Interior, is one of the most effective strategies for mitigating wildland fire risk.

For example, in the Department of the Interior's Resilient Landscapes Initiative, DOI bureaus actively engage partners at the local level on fuels management projects that achieve fire resiliency across multiple jurisdictions and broad landscapes.

This year the Department-supported initiative has added value to private landowners, tribal, state, local governments, and other federal agencies who work hand-in-hand with the Department to safeguard communities. Together we continue to plan and execute these activities to reduce overstocked forests and woodlands, as well as improve the health of our rangeland landscapes.

It's important also to talk about the advancements in technology that play a critical role in many areas of the Department's fire program.

The use of unmanned aircraft systems (UASs) is becoming increasingly important in our day-to-day fire suppression operations. Interior is the government leader in research and development in the practical deployment of UASs for non-defense purposes. Currently, the Department uses UASs to support firefighters in the field through mapping of fires, use of infrared technologies, and the gathering of data for strategic fire planning. In addition, the Department has established fire operation guidelines for the coordi-

nated use of UASs with state agencies, as well as developing the specifications for a government-owned fleet of UASs.

Looking ahead, we're studying the potential role UASs will play in fire suppression operations, including their effectiveness at delivering fire retardant and cargo in environments that may prohibit the safe use of larger piloted aircraft.

In June of this year the Department announced the expansion of its wildland fire location data-sharing service named current wildland fires available to the public through geoplatform.gov and, in addition, the early adopters of Alaska and Texas. Other states are added which include Wyoming, North Dakota, and California and we're expecting others to engage as well. The system informs drone operators, so it is available to the public, and informs those drone operators in near real time where not to fly so they can avoid interference with ongoing fire operations.

Another important technology advancement that is helping improve the Department's response to wildland fires is the use of high definition cameras with infrared technologies that help spot fires in remote geographic areas across Nevada. The Bureau of Land Management's Fire Camera Network Program is a joint effort with the University of Nevada, Reno's seismological lab. Eight cameras have been installed on remote mountain peaks and are used by fire personnel for early fire detection, allowing managers to shift resources as needed, to better manage fires, reduce costs, and protect local communities. This is yet another service available to the public. The data is readily available.

The Department acknowledges we still have plenty of room for improvement when it comes to fighting fire efficiently and safely. We believe these technology advancements allow us to be better positioned to address wildland fire. We look forward to continuing to build on these efforts in ways that support the safety of the firefighters and the public, enhance our firefighting responsibilities, and promote further collaboration with our partners.

Thank you again for the opportunity to discuss the Department's fire program, and I'll be happy to answer any questions you may have.

[The prepared statement of Mr. Rice follows:]

**Statement of
Bryan Rice
Director, Office of Wildland Fire
U.S. Department of the Interior
Before the
Senate Committee on Energy and Natural Resources
Oversight Hearing on Wildland Fire Management
August 3, 2017**

Chairman Murkowski, Ranking Member Cantwell, and members of the Committee, thank you for the opportunity to provide testimony on the Department of the Interior's (Department) Wildland Fire Management program (WFM).

The Office of Wildland Fire (OWF) coordinates the Department's WFM program with Federal agencies, Tribes, states and external partners to establish policies and budgets that are consistent with and support the goals of the National Cohesive Wildland Fire Management Strategy. OWF provides strategic leadership and oversight to advance the three goals of the National Cohesive Strategy, which are to: 1) restore and maintain fire-resilient landscapes; 2) create fire-adapted communities that will withstand the effects of a wildfire without the loss of life and/or property; and 3) safely and effectively respond to wildfire.

OWF recognizes the importance of collaboration with Federal partners, states and local governments, Tribes, and other stakeholders to achieve the goals of the National Cohesive Strategy and significantly reduce fire risk to wildland firefighters, communities, and landscapes. The success of the WFM program is highly dependent upon full and successful collaboration in every facet of the program. Partnerships are key to DOI's land stewardship responsibilities, including the application of fuels management work that helps reduce fire risk; post-fire rehabilitation work that helps restore landscapes and watersheds; and fire science that provides information needed for fire practitioners and decision makers.

The integration of fire management with resource management functions across the Department is a core principle of the WFM program. For instance, fuels management projects influence wildfire behavior and promote the safety and effectiveness of wildfire response. Through the use of prescribed fire, chemical treatments, and other applications we are able to reduce wildfire risk and safeguard communities and infrastructure. At the same time, these projects enhance wildlife habitat and help watersheds become more resilient to the damaging effects of wildfires. The strategic application of fuels projects in priority areas helps in managing the negative effects of wildland fires, including in areas that are prone to unnatural high intensity fire activity.

Finally, in advancing the goals of the WFM program, OWF recognizes the importance of developing and adopting advanced or emergent technologies. This is critical to becoming a more efficient and more effective wildland fire organization, and is paramount to the oversight and

management of a safe WFM program. Outside of the Department of Defense, DOI is the emergent leader in the research and development and practical deployment of Unmanned Aircraft Systems (UAS), or drones, on wildland fire management operations. Currently, the Department uses UASs to support firefighters in the field, map fires using infrared technologies, and gather data for strategic planning. These advancements support the safety of our firefighters and the public and allow us to be better positioned to address wildland fire. Through a robust UAS program, we continue to be innovative and improve our operational efficiency.

2016 Wildfire Season

The greatest losses during the 2016 wildfire season involved the fatalities of 15 wildland firefighters who made the ultimate sacrifice to protect the lives of others and the lands and resources we are entrusted to manage.

In 2016, wildfire activity was below the rolling ten-year average for the number of fires (92 percent) and number of acres burned (79 percent). The Southern Area burned the most acres – with wildfires consuming over 1.5 million acres. Despite the lower acreage burned, requests for firefighting resources placed with the National Interagency Coordination Center were very close to average. The number of residences burned was more than double the average number. More than 4,300 structures were destroyed, including nearly 3,200 residences. In Tennessee, over 2,000 residences were lost in the Chimney Top 2 Fire; and sadly, 14 people also lost their lives. This reminds us all that wildfire is not only a Western issue and can occur anywhere in the United States.

In fiscal year (FY) 2016, the Department was appropriated \$468.7 million for suppression operations. Including carryover balances, the total budget authority was \$510.4 million. This includes funding appropriated to the Department in the Suppression Account and the Federal Land Assistance, Management, and Enhancement Act (FLAME) Account. Of the total available budget authority, \$371.7 million was obligated, and no Section 102 transfers were required.

2017 Fire Season

Firefighter and public safety is paramount in all firefighting operations. Before engaging in any activity, we fully evaluate risks with a broad perspective for both planned and unplanned ignitions, while considering the people we serve and the landscapes we protect.

The cumulative impacts of drought, invasive species, and climate variability are creating a landscape more susceptible to devastating wildland fires. Long drought, followed by a wet winter and spring, has led to extensive areas with abundant herbaceous growth, while shrublands, woodlands and forests remain impacted by the drought. As the grasses mature and dry, they can readily spread fire to the woody vegetation that has not yet recovered from

drought. These impacts and declining forest health are exacerbated by an ever-expanding wildland urban interface, and the inherent complexities and dangers of fighting wildfire in and around these growing communities. We continue to be impacted by escalating emergency responses and increasingly dangerous and costly wildfire response operations.

In addition to these variables, the wildfire risk in 2017 will be highly dependent upon both weather and human factors. The National Significant Wildfire Potential Outlook, issued by the Predictive Services Unit at the National Interagency Coordination Center, predicts above-normal significant fire potential for the Island of Hawaii (the Big Island) through October. Several parts of California will have above-normal significant fire potential from August through November. The area of above-normal potential from the northern Great Basin through the Pacific Northwest and Northern Rocky Mountains to the Great Plains becomes smaller in October and November. Monsoon rains have returned northern Arizona to near-normal wildfire potential.

So far this season, we have seen outbreaks of large fires in the midwest, southeast, southwest, Northern Rockies and California, as well as individual large fires elsewhere. As of August 1st, nearly 39,000 fires have burned almost 5.5 million acres of land. While the number of fires to date this year is less than the rolling 10-year average number of fires, the acres burned exceeds the 10-year average (3.8 million acres).

Together with our partners at the U.S. Forest Service, we are actively working the 2017 fire season. This season, the Department plans to deploy over 4,600 firefighters, including 145 smokejumpers and 16 Type-1 crews; more than 600 engines and 100 other units of heavy equipment (dozers, water tenders, etc.); and we expect to be able to mobilize approximately 1,300 personnel ready to support wildfire and all-risk incidents (including incident management teams, dispatchers, logistics, and fire cache activities). Collectively, nearly 6,000 Department personnel are prepared to mobilize.

This year, the Department has contracted for 84 single-engine airtankers (SEATs) that are available on an “on-call” basis. SEATs are a good fit for the types of fires that the Department faces on public lands. Many of these fires burn at lower elevations, in sparser fuels, or on open terrain where smaller airtankers are especially effective. In addition, the Department has access to over 350 small and large helicopters and 17 water scoopers. We will utilize U.S. Forest Service contracted heavy airtankers where appropriate, and if necessary, Modular Airborne Firefighting System (MAFFS) equipped C-130 aircraft from the Department of Defense. Agreements are also in place to use supplemental aircraft from our state and international partners.

Enacted WFM program funding for FY 2017 totals approximately \$1 billion, including \$460 million for suppression. We believe these resources and carryover balances will allow us to continue to provide effective wildland fire preparedness and suppression across more than 500

million acres of Department managed public lands.

Collaboration and Coordination in Wildland Fire Management

The National Cohesive Wildland Fire Management Strategy was built upon the need for collaboration between Federal agencies, Tribes, state and local governments, and other partners. Collaboration is foundational to wildfire planning and suppression operations; to the identification and mitigation of wildfire hazard and risk; and to post-fire treatments that stabilize soils and restore lands. The majority of issues in wildland fire management arise from the ground up, and most are managed first at the local or landscape level, across ownerships and amongst interested stakeholders. For example, the National Park Service (NPS) and the State of Alaska joined in creating fuel breaks on Federal and state administered lands to protect the McCarthy community after being threatened by the 2009 Chakina Fire.

The Department has actively supported the preparation of Community Wildfire Protection Plans (CWPPs), as directed by the Healthy Forests Restoration Act (HFRA), not just on lands treated under HFRA authorities, but wherever communities are near Department landholdings. By their very design, CWPPs are collaborative and the Department has provided technical expertise in support of efforts to help ensure that plans are effective. For example, the Fish and Wildlife Service (FWS) is a member of the Kenai Peninsula “All Lands All Hands” working group in southern Alaska. This group, representing ten different Federal, state, and local agencies, created a collaborative multi-year action plan that identifies and prioritizes on-the-ground activities intended to reduce wildfire risks to communities and the environment. The fuel breaks funded by the FWS and implemented by FWS, state and local contractors, provided the Alaska communities protection from three separate wildfires. The fuel breaks were effective in reducing fire behavior and provided an anchor point for suppression resources limiting potential loss to the communities of Soldotna, Sterling, and Funny River. For the 2014 Funny River fire, every dollar of Federal investment provided protection for \$164 worth of residential and commercial structures.¹

The National Wildfire Coordinating Group has chartered a number of working groups that foster cooperation between the Federal agencies, states, Tribal, and local partners. States are represented on these working groups, e.g., the Geospatial Subcommittee, which sets data standards for wildfire incidents. These standards allow for the seamless integration of Federal, state, and local data to permit interoperable online collaborative geographic information systems (GIS) that use mobile phone, tablet and other computer systems. Coordination of data used in GIS allows for safer and more efficient wildfire suppression operations in a manner parallel to using mutually compatible radio frequencies and compatible hose fittings on wildland fire

¹ Saperstein, Lisa, Brett Fay, Josh O'Connor, and Brad Reed. Fuels Treatments Made Difference in Protecting Communities – 2014 Kenai Peninsula. Rep. N.p.: n.p., 2014. Print. U.S. Fish and Wildlife Service.

engines and hoses. To the extent practicable, systems use readily available, accessible technologies to help reduce costs and make the tools available to all users.

While the Cohesive Strategy and CWPPs represent collaboration and partnerships at the local, Tribe and state levels, the Wildfire Leadership Council (WFLC) represents cooperation and collaboration at higher organization levels that include agency executives and representatives from Tribal, state, and local governments. WFLC helps coordinate issues at the national or multi-state level, especially those issues that are inconsistently or less readily resolved at local levels. The mission of WFLC is to provide consistent implementation of wildland fire policies, goals, and management activities. WFLC provides strategic recommendations to help ensure policy coordination, accountability, and effective implementation of Federal wildland fire management policy in support of fire-adapted communities and resilient landscapes.

Fuels Management and Forest Health

Our partnerships with other Federal agencies, Tribes, states and local governments, and other stakeholders are increasingly important as we implement an integrated WFM program. By focusing on collaborative landscape-level treatments that remove unnaturally stocked forests and woodlands, maintaining previous treatments, and allowing wildfire to occur at the appropriate intervals and intensities, we can better protect the health of the landscape and the safety of the public and our firefighters. We believe that over the long-term this strategic approach will help manage wildland fire and the increasing costs associated with post-fire rehabilitation.

Fuels management is an economic investment that, when successfully implemented, can provide cost-effective benefits to the American people and to Federal, Tribal, state and local lands by managing the negative effects of unnaturally high intensity wildland fire. For example, a report from Northern Arizona University on the 2010 Shultz Fire states: *"...it is sobering to note that by treating a significant portion of the Schultz Fire imprint with an investment of \$15 million could have greatly reduced the cost of the Schultz Fire and avoided the damage and loss of life associated with post-fire flooding that is now conservatively estimated to be between \$133 and \$147 million."*²

Examples of fuel treatments include the use of prescribed fire, thinning of overstocked stands in areas with critical wildlife habitat, removing trees encroaching on meadows or wetlands with significant resource value, and controlling invasive weeds – including through native seed supply – that degrade habitat, compete with native vegetation, and increase the risk of wildfire. In FY 2016, more than 1 million acres of Department lands were treated to address or maintain desired resource conditions; so far in FY 2017, more than 700,000 acres have been treated with additional work scheduled this coming fall. These projects play a critical role in influencing

² Combrink, Thomas, Cheryl Cothran, Wayne Fox, Jeff Peterson, and Gary Snider. "A Full Cost Accounting of the 2010 Schultz Fire." (May 2013): n. pag. Web. <<http://franke.nau.edu/images/uploads/rpi/AFullCostAccountingOfThe2010SchultzFire.pdf>>.

wildfire behavior, enhancing the safety and effectiveness of wildfire response, reducing wildfire risk, and safeguarding our communities.

Veterans

The Department is a leader in providing training and job opportunities for veterans who wish to continue their service to our country. We will continue our efforts to emphasize the hiring of veterans to fill the ranks of our firefighting forces. Through the Department's partnership with Team Rubicon, an organization founded by military veterans, the Bureau of Land Management has provided Wildland Firefighter Type I and II training and certification for over 800 veterans. Almost \$1.4 million has been provided for training and fire assignments over the past three years and 269 veterans have been deployed on incidents.

One of the largest accomplishments has been the successful placement of 74 trained veterans who competed for and accepted Federal jobs. Eight veteran wildland fire crews are stationed in Arizona, California, Montana, Nevada, Oregon, South Dakota, Washington, and Wyoming. We take great pride in the role these men and women play in our wildland fire community and we look forward to working with Team Rubicon on continuing this important program.

Use of Emerging Technologies in Wildland Fire Management

OWF has been actively engaged in supporting the development of emerging technologies in all facets of wildland fire management from planning to suppression operations to post-fire burned area rehabilitation. The use of technology is quite extensive and only a handful of examples are included in this testimony.

The Department's Office of Aviation Services, in cooperation with Department agencies, has successfully carried out a number of demonstration projects that document the effectiveness of using UASs and optionally piloted aircraft to improve wildland fire management operations and the safety of firefighters. The Department has initiated the successful integration of small UAS technology in support of wildland firefighting, including developing specifications for a government-owned fleet of UAS aircraft; training 42 wildland firefighters from around the country as UAS operators who will have access to UAS fleet assets during the 2017 fire season; leading the development of an interagency fire UAS operations guide to facilitate coordination between Federal and state agencies when using UASs on wildland fires; and prototyping the deployment of small UASs embedded with wildland firefighters to enhance their tactical situational awareness. The Office of Aviation Services is also building on Department of Defense operational capabilities as we explore innovative and economic uses of technologies.

One potential near-term use of UASs is their effectiveness at detecting and mapping wildfires in heavy smoke conditions, particularly during evening and nighttime operations. Aircraft equipped with infrared technology provide the ability to take action during these low visibility times. When

large fires may be a priority for nighttime infrared flights, the UASs, with relatively lower operational cost, may be deployed to multiple fires while they remain small. In the long-term, larger UASs have the capability to deliver fire retardant and cargo in a cost-effective manner and in environments that may prohibit the safe use of larger piloted aircraft. In each of these cases, firefighter safety remains a primary focus, both for those on the ground and those who might otherwise be in aircraft deployed on incidents.

Building on recent initiatives to prevent privately operated UASs from interfering with Federal, state, and local wildland firefighting operations, the Office of Aviation Services has expanded "Current Wildland Fires," a program which provides location data on any wildland fire reported in the last eight days. The data is in near real-time map format and is accessible through the Geoplatfrom ArcGIS Online Organization. This initiative informs drone operators where not to fly so that they can avoid incursions on wildland fires, which has become a growing problem.

Innovative uses of technology do not always require unfamiliar, expensive or extremely sophisticated components. One example of off-the-shelf technology that may save firefighter lives is the use of Global Positioning System (GPS). The FWS used GPS transmitter collars to monitor the locations of multiple firefighters, vehicles, equipment and aircraft during wildfires and prescribed fires. The system proved itself as an important safety tool during its first field trial in heavy fuels in the southeast when it was used to direct a firefighter lost in unfamiliar terrain to safety.

Using webcams, the U.S. Geological Survey is helping to coordinate a wildfire monitoring system with the Department, the U.S. Forest Service and the State of California. Real-time observation cameras are used to monitor fire occurrence and smoke, and to help forecast air quality conditions over a broad area in the Sierra Nevada Mountains. Similar uses of webcams occur regularly on individual wildfires nationwide, where the data are used by the states and by Air Resource Advisors assigned to work with incident management teams.

Conclusion

This concludes my statement. Thank you for your support to the Department's Wildland Fire Management Program and for the opportunity to testify before this Committee. I welcome any questions you may have.

The CHAIRMAN. Thank you, Mr. Rice.
Welcome, Mr. Maisch.

STATEMENT OF JOHN “CHRIS” MAISCH, ALASKA STATE FORESTER AND DIRECTOR, DIVISION OF FORESTRY, ALASKA DEPARTMENT OF NATURAL RESOURCES

Mr. MAISCH. Thank you.

Good morning, Chairman Murkowski, Ranking Member Cantwell, and members of the Committee and my fellow panel members.

My name is Chris Maisch, and I am the State Forester and Director of the Alaska Division of Forestry and past President of the National Association of State Foresters. I appreciate the opportunity to speak with you today on the topics of wildfire risk mitigation and the use of new technology on the fire line.

The mission of my division is to proudly serve Alaskans through forest management and wildland fire protection. The Division is the lead agency for fire management services on 150 million acres of land with a primary goal to protect life and property.

My staff works closely with two key partners in Alaska, the USDA Forest Service and the Department of the Interior, Alaska Fire Service with the latter agency being our main partner in Alaska.

I'd like to address my first topic on reducing risk to communities and firefighters by walking you through the process of how a fuel mitigation project is created and then deployed on the ground.

My written statement has included several case studies of fuel reduction projects that were used in actual wildland fire incidents, but I'm going to focus on one project in Alaska. The process starts with the State Action Plan which is a key document that focuses limited resources via a publicly vetted process and reflects individual state priorities. This tiers into a CWPP, or Community Wildfire Protection Plan, that goes into more detail and can be for a whole community, a neighborhood or any jurisdictional unit that works well for the planning process.

Agencies provide science-based input to the types of fuel breaks or other fuel treatments that are appropriate for the circumstances. Work is conducted at the landscape level and for individual properties in Alaska, via our Forest Stewardship Program and a nexus with Firewise USA principles. Stewardship foresters are experts at working with small landowners and, in our program, we offer cost share incentives to work with and encourage landowners to fully implement recommendations to reduce risk. This work is cross boundary and at scale and follows the strategy of defense and depth.

If you are students of military tactics, you will recognize this doctrine—outer rings of landscape fuel breaks and forest management that scale into individual treatments and for individual properties as you move further into the interface.

In 2014, the Funny River Fire on the Kenai National Wildlife Refuge was successfully stopped at the outskirts of the community along the Funny River Road by a landscape scale fuel break and a burnout operation as the main fire approached. And if you have

the written testimony, you can look at page 2, Figures 1 and 2, for examples of what these treatments actually look like.

The fire log for the incident reports the progression of the fire, and I'd like to read to you several entries:

- May 19th, at 1600 hours, the Funny River Fire is reported. It's driven by strong northerly winds and by 2230, the fire is seven miles long and three-quarters of a mile wide. That's in two and a half hours.
- May 20th, the fire grows an additional 21,000 acres and the Alaska Type 2 team takes command of the fire.
- May 21st through May 24th, the fire increases by another 83,000 acres.
- And finally, on May 25th, the fire grows an additional 45,500 acres and the fuel break is used in a burnout operation.

You can refer to page 4, Figure 3, to see this operation taking place as the actual fire hits the fire line.

Property values protected were over \$250 million in value. This was a significant test for this type of a fuel break. Around the country there are other examples and there are three other case studies cited in my written statement, one additional project in Alaska and two in Arizona.

It is worth mentioning that last year 82 percent of wildfires and almost 50 percent of acreage burned were on state or private lands. Collectively, we need to get in front of this problem and continue to provide solid, fiscal support for the full range of state and private forestry programs, particularly for the SFA and VFA line items. These programs help create fire-adapted communities, increased capacity of agencies to respond, create defensive space and educate the public.

Turning to my other topic, I would like to briefly address the use of technology incentive—some of the innovative uses of UAVs. In my testimony, page 6, Figure 4, you'll see this figure shows the Texas Forest Service utilizing a UAV during an initial attack fire. This technology has great potential to improve fire line safety, increase situational awareness for the Incident Commander and operation staff, as well as become a standard tool utilized for several purposes.

The addition of an infrared camera to a UAV platform shows great promise for assisting mop-up operations by identifying heat in the areas being gridded in real time for crews. My written testimony goes into the details of the Texas Forest Service Program and joint efforts by the Alaska Fire Service and Division of Forestry to incorporate UAVs into our operations, including training, equipment needs, and the next steps to continue this process.

In closing, I would like to stress the importance of cross boundary fuels work on federal, state and private lands for protecting the communities as well as increasing operational value and safety benefits of new technologies, such as UAVs and fire suppression operations.

The Forest Service state and private programs are critical funding sources for these types of activities and, as demonstrated in today's panel, states and the rural fire departments are at the forefront of the nation's wildland fire problem.

In addition to the activities discussed, there is an urgent need to increase the amount of active forest management taking place on federal lands throughout the country. There are good examples of federal land managers that are rising to this challenge, but too often the appeal process or litigation of NEPA documents delay needed projects. Reform is needed to address this problem.

Another helpful tool is the Good Neighbor Authority which allows state agencies to partner with the Forest Service and BLM to get work done on the ground. Improvements in this authority can also be made and that would be based on experience of the 95 Good Neighbor Authority agreements and the 29 states throughout the country.

Thank you again for the opportunity to discuss these important issues and topics with you. This concludes my testimony, and I would be happy to answer any questions you might have.

[The prepared statement of Mr. Maisch follows:]

**Written Public Testimony of John “Chris” Maisch
Alaska State Forester and Director Division of Forestry-DNR
on Behalf of the State of Alaska**

**Submitted to the U.S. Senate Energy and Natural Resources Committee
August 3, 2017**

Good morning, Ms. Chairman Murkowski, Ranking Member Cantwell, and Members of the Committee. My name is Chris Maisch, State Forester and Director of the Alaska Department of Natural Resources, Division of Forestry (DOF) and past President of the National Association of State Foresters (NASF). I appreciate the opportunity to speak with you today and submit written testimony as the Committee explores the benefits and challenges of incorporating new technology into wildland fire fighting operations and to examine real world examples of various types of fuel breaks and how they can mitigate risk to firefighters and the public.

The mission of the DOF is to proudly serve Alaskans through forest management and wildland fire protection. The DOF is the lead agency for wildland fire management services on 150 million acres of land with a primary goal to protect life and property (That is almost as much forest land as is in the National Forest System in the lower 48 states). The Division works closely with two key partners in Alaska, the USDA Forest Service (Forest Service) and the Department of Interior (DOI), Alaska Fire Service (AFS) with the latter being our main partner and lead agency for the other DOI agencies in Alaska. This interagency approach is reflected in the Alaska Interagency Wildland Fire Plan, in our suppression activities, and in our fuels mitigation and risk reduction work throughout the state.

Community and Individual Planning for Wildland Fire Incidents and Cross Boundaries Fuels Work

I’m very excited and pleased that the Committee is interested in proactive measures to assist communities and individual home and business owners in reducing the risk to their property and lives thru advanced planning and implementation of a suite of risk reduction measures that will achieve this objective. As with most worthwhile projects, advanced planning is a key component that will direct funds and energy toward the highest return projects; this is frequently accomplished thru the State Action Plan and a Community Wildfire Protection Plan (CWPP) process¹. A plan can be scaled to a community, neighborhood or other logical jurisdiction where a cross section of people, local, state and federal governments and agencies work together to address needs of the participants. Typically, a fuels map is produced from the analysis of vegetation types; this data is combined with topographic and cultural datasets to produce “risk” maps or zones of concern for the area the plan is addressing. Agency staff provide insight to the types of fuel treatments and methods to accomplish the objectives of the plan. This can range from a landscape scale fuelbreak (Figure 1), to shaded fuelbreaks (Figure 2), or pruning and removal of understory vegetation. Each area of the country has different approaches based on

¹ For more information on CWPPs see this link: <https://www.forestsandrangelands.gov/communities/cwpp.shtml>

their local situation and what a community deems socially acceptable. At times, there can be a conflict or disagreement about a proposed treatment, often because of how it will look or people's perception of how it will impact their slice of the world!

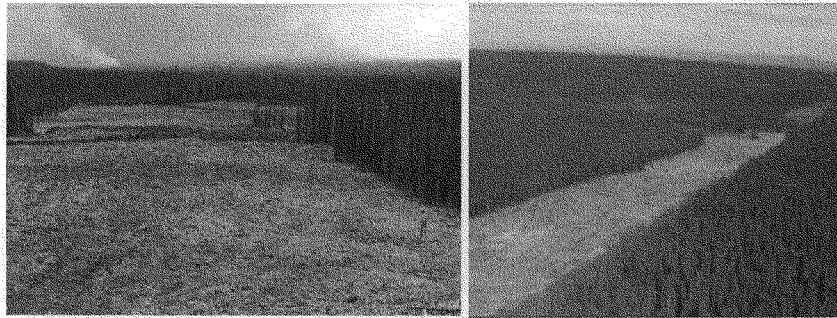


Photo: State of Alaska DOF.

Figure 1- Masticated fuelbreak completed with heavy equipment by DOF with funding from USFWS.



Photo: USFWS.

Figure 2- Firing from a shaded fuel break, Funny River fire Alaska 2014.

Often in concert with this larger planning effort, work will also be accomplished at the neighborhood and individual level via Firewise USA² or other similar program that educates the public on actions they can take to reduce the risk of wildland fire to their property, business or

² For more information on Firewise, see this link: <http://www.firewise.org/>

home, while improving both their safety and firefighters safety if a fire threatens their property. Once again, this is a suite of recommendations and activities that reduce fuels in the home ignition zone, ensure safe egress and ingress to a property, identify water sources and make other specific recommendations to a property owner. In Alaska, interest in the Firewise program often spikes in an area following a nearby wildland fire incident or during years of high fire activity in the state. These “teachable moments” are when we can accomplish significant work, especially if staff are available to meet with neighborhood groups and individuals to explain the program, inspect properties and to write-up specific recommendations to implement. The Forest Stewardship program, which is a component of the Forest Service State and Private Forestry program area that is administered by State Foresters, is our main interface with landowners. Stewardship foresters are already experts at working with small, private landowners and incorporating Firewise work into stewardship planning. It is a natural fit. In Alaska, my agency has been the recipient of several competitive grants via the S&PF Redesign Program that allow us to offer a cost share program to individuals that implement Firewise recommendations on their property, approximately a 50/50 match in most situations.

The strategy we are employing is essentially a defense in depth, where the outer ring of fuel reduction treatments compliments individual treatments that provide a much higher potential for structure survival and safety of residents should their property be threatened by wildland fire. As you can imagine, much of this work also involves educating people on the real risks they face and being prepared to deal with this type of situation. Another aspect of these efforts is the Ready, Set, Go³ program that teaches residents what to expect and how to prepare for a possible evacuation in a wildland fire event. This type of program can go a long way to reducing panic and stress for everyone involved and once again demonstrates that pre-planning and preparations are key components of a holistic approach to dealing with wildland fire. Together, this can be summed up by the goals of the National Cohesive Strategy: Resilient Landscapes, Fire Adapted Communities, Safe and Effective Wildfire Response.

Fuel Reduction Projects - Case Studies That Worked!

Funny River Fire Alaska 2014: The Kenai National Wildlife Refuge has been creating fuelbreaks – these are large landscape level projects that were part of an interagency and multi-landowner (cross boundary) effort to design and construct fuelbreaks that would protect homes, businesses and other values at risk should a fire start on the refuge and move toward the community. The DOF was a key partner and completed the on-the-ground treatments over the course of several years. At the same time, individual fuel mitigation projects were pursued with homeowners, utilizing the Firewise program, as part of the overall implementation of the community’s CWPP. These advanced preparations paid off when in the spring of 2014, a lightning initiated fire threatened the outskirts of the town of Soldotna in an area called the Funny River Road.

Thick plumes of smoke dominated the skyline as firefighters dispersed through subdivisions and prepared for dealing with the advancing fire. Some residents had already been evacuated and the

³ For more information on Ready, Set, Go see: <http://www.wildlandfirersg.org/>

entire area was now under an evacuation order. People streamed out the one highway that leads into the area. The community was sandwiched between the approaching fire and the Kenai River, with only one-way in and out. It was also the start of the Memorial Day weekend and this was the last thing most people had on their minds a few days earlier. Now they were wondering if they would have a home to which they could return. Moving fast on multiple fronts, firefighters were looking for any break they could get. The fuelbreaks made all the difference.

The call came in around midnight that the fire was going to hit the Funny River Road. By the time crews arrived, there was not much time to start a burn-out to rob the approaching fire of fuel. For the Incident Commander, the question was where to start? "Suddenly I realized I was in an area that was thinned of trees; they had built a fuelbreak!" he said. "The fuelbreak slowed the fire down enough for crews to safely and successfully light the burnout" (Figure 3). Over 2,400 structures were protected with an assessed value of more than \$250 million.

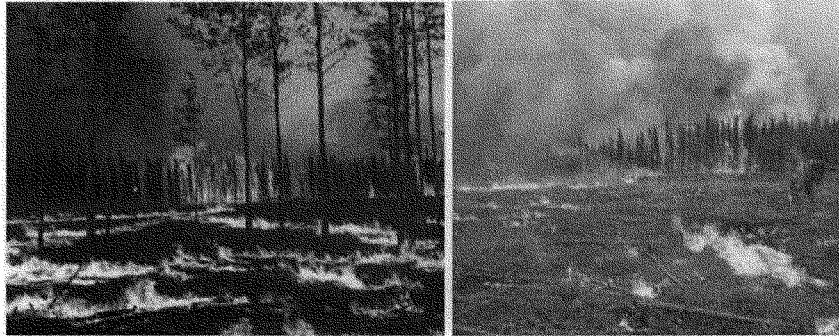


Photo Chena IHC- BLM/AFS.

Figure 3- Burn out operation along the masticated fuelbreak as the main fire approaches.

Eagle Trail Fire Tanacross Alaska 2010: This was a joint project conducted by the Alaska Fire Service and the village of Tanacross to reduce wildland fire risk to the community. A shaded fuel break was constructed on village lands by local labor. The local EFF Type II Crew and newly trained members of the community participated in the layout and construction of the fuel break, which was along the back edge of the community where a very flammable coniferous forest ran right up to, and into the community. Wood removed in the project was utilized to heat homes during the winter in a place that commonly sees some of the coldest temperatures in Alaska, -50F and colder. However, on the day that the fuelbreak was used to protect the community from the advancing Eagle Trail fire, it was hot and smoky when crews burned out from the break. The treatment reduced risk and improved the safety profile for the crew conducting the operation; they had access, water and could see the advancing fire and each other in the shaded break, as opposed to working in the dense fuels that once occupied the site.

Examples from Arizona:

Mayer Arizona 2015: Using state monies, treatments were made on 275 acres on the west side of Mayer, Arizona. Treatment masticated 60% of the chaparral fuel type creating a mosaic pattern leaving 40% uncut. In 2017, the Goodwin Fire was burning towards Mayer and stopped at the treatment area and did not enter the community of Mayer.

Yarnell Arizona 2015: Using WHFH grant funds, a 100ft fuel break was placed along the east boundary line of the community of Yarnell in 2015. The 2016 Tenderfoot Fire ran down the hill from the east toward Yarnell, and the operations folks were able to use the fuelbreak to burnout. This operation was successful in keeping the fire from burning structures.

Here is an example of a completed treatment but not tested ... yet:

Mazama Washington Fuels Reduction: The desire to reduce the threat of catastrophic wildfire in Washington is significant. The 2012-2014 Mazama Fuels Reduction project was a coordinated effort across private and federal lands within the Wildland Urban Interface (WUI) of the Mazama community in Northeast Washington. The project area was identified as being in a high priority landscape for fuels reduction in DNR's Statewide Forest Resource Assessment & Strategy. The project focused on prioritized non-federal lands in the Okanogan County & Methow Valley CWPPs which funded the development of strategically located fuel breaks and defensible space treatments to lessen fire behavior, size and intensity thereby reducing risk to lives, homes, community infrastructure and natural resources. The project was funded through a Forest Service WUI Community Assistance grant (\$200k) and matching state, CWPP and landowner funds (\$200k). Partners completed 400 acres of thinning, chipping, pruning & hand pile burning.

These case studies are a small sample of projects being conducted nationwide and are all good examples of efforts that have made a difference or are improving the odds that a community will survive a wildland fire incident. It is worth mentioning that last year 82% of wild fires and almost 50% of acreage burned were on state and private lands including the ignition points for some particularly costly federal fires. Funding for wildland fire fuels mitigation planning and projects, along with stable or increased funding for State Fire Assistance and Volunteer Fire Assistance programs to the states via the State and Private Forestry program is the best investment for continued success. Through state forest action plans, CWPPs and joint state/federal efforts we can increase the scope, scale and pace of this type of work.

Technology Advances in Wildland Fire Operations or the Age of the Drone

Most firefighters call them "drones" but the more common term is Unmanned Aerial Vehicle (UAV)⁴, at least in polite circles! The development of new applications that make use of innovated and advanced technology is a hallmark of many U.S. companies and agencies. The

⁴ Note both UAV- Unmanned Aerial Vehicle and UAS- Unmanned Aerial System are common terms used to describe these types of systems.

fire community is no different and UAV technology is rapidly finding its way to the fire line, especially in state and some federal wildland fire agencies (Figure 4).

Following the lead of the Bureau of Land Management –AFS, the DOF Wildland Fire and Aviation program started its own UAV program. The state is mirroring the AFS, which is at the forefront of the use of small UAV for direct fire crew support, infrared, mapping and reconnaissance missions on wildland fires. Prescribed fire and resource management projects are among the additional missions flown and planned for both agencies in Alaska. UAV derived data and imagery empowers incident personnel to make informed decisions based on real-time information. Data gathered from UAV is unique due to the ability of the aircraft to fly low and slow while collecting high-resolution imagery and sub-centimeter data.

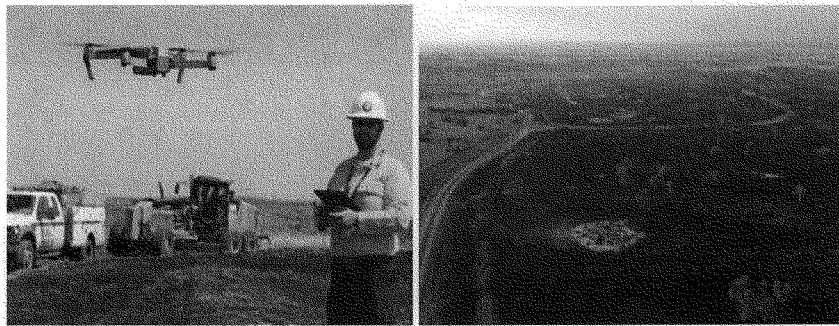


Photo Texas A&M Fire Service

Figure 4- Texas A&M Forest Service deploys a small UAV on the 4,500-acre Aeromotor Fire, Don Hannermann pilot.

The standard platform that DOF uses is a 3DR Solo quadcopter with a variety of sensors that can include the GoPro 4, Forward Looking InfraRed (FLIR), and the Ricoh digital camera. The 3DR Solo is the ideal platform for quick and easy situational awareness, mapping, small photo missions and surveys. The UAV utilized by DOF are all equipped with a GoPro4 camera. The next advancement will be a FLIR infrared camera that can detect and map residual hot spots on small sections of fires.

The primary mission of the quadcopter is small-scale data collection and situational awareness. Because the 3DR Solo is limited by range and battery life, it will not replace the helicopter for heat-seeking or reconnaissance flights on an entire wildfire. However, it has proven to be valuable to crews because the quadcopter can quickly deploy to distinguish type changes, natural barriers, and aid in fireline route selection. A FLIR camera can be utilized to detect and map hot spots.

Operation of the quadcopter requires a UAV pilot and a visual observer. The remote pilot or observer must maintain line of sight with the drone at all times, therefore it can only be flown during the day and is limited on the amount of ground it covers.

UAV Use in Alaska:

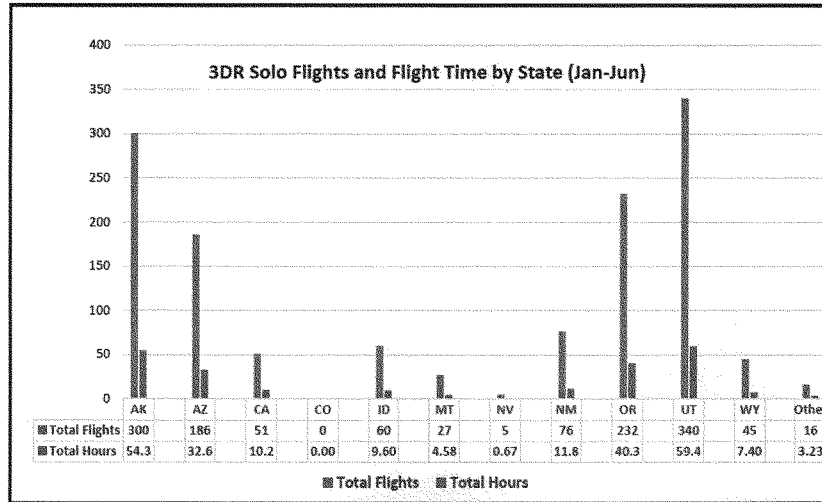
- This spring, State of Alaska/DOF trained two pilots, two data collectors and two observers. The AFS certified 17 remote pilots. Each pilot is certified as a remote pilot under Part 107 by the Federal Aviation Administration (FAA).
- The State of Alaska/DOF owns six 3DR Solos and AFS owns 17.
- Each drone costs about \$400, plus the sensor package. A GoPro 4 is the common sensor, while a FLIR camera is \$2000. This contrasts with a contracted light helicopter that costs \$1,500-\$2,100 a day for availability and \$400-\$585 per hour to fly. The IR sensor package costs approximately \$2,000.
- UAV flights limit exposure and reduces risk to pilots and wildland firefighters.
- 3DR Solos are quickly deployed and provide real-time situational awareness.
- The 3DR Solo falls into the small-sized quadcopter category weighing less than 55 pounds. It has a range of a half mile and maximum endurance of 20 minutes. Batteries take two hours to recharge.

As of June 30th, DOF personnel have used the 3DR Solo for panoramic photo and video missions on prescribed fires as well as situational awareness missions on four wildfires in Alaska. DOF and the AFS remote pilots have flown 221 flights for a total of 42 flight hours (Figure 5). Alaska's UAS program notables include:

- Alaska DOF employee Cal Maki was the first regular wildland firefighter in Alaska to deploy a small UAS on a wildfire.
- Midnight Sun Interagency Hotshot Crew (IHC) was the first out of 113 national IHC to deploy a small UAS on a wildfire.
- Two sets of missions using the IR camera have been performed on wildfires and shown that the IR application is highly effective for finding hot spots and very low impact to other aerial operations.

UAV Use in Texas:

- Texas A&M Forest Service (TFS) recently entered the UAV world after three employees attended the Texas A&M University System supervisory training for UAV operations in Corpus Christi. Following that training, 13 TFS employees participated in a TFS-led FAA Remote Pilot Test training course and so far 10 personnel have successfully passed the pilot test and are able to fly under FAA Part 107 rules.
- Texas A&M Forest Service deployed its first UAV on two wildfires on July 25, 2017 in the Texas Panhandle. Planning and Preparedness Department Program Leader Don Hannemann utilized a UAV on the Gibson Ranch Fire, a small initial attack fire, in Cottle County to assist TFS ground crews in analyzing terrain and checking for active fire behavior along the fireline.
- The second deployment later that day was on the 4,500-acre Aeromotor Fire near Matador where the UAV completed reconnaissance on a small spot fire outside the line, assisted with perimeter mapping and checked for smoke in inaccessible terrain.



Source- Alaska Fire Service.

Figure 5- Federal fiscal year 2017 (January to June only) statistics on BLM UAV use by location.

Next Steps:

- Continue to evaluate the 3DR Solo and develop the UAV program in a gradual approach working directly with the AFS.
- Increase the number of UAV pilots within the Division's firefighting ranks. Expand the number of pilots in the resource management ranks that can assist firefighters.
- Cultivate the infrared camera capabilities and adapt supporting equipment to make data collection easier while on a wildfire.
- Mitigate limitations created by short battery life, recharge time, and recharging in remote locations.
- UAVs can be utilized on future wildfires to help firefighters determine the most efficient path for constructing dozer line, provide situational awareness as to structures or civilians threatened and assist with firefighter safety in the event of an entrapment.
- Continue to improve data collection and data sharing.

Other Key Programs that Advance Technology Development and Implementation

The Joint Fire Science Program is funded by the Department of the Interior and Forest Service and since its inception in the mid-90s has become a key program for developing new technology and applications of current knowledge to address the need of wildland fire agencies. The mandate of

the program is to focus on the development and applications of tools for managers and one of the key areas of work is in the effectiveness of various fuel mitigation treatments. Once a fuel treatment is in place, there are long-term maintenance needs and potentially a different set of vegetative conditions will develop over time. This is an evolving area of science and having a program focused on this topic will help agencies develop guidelines and treatment prescriptions to ensure the effectiveness of a fuel break over time. Funding for this program has been significantly reduced in the current budget process and I hope that funding can be maintained at the FY16 levels. This is a good program that provides tools and information wildland fire managers can use every day!

Conclusion

In closing I would like to stress the importance of cross-boundary fuels work – on federal, state and private lands - for protecting communities as well as the increasing value and safety benefits of new technology such as UAV's in fire suppression. The Forest Service State and Private Forestry program area is a critical funding source to the states for these types of activities and as demonstrated in today's panel, states and their rural fire departments are at the forefront of the nation's wildland fire problem. Our agencies are more nimble and able to adapt rapidly to new technology and ways of conducting operations, and are a cost effective and efficient way to get in front of this problem. In addition to the activities discussed, there is an urgent need to increase the amount of active forest management taking place on federal lands throughout the country. There are good examples of federal land managers that are rising to the challenge, but too often the administrative appeal process or litigation of NEPA documents delay needed fuel mitigation projects on federal lands. Reform is needed to address this problem.

Another helpful tool is the Good Neighbor Authority (GNA) which allows state agencies to partner with the Forest Service to get work done on the ground. Improvements in this authority can also be made based on the experiences of the 95 GNA agreements currently in place with 29 states throughout the country.

Thank you again for the opportunity to discuss these important issues and topics, this concludes my testimony and I would be happy to address any questions the Committee may have.

The CHAIRMAN. Thank you, Chris.
Mr. King, welcome.

**STATEMENT OF STEVE KING, ECONOMIC DEVELOPMENT
DIRECTOR, CITY OF WENATCHEE, WASHINGTON**

Mr. KING. Good morning, Madam Chairman Murkowski and Ranking Member Cantwell and members of the Committee. Thank you so much for this opportunity to come to DC and present to you. It's my first time.

And let me present just a little bit of background about my career. I serve the City of Wenatchee as Economic Development Director and interestingly, 15 years ago, I started performing civil engineering work to design water systems for fire response based on structure loss in the 1992 Castle Rock fires in which over 20 structures were lost in Wenatchee. In 2015 when the Sleepy Hollow fires hit our city, we did not run out of water, so that was a successful mitigation effort.

However, the disaster still occurred which tells us we need to look more comprehensively at how we address wildfire.

I hope that my testimony today will communicate to you the value and the power in communities to act, and the value of implementing the risk reduction strategies through multiagency collaboratives and partnerships.

Just a little context for Wenatchee. Most people, when I tell them I'm from Wenatchee in Washington State, they assume where I am from, we have lush rainforests all around us. Wenatchee is on the east slope of the Cascades. It's beautiful, but we get ten inches of rain a year and our communities lie on the downgradient, downwind sides of the foothills of the Cascades. The forests give way to shrub steppe environments and wildfire is a reality.

I grew up in Omak, Washington, two hours north, just shy of the Canadian border and next to a retardant base, or back then they called it "borate bombers," where we had the World War II aircrafts dropping borate on fires just about every year. We didn't have large structure loss or huge human impacts at that time. I barely remember any losses other than a few outbuildings being lost in those events.

Times have changed. Our communities have grown as we push into the Wildland-Urban Interface, and it requires a different approach. My uncle served for 30 years with the Okanogan-Wenatchee National Forest as the spokesperson. I remember specifically two times when he had to deal with firefighter deaths, so my heart goes out to the folks in Montana.

In 2015, we had the Sleepy Hollow fires one year after the Carlton fires when 322 homes were lost in the Okanogan area. The Sleepy Hollow fires caused the loss of 29 homes and 30 acres of warehouses right in the middle of our community.

I was there during the event. I saw the fire turn from a calm, brush fire and when the winds picked up in the afternoon, the fire traveled over a mile in 20 minutes and was in the edges of our city and houses were exploding. I saw that and watched in horror as the firefighter response efforts were quickly overwhelmed, and we then saw house embers leaping from house to house. And then over a two-mile jump into the heart of the city. It's hard to imagine, as

you're in the middle of that, that all of a sudden, the radio calls out, and we have structures in downtown and a chemical facility ablaze, and it was like, oh boy, this just went to a whole new level. So, I will never forget this, but people do, people that aren't directly impacted do forget, and new people come to a community. And so, keeping that presence of understanding that we live in an environment where this can happen is really important. And I'll talk a little bit about how risk mapping does that, it helps keep that in the forefront.

I also want to say thank you for the effort or the investment in training opportunities through the National Fire Academy, through the Community Planning Assistance for Wildfire Programs. The Chief of our fire department and us have taken up these opportunities. One of our goals is to become better educated in the understanding of this, of the realities of these events.

Risk mapping. Two weeks ago, I sat down with the staff from the Forest Service, Rocky Mountain Research Station, and we worked on the risk map for Chelan County. There's some significant values that come out of risk mapping and one of them, as evident last week or the last couple weeks, was that it brings everybody together. Agencies have different value sets and that comes out when you start talking about risk mapping and fire behavior.

It's also a tool for call-to-action. As I mentioned before, people forget. Risk mapping lets you simulate a disaster without actually having to go through the disaster. It lets us inform. It informs us on how to implement our codes, our wildland-urban interface codes. It tells us the effectiveness of risk reduction strategies such as vegetation management. It provides us information on how to protect critical infrastructure, like water systems or communication systems.

And then, the technology is changing and will continue to change. For example, there's a lot of studies being done right now on ember transport, especially from structures. And so, risk mapping, ultimately, will incorporate that new science and technologies to help us grow as the science becomes available.

I just want to, again, come back and stress that our Wenatchee Foothills are made up of lands owned by the Forest Service, the Department of the Interior, our local non-profit land trusts, our State Natural Resources Department and the City of Wenatchee, Chelan County, and the private property owners. It's absolutely paramount that everybody participates in these activities.

Risk mapping also shows the importance of that. One property owner can lose their house, then you can lose it all if somebody doesn't participate. So, once again, it's a call-to-action. It's a leveraging tool, as well as a technology tool that brings people together.

So I hope you can see our passion at the City of Wenatchee and how we're trying to prevent this from happening again.

I had to tell our planning commission that we live in a world of wildfire and that wildfires will continue to happen, and disasters will happen. But if we do this successfully, we can—maybe instead of 20 years, it will be 100 years before the next disaster, or better yet, not even 100 years. And it takes this comprehensive approach to actually achieve that goal.

So, with that, again thank you, and I would be happy to answer any questions.
[The prepared statement of Mr. King follows:]

U.S. Senate Committee on Energy and Natural Resources

*Testimony for Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland
Fire Risk to Communities and Enhance Firefighting Safety and Effectiveness*

August 3, 2017

Steve King, City of Wenatchee Economic Development Director
129 South Chelan Avenue
Wenatchee, WA 98801

Members of the Committee on Energy and Natural Resources, my name is Steve King and I have the pleasure of serving the City of Wenatchee as the city's Economic Development Director. I am honored to have this opportunity to present testimony on the value of multiagency partnerships and collaboration associated with efforts to reduce the risk of wildland fire disasters. The City of Wenatchee and other communities in North Central Washington have experienced a number of significant events in the last five years and thus wildfire is in the forefront of our minds. I would like to start this testimony with a recount of the night of June 28, 2015 when the City of Wenatchee lost 29 homes and several industrial warehouses to wildland fire that spread indiscriminately into the heart of our city. The seemingly harmless brush fire in the early afternoon of June 28th turned in to a torrent of flames traveling over a mile in less than 20 minutes when the winds picked up that late afternoon. I personally watched the whole event unfold from a distant vantage point watching helplessly and in horror as the edge of our city went up in flames. The Sleepy Hollow fires and the losses our community suffered is forever burned in my mind. Watching this event unfold in your beloved home town is incomprehensible. During the event itself, we saw emergency crews work to do everything they could to ensure people's lives came first and then to triage structures to save homes that had half a chance of being defended. I recall specifically standing below one neighborhood watching homes explode in flames when the radio reported warehouses on fire in the middle of the city. Just when we thought it couldn't get worse, it did with an agricultural chemical supply plant fully involved over two miles away from the wildland urban interface. Finally, after a couple more hours of chaotic conditions, thankfully the wind died down and the fire stopped spreading. I tip my hat to our firefighters who worked so hard in seemingly hopeless firestorm conditions that night. The next day, when dawn broke, the scene was not much better. I can honestly say that there is nothing worse than driving through a neighborhood where all that remains are chimneys and smoldering remnants of once beautiful homes. Occasionally, out of the blue, one home would be standing untouched with no rhyme or reason. This is the beginning of after the fire period in which the human and community impacts are just getting started. The human impacts after the fire last for years and is

heartbreaking to witness. I share this story as an introduction to illustrate the importance of employing preventative measures to reduce the chance of our community and others from ever having to experience this type of natural disaster tragedy in the future.

Employing What We Have Learned

Since the Sleepy Hollow Fires of 2015, Chelan County Fire District No. 1 Chief Burnett and I have gone to extensive training concerning the Wildland Urban Interface. This training included attending the National Fire Academy Wildland Urban Interface course, securing and working through a Community Planning for Wildfire Assistance grant, and attending a 2016 National forum in Boulder Colorado to share and learn about the successes and challenges other communities face associated with this topic. Members of the committee, I want you to know how federal support of this type of training is highly valued and appreciated. We, in Wenatchee, can attest that this training does make a difference. Without this support we would not have learned that the risk of occurrence of the afore mentioned disasters can be substantially reduced through implementation of multipronged strategies and best available science. These strategies not only include more traditional response measures, but they also now include prevention strategies such as land use planning, community engagement, using fire resistant building materials for susceptible structures, creating and maintaining defensible space, and employing vegetation management practices in the wildlands. All of these strategies will be tied together in a Community Wildfire Protection Plan and the County Hazard Mitigation Plan which reinforces the need for partnerships among property owners; wildland managers; city, county, state, and federal government; as well as emergency response agencies. I cannot emphasize enough the importance of these partnerships as wildfire knows no boundaries. This is particularly important in Chelan County in which over 80% of the land area is in public ownership. In our County, our communities live down valley and downwind of the wildlands. The risk of wildfire starting in the wildlands and migrating into the urban areas is acute given our arid climate and susceptibility to dry lightning ignited wildfires.

Value of Risk Mapping and Modeling

Understanding how risk is impacted by the implementation of multiple strategies while taking into account the complex science of fire behavior, weather conditions, vegetative environments, slopes, and wind speeds requires the use of technology based tools. Risks mapping and modeling is an amazing tool to help accomplish this intense and complicated task. Risk mapping and modeling also provides numerous other benefits as follows:

- Risk mapping gives us a way to communicate the importance of becoming fire prepared and the need to employ risk reduction strategies in specific locations of our community.

- It helps us prioritize where to apply limited resources based on the greatest risk to the community and the largest potential for loss.
- Risk analysis becomes a tool for a call to action which helps professionals engage the public in terms in which they can understand. Interactive maps allow property owners to look specifically at their neighborhood and expected fire behavior in the adjoining wildlands.
- Risk maps provide a tool for cities and counties to adopted relevant codes such as the Wildland Urban Interface code. The City of Wenatchee will be making changes to our Wildland Urban Interface development codes based on information derived from risk mapping.
- Risk modeling helps us assess effectiveness of strategies when applied comprehensively or individually. More importantly, risk modeling tells us what happens when certain strategies are not implemented. For example, if a community develops a vegetation management strategy in the adjoining wildlands and it is only implemented by 80% of the landowners, risk modeling will show whether or not risk is actually reduced commensurate with the investment. It then becomes a call to action to secure 100% participation of landowners.
- Risk assessments allows communities to prioritize protection of critical infrastructure. For example, often times wildfire cause power outages which shuts down water pumps that support wildfire fighting efforts.
- In the case of Wenatchee, risk mapping taught us that the fire behavior in our shrub steppe environment is fairly predictable and relatively constant over time. Thus, this conclusion supports the implementation of strategies such as defensible space that will be just as effective in 20 years as it is today if it is maintained.
- Understanding fire behavior in the worst conditions helps fire and emergency response agencies understand how best to defend structures and a community when wildfire does strike. This is part of living in an environment prone to fire and recognizing that extreme fire events have happened, do happen, and will continue to happen. How we prepare ourselves for the next fire is our choice.
- Finally, risk modeling and other fire behavior tools are becoming more advanced as scientific research digs deeper into the causes of wildland urban interface fires. For example the science of ember cast and transport is currently being further developed. Ultimately, this science will be incorporated into risk models. Risk modeling will become more and more useful over time as technology and science is improved.

As demonstrated above, the value of these elements of risk mapping and modeling is tremendous. As our community continues to learn about wildfire and risk mapping is further refined for Chelan County, we have come to appreciate its importance.

Current Risk Mapping Efforts – Nonfederal and Federal Partnerships

As part of the Community Planning for Wildfire Assistance (CPAW) grant, the city developed a risk map for the areas around Wenatchee in 2016. This opened the door to understanding and discussions around the complexity of our natural environment. In July of 2017, local agencies convened to work on a comprehensive risk map for Chelan County as part of the County's CPAW grant. This map is being developed by professionals from the U.S. Forest Service Rocky Mountain Research Station. The discussion, led by the Forest Service, brought together agencies including the Washington State Department of Natural Resources, Chelan County Planning, Chelan County Fire Districts (Nos. 1 and 6), City of Wenatchee, and the CPAW professionals. The discussion around the map that ensued was extremely valuable in helping agencies with different missions and goals understand comprehensively how wildfire is viewed and managed from a resource protection standpoint. I can't emphasize enough the value of convening multidisciplinary professionals from various agencies to work together on the development of risk mapping. The creation and maintenance of a risk map computer model requires input from experts in order to 1) understand the realities of the impact of fire and 2) develop risk mitigation strategies that make a difference while considering the values of each organization and the public.

Developing a risk model is not only a cost effective tool, but it leads to effective collaboration that extends beyond the map. Relationships and understanding organizational values are the keys to effective partnerships. For example, city and county agencies learn about forest health, environmental stewardship, and range management objectives from the Forest Service, Bureau of Land Management, and the State Department of Natural Resources. In addition, these agencies learn from cities and counties how the built environment interacts with the natural environment and the associated value sets shared by people living in urban areas and more particularly in the wildland urban interface.

Once the mapping effort is complete we will be able to approach the general public with a united front which will help us secure resources and empower individuals to take action to do their part to reduce the risk of wildfire disasters as we look to the future.

Conclusion

We have experienced the horrors of wildfire and loss that extends far beyond the homes themselves. The emotional toll on people is indescribable. One of the homeowners that lost their home in the fire, told me it is like losing a limb at the same time as becoming homeless. Your home is a part of you as a person he said and losing your home takes a piece of you with it. The cost and resources expended to recover from a disaster are enormous, but not nearly as impactful as the human cost suffered by a community and individuals.

We hope that you will see in this testimony why we are so supportive of investment in resources that will help reduce the risk of this happening again in our community and just as importantly in other communities. In the era of mega fires in which human habitation is butted up against the wildlands, we know it is only a matter of time before smoke fills the air and more losses are suffered. Thankfully, we learn from our experiences and every step we take reduces the chance of disaster. This is why we put forth our efforts and resources to become more fire resilient. We sincerely appreciate the support of Senator Cantwell, this senate committee, and the federal agencies who are helping us with our efforts of becoming a fire adaptive community. Thank you.

The CHAIRMAN. Thank you, Mr. King, I greatly appreciate it. Dr. Miller.

STATEMENT OF DR. MARY ELLEN MILLER, RESEARCH ENGINEER, MICHIGAN TECH RESEARCH INSTITUTE

Dr. MILLER. Good morning, Chairwoman Murkowski, Ranking Member Cantwell and members of the Committee. My name is Dr. Mary Ellen Miller, and I'm a Research Engineer at Michigan Tech Research Institute. My Ph.D. is in Environmental Engineering with a Master's in Imaging Science. Thank you for inviting me here today to share with you my NASA-applied science work in post-fire remediation.

My team has built an online data base to rapidly combine earth observations of burn severity with process-based model inputs. Post-fire flooding and erosion can pose a significant threat to life, property, and natural resources such as our valuable water supplies.

As part of my Ph.D. program, I worked on a very large-scale EPA project designed to help plan fuel reduction treatments with a goal of protecting our water resources from high-severity fire impacts. When this project ended, I used the data sets and tools that had been developed to rapidly predict post-fire erosion for Forest Service BAER teams in Colorado.

BAER, or Burned Area Emergency Response teams, just have one week to assess a wildfire scar and decide if they need to make remediation plans or not. So earth observations of burn severity are critical in this process but I was very surprised to learn from my Forest Service research colleagues that spatial process-based, hydrological models were being underutilized.

I really didn't understand why until 2011 when the National Park Service asked me to model a small watershed that burned within the Rock House Fire in Texas. It was only 500 acres, and I had previously modeled 75 percent of the forests in the West in three months. So I thought, this is going to be easy, I can do this.

I was wrong. Texas was not part of the original EPA area, and it took me over a week to assemble the inputs that I needed. I was one day late in getting the modeling to the BAER team so it could not be used in the analysis. A year later, in 2012, I modeled 80,000 acres of the High Park Fire for the BAER team in two to three days.

The difference between success and failure was, simply, preparation. I didn't want what happened at the Rock House Fire to happen again, so I'm very proud to introduce a new, online, Rapid Response Erosion Database. We're calling it RRED, for short. RRED allows users to upload a soil-burn severity map into the online database and within seconds download all the properly formatted spatial model inputs needed to use process-based models. RRED was created through a collaboration between Michigan Tech, the NASA Applied Sciences Wildfire Program, and the USDA Forest Service Rocky Mountain Research Station.

Data preparation that used to take a week can now be done in seconds. Spatial predictions of runoff and erosion will allow the BAER teams to spatially prioritize costly, post-fire remediation treatments.

I'm proud to say RRED has been used on several major fires—last year on the Soberanes Fire. The year before, in 2015, the modeling results were used to spatially place \$3 million worth of projects in watersheds. And the year before in the King Fire, \$1 million worth of mulching in order to protect a valuable hydroelectric water reservoir. RRED has also been used on four large fuels planning projects to protect our water supplies, including one in the Mokelumne Basin in California.

Our future goals include expanding our spatial coverage to include Alaska and Hawaii. We would also like to improve RRED's capabilities for supporting fuels planning projects, and we are developing a new modeling interface to work in conjunction with RRED to make it even easier.

Thank you very much for your interest in fire science. It is very important. Research and education outreach are vital in order to support our brave, wildland firefighters and BAER teams.

Thank you very much, and I will be happy to answer any questions.

[The prepared statement of Dr. Miller follows:]

Statement of
Dr. Mary Ellen Miller
Michigan Tech Research Institute, Michigan Tech
Before the Committee on
Energy and Natural Resources
U.S. Senate
August 3, 2017

Full Committee hearing to examine federal and nonfederal collaboration, including through the use of technology, to reduce wildland fire risk to communities and enhance firefighting safety and effectiveness.

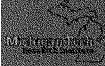

Good morning Chairwoman Murkowski, Ranking Member Cantwell, and Members of the Committee. Thank you for inviting me here today to share my NASA applied science work in post-fire remediation. My name is Dr. Mary Ellen Miller and I am a research engineer at Michigan Tech Research Institute. I have a Master's degree in Imaging Science and a PhD in Environmental Engineering.

Post-fire flooding and erosion can pose a serious threat to life, property, and natural resources. As part of my PhD I worked on a large scale EPA project designed to help prioritize fuel reduction treatments in order to help protect water resources in the Western US from post-fire sedimentation. When this project ended I used the datasets and modeling techniques I had developed to rapidly model post-fire erosion for Forest Service BAER Teams in Colorado. BAER or Burned Area Emergency Response Teams are under tight time schedules; they usually have just one week to assess burned areas and make remediation plans with or without good information. Earth observations of burn severity are an integral component in their remediation planning, but I was surprised to learn from Forest Service Colleagues that BAER Teams were not utilizing spatial process based models in conjunction with satellite data. In 2011, I was invited by the National Park Service to model a small watershed (536 acres, Hospital Canyon) that burned within the Rock House Fire, Texas. I had one week – I thought it would be NO problem! However, it was a problem as Texas was not part of the original fuels project and I could not assemble the soil input data fast enough for the results to be included in the BAER analysis. One year later I was able to model over 80,000 acres of the 2012 High Park fire in Colorado – because I had base data layers consisting of soils, vegetation and terrain formatted so that I could easily join the data with Landsat derived burn severity maps. The difference between success and failure was simply preparation.

I am proud to introduce a new online Rapid Response Erosion Database (RRED, <http://rred.mtri.org/rred/>) to support post fire remediation using NASA satellite imagery and process based hydrological models. RRED was created through a joint collaboration between Michigan Tech, the NASA Applied Sciences Program and the USDA Forest Service Rocky Mountain Research Station.

- 1) Data preparation that used to take a week can now be done in moments, making it feasible and much faster for BAER Teams to utilize NASA earth observations and spatially explicit process-based models.
- 2) Spatial predictions of runoff and erosion allow for the rapid spatial prioritization of costly post-fire remediation treatments. The database has been used to support BAER teams on several major fires in the Western US including the King Fire where modeling results were used to spatially prioritize a million dollars' worth of mulch and to plan 3 million dollars' worth of wood shreds for the Butte fire. RRED has also supported four fuel's projects including one in the Mokelumne Basin.
- 3) Future goals include expanding spatial coverage to include Alaska and Hawaii as well to improve RRED's capabilities for supporting fuel's planning projects designed to reduce the risk of high severity fires on valuable water reservoirs. This can be accomplished by expanding support to additional models.

This concludes my prepared statement. I am happy to take any questions you may have.

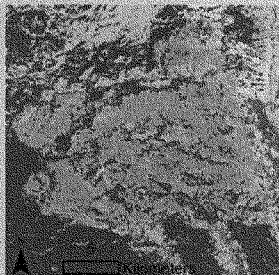

NASA RRED:
Rapid Response Erosion Database


Created by a collaboration between **NASA**, **Michigan Tech Research Institute**, and the **USDA Forest Service**, the **Rapid Response Erosion Database (RRED)** is an interactive web application designed to support process-based hydrological modeling for **post-fire remediation** efforts. **RRED** supports this modeling by using **NASA** satellite data to rapidly create the required geospatial model inputs, expediting the process so that the spatially explicit erosion and run-off prediction outputs are more readily available for use in assessing and prioritizing post-fire remediation.

Prior to RRED, assembling and formatting these geospatial model inputs would have taken several days; RRED delivers these inputs in mere seconds.

Modeling database:
rred.mtri.org/rred

Data can be delivered in both burned and not burned formats, providing flexibility for other applications such as **agriculture, construction** and for **fuels planning** projects seeking to **protect water resources**.



Water	Forest	Cultivated
Developed	Short Grass	Wetland
Road	Tall Grass	Low severity
Barren	Shrub	Mod severity
Young Forest	Pasture	High Severity

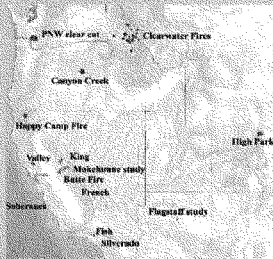
Why RRED matters

Post-fire flooding and erosion can pose a serious **threat to life, property and municipal water supplies**. To respond to this threat, interdisciplinary **Burned Area Emergency Response (BAER)** teams are formed to assess potential erosion and flood risks. BAER teams must quickly determine if expensive remediation treatments are needed and how to prioritize their spatial application. One of the primary sources of information for making these decisions is a burn severity map that reflects fire-induced changes in vegetation and soil properties. Slope, soils, land cover and climate are all important parameters in assessing risk. Process-based hydrological models, such as the **Water Erosion Prediction Project (WEPP)**, are needed to estimate the effects of these parameters.

(left) a disturbed land cover map created by RRED from an uploaded Landsat burn severity map of the 2012 High Park Fire, Fort Collins, CO. Spatial soils and DEM layers are also generated.

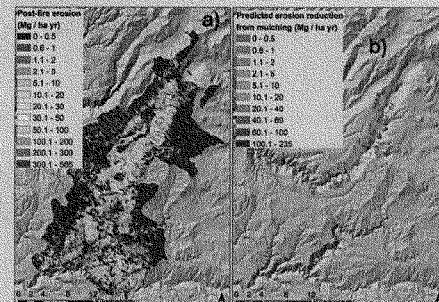
Michigan Technological University • Michigan Tech Research Institute
 3600 Green Ct., Ste. 100 • Ann Arbor, MI 48105 • USA • 734.913.6880 (T)
 For more information visit • www.mtri.org • <http://rred.mtri.org/rred/>
 Contact: **Dr. Mary Ellen Miller** • memiller@mtu.edu • 734.994.7221

RRED in action

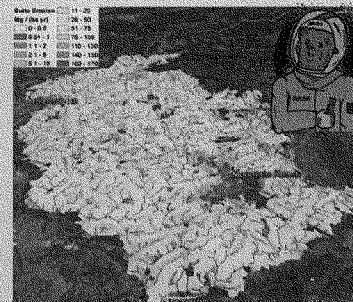


RRED in action on 11 wildfires that burned in the Western US in 2012-2016 and on two fuels projects in the Mokelumne watershed and Flagstaff, Arizona.

RRED has been used to support multiple BAER teams and fuels projects. The **French** (5,600 ha) and **Silverado** (390 ha) fires were relatively small, and predictions of post-fire erosion and runoff were generated within hours of receiving soil burn severity maps. For the **Butte** (8,700 ha) and **Valley** (30,800 ha) fires, BAER teams were interested in modeling a wet climate due to El Niño concerns. BAER teams on the **King** (39,500 ha) and **Happy Camp** (54,200 ha) fires modeled predictions of average first year post-fire erosion and erosion from a single storm event. On the King and Silverado fires, multiple modeling runs were used to estimate impacts of proposed mulching treatments. Modeling work on the King fire was used to justify and target more than \$1 million in mulching treatments, which the Sacramento Municipal Utility District helped pay to protect a hydroelectric and water supply reservoir downstream of the fire. Hillslope scale predictions **save money** by allowing for the spatial prioritization of costly post-fire remediation treatments.



Predicted first-year post-fire hill slope erosion a) for the King fire and b) expected reduction in erosion due to proposed mulching treatments.



Predicted first-year post-fire hill slope erosion for Butte fire, CA using a "wet" climate to address El Niño concerns.

Future vision

Our vision is for advanced GIS surface erosion and mass failure prediction tools that use Earth Observations data to be easily applied to post-fire analysis using readily available spatial information from a single online site. RRED currently covers the contiguous US and we are seeking support to expand coverage (Alaska, Hawaii, internationally). Future goals also include supporting additional post-fire debris flow models, a dry ravel model, and models for predicting erosion impacts on reservoirs. We are also developing a new open-source interface for WEPP that will work seamlessly with RRED and can be customized for multiple applications including trafficability of unpaved roads, agriculture, and construction. Our goal is to make the latest technology and satellite data easily accessible to the land managers tasked with protecting lives, property and natural resources.

USDA Forest Service Partners:

William Elliot (weliot@fs.gov.us) & **Peter Robichaud** (probichaud@fs.fed.us)
USDA Forest Service Rocky Mountain Research Station Forestry Sciences
Laboratory, Moscow, ID

Development of RRED was funded by the **NASA Applied Sciences Program**.
For more information, visit: <http://appliedsciences.nasa.gov>.



Background

Forests protect watersheds and reservoirs because their canopy and surface cover protect forest soils from runoff and erosion (Robichaud 2000; Moody and Martin 2001). After a wildfire, this protective cover is removed and the resulting flooding and erosion can threaten lives, property and natural resources. Flooding after the 1996 Buffalo Creek Fire in Colorado resulted in the deaths of two people, and sediment from this fire reduced Denver's municipal reservoir capacity by roughly a third (Agnew *et al.* 1997). The hazards of flooding due to increased runoff and mass movement events are of special concern near the wildland urban interface, cultural sites, municipal water sources, and sensitive habitats (Robichaud and Brown 2000; Moody and Martin 2001; Cannon *et al.* 2010; Moody *et al.* 2013).

Planning the mitigation of post-fire threats is undertaken by state or federal agencies. On a federal level, interdisciplinary Forest Service BAER and Department of Interior Emergency Stabilization and Rehabilitation (ESR) Teams work diligently to estimate erosion and flood risk. Their assessments are used to develop recommendations to mitigate increases in runoff and erosion (US Department of Agriculture and Forest Service 2004; US Department of the Interior 2006).

Burn severity maps derived from satellite data reflect fire-induced changes in vegetative cover and soil properties. Slope, soils, land cover, and climate are also important factors that require consideration. Many modeling tools and datasets have been developed to assist remediation teams, but process-based and spatially explicit models are under-utilized compared to simpler models because they are difficult to setup and require properly formatted spatial inputs. To facilitate the operational use of models in conjunction with NASA earth observations my research team and I have developed an online spatial database (<http://rred.mtri.org/rred/>; Miller *et al.* 2016a) to rapidly generate properly formatted modeling datasets modified by user-supplied soil burn severity maps. Automating the creation of model inputs facilitates the wider use of more accurate, process-based models for spatially explicit predictions of post-fire erosion and runoff.

Rapid Response Erosion Database (RRED)

RRED was created through a joint collaboration between Michigan Tech, NASA applied sciences and the Forest Service Rocky Mountain Research Station to facilitate the operational use of spatially explicit and process-based models (Miller *et al.*, 2016a). Our online database delivers model inputs in mere seconds, replacing days of assembling and formatting spatial data and model parameters. Users may select a historical fire, upload a new burn severity map, or upload a prediction of future burn severity. Once uploaded, the burn severity map is combined with vegetation and soils datasets and delivered to the user pre-formatted for modeling. Vegetation datasets are derived from the Landfire Existing Vegetation Type (Rollins 2009; LANDFIRE 2011) and the soil layer was created using the SSURGO or STATSGO (STATe Soil GeOgraphic) NRCS (Natural Resources Conservation Service) soil databases (US Department of

Agriculture 1991; Soil Survey Staff 2014). Digital elevation model (DEM) data is acquired from the USGS national elevation dataset (Gesch et al. 2002; Gesch 2007).

For added flexibility, users can also select an area of interest with a drawing tool and download inputs formatted for agricultural or rangeland applications. Model inputs produced by the web database application are designed to be used by spatial Water Erosion Prediction Project (WEPP) models including GeoWEPP (Renschler, 2003) and a brand new open source interface QWEPP (Miller et al., 2016b) being developed specifically for use with the database. Support for additional models is provided by flexibility in the format of the model inputs. Early applications of the database included creating inputs for fuels planning projects using predictions of burn severity (Elliot et al., 2016; Elliot and Miller, 2017). The RRED site also provides modeling support for historical fires with the inclusion of fires from the Monitoring Trends in Burn Severity (MTBS) project (USDA, Department of the Interior 2009). The MTBS database enables researchers and land managers to model cumulative watershed effects and compare the watershed impacts of proposed land management practices to erosion following historic fires.

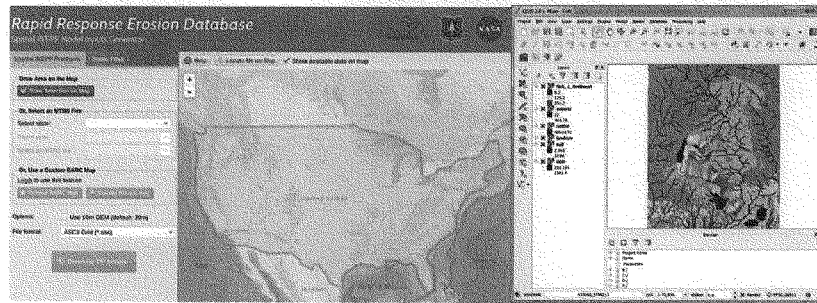


Figure 1. a) Rapid Response Erosion Database (RRED) for supporting erosion modeling and b) QWEPP, a new open source interface to the Water Erosion Prediction Project which works with data from RRED.

The Water Erosion Prediction Project (WEPP)

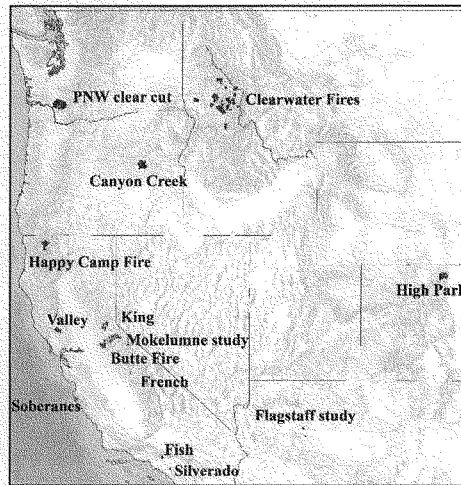
RRED provides comprehensive support for WEPP, a physically-based hydrology and soil erosion model developed by an interagency team of scientists (Lafien et al. 1997). The surface hydrology component of WEPP utilizes climate, topography, soil, and vegetation properties to predict plant growth, residue decomposition and soil water balance on a daily time step and infiltration, runoff, and erosion on a storm-by-storm basis. WEPP then provides runoff, erosion and sediment delivery by event, month, year, or average annual values for time periods ranging from a single storm to 999 years for either an individual hillslope or a watershed containing many hillslopes, channels and impoundments. A key advantage of WEPP is that it is process based and unlike empirical models can be applied outside the region where it was developed (Elliot et al. 2010).

The newly developed Rapid Response Erosion Database makes use of WEPP soil and vegetation parameters developed by the Forest Service for managing disturbed forests. USDA Forest Service scientists have developed user-friendly online interfaces for the hillslope version of WEPP to model both unburned hillslopes and hillslopes following wildfire (Elliot et al. 1999; Elliot et al. 2006; Robichaud et al. 2007a). The two main hillslope tools available for post-fire analysis are Disturbed WEPP, which predicts average annual surface runoff and erosion values, and the Erosion Risk Management Tool (ERMIT) that predicts the probability associated with sediment delivery from a single runoff event (Elliot et al. 2006; Robichaud et al. 2007a). Both interfaces link land cover to vegetation and soil properties, so users need only select a land cover and soil texture. Disturbed WEPP has land cover for mature and young forests, skid trails, shrubs, grass communities, and low and high soil burn severity. In order to support BAER teams; spreadsheet tools for both ERMIT and Disturbed WEPP were created within Microsoft Excel to allow users to run multiple hillslopes (Elliot 2013).

RRED in action

RRED has supported BAER Teams on multiple fires that burned in California (CA), Idaho (ID), and Oregon (OR). The 2014 French (5,600 ha) and 2014 Silverado (390 ha) fires in California were relatively small; therefore, predictions of post-fire erosion and runoff could be generated within just a few hours. The larger 2014 King (39,500 ha), 2014 Happy Camp (54,200 ha), 2015 Valley (30,800 ha) and 2015 Butte (28,700 ha) fires in California required one to two days.

RRED has also been used on at least four fuel's planning projects to protect water quality and reservoirs (Mokelumne, CA; Flagstaff, AZ; East Deer Creek, WA; and Clear Creek, ID) (Srivastava et al., 2015; Elliot et al., 2016; Elliot and Miller, 2017). Recent non fire applications for RRED include the use of the database to predict erosion from silver mining activities in Idaho (Martin Jacobson, personal communication, 9/9/2016) and utilizing the database to predict the long term effects of clear cutting in the Pacific Northwest (Banach 2017).



The 2014 King Fire BAER Team utilized several modeling scenarios including predictions of average first year post-fire erosion with 25 years of climate and post-fire erosion from a single 5-year storm event. Using our web application, spatial DEM, land cover and soils were created in seconds and modeling scenarios were completed within two days. For both climate scenarios the burned watersheds were modeled in both pre- and post-fire state in order to

estimate additional erosion due to the fire. Once initial modeling was completed the BAER Team proposed several mulching treatments expected to increase ground cover to 72%. Effects of increased ground cover due to mulching were then modeled and results were used to target more than \$1 million in mulching. Predictions also helped justify treatment costs, some of which was paid for by the Sacramento Municipal Utility District, to protect a hydroelectric and water supply reservoir downstream of the fire (Jeff Tenpas, USFS Region 5, Personal communication, 10 April 2015).

In 2015 spatially explicit predictions of post-fire erosion made possible by RRED were used by FEMA, BLM, BIA and Cal Fire on the Butte and Valley fires in California. The spatial application of at least \$3 million dollars' worth of mulching were targeted using process-based hydrological data in conjunction with satellite observations of burn severity.

Conclusion

Our vision is for advanced GIS surface erosion and mass failure prediction tools that use Earth Observations data to be easily applied to post-fire analysis using readily available spatial information from a single online site. RRED currently covers the contiguous US and we are seeking support to expand coverage (Alaska, Hawaii, and internationally). Future goals also include supporting post-fire debris flow models, a dry ravel model, and models for predicting erosion impacts on reservoirs. We are also developing a new open-source interface for WEPP that will work seamlessly with RRED and can be customized for multiple applications including trafficability of unpaved roads, agriculture, and construction. Our goal is to make the latest technology and satellite data easily accessible to the land managers tasked with protecting lives, property and natural resources.

RRED was made possible through funding from both the NASA Applied Sciences Program for Wildfires (Grant: #NNX12AQ89G; M.E. Miller, PI) and the USDA Forest Service. Forest Service funding for QWEPP and for utilizing RRED for fuel's planning projects was provided by USDA Forest Service Agreement Numbers: 12-JV-11221634-175 and 13-JV-11221634-175. The proposal for RRED was competitively selected by peer review from a solicitation of the scientific community. Our operational partners and Co-Investigators William Elliot, PhD, PE and Peter Robichaud, PhD, PE from the Rocky Mountain Research Station provided vital support for project success. I would also like to acknowledge Michigan Tech Research Institute's Michael Billmire who served as lead programmer as well as Nancy French, PhD, Robert Shuchman, PhD, William Breffle, PhD, David Banach, Michael Battaglia, Richard McClusky, PhD, K. Arthur Endsley, Anthony Russel, Anthony Chavez and Brent Palarz. Support in the form of a travel grant and educational outreach was provided by the Joint Fire Science Program. The program is also grateful for the support of the NASA Applied Science management team Lawrence Friedl, Amber Soja, and Vincent Ambrosia.

References

- Agnew, W., Labn, R.E., and Harding, M.V. (1997). Buffalo Creek, Colorado, fire and flood of 1996. *Land and Water*, 41, 27-29.
- Banach, D.M. (2017). Mapping clear-cut logging operations using satellite imagery and quantifying erosion using QWEPP. Master's Capstone Project - University of Maryland - College Park.
- Cannon, S.H., Gartner, J.E., Rupert, M.G., Michael, J.A., Rea, A.H., and Parrett, C. (2010). Predicting the probability and volume of postwildfire debris flows in the intermountain western United States. *Geological Society of America Bulletin*, 122, 127-144.
- Elliot, W.J. (2013). Erosion processes and prediction with WEPP technology in forests in the Northwestern U.S. *Transactions of the ASABE*, 56, 563-579.
- Elliot, W.J. and I.S. Miller. 2017. Watershed analysis using WEPP technology for the Clear Creek Restoration Project. Presented at the 2017 ESRI User Conference, 10-14 July, San Diego. 20 p
- Elliot, W., Hall, D., Scheele, D. (1999). Forest Service interfaces for the water erosion prediction project computer model. USDA Forest Service, Rocky Mountain Research Station, Logan, CO.
- Elliot, W.J., Miller, I.S., and Glaza, B.D. (2006). Using WEPP Technology to Predict Erosion and Runoff Following Wildfire (Paper No. 068011). Presented at *The ASAE Annual International Meeting*. St. Joseph, MI: ASAE.
- Elliot, W.J., Miller, I.S., and Audin, L. (eds.). (2010). *Cumulative watershed effects of fuel management in the western United States* (General Technical Report RMRS-GTR-231). Fort Collins, CO: U.S. Forest Service.
- Elliot, W.J., Miller, M.E., and Enstice, N. (2016). Targeting forest management through fire and erosion modeling. *International Journal of Wildland Fire*, 25(8), 876-887.
- Gesch, D.B. (2007). The National Elevation Dataset. In Maune, D. (ed.), *Digital Elevation Model Technologies and Applications: The DEM Users Manual, 2nd Edition*. Bethesda, MD: American Society for Photogrammetry and Remote Sensing.
- Gesch, D., Oimoen, M., Greenlee, S., Nelson, C., Steuck, M., and Tyler, D. (2002). The National Elevation Dataset. *Photogrammetric Engineering and Remote Sensing*, 68, 5-11.
- Laflen, J.M., Elliot, W.J., Flanagan, D.C., Meyer, C.R., and Nearing, M.A. (1997). WEPP--Predicting water erosion using a process-based model. *Journal of Soil and Water Conservation*, 52, 96-102.
- LANDFIRE: LANDFIRE 1.1.0 Existing Vegetation Type and Biophysical Settings layers. 2011. Available online at <http://landfire.cr.usgs.gov/viewer/>; last accessed Apr. 1st, 2015
- Miller M. E., Elliot W. J., Billmire M., Robichaud P. R., Endsley K. A. (2016a) Rapid-response tools and datasets for post-fire remediation: linking remote sensing and process-based hydrological models. *International Journal of Wildland Fire* 25, 1061-1073. <http://dx.doi.org/10.1071/WF15162>
- Miller, M. E., Billmire, M., Elliot, W. J. and Robichaud, P. R. (2016b) Rapid Response Tools and Datasets: Linking Remote Sensing and Process-based Hydrological Models to support Post-fire Remediation and Fuels Planning. High Park Fire Science Workshop Fort Collins, CO, November 15, 2016.
- Moody J.A., and Martin D.A. (2001). *Hydrologic and sedimentation response of two burned watersheds in Colorado* (U.S.G.S. Water Resources Investigative Report 01-4122). Denver, CO: U.S.G.S.
- Moody, J.A., Shakesby, R.A., Robichaud, P.R., Cannon, S.H., and Martin, D.A. (2013). Current research issues related to post-wildfire runoff and erosion processes. *Earth-Science Reviews*, 122, 10-37.
- Renschler, C.S. (2003). Designing geo-spatial interfaces to scale process models: the GeoWEPP approach. *Hydrological Processes*, 17(5), 1005-1017.

- Robichaud, P.R., and Brown, R.E. (2000). What happened after the smoke cleared: onsite erosion rates after a wildfire in eastern Oregon. In Proceedings of Annual Summer Specialty Conference (Track 2: Wildland hydrology), pp. 419-426. (American Water Resources Association: Middleburg, Virginia)
- Robichaud, P.R. (2000). Fire effects on infiltration rates after prescribed fire in Northern Rocky Mountain forests, USA. *Journal of Hydrology* 231-232, 220-229.
- Robichaud, P.R., Elliot, W.J., Pierson, F.B., Hall, D.E., and Moffet, C.A. (2007a). Predicting postfire erosion and mitigation effectiveness with a web-based probabilistic erosion model. *Catena* 71: 229–241.
- Rollins, M.G. (2009). LANDFIRE: a nationally consistent vegetation, wildland fire, and fuel assessment. *International Journal of Wildland Fire*, 18, 235-249.
- Soil Survey Staff. (2015). *Soil Survey Geographic (SSURGO) Database*. Available online at <http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>; last accessed Apr. 1st, 2015.
- Srivastava, A., W.J. Elliot and J.Q. Wu. 2015. Use of fire spread and hydrology models to target forest management on a municipal watershed. Presented at the 2015 EWRi Watershed Management Conference, 4-7 August, 2015, Reston, VA.
- US Department of Agriculture, Department of the Interior (2009). Monitoring Trends in Burn Severity. MTBS Project Team (Forest Service and U.S. Geological Survey), Salt Lake City, UT. Available at <http://www.mtbs.gov/index.html> [Accessed 01 April 2015].
- US Department of Agriculture, Forest Service (2004) Forest Service Manual 2520, Amendment No. 2500-2004-1. USDA Forest Service, Washington, DC. Available at <http://www.fs.fed.us/im/directives/fsm/2500/2520.doc> [Accessed 14 April 2015].
- US Department of the Interior (2006) Interagency Burned Area Rehabilitation Guidebook Washington, DC. Available at http://www.fws.gov/fire/ifcc/esr/Policy/BAR_Guidebook11-06.pdf [Accessed 22 June 2015].
- USDA. (1991). *State soil geographic (STATSGO) data base data use information* USDA Miscellaneous Publication 1492. 113 p.

The CHAIRMAN. Thank you, Dr. Miller.

I thank each of you. I think we recognize that how we are approaching firefighting, how we are approaching forest management, has changed over the years. And when you listen to the technologies that are now available to us, we have seen a lot of innovation.

Dr. Miller, I appreciate the research and the mapping that you are doing.

I think we recognize that we have new tools, which is great, but we are dealing across multiple agencies, dealing with tribal lands, dealing with state and private and federal lands. It is an example where if you are not working together, collaboratively, bad things can happen.

Sitting in this Committee for the past 14, 15 years, listening every year to where we are with fire status report and how we are working across agencies, the discussion is always, oh yes, we are working together. It is interagency. It is collaborative. I really do think that we have made extraordinary gains in doing just that.

Chris, you mention the cross-boundary fuel efforts. I will direct this question to you, Ms. Christiansen, and Mr. Rice and Mr. Maisch as well. With regards to how we determine or the process that the federal agencies utilize to determine where these fuel mitigation projects should occur on federal or across boundary lines, what is the process? I am assuming that your offices work with the land managers to help make these decisions?

What more do we need to be doing to make sure that we are not just talking about good collaboration but that any impediments to that are removed because, as we all know, the fire does not know the boundary between BLM lands or state or private lands? What more do we need to be doing in this realm?

Ms. CHRISTIANSEN. Thank you, Senator. I'll take a first go at this.

I really appreciate the perspective and that really is the articulation of the Cohesive Strategy, the three national implementation principles of the cohesive strategies collectively across jurisdictions in a landscape scale inclusive of communities to which we say, co-manage risk, to look at the risk factors in an entire landscape and what those critical values are at risk.

And no one agency can take on an activity that might transfer risk to others. Prescribed fire is a perfect example. Prescribed fire is often a very important tool to—it's taking on some short-term risk, but to greatly reduce the long-term risk by—

The CHAIRMAN. Well, translate that into real application though. You have one agency that believes you should move forward with prescribed burn, but your community says no, this is a dangerous time of year to be doing that. We know we get high winds and the conditions on the ground. There is inherent tension between the desire of one agency—

Ms. CHRISTIANSEN. Yes.

The CHAIRMAN. —and what you may have in another agency or out in the community.

Ms. CHRISTIANSEN. Yes, thank you.

As Mr. Maisch mentioned, tiering from some very state level plans or federal level plans into community wildfire protection

plans, we, our analytics are so improved that we can sit down together with different jurisdictions and community members and we can map and show the risk, as Mr. King suggested. So it's our real-time analytics are so advanced than they were even five years ago that brings the collaboration principles for decision-making in that risk sharing.

So——

The CHAIRMAN. Right.

Let me interrupt because I am running out of time here.

Ms. CHRISTIANSEN. Sure.

The CHAIRMAN. Let me ask, Mr. Rice and Mr. Maisch, are you satisfied that we really are as integrated as we need to be?

Mr. RICE. Chairman, thanks for the question, the topic. I know your time here is short, but it's complicated, right? And with it being complicated, the conversations that need to take place, the engagement that needs to happen across all the jurisdictions. So, whether it's dealing with Indian tribes, federal lands, state lands, counties, all the other jurisdictions, it takes this level of personal engagement for all of our managers, our leaders, everyone that's involved.

Can we improve? I think we can improve, but as Ms. Christiansen was just saying, we're making leaps and bounds from where we've been in the past.

The CHAIRMAN. Mr. Maisch?

Mr. MAISCH. Yes, thank you, Senator.

I would agree with our previous two speakers here that there's places in the country where we're definitely very coordinated and then there's other places where there are challenges.

The CHAIRMAN. Hopefully, we can learn from that, though.

Mr. MAISCH. Yup, for sure.

You want to do the lessons learned and then definitely learn from mistakes that have been made in the past.

I think one of the ways to help with the community piece in terms of buy-in, getting communities to buy in, is demonstrating that these projects actually do work and when there is an incident that there is payback, that we are able to, in many cases, use those fuel breaks and the preparations have been taken to reduce the risk, not only to the community, but more important, not more importantly, but equally importantly, to the firefighters that are actually protecting the values at risk.

The CHAIRMAN. I think we saw that with the Funny River Fire.

Mr. MAISCH. For sure.

The CHAIRMAN. Yes.

Mr. MAISCH. And some of that is using, you know, technology.

The Joint Fire Sciences Program is a key program that really provides a lot of very good information to practitioners at the operational level.

One project in Alaska that program is working on at the University of Alaska Fairbanks is showing and demonstrating that the fuel mitigation projects, the different types, a shaded fuel break, a masticated fuel break, pruning, all the different things we can do, how effective those actually are in different fuel types when a fire impacts one of those treatments.

The CHAIRMAN. Thank you.

Mr. MAISCH. So that buys confidence from a community that what you recommended will work.

The CHAIRMAN. Which is key.

Senator Cantwell.

Senator CANTWELL. Thank you, Madam Chair.

Mr. King, the only thing you didn't say was that Wenatchee is the apple capital of the world.

[Laughter.]

When you think about apples and our economic input/output in that central part of the state, it is about \$2.4 billion or \$2.5 billion a year. So it's a big risk when fire impacts it. And you did a good job of explaining that we are on the slope.

One of the questions I have for the panel is this: use of new technology, because that is really what we are finding with these changes of conditions, that having data and information can help us know when to go and when not to go.

I think we can all say there were probably some incidents in the last two big fires we had in Washington where people probably did go and that was probably the wrong decision. The conditions were just too volatile to try and create a stand there.

So my questions are—Mr. King, what is the output? Right now I know that when you were talking about house-to-house, literally a community was at risk when one person had shrubs. You go along and you would see that these houses would be burned and this house would be saved. So what is it you think risk mapping is going to give you?

Mr. Rice, can you talk about the GPS system and whether you support the GPS system and the aerial mapping my colleague, Senator Gardner, and I plan on introducing to encourage monitoring, real-time mapping?

Ms. Christiansen, if you or Mr. Rice want to comment, I don't understand why we have foreclosed on this water scooping contract with the Forest Service. I don't know that we have conclusive data on its cost versus effectiveness. One of the things we've learned in the central part of the state is when you need hasty response, one of the best tools that you have is scoopers to access and dump water on these sites. Why would you conclude right now that we really don't want to have that kind of capacity at all?

If you could address those, thank you.

Mr. KING. Yes, good question.

The risk mapping has been phenomenal in informing us about the characteristics of how the fire approaches a city and gives us some idea of how to implement mitigation strategies along the structures.

And so, two things. One, it tells us how to manage the landscape so that that predictable fire behavior is what we understand will happen. And then two, it tells us, for example, ember casts from the vegetation, what depth into the city do we expect to have a risk of structure loss.

The number one strategy is you don't want any structures to go up. Once the structures go up, you're into a new fuel type. It's called housing fuel types and it's—that's a whole different game.

It really demonstrates the importance of, as I mentioned earlier, engaging all the property owners, whether they're spread out into

the wildland areas or in the city themselves, to make sure and implement those practices to prevent that structure from going up.

Then it also empowers the land managers, whether it's BLM, DNR, city or county, to implement the right type of fuel mitigation strategy so that, basically, the flames lay down before they get to the houses.

Senator CANTWELL. Thank you.

Mr. Rice, does DOI support GPS for firefighters?

Mr. RICE. Senator, great question and thank you for that.

The way that we're looking at GPS and the technology that we're using within fires, there's a litany of options. There are numerous types of capabilities that are out there.

We're looking at cost capability, what can actually be deployed and then how do we manage that data on the back end to make it useful.

In terms of do we support looking at ways—we support looking at different options and how we can actually come up with a solution that's beneficial to the firefighters on the ground, the managers in the field, the leadership that's actually involved at all levels.

Senator CANTWELL. Okay. I'm going to come back for more clarity on that.

Ms. Christiansen, what about using these water scoopers? Why have we concluded right now that that's not a good idea?

Ms. CHRISTIANSEN. Thank you, Senator Cantwell.

Water scoopers are certainly a tool in our aviation toolbox, our aviation strategy. We have not concluded that they're ineffective, but as you know in our proposed FY'18 budget we had to make some critical choices and look at being good stewards of the taxpayer's dollars. And so, in that choice-making, we will not, we're not planning to hold an exclusive-use contract that can access these water scoopers through, what we call, the call-when-needed mechanism. Currently this year, we have two under exclusive-use contract and two on call-when-needed.

Senator CANTWELL. I'll follow up with this on another round.

Thank you, Madam Chairman.

The CHAIRMAN. Thank you, Senator Cantwell.

Senator Daines.

Senator DAINES. Thank you, Chair Murkowski, Ranking Member Cantwell, for holding this hearing.

As it has already been discussed earlier, Montana is experiencing a very busy wildfire season. We have seen over 1,200 fires so far this year. In fact, as we speak, there are 31 fires burning across the state. Just yesterday, the top ten national priority fires were all burning in Montana.

Much of Western Montana is clouded by smoke. It is leaving unhealthy air quality for tens of thousands of Montanans. Hundreds more are under evacuation orders.

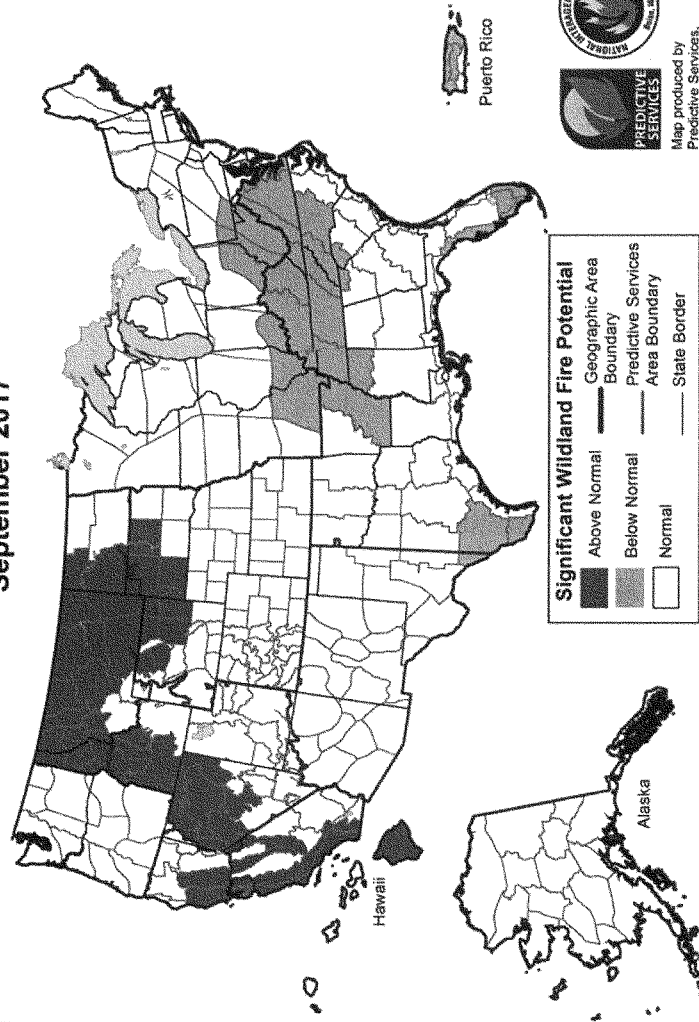
Tragically and worst of all, Trenton Johnson, a courageous, 19-year-old from Missoula, who also was a sophomore at Montana State University, my alma mater, died while battling a fire. Then just yesterday afternoon, we received word of another loss of life. We lost a firefighter while fighting the Lolo Peak Fire. The name has not yet been released. Our thoughts, our prayers, go to the

families of these brave men and women, who are protecting our lives, protecting our property while risking their lives on these wildfires on the front lines. Both appear to have been hit by falling trees.

Unfortunately, the National Interagency Fire Center anticipates above normal wildfire potential in Montana. Ranking Member Cantwell shared the map, the August map. Looking forward now, the September map shows that the dire conditions look to continue.

[The information referred to follows:]

Significant Wildland Fire Potential Outlook September 2017



Above normal significant wildland fire potential indicates a greater than usual likelihood that significant wildland fires will occur. Significant wildland fires should be expected at typical times and intervals during normal significant wildland fire potential conditions. Significant wildland fires are still possible but less likely than usual during forecasted below normal periods.

Senator DAINES. We are having discussions now in early August that normally happen in early September, so we have a long way to go yet in this fire season.

We do need to address how we fund and prepare communities for wildfires.

We also need to recognize wildland firefighters for what they do and give injured firefighters flexibility in the retirement compensation. This legislation that Ranking Member Cantwell and I have introduced would do just that.

It is also critical that we pursue management reforms that allow us to use proven tactics that reduce the threat of wildfires near our Montana communities and do what we can to reduce the intensity of the fires during these times of higher potential.

Furthermore, we know that wildfires will never know the difference, as the Ranking Member and the Chair have just said, between Forest Service, BLM, and private property, so reducing fuel loads across boundaries is integral to reducing fire severity.

On a phone call I had last night, it seems like I am on the phone a lot at the moment with our county commissioners, our sheriffs, other law enforcement officials, those who are running these fires, incident commanders. Just last night I had a conversation with one of our county commissioners in southwest Montana in the midst here of evacuation orders being issued of a large fire that is rapidly spreading. He mentioned to me that they cannot get near one of the large transmission lines that cuts across our state because of the additional carbon particulate in the air which creates arcing with high voltage transmission lines and it presents a risk to the firefighters. So it just reminds us that we need to move forward here.

There is a bill that I am going to be working on and am planning to introduce, that has passed the House, called the Electric Reliability and Forest Protection Act. It passed the House 300 to 118 in June.

What it does. It will speed up the process for removing hazardous fuels that are adjacent to electrical infrastructure, because I will tell you what, when the fires are burning like this, we cannot even get our firefighters near it because it presents a risk to their lives. We need to do that proactively ahead of time.

We need to get to the heart of the discussion and showcase the value of collaboration, this cross-boundary work. Our forest communities will only continue to be frustrated by a lack of management as they live in fear of wildfires.

Ms. Christiansen, the Park Creek and Arrastra Creek fires in the Helena National Forest are burning in the location of the Stonewall Vegetation Management Project. This area was identified by the Forest Service and local collaborative as an area in need of restored treatment and in need of hazardous fuel reduction, but this project was blocked through an injunction due to the disastrous Cottonwood decision. Now we unfortunately have intense wildfires burning over 8,000 acres and one can only wonder if implementing the project without delay might have made a difference. This is infuriating.

My question is, was the Stonewall Project conceived through a collaborative process?

Ms. Christiansen?

Ms. CHRISTIANSEN. Yes.

Senator DAINES. Did the Forest Service do robust, scientific analysis in preparing the project?

Ms. CHRISTIANSEN. Yes, Senator, we did.

Senator DAINES. Absent the injunction, would the Stonewall Project have reduced the area's susceptibility to wildfire?

Ms. CHRISTIANSEN. For this particular project, I cannot say for certain, but in the over 3,000 assessments of hazardous fuels treatments we have assessed, 90 percent of them, when tested by wildfire, have changed the behavior of the fire.

Senator DAINES. I am out of time.

I will say I appreciate Secretary Purdue, as well as Secretary Zinke's clear support of my legislation to undo the damage of the Cottonwood decision.

Senator Tester and I are together on this. The Obama Administration was supporting us in these efforts, and we will keep fighting until it is signed into law.

Thank you.

Senator BARRASSO [presiding]. Senator Wyden.

Senator WYDEN. Thank you very much.

I want to thank all our witnesses. I think it is very clear that the system of fighting fire in this country is a broken, dysfunctional mess. This fight has been going on. It is the longest running battle since the Trojan War. And now we have an emergency, a wildfire emergency, declared by our Governor.

Now Senator Crapo and I went with one approach. Two hundred fifty groups—forestry groups, scientists, environmental folks, all of whom endorsed the legislation. Still nothing happened.

I asked the Chief here a few weeks ago about the costs of inaction, and the Chief said, "It is millions of acres untreated and we're out \$1 billion over a 10-year period." This just cannot continue.

So what I would like to ask is about a new approach that reflects that FEMA, the Federal Emergency Management Agency, recently said that wildfires change landscapes so dramatically that communities affected by them are at a significantly higher risk of flooding.

Now a few weeks ago, the Banking Committee, led by Chairman Crapo and Senator Brown, introduced a Flood Insurance bill that incorporates a wildfire fix.

Ms. Christiansen, to what extent do wildfires increase the risk of catastrophic flooding?

Ms. CHRISTIANSEN. The—there is an association, Senator. Often, the catastrophic fires that are very intense, burn hot, they scar the soils and the water is not able to penetrate into the soil bed. So that's why we have our BAER process, as Ms. Miller described.

Senator WYDEN. You do not have difference of opinion, though, with respect to FEMA, that the wildfires can cause a significantly higher risk of flooding?

Ms. CHRISTIANSEN. We, the Administration, have not taken a position on that particular bill.

Senator WYDEN. I asked you.

Ms. CHRISTIANSEN. Yes.

Senator WYDEN. I am not asking you about your position. I am asking about the science. FEMA is talking about the science. Do you disagree with the science?

Ms. CHRISTIANSEN. No, sir.

Senator WYDEN. Thank you.

One other question and also Mr. Chairman, as a matter for the record, Senator Risch, Senator Heinrich and Senator Merkley and I would like to have put into the record a support, a letter of support for the Crapo/Brown proposal.

Senator BARRASSO. Without objection.

[The information referred to follows:]

United States Senate
WASHINGTON, DC 20510

August 3, 2017

The Honorable Mike Crapo
Chairman
Senate Banking Committee
534 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Sherrod Brown
Ranking Member
Senate Banking Committee
534 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Crapo and Ranking Member Brown:

On July 17, you introduced a bill to reauthorize the National Flood Insurance Program (NFIP). Along with the reauthorization of these flood and disaster programs, the Committee also included a provision of great interest to us – a wildfire funding fix. We write to strongly urge you to ensure this provision remains in the final bill as it is considered by the Committee and in the full Senate.

We have worked together in a bipartisan fashion on wildfire budgeting issues for years to end the cycle of underfunding fire suppression, which currently forces federal agencies to steal from fire prevention in order to put out fires, or “fire borrow.” Senator Wyden and Senator Crapo introduced the Wildfire Disaster Funding Act (WDFA) in 2013 to address this problem. The bill had 17 cosponsors in 2013 and 20 cosponsors when it was introduced again in 2015. The bill had the support of more than 250 groups and it was included in the president’s budget two years in a row. The Senate Energy and Natural Resource Committee held dozens of hearings on wildfire and agency heads testified in support of the bill and efforts to fix the fire borrowing problem.


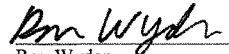
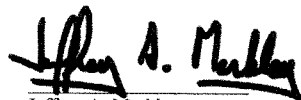
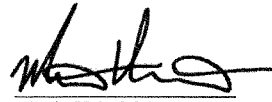
Over the years, we have worked to fix fire borrowing in any way we could find. We have worked together on amendments, letters to the administration, spoken repeatedly at committee hearings, and given speeches on the Senate floor to bring attention to the severity of this problem. Yet year after year, fire season after fire season, the fires continue to worsen and any attempt at a fix gets snarled in Washington politics.

It has become clear that we must take every opportunity available to try and move a fire fix forward because the longer Washington, D.C. gridlock prevents any real change from happening, the worse the fires get and the more our communities are put at risk.

The reality is, severe fires can and do lead to severe flooding. According to the Federal Emergency Management Agency (FEMA), “wildfires leave the ground charred, barren, and unable to absorb water, creating conditions ripe for flash flooding and mudflow. Flood risk remains significantly higher until vegetation is restored—up to 5 years after a wildfire.” Addressing the fire funding problem and getting more fire prevention work done on the ground will improve forest health and reduce the risk of flooding. That is a win for communities and a win for our forests and watersheds. We support the opportunity to address all of these issues in one place – the flood insurance reauthorization bill.

Once again, in the middle of summer 2017, the need for this fix is spotlighted as our states watch wildfires rip through their woods. Thank you for recognizing that wildfires cause devastation to communities across the country, and should be treated as the national disasters they are. Fixing the broken system of wildfire funding through the National Flood Insurance Program Reauthorization Act of 2017 will ensure that federal agencies have the stable funding they need to not only fight wildfires but also complete forest health projects that will reduce the risk and severity of future fires. We stand ready to help in any way we can to get this over the finish line.

Sincerely,


James E. Risch
United States Senator
Ron Wyden
United States Senator
Jeffrey A. Merkley
United States Senator
Martin Heinrich
United States Senator

Senator WYDEN. One last question, if I might, Ms. Christiansen. The Obama Administration supported finding an end to fire borrowing. Every year, more and more of the budget is used to pay for wildfires, leaving forests in poor health and at an even greater risk of catastrophic wildfires.

I would just like to get, for the record, because I don't think you all have been asked about this, is the Trump Administration's position the same as the Obama Administration's position on this? Do you support ending fire borrowing and finding a way to address the rising 10-year average? I just think Senators need to know whether the Trump Administration, on that issue, is willing to support the Obama Administration's position?

Ms. CHRISTIANSEN. Senator, thank you.

Yes, the Administration is absolutely committed to finding a solution that addresses the increasing 10-year average as well as ends the practice of fire transfer.

Senator WYDEN. I think I am going to say that you are pretty much in sync with the Obama position on that.

Ms. CHRISTIANSEN. This Administration supports a fire funding fix. Yes.

Senator WYDEN. Do you have a problem with saying you are pretty much in sync with the previous Administration?

I just don't want us to have to start over. I want to work in a bipartisan way with the Administration.

Ms. CHRISTIANSEN. I would say it is a continuation of, as you suggested, a long-standing issue that we know needs to be resolved, Senator.

Senator WYDEN. Mr. Chairman.

Senator BARRASSO. Thank you.

Senator Lee.

Senator LEE. Thank you, Mr. Chairman. Thanks to all of you for being here.

Ms. Christiansen, I would like to start with you, if possible.

Utah recently suffered a catastrophic, 70,000-acre wildfire in the Dixie National Forest in Southern Utah. The fire destroyed a total of 21 structures, including 13 homes, and it also resulted in a 13-day evacuation of the nearby town of Brian Head. So we have two 13 numbers there. It sounds like a lot of bad luck, and it is.

But there is more than just bad luck at play here. I think there is some policy at play that needs to be looked at. While the Brian Head fire began, of course, on private land, it was of no surprise to local residents that once that fire started it quickly spread into the Dixie National Forest which was soon engulfed in flames.

I have heard frequently from local leaders at the area who have described this entire area as a tinder box. This was a wildfire that was just waiting to happen, in part, because it was overrun with dead and insect-infested timber and that this area was just full of hazardous fuels. A fire of this magnitude of this area was, as a result, all but inevitable, largely because of poor management.

Now you mentioned that the Forest Service treats about two million acres of forest land each year for hazardous fuel treatments.

Ms. CHRISTIANSEN. Three million, Senator.

Senator LEE. Three million, which is great that you are treating three million.

It is my understanding that only about 200,000 of that involves timber harvest. Is that right?

Ms. CHRISTIANSEN. That's correct.

Senator LEE. Okay, so I think this ought to be examined, because beyond its use in wildfire prevention this also carries other benefits with it as well.

This is a reliable, renewable source of income for a lot of these communities where there is a lot of forest land. But I consistently hear from county commissioners and other officials in my state and local residents in many of these affected areas that forest management policies make it harder to harvest timber, even where doing so, as I am certain would have been the case here, would result in significant mitigation against the risk of wildfires.

So what can you tell me? What is the Forest Service doing or planning to promote timber harvesting as a mutually beneficial means of preventing wildfires and reducing hazardous fuels?

Ms. CHRISTIANSEN. Thank you, Senator.

The Forest Service is very committed and working aggressively on increasing the scale and the pace of our forest management and fuels treatment. We are working to streamline our environmental clearances processes and working with others on new tools and ways to do that, but the bottom line is the community engagement, the collaboration early.

Secretary Purdue has said it's an absolute priority. We absolutely are on board that we engage communities, that would be the environmental community, the industry, those that their jobs and livelihoods are dependent on these forest resources, early, in project proposals. So that's how we can get to agreement and we can get the work done in the clearance.

Now, as you know, more and more of our resources have gone to wildland firefighting. In just the last three years, as the increasing 10-year average has gone up, that's \$270 million out of our non-fire budget that the Forest Service no longer has available. So, we do have a resource constraint as well.

We're both working on early collaboration, getting, we get communities to buy in and that we can add supported projects, working on efficiencies in our environmental reviews and clearances and with your help, working on a long-term fire funding fix so we have the resources to do just what you said.

Senator LEE. Timber harvesting is part of that?

Ms. CHRISTIANSEN. Absolutely.

Senator LEE. Okay.

Thank you very much. I see my time has expired.

The CHAIRMAN [presiding]. Senator Barrasso.

Senator BARRASSO. Thank you very much, Madam Chairman.

This is a question I am going to ask a couple different witnesses to comment on. As wildfires burn across the country, the need to take swift action to improve forest health and prevent another year of catastrophic wildfires, to me, is undeniable. As these fires become more frequent, more severe, more costly, wildland habitat is destroyed, air and watershed quality is compromised, and human life is threatened. Hundreds of millions of acres require immediate treatment, and I believe this number is going to continue to rise

if we do not improve active forest management. Ms. Christiansen, you are shaking your head yes.

Mr. Rice, I have a question for you. What additional tools do you need to be more proactive in forest management and enhance some of this cross-boundary coordination that I believe is critical?

Mr. RICE. Thank you, Senator.

So looking across the Department of the Interior, we have four bureaus, three of which have active timber programs of various sizes and scales.

To give you more detailed information, I would have to gather it from them and provide it to you for the record, but in general the things that really improve and increase our actions on the ground is this notion of collaboration. So, it's empowering our managers, our local leaders, to engage, outside the boundaries, to work cross-boundary and increase the activities.

Senator BARRASSO. Ms. Christiansen?

Ms. CHRISTIANSEN. Thank you, Senator.

I will say that the tools afforded in 2014 Farm bill, Good Neighbor Authority, insect and disease designations, those have really been helpful because we look at the landscape scale. We're able to work with our partners who have the resources at the right time, whether it's our state partner or another federal partner, a tribal community. We're able to engage and activate across boundaries.

So continuing, we have, I think you know we have a few fixes we need in the Good Neighbor Authority, continuing those cross-boundary authorities. And just in state and private, for example, we're able to easily have authorities to work with our state partners so sometimes they can institute some leverage funds that we're able to give them. That's the thanks, and let's keep on working on those tools.

Senator BARRASSO. Mr. Maisch, anything you would like to offer as well?

Mr. MAISCH. Yes. I would say categorical exclusions are a tool that can be used and the increase in the size of those types of inclusions would certainly be helpful.

As Vicki has already discussed, Good Neighbor Authority, I believe, is a very strong tool that should be expanded dramatically. It's really a co-management concept where the states and federal agencies can work together, side boards on appeals and litigation would certainly help with moving projects along quicker.

And the forest plans, themselves, as they're amended or updated, need to really reflect timber management as a key way to achieve many of the objectives that we're talking about here today. And right now, in my opinion, a lot of plans do not.

Senator BARRASSO. Thank you.

Ms. Christiansen, today you repeated the agency's statistics. I think nearly 480 million acres across the country are in need of some sort of treatment because 480 million acres are at an elevated risk of catastrophic wildfire.

Now it says the Forest Service meets their goal for this year, the agency is going to treat only 2.2 million of the 480 million acres. And I appreciate the barriers the Forest Service and other land management agencies are facing.

The fact remains that failing to address overgrown forests and wide swaths of dead trees due to beetle kill have made many of the forests a ticking time bomb when it comes to fire.

Just yesterday the National Interagency Fire Center updated the significant wildland fire potential outlook map for August. I know it has already been shown here today. A significant portion of Wyoming is at above normal risk for a catastrophic wildfire event.

How do reports from groups like the National Interagency Fire Center and data from state agencies factor into the Forest Service's planning for future fuel treatments?

Ms. CHRISTIANSEN. Thank you, Senator.

I definitely agree with your sentiments, but just a slight correction. Our estimate is 480 million acres of all forests in the nation are at risk of catastrophic wildfire. Of that, 94 million are National Forest System lands. So we're all in this together. We still have a big challenge as a nation, certainly.

The analytics that we've been talking about, about risk and the projections that we have from our researchers on the fire risk, we can start to marry those together better. Now weather is the factor that goes into these three-month projections, and unfortunately they're not so good to be able to project weather out over a two-year period. But we do have projections where we have come from and where we think we will remain in drought and otherwise.

With the thanks to the additional hazardous fuels funds from Congress, we are really working with these predictions of where our highest hazard areas are and where there are state and federal and tribal governments that are ready to synergize with us. So we go risk and then we go priority and we look at these projections. We're not just sending these dollars out in a formula fashion. We're really investing them, highest priority, where we can get the highest leverage with others.

Senator BARRASSO. Thank you.

Thank you, Madam Chairman.

Let me just conclude by saying, Madam Chairman, that our forests are diverse ecosystems that need immediate attention. Thinning of overgrown stands and removing dead and downed timber are going to reduce fire risk.

We must also make sure that we are spending the federal dollars responsibly, as you have just said. I recognize coordination among local, state and federal agencies as a key to success. I am concerned that some offices, like the one that Mr. Rice represents today, duplicate functions of more successful agencies.

I am going to submit questions on this issue for the record, and I look forward to hearing from you, Mr. Rice, with some of those responses.

So, thank you very much, Madam Chairman.

The CHAIRMAN. Thank you, Senator Barrasso.

Senator Franken.

Senator FRANKEN. Thank you, Madam Chair.

First of all, our hearts go out to the two firefighters that were lost in Montana and our hearts are with their families and also with those who are still fighting those fires out there.

Chief Tidwell, of the Forest Service, and I have discussed the impact of climate change on wildfires several times in this Com-

mittee. As Chief Tidwell shared, Forest Service scientists believe that climate change is one of the major factors in driving the longer fire seasons that we are seeing with wildfires that are larger and more intense. In fact, fire seasons are now, on average, nearly 80 days longer than they were in 1970 and wildfires burn twice as many acres today as they did in 1980, the first was 1970.

Do any of the panelists disagree with the Forest Service scientists that climate change is driving longer and more intense, fire seasons?

Anybody disagree?

[Panelists all shake their heads, no.]

Okay.

And do any of the panelists disagree that we are seeing significant costs associated with fighting these fires?

By your testimony, of course not.

[Panelists all shake their heads, no.]

So despite this Administration's attempt to deny climate science and to muzzle experts, we are already seeing the impacts of climate change. We are seeing longer and more intense fire seasons that have real consequences, as we have seen, to our ecosystems and to our rural communities is driving up costs to the Federal Government and will just continue to get worse if we do not take decisive action.

Now these increases in firefighting costs are leaving less funding for other important programs, fire borrowing. In fact, the Forest Service has 39 percent fewer staff in non-fire positions today than it did less than 20 years ago. This is seriously impacting forest management in Minnesota and elsewhere.

It is even impacting work to reduce wildfire risk through hazardous fuels treatment. Ms. Christiansen, in your testimony you state that fuel treatments can save two to three times in avoided costs of fighting fires down the road. Could you talk about how fuel treatment can ultimately save money?

Ms. CHRISTIANSEN. Thank you, Senator.

Yes, that study is a study done in the Sierras in Nevada, the Joaquin Watershed, where the avoided \$1 spent on hazardous fuels treatments could save \$2 to \$3 in avoided costs of fire suppression, the loss of watershed viability and other losses due to a wildfire. And there's some other studies locally, Flagstaff, the area of Flagstaff has done similar.

The metrics might be slightly different in different fuel types, but there is a breaking point where roughly we're able to treat 20 to 40 percent of a landscape that we believe our suppression costs will be reduced significantly and exposure to firefighters and all of the other costs.

Senator FRANKEN. So the evidence is that this can pay for itself or come close to paying for itself?

Ms. CHRISTIANSEN. Yes.

Senator FRANKEN. Or maybe more than pay for itself?

Now, when Chief Tidwell came before the Committee in June to defend the President's budget, we discussed the possibility of hazardous fuel management supplying biomass for district energy projects or combined heat and power plants, especially in the wildland-urban interface.

In Minnesota, however, these types of plants are having trouble competing in the electricity markets.

Are there ways to incentivize the use of hazardous fuels to generate electricity? In other words, can we recognize the co-benefit of wildfire risk reduction in these cases, especially on the wildland-urban interface, so that we are not looking at losing homes, you see? And does anyone have any thoughts on this because this is something, I think, we can, and I know the Chairwoman and I have sponsored combined heat and power and other ways to do energy projects using hazardous fuel. Anyone have any thoughts? Yes?

Mr. MAISCH. Ah yes, Senator.

Certainly Alaska has a bit of an advantage because of our cold climate and projects like that actually pay their way. They don't need further incentive.

Examples would be Tok, Alaska, Galena, Alaska, and other places where it's primarily for space heating and we do fuel mitigation work around the communities. The communities actually do the work with, sometimes a non-profit or a private business provide that fuel directly to the school or the other entity that has heating needs and these boiler systems provide the heat for the community.

The Galena project is a classic example. It's a new one. I think there are 26 different buildings on a heat loop that are heated entirely from biomass from around the town. So it's a great example.

There's only one example in Alaska where electricity is produced at a very low level, in Tok, but it provides the needs for the school when the boiler is operating at its highest.

Senator FRANKEN. You can also use it to cool. I mean, this is creating electricity.

Mr. MAISCH. Sure.

Senator FRANKEN. In light of and I know I'm out of time, but I just want to end with a comment.

In light of what Ms. Christiansen is saying, where this clearing hazardous fuels can pay for itself or more than pay for itself and then on top of that, if we give some incentives to do district energy, to do energy projects in the wildland-urban interface to save homes, I mean, so that we do not have to lose homes.

It seems to me that it is just win/win/win, and I would like to work with the Committee on moving forward with that, those kinds of incentives to have those kinds of projects.

Thank you, Madam Chair.

The CHAIRMAN. Thank you, Senator Franken.

I think the example that Mr. Maisch has given is a very small one, very discreet in a very remote area, but it certainly demonstrates the viability.

We look forward to working with you.

Senator King.

Senator KING. Thank you.

I never thought I would have a chance to share this bit of knowledge, but one of our former state foresters informed me, and Ms. Christiansen you got it right, that Smokey Bear doesn't have a middle name. His middle name is not "the," it is Smokey Bear. Is that correct?

Ms. CHRISTIANSEN. That is absolutely correct, Senator.

Senator KING. I think we want to clarify that for the record.

Ms. CHRISTIANSEN. Thank you.

Senator KING. That is a common misperception.

Like I said, I never thought I would have a chance to get that straight in a Senate hearing.

I would like to ask for some research, and I don't know exactly where it should be, perhaps you, Doctor, perhaps at the Department, to compare fire frequency and extent across the nation controlling for climate and species.

What I am getting at is this. Maine is the most forested state in the country and certainly we have issues with forest fires, but nothing like the magnitude that we are seeing out West. When I talk to my forestry people in Maine, they say the solution is very clear. Our forest land is privately owned and it is intensively managed. In the West, it is mostly federally owned and it is not very intensively managed and there's not enough forestry being practiced.

I would like to see some data that will either verify that or refute it. I think it would be very interesting, insofar as the science can do, can control for, as I say, things like climate and species and other differences to try to isolate the issue of intensity of forest management as playing a role because everything I have read is that the real problem in the West is too much fuel. There is too much fuel.

If there is more intensive forestry practiced, the Federal Government will get more revenues from the stumpage, the economies will benefit, and I believe we will see less forest fires. The cheapest forest fire of all is the one that doesn't occur. Ms. Christiansen, can you help us on the research here?

Ms. CHRISTIANSEN. Senator King, I appreciate your observations. I don't have any research in my back pocket to share with you, but I do understand. I mean, we can certainly look at that. I'm sure we may have something.

Now, I was a former state forester for 30 years for the State of Washington and the State of Arizona, and I partnered with the Forest Service for my entire time.

Senator KING. You probably know my former colleague, Susan Bell, who was the first female state forester in America.

Ms. CHRISTIANSEN. Yes, I do.

Senator KING. She was the one that told me about Smokey Bear.

Ms. CHRISTIANSEN. Yes.

My point is, and maybe you were out when I referenced the data, our research does suggest that there's 480 million acres across the nation's forests, there's about 773 million acres of forest in this nation that have some kind of risk of uncharacteristic wildfire—94 million acres are National Forest System lands. So there are other lands that are at risk, but the practices of fuels management and how that relates to wildland fire risk, in particular, ecosystems and terrain and fire weather patterns. I think we do have studies about that, not necessarily comparing Maine to the Western U.S.

Senator KING. Well, I was thinking of Newton, Maine, or New England, generally—in New Hampshire/Vermont, there's a great deal—

Ms. CHRISTIANSEN. We'll certainly have a look and we'll get back to you.

Senator KING. I just think if you could isolate——

Ms. CHRISTIANSEN. Yup.

Senator KING. Down to what the factors are, it would be important, again, to either verify what my foresters in Maine from the private sector have been telling me for years or not. But it may be that part of what we need to be talking about here is breaking down some of the barriers to more intensive, sustainable forestry on the Western lands.

That is all I have, Madam Chair. Thank you.

The CHAIRMAN. Thank you, Senator King.

Senator Cortez Masto.

Senator CORTEZ MASTO. Thank you, Madam Chair.

To follow up on that, I am the Senator from Nevada, and Senator King and I just had this conversation.

This is to Mr. Rice and Ms. Christiansen. Can you talk a little bit about cheat grass because in Nevada, as we know, sage brush is one of the most imperiled in the United States because of this invasive species, cheat grass? It is a fuel for the fires that we are seeing, particularly now in the State of Nevada when we had an incredible snow pack. We had beautiful green hills and mountains. Now it is dry and now it is turning into fuel, and what we are seeing in the wildfires is what you saw in that map in Northern Nevada. So I want to open it up and just, kind of, talk a little bit about this cycle of fire and cheat grass, if you would, please?

Mr. RICE. Thank you, Senator.

So the Sage Steppe ecosystems are these incredibly fragile, incredibly diverse ecosystems that we have throughout the Great Basin and the surrounding states. And what happens and from where I'm at in my position, looking at how wildfire interacts in that environment, historically, without cheat grass, the Sage Steppe clumps, the sage clumps, right, would be the natural breaks because it's not a continuous field that grows. What's happened is cheat grass has actually grown up and filled the gaps, so it ends up being this carrying fuel to, basically, perpetuate wildfire in large proportions across the Great Basin. In the Department of the Interior, we've spent the last several years and several years even prior to me being in this role, focusing on priorities in the Great Basin and addressing cheat grass.

So in terms of doing rehabilitation work for large fires, one of the most recent fires I can talk about is the Soda Fire, estimated at nearly \$60 million to rehabilitate that landscape, several hundred thousand acres. And there's a whole myriad of applications that are being tested so we can learn what can we actually do to address the cheat grass problem because it's not necessarily the fire problem in those areas, it's more a cheat grass issue.

Senator CORTEZ MASTO. And do you have the resources you need? This is my concern with what I have seen coming out of the recommended budget out of the Administration. It is cutting back on the resources that are necessary to engage in this type of management to prevent these fires that we are seeing.

Mr. RICE. So to look at the budget do we—the way that we allocate across the different bureaus within the Department of the In-

terior is balancing the priorities, and there's four bureaus, four priorities. And then, once we start looking externally with our partners, counties, states, even in areas where we're jointly addressing issues with the Forest Service, it ends up we have to make trade-offs. We have to look at making those decisions as we make the priorities.

Senator CORTEZ MASTO. That is my concern.

As you well know, over 70 percent of Nevada is managed by a federal agency. And so, back to the Chairwoman's concerns. The interaction between those federal agencies and state and local agencies is so important as to how we manage this.

My concern will always be tearing down any barriers and utilizing best practices to make sure we are doing the most that we can to protect that land and prevent wildfires and giving you the resources that you need. That is something that I will be very cognizant about.

I am running out of time, but let me just touch on one other thing.

I was just up in Northern Nevada. Nevada is one of the sites for testing of the UAVs. I was at Stead/Reno Airport and actually there while they were flying the drones and was able to manage the cameras and interact and operate the drones. It is incredible.

They are working with our fire departments and fire services to really bring a whole new technology to the assistance in fire management, fire suppression, firefighting.

I am curious. What are the barriers? What barriers are you seeing, if any, here at the federal level that prevent us from or our firefighters from using that new technology?

Mr. RICE. Thank you, Senator.

So looking at UASs, unmanned aircraft systems, and how we're integrating them into our operations. The first step, and we've cleared this hurdle, is working with the FAA and to have clearances and have the required COAs and different things needed to actually fly in those types of situations. The other areas that we're addressing is having trained pilots, having the actual technology. Is it a quadcopter? Is it a fix wing platform that we're working off of? And then what type of data are we capturing and how are we managing that on the back end because—and then the other piece of that I would add to it, as we're looking at integrating this new technology into our current operations, it's plug and play. But it's not plug, play and replace right away because in many instances where we have manned or piloted aircraft or we're moving people or we're moving equipment with piloted aircraft, we don't stop one or we can't stop one and begin the other.

There needs to be this layer of overlap where we make sure we have the testing right. The research and development is in place. We have all the safety parameters because ultimately our number one priority is to ensure that the safety of our firefighters is taken care of in those operations.

So, there's that overlap time. And whether that's one fire season or two fire seasons to get it right and actually deploy all of those assets, that's still going to take a little bit of time.

Senator CORTEZ MASTO. Thank you.

The CHAIRMAN. Thank you, Senator.

Senator Hirono.

Senator HIRONO. Thank you, Madam Chair.

Ms. Christiansen, I am particularly interested in the role that education plays in wildfire prevention, and your testimony referenced a study in Florida that the benefit-to-cost ratio was as much as 35 to 1.

I would like to note that wildfire risk is very high in Hawaii. Some people may not think so, but a greater percentage of Hawaii's land area is subject to a higher risk of wildfire than the 16 Westernmost of the states. So it is a huge issue for us.

And nationally, 80 percent, 84 percent, I am told, of wildfires are caused by human action, but in Hawaii it's 98 percent. So obviously educating people to not do certain things is a really important way to prevent.

Senator KING. You need Smokey Bear.

Senator HIRONO. Yes or whatever. It could be ManuHuni Bear, I don't care.

[Laughter.]

Okay, he is getting me started. For example, there are programs that we can have for children, especially to get them educated at a young age on things to do and not do. The National Park Service Centennial had a program called, "Every Kid in the Park," which really enabled a whole new generation of young people to understand the importance of our public lands.

I am wondering whether you have in the Forest Service youth programs that would educate children on wildfire prevention? Maybe you can think of something like Every Kid Preventing Wildfire programs in 2019? What are some of your thoughts on educating young people?

Ms. CHRISTIANSEN. Well, Senator, you can really get me started here, so let me try to be brief.

We have a robust conservation education program in the Forest Service and it is, it aligns with the Smokey Bear Fire Prevention Program.

As I said in my opening remarks, Smokey will be 73 next year and he's one of the world's most recognized characters along with the slogan of, "Only you can prevent unwanted wildfire."

So we absolutely have tiering of what age groups we tier to. SmokeyBear.com has all kinds of tools and tool kits for parents and teachers and activities for kids. It will take you to discover the forest. It's another website that we manage.

And it's not just to get folks to the national forests, of course, or the national parks, but discover a forest where you're at, whether you're in an urban area or a rural area. It might be a local park, a state park, an open area. There are many opportunities for us to engage.

Senator HIRONO. I am glad that you are doing that. I am just wondering that as you collaborate with state and other stakeholders, do you know if these tools are being utilized, if the education tools are being utilized extensively in every state, i.e. Hawaii?

Ms. CHRISTIANSEN. Yes.

Smokey Bear, we're co-parents, Mr. Maisch and myself, are co-parents of Smokey Bear for the last 73 years. It's the state for-

esters and the U.S. Forest Service, in addition to the Ad Council. So they have access to all the programs. We have a joint council that governs Smokey and Discover the Forest campaigns. All of the access is with and through others, and the Every Kid in the Park, it was to celebrate, certainly, the National Park Centennial, but all of the federal agencies have offered the same passes. So we really work to not have the public or children no boundaries. It's about connecting to their resources.

Senator HIRONO. I will certainly check with our Hawaii people as to how extensively they are using these tools.

Ms. CHRISTIANSEN. Great.

Senator HIRONO. I do have a question about hazardous fuels to Mr. Rice.

You note the importance of hazardous fuels management, specifically identifying how to control invasive weeds which is a huge problem in Hawaii. My question is you did note the use of technology during wildfire events. Can you briefly describe the Department's use of technology for prevention, say, to identify fire prone invasive species for removal before a wildfire starts?

We have a lot of invasive species in Hawaii, including a lot that can be—that are just, they are hazardous fuels for wildfires.

Mr. RICE. Thank you, Senator.

So the way I would begin by looking at this—so, over the last year the Department of the Interior, the bureaus within the Department of the Interior, there's been hundreds of flights of UASs that have been utilized for various activities. Some have been testing on load carrying capabilities, others have been testing on data, elevation, mapping, infrared, just the different types of sensors that can go with it. So it has been used. It hasn't been deployed full heartedly across all the different disciplines but it's being looked at in all the different areas.

Within the Department of the Interior, there's an aviation office, the Office of Aviation Services. My counterpart director there is leading the development of all of those activities. And then they're executed by each of the bureaus so, Bureau of Land Management, National Park Service, Fish and Wildlife Service, Bureau of Indian Affairs, across the board.

Senator HIRONO. I should check to see whether these unmanned systems or these drones are being used in Hawaii to identify areas where invasive species would be able to be their own fire hazard.

Mr. RICE. I'd be happy to find out the specifics and provide it to you.

Senator HIRONO. Thank you very much.

Thank you, Madam Chair.

The CHAIRMAN. Thank you, Senator Hirono.

I appreciated the question from Senator Cortez Masto about the limitations on the UAVs and recognize that you still have some technological issues you are dealing with.

The battery, as I understand reading through your testimony, Mr. Maisch, you have two hours, batteries take two hours to recharge. The 3DR solo has a range of a half mile maximum, endurance of 20 minutes. You are still limited to range of sight which means that you can only do this during the day and for us in Alaska in the summertime, we have the benefit of 24 hours up there,

but in other places you have more limited application. But also, when you are in the thick of a fire, it is pretty dark in there with the smoke.

Where I am going with this is the innovation within this, I think, is a very exciting area and application for UAVs, we still recognize that we need to push some of this out and it will allow us to do more.

I will direct this question to you, Dr. Miller, because you have been engaged in some of the research. In addition to developing better UAV systems that will allow us greater opportunities, what else is out on the horizon there? You mentioned the mapping, but what is new and innovative that we might be looking to that can be utilized as yet another tool in the toolbox?

Dr. MILLER. Well, one of my colleagues, Dr. Nancy French, recently won a NIST award where they're going to try to make sure there's internet connectivity for the firefighters and BAER teams so they'll have mobile, you know, to create faster ways to get all the new information that's coming in.

I'm looking forward to using my database with UAVs because there's no reason—right at the moment, it usually uses earth observation data from satellites, but there's no reason it couldn't come from mapping from the UAVs as well.

The CHAIRMAN. I don't recall who made mention that we have these infrared cameras that are placed on certain mountaintops, maybe that was you, Mr. Rice? I just think of the Alaska example and we are just so huge, we are so big. We're talking in terms of millions of acres rather than thousands.

And you mentioned the internet and the connectivity. That is a dream for us in most of these remote areas where we are dealing with the fires. Again, what more can you do? You just cannot hope that you put these sensors or these cameras in the right place and get lucky.

You mentioned, Ms. Christiansen, that, I think, it was nine out of the ten forest fires are started by man. Okay, we can pinpoint better some of those literal hot spots, but in Alaska most of our fires are lightning strikes.

Where else do you see us going, Mr. Rice or Mr. Maisch?

Mr. MAISCH. I'll start out. Thank you, Senator.

I'll give you an example in Oklahoma. Oklahoma is working with the National Weather Service (NWS) and a Geo16 satellite that would actually do real-time detection of fire starts. And so, they piloted a project this year. It's, kind of, a beta test. And what this does is it gives you potential size. It gives you coordinates and the probability of error, whether it's a false detection or not. But it's still a very new effort and there happens to be a state that is pioneering that effort with, like I said, NWS. So there could be some application for that in other locations of the country as that technology is further refined and the algorithms that do the detection and model that are refined and tested.

Another example is in CAL FIRE. They have a great application. It's an app that's available to improve public safety. It just came out, I think, this year. You can register as a member of the public to be notified in your county if there is an incident that you need to be made aware of. It's kind of like reverse 911, but it's actually

an application, an app that you register to be part of. You can also allow it to track you. If you're traveling around the State of California it will send you notices for any areas that you happen to be that might have an incident that's unfolding.

So, there's new technology out there, a lot of it, and I think a lot of it is just pushing it out to the agencies so they can start using it. As we use it, we're going to find new and more innovative ways to make it work better for us.

The CHAIRMAN. Working with the FAA and dealing with the whole line of sight issue, do we have greater latitude in Alaska through our UAV Center of Excellence? Up on the North Slope, we have received permission to do testing that is beyond line of sight because of where we are. Are we able to utilize any of that with the UAVs that we are currently using to help us address the fire issues or are we still subject to the same limits?

Mr. MAISCH. Yes, to answer your question, we are still restricted to that line of sight or an observer that's in radio communications with the pilot. So, you can, kind of, tier it out further if you have someone that actually can observe the UAV in operation and communicate back to the pilot. At least, that's how we're doing it currently. But I think that will evolve as people become more comfortable with the safety aspects of using these types of tools in the same airspace that we other helicopters and——

The CHAIRMAN. Yes, you have a lot going on.

Mr. MAISCH. That's right.

The CHAIRMAN. Mr. Rice, did you want to add anything?

Mr. RICE. Senator, what I would add to Mr. Maisch's comments.

So FAA weather cams are all through the State of Alaska. Being a pilot, I've used them numerous times and being able to pick up anywhere if you're down in Juneau and you want to look at Barrow or you're out in Western Alaska and you need to see what's going on in the "pass" to get back into Anchorage.

I think the ability and that type of example exists all across the country whether it's street cams or recreational cams that folks have up. Being able to leverage those different data streams is an option that we need to explore. It's something where, you know, right now we're talking about what do we have and what can we use.

But let's talk about what's out there and what's available and how do we actually capture that and leverage those investments? So that's the first place.

The other place, within some of the federal agencies, especially in DoD—so the Department of the Army has some smartphone devices, smartphone software, that allows data sharing rapidly. Right now it's only android base, so it's not on your iPhone, but it's on your other types of phones. But that's another example of ways that we can start managing technology better and building off of each other's investments.

The CHAIRMAN. Thank you.

I am going to have to go to the Floor. We have a vote coming up quickly, and I am going to go make a comment. I will ask Senator Cantwell to close out the hearing and just give you all my appreciation. Know that we want to work with you as we address

these issues of fire management and how we deal with our wildfires around the nation.

Thank you.

Senator Cantwell.

Senator CANTWELL [presiding]. Thank you, Madam Chair.

Mr. Rice, I wanted to follow up, obviously as Director of Office of Wildland Fire, on your comments just now about use technology that's out there.

I'm aware of this USA Today article by Robin Will about a U.S. Fish and Wildlife Service presentation that they did, I'm reading now from the article, "... presented its second annual National Fire Safety Award to Bart Rye," who was, "He helped direct a lost firefighter to safety during a prescribed fire. Rye suggested to his fire crew on foot and all-terrain vehicles to carry GPS transmitter collars like those worn by hunting dogs so that up to ten resources could be tracked in real-time by a Burn Boss on a single hand receiver device."

[The information referred to follows:]

USA Today: St. Marks Refuge staffer wins Fire Safety Award

Robin Will; June 11, 2015

On May 7, the U.S. Fish and Wildlife Service (FWS) presented its second annual National Fire Safety Award to Barton (Bart) Rye, Prescribed Fire/Fuels Technician from St Marks National Wildlife Refuge for a simple suggestion that helped direct a lost firefighter to safety during a prescribed fire. The Award, presented by John Segar, FWS Chief, Branch of Fire Management from the National Interagency Fire Center, recognizes Rye for his innovative use of Global Positioning System (GPS) technology to more easily map, track and monitor the location of multiple firefighters, vehicles, and aircraft during large burns on the 70,000-acre refuge.

Rye suggested to his fire crew on foot and all-terrain vehicles (ATVs) carry GPS transmitter collars, like those worn by his hunting dogs, so that up to 10 resources could be tracked in real-time by a Burn Boss on a single hand-held receiver device. ATVs and dozers on southeastern forests commonly become high-centered on hard-to-spot stumps, in heavy vegetation where they cannot be readily seen by others, risking the loss of life and/or equipment during fires.

The refuge first tested the use of the collars last spring. When a firefighter unfamiliar with southeastern terrain walked into a sawgrass pond while igniting a burn, becoming disoriented in knee-deep water with grass over his head, the GPS device allowed the Burn Boss to verbally direct the firefighter out of harm's way. In February, a helicopter working a 3,800-acre burn carried a collar to allow immediate location of the aircraft in case of an accident.

"Bart's initiative added a level of safety that wasn't there before and may very well lead to national implementation," said Segar. "This system is off-the-shelf and simple to operate." The Refuge purchased two hand-held receivers — one each for a Burn Boss and Firing Boss — and a transmitting collar for each prescribed fire crew member. A single transmitter and hand-held receiver together cost about \$500. "It was an outside-the-box idea that had great implications for the safety of our firefighters," agreed Refuge Manager Terry Peacock.

St. Marks National Wildlife Refuge along Florida's Gulf Coast conducts 40-50 prescribed burns annually, averaging 300-400 acres each, to reduce the risk of wildfire and maintain fire-resilient landscapes.

###

Senator CANTWELL. Now, if this is available today and with what Mr. Maisch has just said about the drones, why not combine these two technologies today to get more firefighters more safety and security as they deal with these unbelievable conditions that can change so quickly?

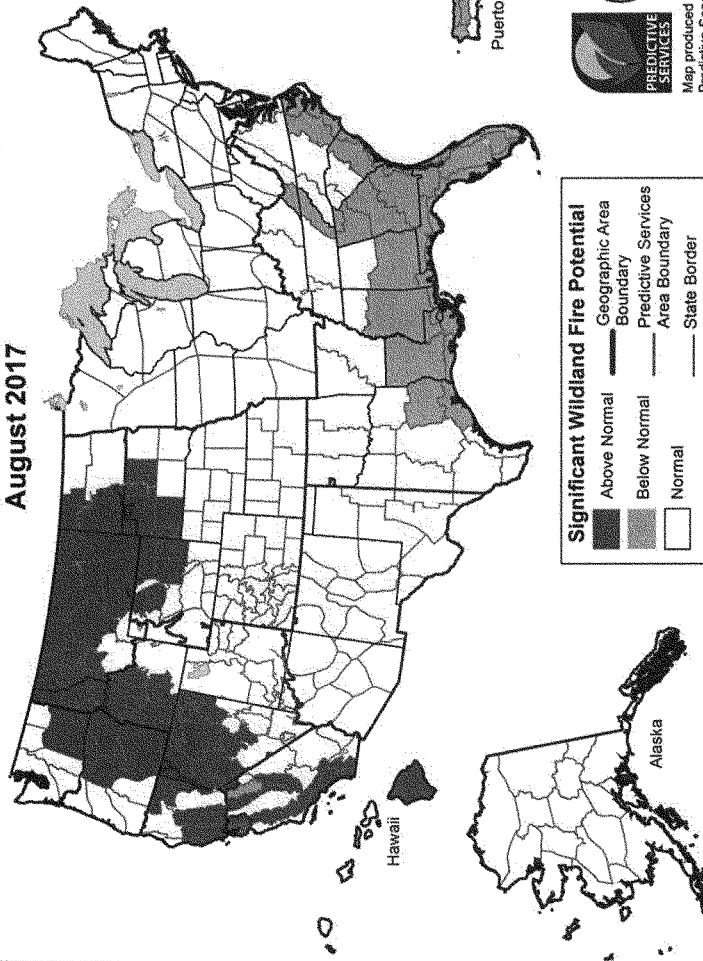
Mr. RICE. Senator, that's—it's a good idea and when Secretary Zinke came on board and we walked him through fire operations and how we have communications and what it all looks like and how we have the incident command system managing fire operations, one of the first things that he said to me was figure out how to keep track of our firefighters in a better way. So it's something that we're looking at.

And this references your earlier question about, supportive of looking at it, we just don't know what that right tool is yet because with any number of tens of thousands of firefighters that can be out in the field during a fire season, we want to have the right solution that's effective, that's plug and play for anybody that shows up on a fire, just like there are Nomex that shows up on a fire is interoperable. We want the technology to be interoperable as well.

Senator CANTWELL. Well, I would say given this fire map and where we are, it is just scary.

[The information referred to follows:]

Significant Wildland Fire Potential Outlook August 2017



Above normal significant wildland fire potential indicates a greater than usual likelihood that significant wildland fires will occur. Significant wildland fires should be expected at typical times and intervals during normal significant wildland fire potential conditions. Significant wildland fires are still possible but less likely than usual during forecasted below normal periods.



Map produced by
Predictive Services,
National Interagency Fire Center
Boise, Idaho
Issued August 1, 2017
Next issuance September 1, 2017

Senator CANTWELL. Now I can see that it is further into eastern Washington than the previous map had it as that was out a few months ago. A few years ago people said to us, you are going to be at the epicenter, and boy, were we. I'm just saying with this level of the West under these conditions, why not? I mean, if it's so easy just to go get some now, why not let the flexibility in the suggestion for this fire season be there?

All I'm saying is the reason I am coming back to you on this is because in your first answer it was, kind of like, yes, we are going to look at it. We are going to see what we can do. These, as you just said, are tools that we can put in place today. You could even say that voluntarily we give the okay for these to be used. In this case, a U.S. Fish and Wildlife Service individual did it and then, as I said, received an award for the innovation of it.

I would just say that the reason I am working with Senator Gardner is because I came to the Senate shortly after the Storm King Fire that killed so many people. Then we had the Thirtymile Fire which killed several individuals in our state. And then to have the loss of life two years ago. It is just a reminder that these conditions can get out of control so quickly and if we can put the firefighters, many times who are young, very new to the job, in a situation where they are depending on somebody who has greater visibility into a risk, I just think it would be so helpful to us, and also helpful in attacking the hotspots of the fire as well. Or knowing when we can pull back or knowing when to use other resources to attack it.

So what about right now just moving forward on a voluntary basis to make sure that is clear to people that if they wish to, they can?

Mr. RICE. Senator, so it is being used. I apologize for not being clear in my earlier answer. We do have folks in Fish and Wildlife Service, in the National Park Service, in the Bureau of Land Management, that are using this technology, but it's in very local areas. And so we're learning from that and looking at different ways that we can apply it across the enterprise. But that doesn't preclude our staff from using them locally, under—

Senator CANTWELL. So anybody could use them now? We could use them in the Northwest if we wanted to?

Mr. RICE. The staff that are local are going to work through their local line officers. And this leads to a much broader question of at the department level we're empowering our line officers to make decisions in the field. And in order to do that—

Senator CANTWELL. Just so you know, it got so bad we called out the National Guard. I mean, we were taking volunteers—we had not done that in our state in a long time.

I know Ms. Christiansen has been the forester there before, but the Northwest loves technology and it loves to keep pushing the envelope. So don't hold us back to getting solutions in the marketplace this summer if we can.

Thank you.

Senator King.

Senator KING. I am all set, Madam Chair.

I just wanted to thank the witnesses. This has been a very informative hearing, and I thank you for your work and look forward to continuing to work on this problem with you. I appreciate it.

Senator CANTWELL. Senator Cortez Masto, any follow-ups?

Well, I, too, would like to thank all the witnesses and the Chair for having this hearing. So timely. As we said at the beginning, we've already used up 50 percent of our resources. This map says it all.

We have to keep ahead of these changing conditions which are giving us more volatile, more territory, more really, really economic and human loss to our nation that we need to deal with.

Thank you all for your innovative ideas.

We are adjourned.

[Whereupon, at 11:56 a.m. the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Ms. Victoria Christiansen*

Questions from Senator Ron Wyden

Question 1: Just yesterday, Governor Brown declared a State of Emergency for Oregon to address wildfires across our state.

Over the last four years, Senators Crapo and I have fought to change the current, backwards system of funding wildfire suppression through fire borrowing. More than 250 groups voiced support for our bill.

Chief Tidwell testified in June that with a funding fix, the agency could treat millions of acres of forests, which would lower the cost of fighting wildfires.

According for the Federal Emergency Management Agency, wildfires change landscapes so dramatically that communities affected by them are at a significantly higher risk of flooding.

Ms. Christiansen: To what extent do wildfires increase the risk of catastrophic flooding events?

Answer: While flooding, and even flash flooding, are natural events that can occur at any time in response to rain, the removal of protective canopy and ground cover during high severity wildfire can intensify rainfall effects, resulting in increased runoff. Every wildfire is different, but the increased risks of flooding and debris flows are usually related to amount and location of moderate and high burn severity, slope, amount of hydrophobic or highly erosive soil and speed of natural recovery.

Question 2: Does the Forest Service agree with the Federal Emergency Management Agency's assessment that wildfires can have severe impacts on flooding events, including flash floods and mudslides?

Answer: The Forest Service has long recognized the connection between wildfire and watershed responses such as flooding, accelerated erosion and debris flows. The Forest Service's Burned Area Emergency Response (BAER) program was established in the mid-1970s specifically to respond to post-fire risks. While flooding, and even flash flooding, are natural events that can occur at any time in response to rain, the removal of protective canopy and ground cover during high severity wildfire can intensify rainfall effects.

Question 3: Ms. Christiansen – the Obama Administration supported finding an end to fire borrowing.

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Ms. Victoria Christiansen*

Every year, more and more of the Forest Service budget is used to pay for wildfires, leaving forests in poor health and at an even greater risk of catastrophic wildfires.

Ms. Christiansen, is this administration's position the same as the Obama administrations? Do you support ending fire borrowing and finding a way to address the rising 10-year average?

Answer: We are committed to finding a solution that addresses the growth of fire programs as a percent of the agency's budget, and also ends the practice of transferring funds from non-fire programs when suppression funds fall short before the end of the fiscal year.

Questions from Senator Joe Manchin III

Question 1: 50% of our Nation's forests are privately owned and over 90% of the timber harvested comes from private lands. The remainder comes from state and federal lands. In West Virginia, like our coal communities, our timber industry could certainly use some help. An overall reduction in timber production in recent years has led to lower activity in this industry and economic uncertainty for our forested communities. I am pleased that the Monongahela National Forest is expected to harvest 11.1 million board feet of lumber this year. The good news aside, our division of forestry is interested in finding ways to improve our by economy by maintaining and attracting new primary and secondary forest product manufacturers. But also doing so in a sustainable way that recognizes the importance that our forests can play in carbon dioxide reduction.

What is the new Administration doing to support our timber industry?

Answer: The agency is focusing on collaborative restoration projects and partnerships on a landscape scale that will produce more volume, develop efficiencies in our contracting and environmental analysis procedures and improves sale preparation for producers. In addition, the agency is supporting emerging markets for innovative wood products which contribute to diversified rural economies and support sustainable forest management. Through the Wood Innovations grant program, the Forest Service awarded over \$8.3 million in FY2017 to substantially expand and accelerate wood products and wood energy markets. Federal funds will leverage almost \$37 million in matching funds from 36 business, university, nonprofit, and tribal partners in 19 states for a total investment of over \$45 million in FY2017. The public-private partnerships leveraged with these grants will lead to the removal of hazardous fuels from forests while spurring the economic development of rural communities.

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Ms. Victoria Christiansen*

What best practices have you witnessed or experienced within our states forests' timber industry that can be applied in our national forests?

Answer: The Agricultural Act of 2014 included the Good Neighbor Authority that provided permanent authorization for states to work on National Forest System lands under contracts and agreements with the Forest Service. Since implementation began in 2015, 29 states have entered into agreements with the Forest Service, many of them to perform forest and timber management activities. In addition to increasing landscape treatments, we view this as an excellent opportunity to witness states' management practices and evaluate them for opportunities that could be applied to Forest Service policies. Most state projects on Forest Service lands are in early stages of implementation, but timber has been sold under this authority in Georgia, Colorado, Idaho, Wisconsin, Michigan, and Minnesota. As these and other projects progress, we will witness and evaluate a variety of different approaches to the various elements of timber sale preparation and timber sale contract administration. Examples include how cutting boundaries are identified; how trees for harvest are designated, measured, valued, and accounted for; roles and responsibilities of individuals in the organizations; and how contracts are administered to meet resource and financial requirements of the sales.

Question 2: The United State Geological Survey recently visited my office to discuss the work they do at the National Civil Applications Center. One of the benefits of the land remote sensing work they do is that wildfire monitoring has been increasingly more accurate. That means that when firefighters and first responders are being deployed to fight these fires, it can be done in a safer and more accurate manner. In fact, the USGS's mapping abilities allow for timely reporting of wildland fires, fire perimeter mapping, and restoration. The increased accuracy in detection and response actually helps in a variety of emergency scenarios including volcanoes, earthquakes, landslides, floods and hurricanes. Fortunately wildfires aren't as prevalent in West Virginia as many western states, we have certainly had our fair share of disastrous floods in the past two years. So, essentially, it's my understanding that the Department of the Interior uses these USGS imaging capabilities to save lives. I believe the Presidents' budget actually made cuts to this program which are concerning in light of the value it brings to emergency response and saving lives.

What can Congress do to support the expanded use of this USGS technology for your agency's purposes?

Answer: The National Civil Applications Center (NCAC) provides remote sensing data that aids in wildland fire detection, fire mapping and emergency response. The Forest Service stands ready to coordinate with the USGS at the funding level Congress appropriates to the NCAC.

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Ms. Victoria Christiansen*

Questions from Senator Mazie K. Hirono

Question 1: The Department of Defense has a significant presence in Hawaii. Since 1975 the USDA and DOI have had an interagency agreement with DOD, which allows DOD to provide firefighting support to the wildland fire management agencies when needed.

Does USDA partner with the Department of Defense (DOD) in fire prevention activities, such as removing nonnative species, or post-fire restoration, such as controlling erosion in forests? Along the same lines, does USDA partner with the DOD to use or implement innovative technologies to better prevent, respond to, or remediate wildfire events?

Answer: The Forest Service coordinates with DOD in some locations to complete wildfire risk reduction activities, primarily hazardous fuels removal through prescribed fire. Work is typically done where DOD and Forest Service manage lands with shared boundaries. Several times in the past, we have provided technical expertise on emergency stabilization to DOD when lands under their jurisdiction have burned.

Likewise, does USDA partner with NOAA in post-fire restoration to control sedimentation and runoff into the surrounding ocean?

Answer: The USDA (Forest Service) works in partnership with NOAA (National Weather Service) immediately after wildfires but those efforts focus on flood warnings and public safety. Since NOAA Fisheries is a regulatory agency (not a land management agency) they have limited authority for direct post-fire restoration work themselves. The Forest Service implements post-fire activities to control sedimentation into rivers as part of our emergency stabilization under the BAER program (fire suppression appropriation) and long-term restoration under our normal program of work when appropriated funds are available.

Question 2: You note the Joint Chiefs' Landscape Restoration Partnership and how it has successfully carried out hazardous fuels treatments over the past few years. In 2015 Hawaii was fortunate to have the Koolau Forest Protection project selected to receive funding. Since Hawaii doesn't have a National Forest, we often rely on these cross-agency partnerships to provide resources so that we can make our native forests more resilient.

Given the success of the Partnership, are there plans to expand the program in coming years?

Answer: The Forest Service is currently working with the Natural Resources Conservation Service on the solicitation for new projects in FY2018 and continuing to fund projects selected in 2016 and 2017. We anticipate announcing the new projects in December 2017.

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Ms. Victoria Christiansen*

Question 3: The Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife collaborates with the Forest Service in various ways, which includes receiving funding for fire prevention and response in the Wildland Urban Interface.

Does the Forest Service intend to expand funding assistance to collaborate with states for fire prevention and response in the Wildland Urban Interface?

Answer: The Forest Service recognizes the value of investing in collaborative efforts with states to mitigate risks associated with wildlands and the wildland urban interface (WUI). The State Fire Assistance (SFA) program provides financial assistance through partnership agreements with State Foresters for the prevention, mitigation, control, and suppression of wildfires on non-Federal lands. Expanding SFA and other state assistance will have to be weighed against resource requirements for competing priorities in research, land management and wildfire management programs. SFA grant assistance helps state and local agencies implement pre-fire planning in the WUI and hazardous fuels mitigation programs near communities at risk of catastrophic wildfire. Training funded by SFA grants support the development and maintenance of effective initial response capability, as the first responders on almost 75 percent of wildfires are local fire departments or state agencies. Additionally, the SFA program improves capacity to assist other Federal, state, and local agencies in aiding communities affected by non-fire emergencies such as hurricanes and floods.

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Mr. Bryan Rice*

Questions from Senator John Barrasso

Question 1: Understanding that coordinated responses make all the difference in successfully addressing wildfires, can you tell me what functions the Department of Interior's Office of Wildland Fire does that distinguishes it from other interagency coordination groups?

Do employees of other agency coordination groups also perform these functions?

The Office of Wildland Fire (OWF) is the principal office in the Department of the Interior (DOI) that is responsible for developing Wildland Fire Management (WFM) policy and providing management and oversight of the WFM budget. In carrying out these responsibilities, OWF ensures that implementation of the WFM program is done consistently across DOI and adheres to the goals established by Congress, DOI's Strategic Plan, and other wildland fire policies such as the National Cohesive Wildland Fire Management Strategy. No other organization in DOI or interagency coordination group carries out these responsibilities.

OWF supports all facets of the WFM program through the development of policies that ensure efficient and effective emergency preparedness; suppression operations; post fire rehabilitation; fuels management; and the information technology systems that are required for program planning and wildland fire response. In addition, OWF is responsible for developing policies that integrate all aspects of the WFM program, including fuels management, burned area rehabilitation, and fire science into the bureaus' program of work. This is essential to ensuring the incorporation of wildland fire as a resource objective into the management of public lands. All policy-related work is carefully coordinated so as to ensure input and feedback from interagency coordination groups, offices, and bureaus.

OWF is responsible for establishing internal operating policies and processes for all accounting controls to ensure the fiscal integrity of DOI's financial obligations and to maximize the return on investment for WFM funding. As part of its responsibility to ensure proper oversight of the WFM budget, OWF provides ongoing budgetary and financial management direction to bureaus for effective and efficient program implementation; allocates funds to bureaus and offices and develops annual budget plans; prepares the annual budget justifications; establishes performance metrics and tracks program accomplishments; evaluates program accountability consistent with national standards and policies; develops legislative proposals to facilitate program operations; and responds to congressional inquiries and prepares witnesses for congressional hearings. All of this work is completed in a transparent and collaborative manner in close coordination with interagency coordination groups, offices, and bureaus.

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Mr. Bryan Rice*

Question 2: How many people does the Office of Wildland Fire currently employ, and how many employees were in the office when it began? What are the functions of current employees?

When the office was established in 2001 the staffing plan included a total of 24 full-time staff; today, OWF currently employs a total of 25 full-time staff. OWF staff, in coordinating with interagency coordination groups, offices and bureaus, is responsible for a broad range of responsibilities, including budget management and oversight; the development of WFM policies for all aspects of the WFM program; program development and oversight; and the management of the information technology systems that are required for program planning and wildland fire response. While OWF staff levels have remained relatively constant since the 2001 approved staffing plan, workloads have increased significantly; changing resource conditions throughout the country and their associated challenges on wildland fire have increased the complexity of the WFM program.

Question 3: How does the Office of Wildland Fire measure success and delivery of services on the ground?

The WFM program strives to achieve the goals outlined in the National Cohesive Wildland Fire Management Strategy. Accordingly, all programs are geared to making progress towards resilient landscapes, fire-adapted communities, and safe wildfire response. Success at achieving these goals is derived from the collaborative work of our Federal partners, Tribes, state and local governments, stakeholders, and communities. In addition, all OWF program objectives are tied to DOI's Strategic Plan, Mission Area 5: "Protecting Our People and the Border," and includes three wildland fire-related performance measures to demonstrate and evaluate progress towards achieving these goals. Currently, OWF is evaluating these measures and adding to its performance metrics in order to better track program accomplishments and progress towards program goals. OWF plays a key role in managing the WFM program and continually looks for ways to support DOI's efforts to address the challenges associated with escalating fire complexity, longer fire seasons, increased risk to responders, greater home and property losses, and increased threats to communities.

Question 4: How often do members of your office communicate with other interagency fire coordination groups? Do you share reports or forestry and fire data?

OWF uses a transparent and collaborative approach in the management and oversight of the WFM program. OWF staff is in daily contact with interagency fire coordination groups, offices, and bureaus throughout DOI. The sharing of reports and forestry- and fire-related data is key to DOI carrying out an integrated WFM program, and OWF ensures that such information is widely disseminated throughout DOI, where appropriate. Furthermore, OWF is responsible for the development and oversight of the information technology systems that are used by the wildland

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Mr. Bryan Rice*

fire management community for tracking data, program planning, and responding to wildland fires. OWF ensures the integrity of these systems and the data that is used throughout DOI for WFM program management and by our firefighting partners for daily fire suppression operations.

As a key leader in the Wildland Fire Community, OWF works closely with the U.S. Forest Service, and other Federal, Tribal, state, and local partners to ensure a fully integrated, coordinated, and highly effective domestic wildland fire program. OWF also develops and maintains international partnerships with the Governments of Canada, Mexico, Australia, and New Zealand in support of program management and to enhance wildland fire suppression capabilities.

Question 5: How do the Department of the Interior and the Department of Agriculture weigh data and recommendations from the Office of Wildland Fire with other interagency coordination groups?

OWF is the principal office in the DOI that is responsible for developing WFM policy and providing management and oversight of the WFM budget. In carrying out these responsibilities, OWF ensures that implementation of the WFM program is done consistently across DOI. All of this work is completed in a transparent and collaborative manner in close coordination with interagency coordination groups, offices, and bureaus. In addition, OWF communicates with the U.S. Forest Service and other interagency partners to ensure that policies are consistent across all entities to ensure a seamless and integrated wildland firefighting organization. OWF is also responsible for ensuring the integrity of the information technology systems and the data that is used throughout DOI for WFM program management and by our firefighting partners for daily fire suppression operations.

Questions from Senator Joe Manchin III

Question 1: The United State Geological Survey recently visited my office to discuss the work they do at the National Civil Applications Center. One of the benefits of the land remote sensing work they do is that wildfire monitoring has been increasingly more accurate. That means that when firefighters and first responders are being deployed to fight these fires, it can be done in a safer and more accurate manner. In fact, the USGS's mapping abilities allow for timely reporting of wildland fires, fire perimeter mapping, and restoration. The increased accuracy in detection and response actually helps in a variety of emergency scenarios including volcanoes, earthquakes, landslides, floods and hurricanes. Fortunately wildfires aren't as prevalent in West Virginia as many western states, we have certainly had our fair share of disastrous floods in the past two years. So, essentially, it's my understanding that the Department of the Interior uses these USGS imaging

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Mr. Bryan Rice*

capabilities to save lives. I believe the Presidents' budget actually made cuts to this program which are concerning in light of the value it brings to emergency response and saving lives.

What can Congress do to support the expanded use of this USGS technology for your agency's purposes?

USGS remote sensing work has wide applications and benefits for wildland fire activities across DOI. The continued use of these wildland fire tools is reflected in the President's budget request for Fiscal Year 2018, and they are highly valued by Department users, our partners and stakeholders, and by the public. Any new technologies either would replace existing tools, or be funded within the base budget.

The Office uses USGS's systems and technologies in a variety of WFM program-related areas, including prioritizing fuels treatments to prevent fires, fire mapping to inform response actions, developing fire rehabilitation projects, and creating fire management plans. Specifically, USGS remote sensing technologies supports the wildland fire mapping system (GeoMAC), the wildland fire risk and vegetation modeling system (LANDFIRE) with Landsat as a foundation, compiling fire maps from classified satellite images, wildland fire burn severity mapping to help determine emergency restoration needs, and, more broadly, through USGS participation in the Joint Fire Science Program, which provides leadership to the fire science community by identifying and funding high-priority fire science research. In addition, USGS remote sensing technology has specific applications to the DOI unmanned aircraft system program. This technology provides higher resolution data that improves firefighter situational awareness, particularly at times when manned assets are unable to fly. DOI bureaus also make routine use of this technology for natural and cultural resource needs pertinent to wildfire activity.

Questions from Senator Mazie Hirono

Question 1: In your testimony you note the importance of hazardous fuels management and specifically identify work to control invasive weeds. As you know, in Hawaii our native forests are not adapted to fire. When a fire burns within our native forests, nonnative fire-prone grasses invade the recently burned area, creating a positive feedback loop for future wildfire events.

Can you discuss the Department's use of technology for identifying fire-prone nonnative species for wildfire prevention in Hawaii? Also, is there a process that DOI utilizes to prioritize areas most critical for hazardous fuels removal in Hawaii?

U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Mr. Bryan Rice

Beginning in the 1970s, the National Park Service (NPS) identified fire-prone nonnative species and their impacts through direct observations of wildland fires, research burns, and vegetation/fuel maps. The NPS has collaborated with United States Department of Agriculture (USDA) fire scientists to characterize nonnative fuels in vulnerable native plant communities. Based on these observations, and post-burn studies conducted by NPS staff, academics, and USDA scientists, the NPS has prioritized areas most critical for hazardous fuels removal within the Hawaiian Island parks. The results of these studies have contributed to the development of Islandwide Vegetation Fire Risk Maps. Information is further shared by NPS staff at interagency workshops, conferences and public presentations. NPS staff serve as technical consultants to land managers and state and federal agencies regarding fuels treatments, fire prevention, suppression and post-fire rehabilitation strategies. They also serve as members of the Hawai'i Island Fire Restoration Working Group.

The Pacific Fire Exchange, one of 15 regional Fire Science Exchanges funded through the Joint Fire Science Program, facilitates access to information, technical assistance, and tools by Hawaiian stakeholders. DOI uses LANDFIRE, a landscape fire and resource management planning tool, which provides landscape scale geo-spatial products and data (e.g., fire behavior fuel model, vegetation cover characteristics, disturbance history, etc.), satellite imagery, and localized research to support cross-boundary planning. Recently, the U.S. Geological Survey (USGS), U.S. Forest Service (USFS) and the University of Hawaii - Manoa collaborated to complete a peer-reviewed publication which updates LANDFIRE model parameters for the Hawaiian Islands. In addition, the U.S. Fish and Wildlife Service (FWS) and National Park Service (NPS) have partnered with the USFS Fire Sciences Laboratory to identify and prioritize areas at greatest risk from wildfire including the locations and best management practices to manage fire-prone non-native species.

In Hawaii, FWS and NPS use satellite imagery, wildland fire risk and hazard analysis, and vegetation mapping in setting priorities for fuel reduction projects and suppression activities in an interdisciplinary forum. Prioritization of fuels reduction projects is based on the individual project's ability to meet the strategic goals of the National Cohesive Wildland Fire Management Strategy, which are to make progress towards achieving resilient landscapes, fire adapted communities, and safe and effective wildfire response. Project selection incorporates return on investment and probability of success into the prioritization process.

Question 2: The Department of Defense has a significant presence in Hawaii. Since 1975 the USDA and DOI have had an interagency agreement with DOD, which allows DOD to provide firefighting support to the wildland fire management agencies when needed.

Does DOI partner with the DOD in fire prevention activities, such as removing nonnative species, or post-fire restoration, such as controlling erosion in forests? Along the same lines,

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Mr. Bryan Rice*

does DOI partner with the DOD to use or implement innovative technologies to better prevent, respond to, or remediate wildfire events?

Likewise, does DOI partner with NOAA in post-fire restoration to control sedimentation and runoff into the surrounding ocean?

The NPS and FWS have interagency agreements with DOD which facilitate coordination of wildfire response across boundaries. Both agencies work with the DOD as core members of the Big Island Wildfire Coordinating Group (BIWCG). BIWCG is a leadership forum where Federal, state, and local fire agencies and nongovernmental organizations exchange information and coordinate fire-related programs for more proactive and collaborative wildfire-related education, outreach and technical assistance, project implementation, and research. Activities of BIWCG include, but are not limited to the prevention of human-caused fires, training of personnel to common wildland fire standards, fire prevention messaging, pre-suppression activities, suppression of fires, rehabilitation of areas burned by wildfire, exchange of technologies, fire research, and response to all-risk incidents (earthquakes, hurricanes, and volcanic eruptions). BIWCG furthers inter-agency cooperation through the implementation of directions and standards for various incident management activities. Pooling these resources affords the people of the Island of Hawaii more extensive and effective protection of lives, property, and natural and cultural resources. In other on-going work, DOD plans to continue working with the FWS on the development of Fire Danger Operating Plans.

Furthermore, the FWS and NPS collaborate with NOAA on sediment control and post fire restoration concerns to identify optimal climate conditions conducive to successful fire rehabilitation. DOD plans to continue working with the FWS on the development of Fire Danger Operating Plans. The National Park Service works with NOAA on sediment control and post fire restoration concerns as members of the South Kohala Coastal Partnership. NOAA and the NPS each collaborate with the Hawaii Wildfire Management Organization on coral reef protection through fire prevention efforts. The Pacific Fire Exchange provides a mechanism for sharing information through the Pacific Islands wildfire community.

Nationally, DOI partners with the military to provide additional support for wildland fire suppression operations. Currently, 245 soldiers from the 23rd Brigade Engineer Battalion based out of Fort Lewis, Washington are deployed to the Umpqua North Complex fire in Oregon. A number of military aerial assets are also supporting wildland firefighting efforts, including 2 C-130 airtankers and personnel that are deployed to fires in California, and two RC-26 fixed wing aircraft that are deployed to fires in Washington and California. The National Guard has also been deployed in Oregon, Washington, California, and Montana to provide additional firefighting support.

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Dr. Mary Ellen Miller*

Questions from Senator Angus King

Question 1: *Considering the testimony given at this hearing, it's clear that there is agreement that better forest management and a reduction of the level of hazardous fuels will help in controlling for the damage caused by wildfires.*

Has there been research conducted by a government agency, state agency, public or private institution that shows a comparison of forest fires that occur in intensively managed private forests, such as those in New England, and the less intensively managed public forests in the West, if all variables such as weather and climate were accounted for?

Dear Senator King, Thank you for your interest in fire science and forestry. There are multiple studies and projects to address the effects of forest management and climate on wild fire on national, regional and local scales. I have summarized a few of the larger scale studies below. The research record is mostly focused on the Western states rather than the managed private forests of New England. Federal agencies tend to focus their research on the lands they manage which are concentrated in the Western States. The Joint Fire Science Program (JFSP) was created by Congress in 1998 to sponsor research as an interagency program designed to supplement Forest Service and Department of Interior's research. The JFSP has sponsored research programs such as FIRESEV that compared the probability of severe fire occurrence across both public and private lands within the continental US.

In recent years your state of Maine has not had to deal with large severe wildfires, but as you probably know a quick look at history reveals that during periods of drought the forests, watersheds and people of Maine are at risk from large mega-fires. The Great Fires of 1947 burned ~200,000 acres (~312 square miles) and resulted in significant damages including 15 lost lives and the loss of over a thousand homes (Fobes, 1948). Similar large fires occurred in 1825 when an estimated 832,000 acres (1,300 square miles) burned during a dry autumn and in 1837 when 234 square miles burned (Fobes, 1947).

Federally sponsored research projects:

LANDFIRE project

LANDFIRE is a national vegetation and fuel's database that supports multiple fire behavior and fire effects models (<http://www.landfire.gov>). The LANDFIRE project develops and maintains fuel and vegetation maps for all wildlands (including the managed forests of New England) within the United States (Ryan and Opperman, 2013). The LANDFIRE database includes multiple spatially explicit fuel models such as Anderson, Scott and Burgan, and the FCCS – Fuel Characteristic Classification System that are utilized by a suite of fire behavior and fire effects models (Ryan and Opperman, 2013). These fire models use fuel models in conjunction with terrain, vegetation structure, and weather parameters to predict short to long term fire behavior and fire effects. For example, the FARSITE model (Finney, 2004) can be used to predict the direction and rate of spread of a fire in order to support fire suppression activities (Stratton, 2009). FlamMap is a spatial fire behavior model that uses land cover, topography, and fuel

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Dr. Mary Ellen Miller*

characteristics data from the LANDFIRE database along with fuel moisture and weather data (Finney, 2006). Basic fire behavior outputs include fireline intensity, flame length, rate of spread, heat per unit area, and crown fire activity (Finney, 2006). Land managers currently use FlamMap as a planning tool to predict and optimize the effectiveness of different fuel treatment scenarios (Gercke and Stewart, 2006; Stratton, 2004). LANDFIRE also supports fire effects models such as CONSUME which can be used to predict the amount of fuel consumed and the amount of smoke generated from wildfire (Prichard et al., 2007). It is important to remember that models are a mathematical simplification of complex natural systems and there is always room for improvement through continued scientific and engineering advancement.

The formal name for LANDFIRE is the Landscape Fire and Resource Management Planning Tools Project and it is currently maintained by the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior's wildland fire management bureaus. Congress directed the development of a National Fire Plan in order to address growing concerns over the increasing size, frequency and severity of US wildfires. The LANDFIRE project was developed in response to help make forest management decisions based on the best available science in order to help restore and maintain fire resilient landscapes and communities.

The LANDFIRE project makes extensive use of NASA Earth Observation especially Landsat data in order to create and maintain national maps of fuels and vegetation.

Monitoring Trends in Burn Severity (MTBS) Project

The Monitoring Trends in Burn Severity (MTBS) project has mapped the spatial extent and severity of all US fires from 1984-2015 that are greater than 1,000 acres in the Western US; in Eastern states all fires greater than 500 acres are mapped (<https://www.mtbs.gov/>, Finco et al., 2012). The start date of the project coincides with NASA's launch of the Landsat 5 satellites and continuing Landsat missions have allowed it to continue updating this publically available database on a yearly basis. The MTBS datasets have been used on multiple projects and is an invaluable resource for studying wildfire as the data can be used to compare fire frequency, burned area, and burn severity across different regions of the US (including New England). The MTBS project is currently a collaboration between the USDA Forest Service and the United States Geological Survey and this data is periodically used to help update disturbances in the LANDFIRE database.

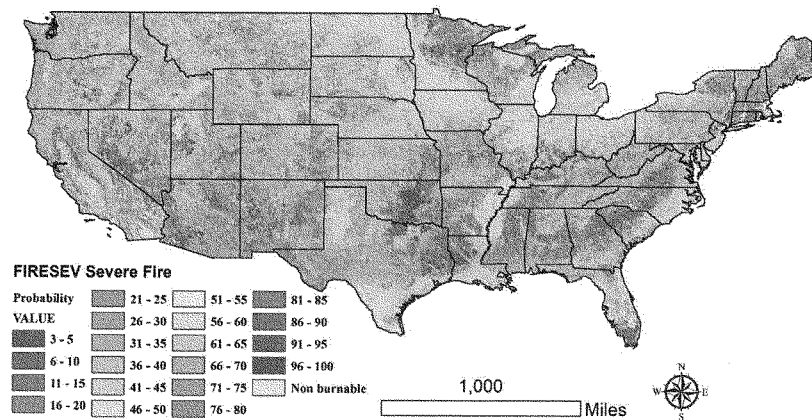
FIRESEV

The FIRESEV project may interest you as this project has mapped estimated potential burn severity between the forests of New England and the West (Dillon et al., 2009). One of the main deliverables of the FIRESEV project was a spatial prediction of the probability of severe fire for the lower 48 states. These predictions are publically available and include maps of the Western and Eastern states (<https://www.frames.gov/partner-sites/firesev/firesev-home/>). The project made use of the machine learning algorithm Random Forests to predict fire severity using the MTBS database as ground truth and multiple spatial inputs including terrain indices, satellite

*U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Dr. Mary Ellen Miller*

derived vegetation indices, and fire weather data as predictors (Keane et al. 2013). The FIRESEV project was funded by the Joint Fire Science Program.

FIRESEV severe fire potential for forest and non-forested lands



Fuel Treatment Effectiveness

Fuel reduction treatments, such as thinning and prescribed burning, have been shown to be effective in reducing both fire behavior and fire severity (Reinhardt et al. 2008; Cochrane et al. 2012). A reduction in fire severity can then help reduce threats to important ecosystem services such as clean water, recreation opportunities, timber, as well as fish and wildlife habitat. The high costs associated with fuel reduction treatments can limit their application (GAO 1999, 2007; Sampson et al. 2000), but more and more communities such as in Mokelumne Basin in California and in Flagstaff, Arizona are choosing to organize and take action to protect their watersheds from risks associated with extreme wildfire (Buckley et al., 2014; Elliot et al. 2015). The Joint Fire Science Program recently funded an analysis of multiple fuel treatment studies, the researchers found fuel treatments were effective in reducing fire severity, but the effectiveness varied depending on vegetation and fuel treatment type (Martinson and Omi, 2013). The most effective treatments were thinning and follow up prescribed burns in conifers and grasslands, while the mechanical mastication in woodlands appeared to actually increase burn severity (Martinson and Omi, 2013). The researchers identified the need for future research to include more information on the effects of fire weather and fuel conditions on the effectiveness of fuel's treatments (Martinson and Omi, 2013)

***U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Dr. Mary Ellen Miller***

Question 2: *We believe that such research would be valuable in addressing how to best manage forests to prevent damaging forest fires on federal lands. Is there interest in undertaking such a research project?*

Yes, there is always a great deal of interest in pursuing research to better manage forests. This interest is multi-agency and includes both public and private institutions. My applied science research to support post-fire remediation was primarily funded by NASA and the NASA applied wildfire program included multiple projects seeking to use Earth Observation data to better manage wildfire (<https://appliedsciences.nasa.gov/programs/wildfires-program>). I am currently collaborating with the USDA Forest Service on a fuel's planning project to map risks of wildfire to water resources, one of the challenges we are facing is the lack of information on post-fire surface cover following fires in the Eastern US.

The Joint Fire Science Program has also been a leader in promoting fire science through funding both applied and basic research. The Joint Fire Science Program provides vital assistance to bridge the gap between the fire science community and fire and land managers so that the latest science can be applied. The communication is a two-way street as the needs of the fire managers and fire fighters help dictate research calls. Currently the JFSP is conducting research in wildfire smoke hazards under the FASMEE program (Ottmar et al., 2017) with the goal of improving our understanding and ability to predict the amount of smoke generated by wild and prescribed fires and how it is transported. Prescribed burns which could minimize risks of catastrophic mega-fires are sometimes not carried out due to valid concerns of the negative health impacts of smoke.

References:

- Buckley, M., Beck, N., Bowden, P., Miller, M.E., Hill, B., Luce, C., Elliot, W.J., Enstice, N., Podolak, K., Winford, E., Smith, S.L., Bokach, M., Reichert, M., Edelson, D., Gaither, J. (2014) Mokelumne watershed avoided cost analysis: Why Sierra fuel treatments make economic sense. A report prepared for the Sierra Nevada Conservancy, The Nature Conservancy, and USDA, Forest Service. Sierra Nevada Conservancy. Auburn, California. Available at: <http://www.sierranevadaconservancy.ca.gov/mokelumne>
- Cochrane M. A., Moran C. J., Wimberly M. C., Baer A. D., Finney M. A., Beckendorf K. L., Eidenshink J., Zhu Z. (2012) Estimation of wildfire size and risk changes due to fuels treatments. *International Journal of Wildland Fire* 21, 357–367.
- Dillon, G.K., P. Morgan, Z.A. Holden. 2009. Mapping the Potential for Severe Fire in the Western United States: A Study Plan for Research under RJVA 09-JV-11221637-270 between the University of Idaho and USDA Forest Service Rocky Mountain Research Station. Submitted 28 September 2009, Revised 09 November 2009.
- Elliot W.J., Miller M. E., Enstice N. (2016) Targeting forest management through fire and erosion modelling. *International Journal of Wildland Fire* 25, 876-887.
<http://dx.doi.org/10.1071/WF15007>

***U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Dr. Mary Ellen Miller***

- Finney, M. A. (2004). FARSITE: Fire Area Simulator-model development and evaluation.
- Finney, M. A. (2006). An overview of FlamMap fire modeling capabilities.
- Finco, M., Quayle, B., Zhang, Y., Lecker, J., Megown, K. A., & Brewer, C. K. (2012). Monitoring trends and burn severity (MTBS): monitoring wildfire activity for the past quarter century using Landsat data.
- Fobes, Charles B. "Historic forest fires in Maine." *Economic Geography* 24, no. 4 (1948): 269-273.
- Government Accountability Office (GAO) (1999). Western national forests: a cohesive strategy is needed to address catastrophic wildland fire threats. Report GAO/RCED-99-65. (GAO: Washington, DC)
- Government Accountability Office (GAO) (2007). Wildland fire management: better information and a systematic process could improve agencies' approach to allocating fuel reduction funds and selecting projects. Report GAO-07-1168. (GAO: Washington, DC) Available at <http://www.gao.gov/assets/270/267638.pdf> [Verified 31 August 2017]
- Gercke, D. M., & Stewart, S. A. (2006, March). Strategic placement of treatments (SPOTS): maximizing the effectiveness of fuel and vegetation treatments on problem fire behavior and effects. In Proceedings of the 1st Fire Behavior and Fuels Conference: Fuels Management—How to Measure Success.
- Keane, R. E., Morgan, P. M., Dillon, G. K., Sikkink, P. G., Karau, E. C., Holden, Z. A., & Drury, S. A. (2013). A fire severity mapping system for real-time fire management applications and long-term planning: the FIRESEV project.
- Martinson, Erik J., and Philip N. Omi. "Fuel treatments and fire severity: a meta-analysis." (2013).
- Prichard, S. J., Ottmar, R. D., & Anderson, G. K. (2006). Consume 3.0 user's guide. Pacific Northwest Research Station, Corvallis, Oregon.
- Reinhardt ED, Keane RE, Calkin DE, Cohen JD (2008) Objectives and considerations for wildland fuel treatment in forested ecosystems of the interior western United States. *Forest Ecology and Management* 256, 1997–2006. doi:10.1016/J.FORECO.2008.09.016
- Ryan, K. C., & Opperman, T. S. (2013). LANDFIRE—A national vegetation/fuels data base for use in fuels treatment, restoration, and suppression planning. *Forest Ecology and Management*, 294, 208-216.
- Sampson RN, Atkinson RD, Lewis JW (2000) Indexing resource data for forest health decision making. *Journal of Sustainable Forestry* 11, 1–14. doi:10.1300/J091V11N01_01
- Stratton, R. D. (2004). Assessing the effectiveness of landscape fuel treatments on fire growth and behavior. *Journal of Forestry*, 102(7), 32-40.
- Stratton, Richard D. (2006). Guidance on spatial wildland fire analysis: models, tools, and techniques. Gen. Tech. Rep. RMRS-GTR-183. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 15 p.

U.S. Senate Committee on Energy and Natural Resources
August 3, 2017 Hearing: Federal and Nonfederal Collaboration,
including through the Use of Technology, to Reduce Wildland Fire Risk
to Communities and Enhance Firefighting Safety and Effectiveness
Questions for the Record Submitted to Dr. Mary Ellen Miller

Ottmar R, et al. (2017). Fire and Smoke Model Evaluation Experiment (FASMEE) study plan. Joint Fire Science Program Project 15-S-01-01, 148 pp.

