Guidelines for Protecting Historic Resources from Wildland Fire

Prepared by

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Prepared for

Preserve Montana &
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PRESERVE MONTANA

This report was prepared with editorial and design assistance by Preserve Montana's Executive Director Jenny Buddenborg. Preserve Montana is a 501(c)(3) tax-exempt charitable organization with a mission to protect Montana's cultural heritage, traditional landscapes and historic places. Since 1987, the statewide non-profit has empowered people and communities to protect Montana's historic and cultural assets through historic preservation.

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ON THE COVER

Photo of residential structure in the Laurence Creek area of Larimer County, Colorado, burned during the High Park Fire in 2012.

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EXECUTIVE SUMMARY

These guidelines are about saving historic resources from wildland fire. Each year, our world is increasingly altered by global warming, human interaction, and the effects of long-standing wildland fire control practices. The threats from wildfire to communities, historic resources, and the American landscape are devastatingly real and growing.

These guidelines are intended to help guide disaster preparedness for the threat of wildland fire. They are written for stewards of historic properties, wildland fire managers, and stakeholders who are invested in protecting historic resources from the threat of wildland fires.

Most of the recommendations focus on actions that should be taken well before a wildland fire threatens an historic property, not during an incident when the presence of well-intentioned actions of individuals may be hazardous to them and impede responders from safely fighting the fire.

The matrix on the following page identifies the action items that are discussed in these guidelines. Some items are under the control of the property steward, some require collaborative and cooperative work with other stakeholders, and other items are beyond the control of the property stewards.

The matrix identifies which party is the *lead*, i.e., who is responsible for initiating the action item. For example, conducting an inventory of the property is the responsibility of the property steward.

Collaborators are parties that do not initiate the action but will participate by providing key input into the process, procedures, or limitations that must be considered for that action item. For example, the local fire organization may initiate the drafting of a community wildfire protection plan and the property steward will collaborate by providing information on the site that is relevant to the plan.

Advisers provide technical assistance. For example, the property steward may initiate documentation of the construction of key structures but the State Historic Preservation Office may provide advice regarding the data collection and storage of the data.

For those items that are under the control of the stewards, it is recommended that they actively pursue addressing those tasks in the near term, as is feasible. The other action items may take time and funding beyond what is currently available but the process can begin. Find out if there is work being done to update or draft a Community Wildfire Protection Plan (local fire officials should know). Talk to local preservation organizations and the State Historic Preservation Office about plans for the property and understand the limitations that some organizations must honor.

In short, be involved.

Table 1. Role of Various Parties by Action Item in the Guidelines

Action item	Historic property steward	Local fire organization/ Emergency manager	State Historic Preservation Office/Local preservation office
Conduct property inventory	LEAD		ADVISER
Establish property priorities	LEAD		
Document construction of key structures	LEAD		ADVISER
Draft Community Wildfire Protection Plan	COLLABORATOR	LEAD	
Communicate inventory per SHPO procedures	LEAD		COLLABORATOR
Communicate property priorities to collaborators	LEAD	COLLABORATOR	COLLABORATOR
Organize work on mitigation	LEAD	ADVISER	ADVISER
Organize work on defensible space	LEAD	ADVISER	ADVISER
Organize work on structure hardening	LEAD	ADVISER	ADVISER
Record data in geographic information system	COLLABORATOR		LEAD
Convey property information to Incident Command Team during a wildland fire	COLLABORATOR	COLLABORATOR	LEAD

Lead = Initiates action item.
Collaborator = Provides key input into processes, procedures and limitations of action item.
Adviser = Provides technical assistance to action item.

PURPOSE OF THE GUIDELINES

"Wildfire destroys historic buildings at Big Basin State Park"

"Wildfire Damages Historic Buildings"

"What's Next for Two Historic Places Ravaged by California Wildfires"

These headlines are from news articles published by the National Trust for Historic Preservation, the National Center for Preservation Technology and Training, and the Santa Cruz Sentinel, respectively.

The stories are real.

These guidelines are about saving historic resources from wildland fire. Each year, our world is increasingly altered by global warming,[1] increased human interaction, and the effects of long-standing wildland fire control practices. The threats from wildfire to communities, historic resources, and the American landscape are devastatingly real and growing (Figure 1). These guidelines are intended to help guide disaster preparedness to address the threat of wildland fire.

Target Audience
These guidelines are written for stewards of historic properties, wildland fire managers, and stakeholders who are invested in

Figure 1. Visibility during the Cameron Peak Fire in Colorado, 2020. The active fire is over 10 miles away.

protecting historic resources from the threat of wildland fires. Historic property stewards go by many names - cultural resource manager, preservation specialist, preservationist, and others based on agency, local, and regional preferences. In these guidelines, use of the term historic property steward or steward refers to any individual with responsibility for an historic property/cultural resource. Historic property can be either public or private.

Throughout the drafting of these guidelines, it became apparent that the connection between the information retained by stewards and the information accessible by fire managers is not as simple as many would hope or expect. Although focused on wildland fire, the guidelines can serve as a framework that can be used to prepare historic resources for other natural disasters.

First, the guidelines describe the basics of wildland fire behavior, fuel mitigation, defensible space, and how firefighters respond to a wildland fire. Understanding the threat of wildfire is essential for stewards to better prepare for a fire. Second, the guidelines describe recommendations, i.e., action items, that stewards can take to better prepare their property or resource. Finally, the guidelines identify the role of collaboration between preservation and cultural resource organizations, both where resource information might reside and the challenges with getting that information into those in command of wildland fire operations.

The Threat
Wildland fire is a threat to cultural resources across the country. Fire season used to be limited to the "summer months" or "dry months", depending on a geographic area. Fire season is now a year-round risk in much of the country and fire intensity is increasing. Warm, dry periods are intensifying; severe drought is more common.

As the threat to communities by wildland fire across the nation grows each year, these guidelines ultimately seek to strengthen the connection between those that know the importance of historic properties under their charge and those that are charged with protecting the wide range of assets and values at risk during a wildland fire.

Desired Outcome of the Guidelines
These guidelines identify means to reduce the threat to historic properties due to wildland fire through actions that property stewards can do and ultimately conveying key information to those responsible for assigning firefighting resources to better protect – and, hopefully, save – historic properties.

Terminology
It is assumed that historic property stewards have a working vocabulary of terms used in the historic preservation and cultural resource disciplines. Throughout these guidelines terminology from both the historic preservation community and the wildland fire community are used. For discussion purposes, the term structure is used, although other cultural resources – artifacts, cultural landscapes, cemeteries, archaeology sites, etc. - could generally be substituted for the term structure in many cases. The terms wildland fire and wildfire are used interchangeably, as they are in the fire community. Although the preservation community has different definitions for structure, building, and the built environment, the term structure is used throughout these guidelines, as is typical practice in the fire community.

The term significance used in the guidelines refers to historic significance as defined in the Secretary of the Interior's Standards for the Treatment of Historic Properties. The use of the term landscape refers to the local environment associated with an historic property, which may or may not meet the formal definition of a cultural landscape. The glossary at the end of the guidelines provides additional definitions and acronyms used throughout the guidelines.

WILDLAND FIRE BASICS

For those that have never experienced a large wildfire, it is a chaotic event. The frantic challenge of preparing for evacuation as a fire approaches creates a sense of near panic, driven not only by news images but more from the intensity of the smoke, heat, wind, ash, and flames. Rational thinking is not the mode for most people under these circumstances.

In wildfire preparedness, individuals may have an evacuation plan that identifies which items are important to save – family photos and mementoes, financial documents, items they would hate to lose forever. It is the first step in saving their personal history. Who coordinates those steps when the fire approaches your historic resource? You do. You're responsible.

If you are responsible for an historic property, you may know which items are important to save. Do you have an inventory that has been prioritized? Have you documented the construction of structures in case they are consumed by the fire? Once you evacuate, how do you know that firefighters know your priorities? How can you protect your historic structures? To understand how or what you can do, you need to better understand the nature of the threat. We start with a brief overview of fire behavior.

It is the objective in this section to present a primer on fire behavior by providing sufficient information for stewards and stakeholders to understand the nature of the threat to their historic property from wildland fire. The goal is not to make the stewards and stakeholders fire behavior experts but rather to give them a clear, concise understanding of the factors that impact fire behavior and things stakeholders can do on site to reduce the risk of damage or loss due to fire. **Most of the recommendations focus on actions that should be taken well before a wildland fire threatens an historic property, not during an incident when the presence of well-intentioned actions of individuals may be hazardous to them and impede responders from safely fighting the fire.**

Wildfires occur in rural areas, far from occupied human development. They occur in urban areas and in the wildland urban interface (the WUI). The WUI is a transition zone between largely unoccupied land and human development. It is a geographic zone where structures or other human development, interspersed with undeveloped wildland or vegetative fuels, are present. While the WUI is identified above, the term "wildland urban interface" has many definitions and is often confusing to professionals and laypersons that deal with the WUI. Based on definitions, a wildfire does not distinguish between the wildland urban interface and rural areas (Figures 2 and 3).

Actions should be taken well before a wildland fire threatens an historic property, not during an incident when the presence of well-intentioned actions of individuals may be hazardous to them and impede responders from safely fighting the fire.

Figure 2. A structure in the wildland urban interface. Note the grass and trees that serve as fuel during a wildland fire.

Figure 3. Historic structures in a rural area that is not considered the wildland urban interface. Note the grass and trees that serve as fuel during a wildland fire is similar, although slightly less in volume than that shown in Figure 2.

Increased development and activities in the WUI across the U.S. have produced a corresponding increased risk of damage or loss due to wildland fire. While the number of structure losses has increased over the past decades, the number of structures saved due to some of the recommendations made in these guidelines is substantial. It should be noted that many historic resources on public land are not within the WUI as defined. Many are isolated and surrounded by undeveloped land.

Fuels, weather, and topography are the key factors in wildland fire behavior. As shown in the well-known fire triangle (Figure 4), it is the interaction of these three variables that responders must address when allocating resources to protect life and property.

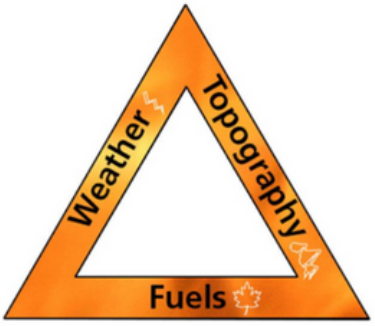

Figure 4. The fire triangle.[2]

The Role of Fuel in Wildland Fire Behavior
Fuel is anything that is combustible. Most commonly, vegetation is the primary fuel for wildfire. The vegetation may be grasses, trees, and shrubs within the landscape. Fuels are categorized by size and how rapidly they can adapt to changes in relative humidity and temperature (affecting the moisture content of the fuel). Grasses are considered fine fuels because they are easy to ignite and will dry very quickly (within hours) as temperatures increase and relative humidity decreases. **Structures are fuel. While the materials used on the exterior of the structure affect the probability of ignition, the contents on the interior are subject to ignition from radiant or convective heat from a fire, or embers that enter the structure. Fuel is the one variable of the fire triangle that we can significantly alter to affect fire behavior.**

The Role of Topography in Wildland Fire Behavior
Topography is the form and features of a landscape. Canyons, mountains, steepness of slope, and elevational differences are examples of topographic features that will influence fire behavior. In most cases, the topography of a site cannot be altered or controlled. On sites that have only slight grade changes (i.e., relatively flat in nature), fire behavior would be influenced more by fuels (structures, vegetation, etc.) and wind during an incident than the topography of the property. However, in areas where topography varies significantly – steepness of slope, elevation, aspect, and other features, fire behavior can be significantly affected, particularly, the fire intensity and rate of spread.

The Role of Weather in Wildfire Behavior
Temperature, relative humidity, and wind are the primary weather factors that affect fire behavior. Precipitation, exposure to ultraviolet radiation, and lightning are other factors that can influence fire behavior. Understanding the impact of changes in weather patterns, primarily higher temperatures, lower precipitation, and high wind speeds in many fire-prone areas is key to anticipating fire behavior on a given site. Many of the recent devastating wildfires have been the result of extreme winds that carry embers (a phenomenon called spotting) much further distances than recorded during fires from only a few decades ago. **It is typically embers during a wind-driven fire in the vicinity that are the greatest risk to a site or structure.**

Heat Transfer and Ignition
Fuel ignites from a variety of means during a wildfire. Many fires are caused by lightning or are human caused and affect a limited geographic area. Historically, most wildland

fires are low-intensity surface fires where direct flame contact has been the greatest threat to a structure. More recently, wind-driven fires of extreme intensity are becoming more frequent and far-more destructive than surface fires. In either case, fuels adjacent to a structure (vegetation, wood, and other structures) that are in direct contact with the leading edge of the flames may ignite. However, it is easy to confuse heat transfer and ignition during a wildfire. Said another way, "it might get hot, but it doesn't necessarily burn." Reducing the fuel load through fuels mitigation and creating a defensible space can reduce the likelihood of a structure burning even though it may "get hot".

Heat transfer occurs through convection, radiation, or conduction. Convection is the movement of hot air due to heating of the air molecules. Convection is the primary means of fire spread by pre-heating fuels in advance of the fire, including the upper crowns of trees. Convection also contributes to ember transmission described below. Radiation is the movement of heat energy as waves passing through the air. The heat is transferred when the wave reaches a physical object that conducts heat. Radiant heat from a wildfire can ignite combustible materials inside a structure from several hundred feet away in extreme events. Conduction occurs when heat is transferred from molecule to molecule through direct flame contact, similar to the effect that occurs when you touch a hot skillet.

Embers, of firebrands, are airborne burning materials that can cause ignition when they come in contact with unburned fuel. Embers can be from vegetation (pine cones, sticks, leaves, etc.), structures (roofing, siding, even roof sections, etc.), or other burning . Embers can be from vegetation (pine cones, sticks, leaves, etc.), structures (roofing, siding, even roof sections, etc.), or other burning materials. Wind can carry the embers long distances, farther than convection or radiation can transfer heat for combustion, and upon landing can ignite or get into openings (e.g., uncovered vents) in structures and start fires on the interior before the flames ever reach the structure. While embers have always been a concern during wildfires, the wind speeds and gusts recorded in relatively recent fires can travel, or spot, well over a mile in extreme wind events where gusts exceed 60 to 80 mph.

Ignition occurs when a combustible material reaches a temperature sufficient to support combustion of that material. A general rule is that the majority of fuels will ignite during a wildfire at a temperature of approximately 500 degrees Fahrenheit. Embers that travel through the air due to wind or air currents (such as a convective column often seen on large wildfires) are the most common source of structure ignition through spotting. If the embers are large enough to retain heat or are burning when they land on a combustible material, an ignition can occur. Addressing the probability of ignition to or in a structure is critical to reducing the potential impact of embers, particularly during wind-driven fires. Erratic winds can allow embers to enter tight openings that, through conduction, can result in an ignition. Periodic visual inspections to determine accessible fuel or possible entry points for embers should be part of routine maintenance (Figures 5-7).

Figure 5. Pine needles that have accumulated on the roof below the soffit and fascia that are susceptible to ignition from embers. The flames could easily spread to the wood soffitt and fascia.

Figure 6. Wooden stairs in contact with ground vegetation provide a source for spread of the fire from surface fuels to the wood structure.

Figure 7. Deteriorated fascia board that provides an entry for wind-driven embers can result in an ignition on the interior of the structure.

Most structures lost to wildfire are the result of embers causing ignition near or on the structure itself, thus reinforcing the need for fuels reduction and mitigation. For detailed information on early research on structure ignition modeling, see Cohen.[3] Additional research has been conducted over the past decades but Cohen's early research lays the foundation for why structures ignite during a wildland fire.

Most structures lost to wildfire are the result of embers causing ignition near or on the structure.

The above brief introduction and discussion of fire behavior; heat transfer, ignition sources and pathways, aims to provide a general introduction for identifying or evaluating the risk of damage to or loss of an historic structure. It is these mechanisms ofheat transfer and ignition pathways that mitigation efforts attempt to disrupt. A structure with close, overhanging trees and dense shrubs and grasses next to the base of the building provides direct pathways for fire to approach a structure. If these can beremoved or greatly reduced, a building has a better chance of surviving a wildland fire. Maintenance of exterior materials is also critical to reducing pathways.

For a historic property in the WUI, replacement of construction materials should not be taken lightly. For structures listed on the National Register of Historic Places or a National Historic Landmark, their materials are often character-defining features that help to justify their historical significance or integrity. However, as wildfire risk becomes a greater concern to stewards of historic properties and code officials, consideration of structure hardening as a means of reducing the fire risk to ignition increases. Hardening involves (1) replacement of roofing, soffit, eaves or siding materials with products that are less combustible; (2) modifying vents and gutters with screens; (3) replacing windows, and similar changes that can negatively impact

both the public experience and the historic designation.[4] **Any consideration of changing historic materials should be done in consultation with local preservation or code bodies with regulatory authority over the site and the State Historic Preservation Office.**

There is a debate over whether hardening could have made a difference in protecting a structure during a wildland fire in the Sperry Chalet in Glacier National Park (Figure 8).

Replacing the wooden roofing shingles with fire-retardant-treated wood shingles or a metal roof may have afforded additional protection but such replacement would be in conflict with the Secretary of the Interior's Standards for the Treatment of Historic Properties.Additionally, the source of ignition and ultimate loss of the Sperry Chalet was wind-driven embers that gained entry into an opening near a second-story window, not combustion of the roofing shingles.[5]

Figure 8. Remains of the Sperry Chalet in Glacier National Park after the Sprague Fire, 2017. Photo courtesy of the Glacier National Park Conservancy.

Mitigation and Defensible Space
The primary goal of mitigation is to keep the small fires small and provide safe means of escape for individuals and safe access for firefighters. A secondary goal is to protect assets, most commonly homes and other structures. The two primary means of significantly reducing the immediate risk of damage to structures that you can achieve are fuels mitigation and creating defensible space. Table 2 provides an example list of how the action items described later can impact the heat transfer mechanisms described in the previous section.

Fuel mitigation involves removing or trimming vegetation to reduce the total volume of material that can burn (the fuel load) while reducing the horizontal and vertical continuity of the fuel to lower the likelihood of the fire being able to spread without interruption, as across a grassy meadow. Fuels mitigation can be done around a structure, along a road, or in the forest.

Table 2. Means of Affecting Heat Transfer Mechanisms

HEAT TRANSFER MECHANISM	ACTION TO REDUCE THE EFFECT
Convection	Reducing horizontal and vertical fuel continuity
Convection	Hardening to reduce likelihood of ignition
Radiation	Establish defensible space to reduce fire intensity
Conduction	Establish defensible space to reduce direct heat transfer
Embers	Fuels mitigation and defensible space

Horizontal fuel continuity is vegetation or other fuel that is continuous, essentially touching, across the horizontal zone (or the zone parallel to the ground) while vertical fuel continuity is a lack of separation vertically (Figure 9). As seen in the photo, there is little or no separation from tree to tree, shrub to shrub, or between grasses at ground level, thus, horizontal continuity. Similarly, grasses extending to shrubs which extend to tree branches up to the crowns of the trees, provides vertical continuity, also called ladder fuels.

The volume of fuels that need to be reduced and removed through trimming or cutting is typically quite extensive. This is due, in part,to fire management policies over the past century that have attempted to suppress (extinguish) fires as being detrimental rather than relying on potentially beneficial effects of letting them burn in some cases. For historic properties where the surrounding landscape is a defining feature, this can be difficult to execute. However, when considering the survivability of a significant historic resource a critical look at drastically reducing the surrounding fuel load and horizontal and vertical continuity is often the best defense.

Defensible space around a structure that reduces the likelihood of significant damage or loss of the structure is a concept that has been promoted for decades, along with an understanding of the role of building materials and their impact on the risk of damage or loss due to fire.[6] **The extent of mitigation activities conducted is a balance between extremes to protect against fire**

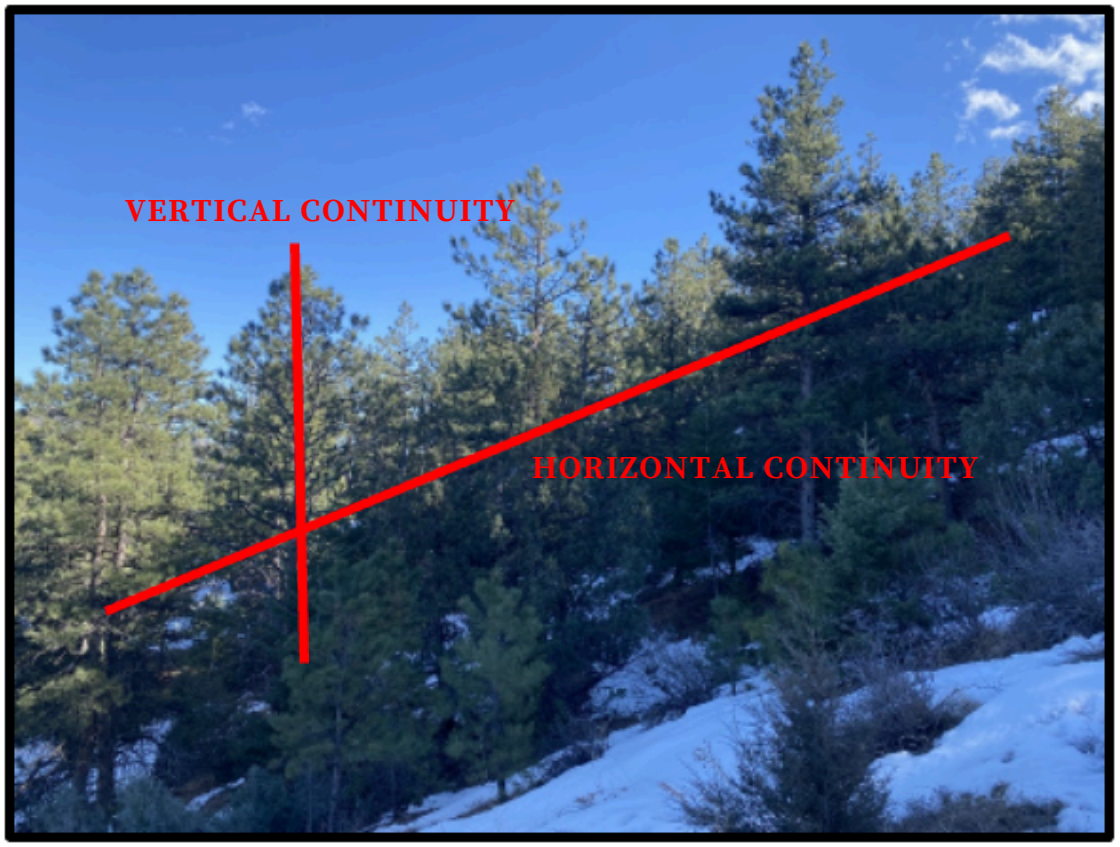

Figure 9. Horizontal and vertical fuel continuity.

and the potential impact on the site. Balancing this risk is generally limited by aesthetic, environmental, historical, budgetary, regulatory, and other considerations and realities.

Protecting any structure, including historic structures and their contents, is improved by having defensible space around the structure. Defensible space reduces the intensity of the fire around the perimeter of the structure and limits the exposure to the heat from the fire. It also improves the likelihood that firefighting resources can safely conduct defensive actions on the site during a fire. Figure 10 illustrates what has been, and still is, promoted as best practices for establishing defensible space around structures (generally, residential) in fire-prone areas. These are generic recommendations that do not consider the local conditions around an individual structure – construction materials, fuel load exposure, position on a slope or many other factors that will affect fire behavior and should, therefore, be considered when establishing defensible space.

Published recommendations are good guidance for many single structures – residential or historic - but not necessarily appropriate for sites with closely spaced historic buildings or designated landscape features that have a historic designation, or may be eligible for designation. For this reason, consultation between cultural resource specialists, wildfire personnel, and property stewards is likely to result in a compromise when evaluating and determining a fuels mitigation plan and creating defensible space around a historic building or site, rather than the idealized mitigation. While the variety of resources describing defensible space may be dizzying, the basic principles are consistent. The lack or defensible space can increase the risk of damage or loss of the structure (Figure 11).

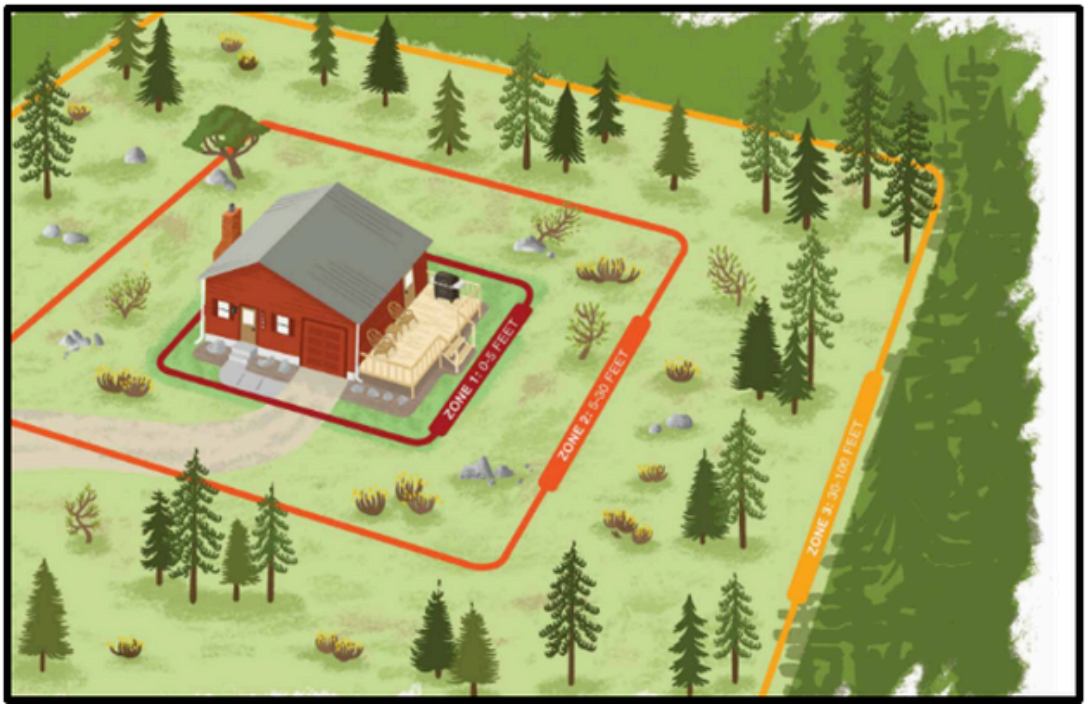

Figure 10. An idealized defensible space that is recommended around a single residential structure. This approach is often not feasible for historic properties due to proximity of other structures, heritage trees, or other features that are significant to the landscape.[7]

Figure 11. A site where mitigation had not been done, resulting in a total loss of the structure. Note that several trees in the immediate vicinity have not been burned, suggesting the likelihood that embers may have been the ignition source.

While defensible space is an important component for addressing risks due to wildland fire, a holistic approach of fire adapted communities is described by the National Wildfire Coordinating Group.[8] An historic property fits into the Fire Adapted Community model quite well. These guidelines touch on several aspects described in the Fire Adapted Community guidelines, primarily mitigation, defensible space, Community Wildfire Protection Plans, and community interface with Incident Management Teams.

It is worth noting that the approach and tools developed by governmental agencies are quite dynamic and increasingly complex, as can be seen from the progression from relatively simple defensible space recommendations to a more holistic means of involving all stakeholders with technical, logistical, political or social interests in the growing wildland fire issue. **Regardless of the complexity, historic property stewards can rely on basic steps of establishing an inventory, priorities, documenting the construction of their structures, and fuels mitigation/defensible space while staying abreast of peripheral aspects of fire-adapted communities that are beyond their immediate span of control, such as those shown in Figure 12.**

Incident Management

Firefighting resources are focused first on life safety, incident stabilization (controlling the progress of the fire), and property conservation (protecting values at risk).[9] Values at risk are typically determined by importance **to the public** (as opposed to **by the public**); private property, natural resources, watersheds, recreational areas, etc. Incident Management Teams (IMTs) that assign firefighting resources during an incident (i.e., a wildland fire) seldom have the details of which historic structures are important to the stewards (i.e., priorities) for the preservation of the history, architecture, archaeology, or landscapes for the American people and visitors to these properties.

Figure 12. Model of the holistic Fire Adapted Communities described by the National Wildfire Coordinating Group.

Wildland fires vary tremendously in size. The complexity of the fire, more than size alone, dictates the response by the fire service following the Incident Command System (ICS).The initial report of a wildland fire is a typically a Type 5 incident (i.e., fire, sometimes designated Type V) and the response is called initial attack. Think of lightning striking a tree and starting a small fire. Local fire officials will respond to a Type 5 incident and it is typically under control in less than a day.

Type 4 and Type 3 may require an extended initial attack using more personnel and equipment. The fire may burn for more than one day. These fires will have an Incident Commander and may have a management team with specific responsibilities such as operations, planning or logistics; the IMT defined above.

Types 1 and 2 wildfires are more complex in terms of values at risk, current and expected fire behavior, size and other factors that requires a dedicated overhead team that manages the fire. In 2023, there was a transition to a Complex Incident Management Team, which encompasses what used to be broken down into Type 2 and Type 1 Incident Management Teams.[10] The IMT does not fight the fire personally but allocates resources – firefighters, engines, water tenders, aircraft, etc. Firefighting resources are not limited to local responders but generally come from across the U.S. based on the specific needs for that fire. As the risks from an active fire increase and a higher level IMT is brought in to oversee the operation, relevant information about values under threat (such as historic property) should be passed on from one IMT to the next.

Local fire responders have a number of ways that they document, respond, communicate within a given area. Some may use hard-copy maps if they do not have access to digital technology. Most fire departments use computer aided dispatch (CAD) with mobile data terminals (MDTs) in the engines and other apparatus to convey critical information to responding fire units. Note that the acronym CAD in this situation is not related to the use of CAD in documentation section discussed earlier.

Runbooks are produced by fire organizations to be used in emergency response apparatus within their response area (e.g., the boundary of the fire department). Runbooks rely on maps, sometimes simple maps but more commonly maps created using geographical information systems (GIS) and global positioning satellites (GPS). GIS is discussed later in the guidelines in more detail.

The simple maps may use a grid system of coordinates with roads, streets, and addresses identified on the maps. GIS-based maps incorporate layers with various attributes that can be displayed as needed (Figure 13). Historic properties can be, or have, attributes recorded if the local fire organization is aware of them.

GIS information regarding historic properties will likely be restricted at the State Historic preservation Office level to individuals within an agency who meet specific Federal and State requirements due to the desire to protect sensitive resource information. Further, the layers and attributes may be unique to agiven department or jurisdiction. This can be problematic, as stated in a paper by the City of Fort Collins, Colorado:

> *"The primary challenge encountered is to overcome different methodologies of address reporting, creating, and updating from different local government agencies. Secondary challenges included; developing a method to use feature linked annotations in runbook map pages...* [11]

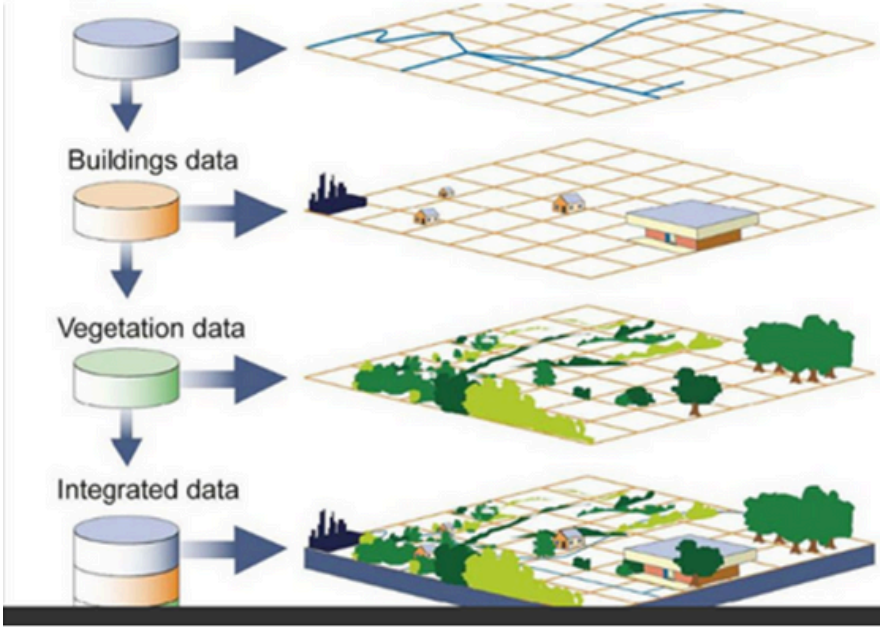

Figure 13. Illustration of various layers of data that can be used in GIS. [12]

Another means of preparedness used by local fire response organizations are structure response plans. The local fire organization breaks their response area into logical geographic boundaries based on placement of apparatus and crews (i.e., fire stations), values and assets at risk, and other factors. The structure response plan is intended to provide guidance on ordering and dispatching resources based on pre-determined strategies and tactics.

Within a specific structure response area, pre-determined apparatus and crews are dispatched to the incident. The severity of the incident, such as high winds on a wildland fire, often dictates that additional apparatus and crews from other areas be dispatched to the incident. An example of the high-level layer of a structure response plan (showing minimal details such as street names) is shown in Figure 14. As with runbooks, historic properties can be, or have, attributes if the local fire organization is aware of them.

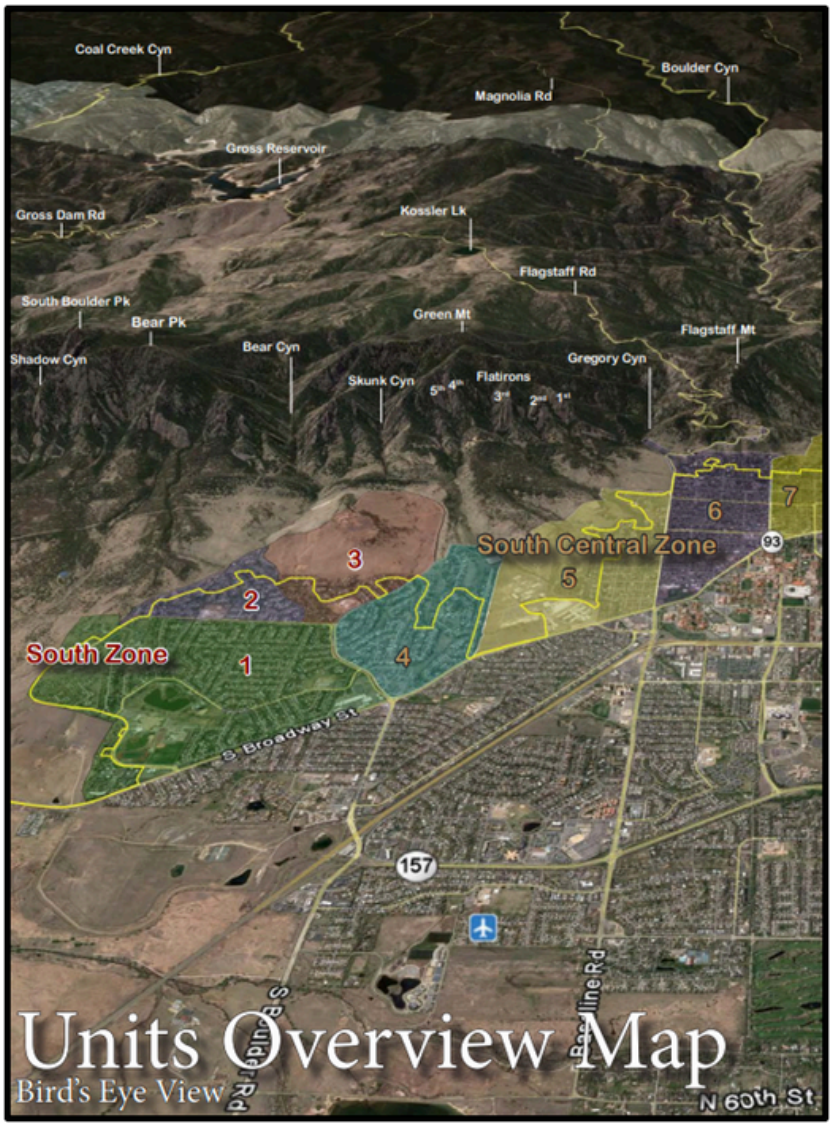

Figure 14. Example of a map from a structure response plan where the response area is divided into sectors that each have detailed response criteria or protocols. Image courtesy of the Boulder Fire Department (Colorado).

When a wildland fire occurs outside of an urban area, responding firefighters often rely on United States Geological Survey (USGS) topographic maps (Figure 15). The maps may be of different scale but the primary USGS topographic map size has been the 7.5-minute quadrangle since the 1940s. At this scale, the map may show major roads, structures, landmarks, and terrain that firefighters use to locate and mark the fire perimeter and topography that may influence fire behavior. The contour lines on the map are used by firefighters to interpret the landscape and topographic features, such as slopes, peaks, and valleys. Such information is key to understanding current and expected fire behavior.

Note that a challenge for coordinating information is the use of different methodologies by different agencies. That is one of the key obstacles: not having a standardized data collection system across jurisdictions (not to be confused with having standards) that could be accessed in the same way by any IMT. Numerous standards exist but use of the standards is not standardized between local jurisdictions, Federal and State agencies, or State Historic Preservations Offices in different states.[13]

Numerous standards exist but use of the standards is not uniform between local jurisdictions, federal and state agencies, or State Historic Preservation Offices in different states.

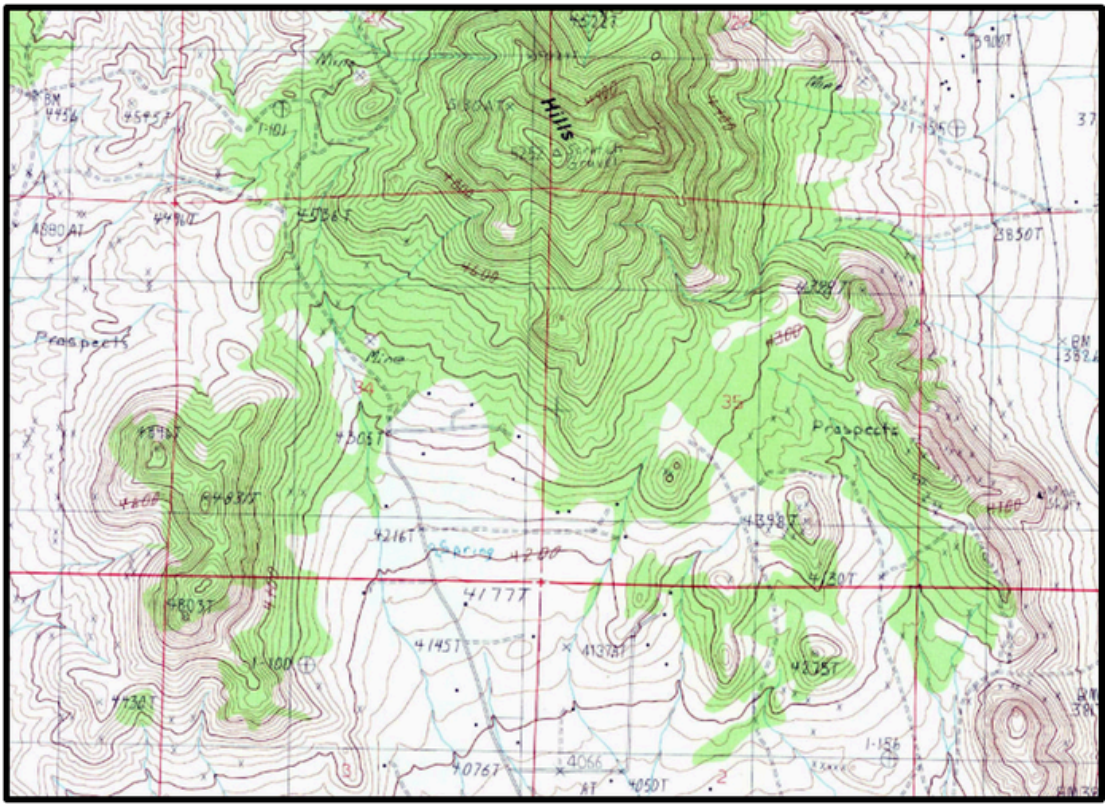

Figure 15. Sample area illustrated on a United States Geological Survey topographic map using a 7.5-minute quadrangle. Image courtesy of the Montana State Historic Preservation Office.

RECOMMENDED ACTIONS

Virtually anyone living in fire-prone areas is aware of the need to establish an evacuation plan with a list of items to be removed for protection. Historic property stewards need to prepare sites under their responsibility by addressing the same considerations. These guidelines do not cover evacuation plans, which generally should include trigger points for certain actions based on current and expected fire behavior. **If an active wildland fire presents an immediate threat to your site, you should not be there.**

Inventory and Establishing Priorities as Action Items

Conducting an inventory and documenting the construction of historic structures is not new. In short, what is on your site and which structures/artifacts/features have the greatest importance, i.e., highest priority in terms of protection from wildland fire? Not all historic property sites have inventories of their assets, nor the financial or staff resources to establish a database to the level discussed in various standards. Having an inventory and documentation of the construction of historic structures is key for protecting historic structures (if appropriate local and preservation authorities and fire organizations are aware of the inventory) and recovery efforts if impacted by wildland fire.

Immediately before a fire impacts the site, there is no time to conduct an inventory or remove items; people should no longer be at the site.

For these guidelines, inventory associated with wildland fire preparedness may be a subset of a more complete inventory for the site. Why a subset? Prior to a wildland fire, there may be time to remove key items to a safer, pre-arranged site for temporary storage. Immediately before a fire impacts the site, there is no time to conduct an inventory or remove items; people should no longer be at the site.

While the fire threatens or impacts the site, firefighting resources – the Incident Management Team managing the fire response, firefighters, engines, aircraft, etc. – do not have the time or resources to determine what is historically relevant on a historic property. At best, they should know the historically significant resources (as listed on the State and National Registers of Historic Properties), which are generally structures, but may be artifacts, burial grounds, landscape features, or something unknown to firefighters on scene. The inventory established by the historic property stewards should lead to a subset that provides responders with only historically significant items (structures, artifacts, landscapes, etc.) that may benefit from firefighting operations by trained crews.

Ultimately, someone from the Incident Management Team to the firefighter on the ground with the ability to save a historic structure needs to know “If I can only save one structure, which structure would that be?” Knowing that starts with the site having an inventory and establishing priorities.

Once an inventory has been produced, priorities can be set. This should be done for key structures and can often be tied to information provided on National Register of Historic Places (NRHP) nomination forms. To be eligible for the NRHP, significance is based on one of four criteria: (1) an event that played a role in American history, (2) a person that made contributions in the American past, (3) design or construction with distinctive characteristics, or (4) has yielded, or may be likely to yield, information important in history or prehistory. There are approximately 100,000 places listed on the NRHP; many more are eligible. A National Historic Landmark (NHL) is a building, object, site, or structure that is recognized by the U.S. Government for its outstanding historical significance. There are approximately 2500 NHL sites in the U.S. **Loss of or damage to a resource due to wildland fire can impact the status of a site on the NRHP or NHL.**

Using similar criteria to those laid out for identifying the significance of NRHP and NHL sites or whatever means is logical for your cultural resource, you should establish priorities for key structures, artifacts, or landscape features. A good starting point is the statement made earlier – **"If I can only save one structure, or artifacts that will fit into one truck, which structure or artifacts would that be"?** If I can only save two structures, what would they be? While this approach seems simplistic, most disaster preparedness information addresses topics such as recovery planning and building awareness to engage stakeholders.These are excellent items to address but this approach is too broad for you to identify what you would not want to lose more than anything else if a wildfire were to impact your site.

It is important to view priorities from the perspective of the historic property steward and the responding fire personnel. Remember that decisions made during a wildfire are constrained by time and logistics. A structure that is the first priority can likely be protected by fire crews. Having a valuable painting in a building as your first priority is not something firefighters can easily remove and store during the chaotic events during a fire.In your inventory, the painting might be your first priority but what is conveyed to fire official through a Community Wildfire Protection Plan (CWPP) or transfer of information to local emergency personnel, fire officials or the State Historic Preservation Office must be realistic in terms of, to put it bluntly, what can be saved.

Documenting the Construction of Historic Structures as an Action Item
For purposes of these guidelines, **documentation is defined as providing a visual representation of structures or other resources of importance so that they might be reconstructed if lost during a fire.** Documentation in this context should not be confused with Section 106 documentation or the use of survey forms that may be submitted to the State Historic Preservation Office (SHPO).

Documentation of a structure is typically conducted through photography, sometimes using the camera on a mobile phone. Historic photographs can provide useful information, even if not particularly detailed, that can be used to guide reconstruction of a structure that has been lost in a fire. More advanced documentation of a resource can be accomplished from the production of as-built drawings, which can be supplemented by the use of digital photogrammetry and /or LiDAR (3D laser scanning); each of which can improve confidence in precision and accuracy, add substantially to the level of detail recorded, and, in many cases, provide measurement where physical access is not practical. These applications have become more affordable and efficient such that they are now standard tools for most professionals employed to record historic structures and sites. A local preservation office or the SHPO may already have some of this documentation.

For historic structures, as-built drawings are often produced by an architect or consultant long after original construction to show the current construction details and condition at a specific point in time (as opposed to a contractor or architect producing as-built drawings during new construction). As-built drawings were traditionally done by hand but now often use computer aided drafting (CAD). The measured architectural drawings show the original construction, current conditions, modifications, and additions at the time of the documentation. As such, as-built drawings tend to be more expensive and time-consuming than other methods. However, drawings excel for things that cannot be captured with LiDAR and photogrammetry such as closed cavities, hidden details and floor plans - things a camera or laser light cannot see.

As-built drawings will have some subjectivity and conjecture along with the empirical observation due to the human aspect of the documentation. A narrative accompanying the drawings can point out areas of speculation and leave room for interpretation of the drawings by the user. The nuances of vernacular architecture and regional variations in construction require the experienced eyes of someone with direct knowledge of the specific region. As-built drawings can be used, depending on the level of detail and quality of the drawings, as the basis to reconstruct the structure if necessary. A good resource for understanding level of detail specifications can be found on the BIM Forum website – bimforum.org/resource.

A specific type of as-built drawings, the Historic American Buildings Survey (HABS), Historic American Engineering Record (HAER), or the Historic American Landscape Survey (HALS) is coordinated through the U.S. National Park Service and stored in the Library of Congress for public access.

Documentation conducted under either HABS/HAER/HALS documentation guidelines provides not only detailed description of the resource and inventory through measured drawings and large-format photography, but also its history and operation. The detailed requirements offered by these programs is not arbitrary and should be considered or emulated when possible.

Other than simple photography, for documentation of structures, photogrammetry is often considered to be the path of least resistance. It can be aerial (from a drone) or terrestrial (tripod mounted) but is generally collected from close range in either case. Photogrammetry is not just the photographs but the methodology of recording, measuring, and interpreting the photographic data. It has the advantage that it need not be processed right away – the images can be easily saved for future processing if the structure or artifact is damaged or lost in a fire; i.e., the costly component of data processing can be delayed until actually needed.

Photogrammetry transforms the individual pixels of overlapping two-dimensional images into a database of three-dimensional data points that can be used to accurately depict and measure the geometric relationships between any parts of the photographed structures or landscape. This technically challenging process has become more accessible in recent years as hardware and software have evolved. Photogrammetry has advantages in instances where it is necessary to determine the extent of edges and corners. The data are simpler to archive than laser scanning data and can be used in most 2D CAD programs that accept scaled images.

Laser scanning, or LiDAR (Light Detection and Ranging), uses pulses of light emitted from a scanner and reflected off of objects to take 3D measurements. Scanners take hundreds of thousands to millions of measurements per second and scan 360 degrees around the machine to capture the geometry of the subject. Anything the scanner can "see" is measured. The measurements are combined into a 3D model known as a point cloud. Once a subject is scanned, all measurements are available for analysis or creating drawings. While not as visually rich as a photogrammetry model, point clouds are much better at capturing complex interior spaces.

LiDAR can be used on landscapes as well as structures and artifacts to produce 3D digital reconstructions of the subjects. LiDAR has advantages when the object is circular or bulbous in shape. Unlike the other documentation methods, the resultant data (point cloud) must be interpreted by someone equipped with a broad knowledge of the technology and its limitations, as well as the needs of the end user.

With LiDAR, there are many factors to consider, one of the most important being when the data will be used. If it is processed immediately, a service provider may work with proprietary software and file types to develop a deliverable such as drawings in .dwg or .pdf format. If the data are to be collected now, then archived for future processing (perhaps due to current budgetary constraints or project phasing), it will be important to "future proof" the data as much as possible and not be locked into a particular data format that may become obsolete.

Both photogrammetry and LiDAR are considered remote sensing technologies. They excel when the object is beyond safe reach and time is of the essence – they eliminate the need to physically touch the object and allow for millimetric data collection from a distance. LiDAR has the advantage that the scanning work can be conducted at night with no need for supplemental lighting. This is a plus for cultural heritage sites with heavy public visitation or when emergencies arise.

A key is that any form of documentation be submitted to a local repository. Having as-built drawings or photographs of a site or structures that is stored only on site is pointless.The easiest way to make sure that the documentation continues to exist is to talk to the local historical society, local preservation office, or State Historic Preservation Office. They can assist with their structure documentation standards and record the resource within their databases.

Mitigation and Defensible Space as Action Items

Fuels mitigation and defensible space provide a means (along with maintaining the mitigation work and defensible space over time) of achieving a level of protection for structures that significantly reduces the risk of damage or loss. Consultants and contractors can help with developing and executing plans for mitigation and defensible space but they should be knowledgeable about historic preservation to avoid making recommendations or taking action that negatively impacts the preservation status of the site.

If you cannot easily see between the trees and shrubs, there is too much fuel.

If you cannot easily see between the trees and shrubs, there is too much fuel. Fuel mitigation along roads provide the means for egress and ingress for the public and firefighters. Reducing the fuel load by thinning trees and pruning low branches decreases the horizontal and vertical continuity of the fuels, which can aid in slowing the spread of the fire while significantly reducing the fire intensity. These efforts not only protect sites and structures but allow for firefighters to safely conduct fire operations, such as burnout operations and structure protection (Figures 16 and 17).

Fuels mitigation along roads into historic properties allow for burnout operations by trained firefighters. Burnout operations are used when fuel can be safely ignited between the fire line and the burning edge of the fire.

The goal of the burnout operation is to reduce the fire intensity as the fire approaches the established fire line so that firefighters can attack the fire.

For historic properties, particularly structures, additional factors can affect how closely the mitigation and defensible space guidelines should, or can, be followed (Figures 18 and 19). Heritage trees and cultural landscapes that impact the historic designation are examples of such factors. Nonetheless, pruning lower branches of heritage trees that can act as ladder fuels can limit the opportunity for low-intensity fires to spread to the adjacent structure. Additionally, crown thinning (cutting a few branches from the upper part of the tree) can also reduce the fuel load.

Figure 16. Firefighters conducting a burnout operation where mitigation work was done. Although the fire intensity seems high due to visible torching of individual trees, the reduced fuel load resulting from the mitigation work (and favorable winds) allow for burnout operations from the road to prevent the fire from spreading across the road.

Figure 17. Firefighters doing structure protection while the fire is less than a quarter mile away. This can be done safely because previous mitigation work along the road and around the structure improved egress should fire crews need to quickly evacuate.

Figure 18. A heritage tree that is significant to the cultural landscape. While idealized mitigation and defensible space recommendations would lead to removal of trees immediately adjacent to the structure, cutting these trees may alter the historic designation , although pruning the lower branches may be a viable means of mitigation.

Figure 19. Horizontal and vertical continuity of vegetation in the immediate vicinity of a structure at an historic site. If the trees and shrubs contribute to its significance, mitigation and defensible space normally done in the WUI may not be appropriate.

Community Wildfire Protection Plan as a Participant as an Action Item

One document used across the interdisciplinary wildfire planning process that should contain your key site/resource information is a Community Wildfire Protection Plan (CWPP).[14] CWPPs were authorized by Congress in 2003 and can be developed for defined "community;" e.g., a homeowner's association, town, county or metropolitan city. Depending on the state, historic districts or park systems may be able to develop their own CWPP so long as they involve the local government, local fire authority and relevant Federal and State management agencies. CWPPs used to be somewhat uncoordinated non-standardized documents drafted by local agencies that wanted a plan for protecting their area. Now they are much more structured and provide key topics or templates. The "community"can be a neighborhood, an unincorporated area, a town, a county, a public space, or many areas. Regardless of the defined area, a typical CWPP often contains:

- Key Stakeholders – This includes residents, tribal members, individuals that work in the community, emergency managers, and entities that provide goods or services in the community. In Colorado, for example, the State Forest Service is a key stakeholder since they oversee the drafting of CWPPs. Your historic property is a key stakeholder in your community. You may need to be the spokesperson for your historic property.

- Identified Risk / Fire History Maps – This includes specific risks to the community and the stakeholders, use of hazard maps, prior fire history.

- Values at Risk and Assets at Risk – These terms are often used interchangeably but sometimes used for different scales.Values at Risk may be a watershed, reservoirs, landscapes, communication towers, or infrastructure while Assets at Risk may be a lesser scale and focus on individual buildings. Historic properties would be considered a value or asset in a CWPP.

- Forest Health / Fire Fuels Class – This includes information on the vegetation and whether it suffers from drought, insect attack, or decay mechanisms or is otherwise at increased risk. It also includes the type of vegetation fuel classified as various configurations of grasses, shrubs, and trees, or any combination thereof.

- Additional Information – This includes available resources that can be accessed during a wildfire. Firefighting resources – volunteer fire departments, career fire departments, seasonal fire personnel, water supplies, fire-fighting aircraft, etc. as well as cooperators that can provide assistance – neighboring fire departments, animal rescue, and emergency lodging are examples of additional information.

- Signature Page – To avoid assumptions, the key stakeholders should sign the CWPP so that everyone involved in the process understands the items described in the CWPP and how it affects them.

Communicating with Local Fire Officials as an Action Item

Up to this point in the process, the inventory, priorities, documentation, and mitigation are the responsibilities of the managers of the historic resource. The result of those recommendations may be a lengthy planning document that is best suited for internal purposes, much like a catalog of everything on your site. That is not necessarily what should be passed on to others that can/will use the information. The information produced now needs to be summarized to a concise level that others can quickly interpret.

Conduct your inventory, establish priorities, and convey them to others prior to an incident.

Except for small fires that may impact your site, it is rare that you as the steward would have an opportunity to talk to fire officials, particularly the IMT, about your priorities during an incident. That is why it is critical that you conduct your inventory, establish priorities, and convey them to others prior to an incident. These steps are mostly under your control but communicating your priorities has not been standardized.

In addition to ensuring that your resource is covered in a CWPP, communicating directly with local fire officials and responding fire departments is critical. This does not mean that communication with local historical societies, local regulatory bodies (e.g., Landmarks Preservation groups), and the SHPO are not important. They are and should be another line of communication to ensure that important information is adequately and properly recorded.

In the context of these guidelines, fire officials may not be limited to fire departments and agencies but also include emergency management departments located in cities, counties, or states. Initial response to a wildfire incident is usually a local fire department. The fire department might be a volunteer department, a career department, the county sheriff, state forestservice fire crews, or federal fire crews from the U.S. Forest Service, the Bureau of Land Management, the National Park Service, U.S. Fish and Wildlife Service, or others. All levels of initial responders are

professional in that the responders have received some level of training and have proper personal protective equipment and apparatus to safely engage the fire.

The delineation between the complexity of and response to wildland fires, particularly between Type 3 and Type 2/Type 1 incidents (now called Complex Incidents), coincides with the level of direct communication you may have with fire managers (the IMT) during an incident. With all Federal agencies there will likely be a cultural resource staff on an IMT (or CIMT). They are there to guide the IMT on avoidance of known cultural resources within a fire area. Typically, these agencies communicate with the SHPO regarding fires and potential impacts on cultural resources. If private landowners properly record their historic property with SHPOs they can increase the likelihood that the IMT is aware of them.

Coordinating with Cultural Resource and Preservation Organizations as an Action Item

The most viable hub for the historic property data is the State Historic Preservation Office. In each state, the SHPO maintains data on historic properties. They are the link between individual cultural resource sites and the listing on the National Register of Historic Places through the review process. They are generally the most complete repository of historic property information in each state.

Coordinating with local preservation organizations that will maintain your information is also recommended.Historical societies, landmarks commissions, and emergency managers may have the means to store your information and act as liaison with fire organizations during an incident. These groups will typically not have the staff or resources, and possibly the knowledge, of the SHPO but can serve as a backup for crucial information at the local level.

COORDINATING INFORMATION WITH FIRE OPERATIONS

On a local level, emergency managers typically interact initially with fire departments and then IMT personnel as a wildland fire escalates. If emergency managers or the local fire organization do not know that your property is at risk and your priorities for the property, they cannot convey the threat to the IMT. The historic property priorities can be implemented into operations plans to influence fire operations. For the IMT, life safety is a priority. Protecting values at risk – property, watersheds, recreation resources, communication towers, access roads – are also priorities for the IMT.

For larger fires, how the historic property priorities can be brought to the attention of the IMT so that they may be assigned firefighting resources is not a standardized process across Federal and State agencies but the SHPO can logically be the hub for information gathering and dissemination. It happens, but is often subject to the limitations of Federal or State laws regarding protection of information on cultural resource sites, the skill, personality, and knowledge of the individual emergency manager or SHPO staff member in combination with the receptiveness of their contact on the IMT.

Information on historic properties can be passed from the SHPO to the IMT using GIS, if available and not limited by federal or state laws. Whether a property's attributes have restricted access under Federal or State laws is a matter for discussion between the historic property steward and the SHPO.

An example of GIS data displayed on the sample topographic map is shown in Figure 20 on the following page (the same map shown in Figure 15). Through GIS, a layer showing the boundaries of historic sites could be displayed if they have been entered into the GIS database and subject to relevant Federal and State laws. A discussion with the SHPO should clarify what attributes should be recorded and can be shared during a wildland fire.

This information can be provided to the IMT for operations planning and assigning firefighting resources to a given area. For firefighters that prefer aerial views to topographic maps, the same layer can be overlaid on the aerial view (Figure 21 on the following page). What is missing are the layers that display the attributes and priorities of individual cultural sites. Additional attributes may exist but they may not be displayed on these maps due to Federal or State laws to protect sensitive sites.

Qualified agency staff would be able access to the attribute information when needed for a fire. This is a coordination issue between the SHPO and the IMT.

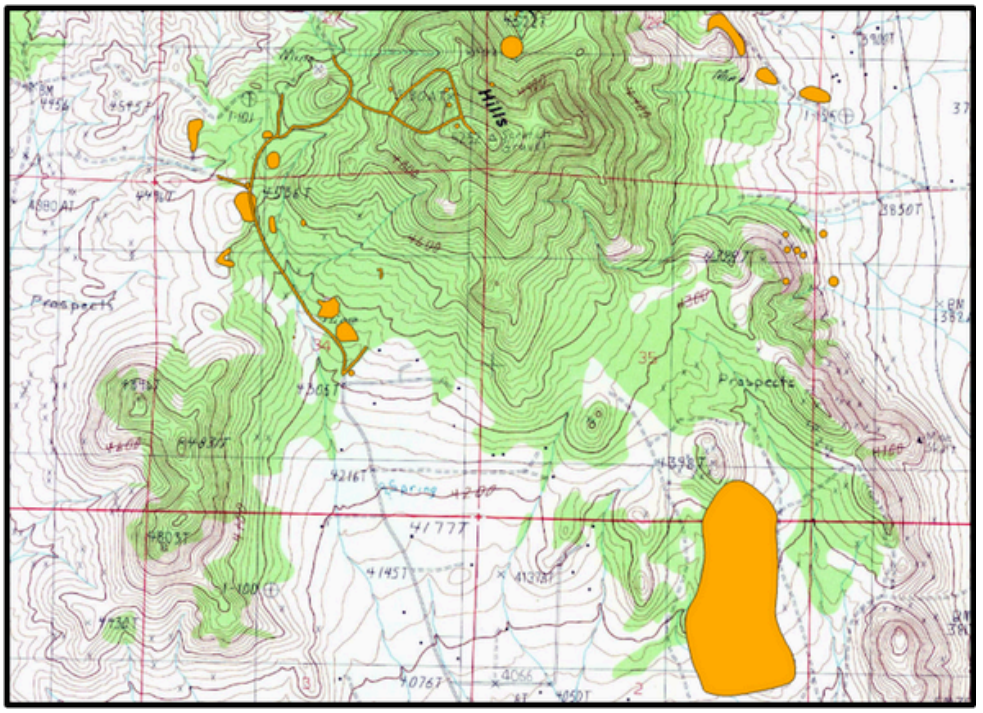

Figure 20. Sample area showing boundaries of historic mining sites illustrated on a USGS topographic map using a 7.5-minute quadrangle. Note that only the boundaries are shown in this layer; no structures or other historic features are indicated. Image courtesy of the Montana State Historic Preservation Office.

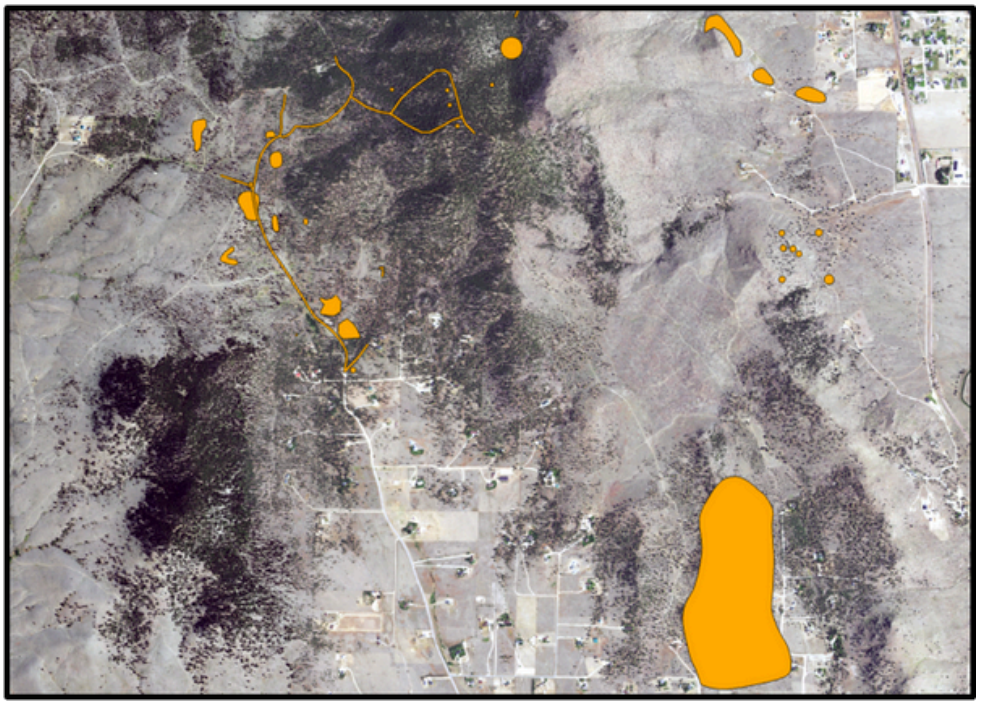

Figure 21. Aerial photograph of the same area shown in Figure 20 showing the boundaries of historic mining sites. Image courtesy of the Montana State Historic Preservation Office.

The means to get information from the historic property to the SHPO as the repository of information is feasible. Getting the information to the IMT for allocating firefighting resources during a wildland fire is, unfortunately, more challenging. Some SHPOs may have better GIS data than others due to backlogs, money, or time constraints. As such, SHPOs may not be in sync with GIS data (the attributes and layers) and, additionally, access to the GIS data may not be available to all levels of IMTs due to privacy laws regarding sensitive site data.[15]

Building on previous work by the National Park Service, the Bureau of Land Management, or the Federal Emergency Management Agency, coordinating and adopting standards that apply to all levels of jurisdiction from individual sites to Complex Incidents seems to be a logical step. See the Appendix for commentary on data collection and dissemination efforts by various Federal agencies. It is certainly beyond the scope of these guidelines to recommend a standardized approach based on existing standards. Developing a national standard that all agencies use has not worked out in the past. Each agency and each state have different priorities on what data should be collected. Some want hundreds of attributes collected for each cultural resource while some only want minimal attribute information collected. Additionally, Federal agencies have different priorities than state agencies when it comes to data collection and storage. Nonetheless, historic property stewards have several action items that can help to protect their property from the destructive forces of wildland fire.

SUMMARY

These guidelines are about saving historic resources from wildland fire. They are written for stewards of historic properties, wildland fire managers, and stakeholders who are invested in protecting historic resources from the threat of wildland fires. First, the guidelines describe the basics of wildland fire behavior, fuel mitigation, defensible space, and how firefighters respond to a wildland fire. Understanding the threat of wildfire is essential for stewards to better prepare for a fire. Second, the guidelines describe recommendations, i.e., action items, that stewards can take to better prepare their property or resource. Finally, the guidelines identify the role of collaboration between preservation and cultural resource organizations, both where resource information might reside and the challenges with getting that information to those in command of wildland fire operations.

What action items can the property steward take directly?

- Conduct an inventory – What is on your site? Coordinate the format of your inventory with the State Historic Preservation Office. Remember that immediately before a fire impacts the site, there is no time to conduct an inventory or remove items; people should no longer be at the site.
- Establish priorities for the site – Think in terms of "if I can only save one structure, which structure would that be?"
- Document the construction of structures - Provide a visual representation of structures or other resources of importance so that they might be reconstructed if lost during a fire. Even photographs that you take yourself can be helpful.
- Develop and implement a plan for fuels mitigation and defensible space – This is a collaborative effort that requires input from experts well versed in fire behavior, mitigation practices, the Secretery of the Interior's Standards for the Treatment of Historic Properties, and Federal and State regulations that may apply to your site.
- Participate in the development of a Community Wildfire Protection Plan – Work with other stakeholders to identify risks, fire history, forest health and fuels, and identify action items to reduce the threats to the community in which your site is located.
- Communicate with local fire officials – Get to know the first responders and talk with them about how they respond and what you want them to know about your priorities.Did you participate in a Community Wildfire Protection Plan with local fire officials?
- Coordinate with local preservation organizations and the State Historic Preservation Office - Local preservation organizations that may be able to retain the information you produced in the previous action items. Have discussions with the State Historical Preservation Office about means of generating data that conforms to their practices, particularly for recording information using Geographic Information Systems.

The following matrix in Table 1 identifies the tasks or steps that have been discussed in these guidelines. Some tasks are under the control of the property steward, some require collaborative and cooperative work with other stakeholders, and other tasks are

beyond the control of the property stewards. For those tasks that are under the control of the stewards, it is recommended that they actively pursue addressing those tasks in the near term, as is feasible. The other tasks may take time and funding beyond what you have available today but you can begin the process. Find out if there is work being done to update or draft a CWPP (local fire officials should know). In short, be involved.

Table 1. Role of Various Parties by Action Item in the Guidelines

Action item	**Historic property steward**	**Local fire organization/ Emergency manager**	**State Historic Preservation Office/Local preservation office**
Conduct property inventory	LEAD		ADVISER
Establish property priorities	LEAD		
Document construction of key structures	LEAD		ADVISER
Draft Community Wildfire Protection Plan	COLLABORATOR	LEAD	
Communicate inventory per SHPO procedures	LEAD		COLLABORATOR
Communicate property priorities to collaborators	LEAD	COLLABORATOR	COLLABORATOR
Organize work on mitigation	LEAD	ADVISER	ADVISER
Organize work on defensible space	LEAD	ADVISER	ADVISER
Organize work on structure hardening	LEAD	ADVISER	ADVISER
Record data in geographic information system	COLLABORATOR		LEAD
Convey property information to Incident Command Team during a wildland fire	COLLABORATOR	COLLABORATOR	LEAD

Lead = Initiates action item.
Collaborator = Provides key input into processes, procedures and limitations of action item.
Adviser = Provides technical assistance to action item.

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- Jenny Buddenborg, Executive Director, Preserve Montana
- Carl Davis - Regional Archaeologist, USFS (retired) and Chair, Preserve Montana Board of Directors
- Erin Bornemann - Archaeological Records and Data Specialist, History Colorado
- Shannon Dennison - Director, Denver Mountain Parks and formerly Cultural Resources Branch Chief, Grand Teton National Park
- Damon Murdo - Cultural Records/Data Manager, Montana Historical Society
- Anne McCleave - Historic Resource Manager & Specialist, Colorado State Historical Fund
- Brian Oliver - Wildland Fire Division Chief, Boulder Fire Department, Boulder, Colorado
- Geoff Butler - Battalion Chief, Poudre Fire Authority, Fort Collins, Colorado
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- Jason Hill, Colorado Chautauqua Association
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GLOSSARY

Terminology and acronyms used in these guidelines come from historic preservation, cultural resource management and wildland fire. The definitions below related to wildland fire are taken primarily from The Glossary of Wildland Fire Terminology PMS 205 published by the National Wildfire Coordinating Group in July 2012.

Assets at Risk – typically smaller scale tangible items considered in a community wildfire protection plan, such as individual structures or architectural features on a structure.

BLM -Bureau of Land Management

CAD - see Computer aided design and Computer aided dispatch

Community Wildfire Protection Plan – A document developed by a community in an area at-risk from wildfire that offer a positive, solution-oriented environment in which to address challenges such as local firefighting capability, the need for defensible space around structures, and where and how to prioritize land management on both federal and non-federal land.

CIMT see Complex Incident Management Team

Computer aided design – the use of computer software to aid in the creation, modification, analysis, or optimization of a design.

Computer aided dispatch – a computer system that automates the flow of information in emergency communications.

Complex Incident Management Team – a single configuration of Incident Management Team for all large, complex fires above the Type 3 complexity level. Formerly categorized Type I or Type II command configurations.

Crown thinning – reducing the fuel load in the crown (upper branches) of a tree as delimited by the vertical projection of its outermost perimeter.

CWPP – see Community Wildfire Protection Plan

Cultural resource – prehistoric or historic remains or indicators of past human activities, including artifacts, sites, structures, landscapes, and objects of importance to a culture or community for scientific, traditional, religious, or other reasons. A cultural resource may be a tangible entity or a cultural practice.

Cultural landscape - settings created by people in the natural world. They reveal fundamental ties between people and the land–ties based on the need to grow food, give form to settlements, meet requirements for recreation, and find suitable places to bury the dead.

Defensible space – the buffer between a structure or other asset and the surrounding vegetation that can fuel a fire.

Fire Adapted Community - A human community consisting of informed and prepared citizens collaboratively planning and taking action to safely co-exist with wildland fire.

Fire fuels class – the types of vegetative fuel that can sustain a wildland fire, such as grass, shrubs, timber-understory, timber litter and slash.

Forest health – the concept of the ability of a forest to sustain its species composition and processes.

Fire intensity - the rate of heat release per unit time per unit length of fire front.

Fuel load - The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.

Geographic Information System - a computer-based system for capturing, storing, checking, and displaying data related to positions on Earth's surface.

GIS – see geographic information system

Global Positioning Satellite - A system of navigational satellites operated by the U.S. Department of Defense and available for civilian use. The system can track objects anywhere in the world with an accuracy of approximately 40 feet.

GPS – see global positioning satellite

HABS – Historic American Building Survey

HAER – Historic American Engineering Record

HALS – Historic American Landscape Survey

Heat transfer - Process by which heat is imparted from one body to another, through conduction, convection, and radiation.

Heritage tree – a tree that has special value due to its historical significance, age, size, or rarity.

Historic resource – evidence that humans have left of their past activities.

Historical significance (specific to structures) - A property can be significant not only for the way it was originally constructed or crafted, but also for the way it was adapted at a later period or illustrates changing tastes, attitudes, and uses over a period of time.

ICS – see Incident Command System
Ignition source - A source of heat that is capable of kindling a wildfire.

IMT – see Incident Management Team
Incident Command System – a standardized management hierarchy and procedures for managing a temporary incident, such as a wildland fire.

Incident Management Team – a rostered group of incident command system-qualified personnel that oversees the operations of an incident, such as a wildland fire.

Ladder fuels - Fuels which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease.

Mitigation - Those activities implemented prior to, during, or after an incident which are designed to reduce or eliminate risks to persons or property that lessen the actual or potential effects or consequences of an incident.

NHL – National Historic Landmark

NPS – National Park Service

NRHP – National Register of Historic Places

Probability of ignition - the chance that a firebrand will cause an ignition when it lands on receptive fuels.

Rate of spread - the relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information.

Risk - A chance of suffering harm or loss.

Runbook – a series of maps produced by fire organizations to be used in emergency response apparatus within their response area.

Section 106 – Part of the National Historic Preservation Act of 1966 (NHPA) that requires federal agencies to consider the effects on historic properties of projects they carry out, assist, fund, permit, license, or approve throughout the country.

Secretery of the Interior's Standards for Treatment of Historic Properties – standards that govern the maintenance, replacement, and repairing of historic materials, as well as the design of new additions and alterations to a property.

SHPO – see State Historic Preservation Office

Stakeholders - individuals that work in the community, emergency managers, and entities that provide goods or services in the community. Stakeholders can also be individuals, organizations, or entities that have an interest in the operation or protection of that community.

Standards – documents that provide agreed-upon specifications, procedures, requirements and/or guidance.

Standardization – the process of implementing and developing technical standards based on consensus of different parties to ensure uniformity and consistency in the creation of products or services.

State Historic Preservation Office, also State Historic Preservation Officer - Appointed officials responsible for administering and managing federal funds to conduct historic preservation activities. Each state historic preservation office is headed by a state historic preservation officer. The abbreviation SHPO is used interchangeably to refer to both the office and the appointed officer.

Structure - A constructed object, usually a free-standing building above ground; material assemblies that extend the limits of human capability.

Structure Response Plan – a document by a local fire organization where their response area is segmented into logical geographic boundaries based on placement of apparatus and crews (i.e., fire stations), values and assets at risk, and other factors.

USFS – United States Forest Service

USGS – United States Geological Survey

Values at Risk - typically larger scale tangible items considered in a community wildfire protection plan, such as watersheds, landscapes, reservoir, communication towers or infrastructure.

Wildland urban interface - The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

WUI – see Wildland urban interface

ENDNOTES

[1] According to the National Aeronautics and Space Administration, global warming refers to the long-term warming of the planet and is encompassed in the concept of climate change, which refers to the broader range of changes that are occurring, including rising sea levels, melting ice masses, shifts in growing seasons, and plant migration.

[2] National Park Service, undated publication. Wildland Fire Behavior. Wildland Fire Behavior (U.S. National Park Service) (nps.gov).

[3] Cohen, Jack D. 1995.Structure Ignition Assessment Model (SIAM) I The Biswell Symposium: Fire Issues and Solutions in the Urban Interface and Wildland Ecosystems, U.S. Department of Agriculture Forest Service Gen. Tech. Rep. PSW-GTR-158.

[4] Lord, Natalie and Ron Anthony. 2023. Wildfire Mitigation Plan Final Report, SHF Grant #2022-M2-001.

[5] National Park Service.April 2018. The Fire at Sperry Chalet Fire Investigation Report, Jimmy G. Stewart, Fire Investigator.

[6] Federal Emergency Management Agency. Undated publication. Protecting your Properties from Wildfires. fema_protect-your-property_wildfire.pdf.

[7] Colorado State Forest Service. 2021.The Home Ignition Zone: A guide for preparing your home for wildfire and creating defensible space.

[8] National Wildfire Coordinating Group. May 2023. NWCG Standards for Mitigation in the Wildland Urban Interface, PMS 052. NWCG Standards for Mitigation in the Wildland Urban Interface, PMS 052.

[9] Values at risk is a phrase commonly used by responding firefighting units to a wildland fire to identify the threat of damage or loss, not an indication of monetary value.

[10] Incident Workforce Development Group. 10 January 2023. Complex Incident Management Team (CIMT): Action Plan for Implementation. eb-iwdg-cimt-action-plan-3.0.pdf (nwcg.gov).

[11] Morales, Tim.Undated publication. Emergency Response Runbook: The Importance of Consistent Street Addressing Methods. pap1599.doc (esri.com).

[12] National Geographic. Undated. GIS (Geographic Information System). (GIS (nationalgeographic.org).

[13] Personal communication (2024), Damon Murdo, Montana Historical Society.

[14] U.S. Fire Administration. May 2020.Creating a Wildfire Protection Plan. Federal Emergency Management Agency. Creating a Community Wildfire Protection Plan (fema.gov).

[15] Personal communication (2024), Damon Murdo, Montana Historical Society.

APPENDIX

COMMENTARY ON DATA COLLECTION AND DISSEMINATION

The problem of data collection and coordination is massive, going well beyond the capability of any SHPO.Geographic information systems (GIS) is a significant subject by its own merit. It has been referenced several times in the sections above. Widely used in numerous applications, its use in historic preservation and cultural resources management is not new. Some Federal land-managing agencies have wildfire-cultural resource protocols (sometimes referred to as standards) in place. Many of those protocols are intended for post-disaster use, not for disaster preparedness. These guidelines will hopefully be used to augment and enhance protocols by the National Park Service, U.S. Forest Service, Bureau of Land Management, the Federal Emergency Management Agency and other agencies to better prepare historic property stewards with pre-disaster and post-disaster planning. As an example, after Hurricane Katrina, the NPS and the Federal Emergency Management Authority (FEMA) stated the following.

Today there are over 5 million cultural resources listed on state inventories of historic structures, archaeological sites, landscapes and objects. Many SHPOs/THPOs manage their resources through GIS, and some now require locational information collected via GPS. At the National level, each Federal land holding agency keeps its own inventory of historic resources, similar to the states or tribes, and most utilize GPS to help locate those sites.

Additionally, each Federal agency, similar to FEMA, that undertakes a project must track resources affected or evaluated during Section 106 compliance.

Taken by themselves each of these efforts to manage cultural resources through the use of GIS functions successfully within the separate states and Federal agencies. However, data produced at the state or local level should be shared with Federal agencies and vice versa for truly productive cultural resource management, particularly in the face of a disaster [this author's emphasis].To better understand the context of each of the resources described in these databases they should share locational information as well. However, most of these databases have no way to relate to each other, and many do not require the collection of spatial data for use in a GIS [this author's emphasis].

If cultural resource specialists can agree that locational information remains a key factor in understanding resources, and their management, GIS then becomes the ultimate tool to bring all of the data from various sources together at local, state and National levels. This integration of data allows cultural resource specialists to immediately visualize the full context of the resources and the damage incurred related to a disaster.

OMB [Office of Management and Budget] Circular A-16 defines the set of requirements that Federal agencies must follow when they create, manage or distribute spatial data. In 2002, OMB identified the National Park Service (NPS) as the lead agency for developing the cultural resource spatial dataset. Developing this dataset includes a variety of tasks, such as setting data content and metadata standards, monitoring progress toward

converting paper inventories into digital data, coordinating cultural resource databases with spatial data, eliminating duplication of spatial data and disseminating best practices information.

As the cultural resource spatial dataset steward under Circular A-16, the NPS must assess the existing standards, identify where needs exist, as well as develop and implement standards compliant with the Federal Geographic Data Committee (FGDC). These standards would then guide all Federal agencies in the collection and management of their cultural resource spatial data as they create inventories, perform Section 106 activities or nominate resources to the National Register of Historic Places. The standards open the door to share cultural resource data across Federal agencies, as well as with state and local entities through GIS. (from McCarthy, Diedre. Undated publication. National Park Service Cultural Resource GIS Facility, Heritage Documentation Programs – http://www.nps.gov/history/hdp/crgis/)

The NPS Cultural Resource Geographic Information System (CRGIS) was designated in 2002 as the lead agency for developing standards for using GIS with cultural resources.

The Cultural Resources Geographic Information Systems facility (CRGIS) is the only program within the National Park Service (NPS) dedicated to developing and fostering the use of geographic information systems (GIS) and global positioning systems (GPS) technologies in documenting, analyzing and managing cultural resources. For 20 years the mission of CRGIS has been to institutionalize GIS and GPS into the daily practice of cultural resource management by adapting these technologies to field surveys and inventory maintenance, as well as addressing links between cultural resource databases using locational information, all with the aim of increasing the effectiveness of cultural resource planning. Functioning inside and outside the NPS, CRGIS partners include other NPS programs and units, State/Tribal Historic Preservation Offices, local agencies, preservation organizations, universities and other Federal agencies. CRGIS provides a wide array of technical services and training as well in applying these technologies to specific cultural resource management projects (Originally located at the website National Park Service: Cultural Resources Geographical Information System Facility (CRGIS) (nps.gov).

While NPS has developed standards through CRGIS, the Bureau of Land Management (BLM) has also been working with SHPOs to develop a different set of standards for collecting data.The BLM Guidance for Implementation of National Cultural Resource Management Data Standard states:

The CRM data standard provides a set of rules the Bureau of Land Management (BLM) will follow to track and store GIS boundaries for cultural resource management and investigations. The BLM Cultural Heritage program investigates, records, evaluates, and manages cultural heritage resources on BLM-administered public lands and in areas of BLM responsibility. The BLM management of cultural heritage resources (archaeological, historic and socio-cultural properties) is conducted in accordance with the provisions of the National Historic Preservation Act (NHPA) of 1966, as amended and other authorities.

and

The CRM data standard applies most directly to historic and prehistoric resources. The standard provides a common data format for compiling spatial and non-spatial data about cultural resources and the investigations associated with those resources. Data collected in accordance with a standardized data format are more useful and effective for cultural analysis and land management by a wide variety of programs and individuals. The CRM data standard provides the ability to determine where investigations have occurred, when they occurred, and what area was covered. The standard provides the ability to determine where resources have been identified in

an area, what type of resources were found, and the regulatory status of each resource.

Two decades after publishing the NPS CRGIS standards, standards exist but there is no standardization across jurisdictions that would allow for recording data on GIS layers (spatial data) that could be communicated to an Incident Management Team during a wildland incident with consistency. There is no consensus. It is a monumental task with constantly changing technology and capabilities with insufficient funds at the Federal, State, and local level to properly establish and implement a standardized system. Think back 20 years ago and we were still using floppy disks, a now antiquated means of storing and transferring data. What are the technological challenges we face today that will make any standardized data collection and an archival system obsolete 20 years from now? A valid question but that does not mean that we cease to search for a better way of strengthening the bridge between historic property stewards and those that must respond to incidents that can impact those historic properties.