# Preventing Wildfire Disasters: An Analysis of Structural Triage and Preplanning in the Wildland Urban Interface for Tualatin Valley Fire & Rescue

Robert Petracca

Tualatin Valley Fire & Rescue, Tigard, Oregon

**Certification Statement**

I hereby certify that this paper constitutes my product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: 

Robert Petracca

Date: March 3, 2022

**Abstract**

On September 8th, 2020, Tualatin Valley Fire & Rescue (TVF&R) experienced the most extensive Wildland Urban Interface (WUI) fire in its 50-year history. The Chehalem Mountain Fire burned 924 acres and threatened 150 residents over seven days (Tualatin Valley Fire & Rescue, 2021). Fortunately, no structures or lives were lost, but what did occur was a recognition by TVF&R of a gap in preparation and mitigation of WUI fires. TVF&R is experiencing the problem of not having a program for structural triage and preplanning residences within the WUI. The purpose of this applied research project is to identify a process in which TVF&R can capture and maintain preplanned data of residences within the WUI environment. The descriptive research method was used to answer the research questions:

1. What components of a structural triage and preplanning program currently exist within TVF&R?
2. What structural triage and preplanning initiatives are used by similar agencies with a WUI?
3. What are the barriers to implementing a structural triage and preplanning program at TVF&R?
4. What strategy would TVF&R employ in developing, implementing, and maintaining a structural triage and preplanning program?

Interviews conducted with two TVF&R Wildland Team members and the District Chief of Telluride Fire Protection District resulted in a focused internal questionnaire. Results show pre-incident structural triage would not only provide significant value but increase accessible data for strategic decision making. Based on the research, it is recommended that TVF&R (a) utilize global information system data to identify wildland urban interface risk areas, (b) support

wildland urban interface training and certification processes, and (c) explore wildfire prevention programs and initiatives.

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## Introduction

On September 8th, 2020, Tualatin Valley Fire & Rescue (TVF&R) experienced the most extensive Wildland Urban Interface (WUI) fire in its 50-year history. The Chehalem Mountain fire burned 924 acres and threatened 150 residents over seven days (Tualatin Valley Fire & Rescue, 2021). Fortunately, no structures or lives were lost, but what did occur was a recognition by TVF&R of a gap in preparation and mitigation of WUI fires. However, the problem is that TVF&R does not have a program for structural triage and preplanning of residences within the WUI.

The purpose of this applied research project is to identify a process in which TVF&R can capture and maintain preplanned data of residences within the WUI environment. The descriptive research method was used to answer the research questions:

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## Background of Significance

TVF&R is Oregon's largest fire district as it serves and protects 535,723 people within its 390-square-mile service area. The fire district's strategically placed fire stations are located in 11 cities and four counties to provide fast and effective emergency response to any situation (TVF&R, 2020a). TVF&R is relatively young for a fire district as its foundation began during discussions in 1986 when the first two fire districts and then an additional fire department considered consolidation (Pitz, 2012).

Eliminating service duplications and reducing overall operating costs drove the conversations between Washington County Fire District No. 1 Chief Jack Snook, Tualatin Rural Fire Protection District Chief Floyd Pittard, and Beaverton Fire Department Chief Oscar Lee. Washington County Fire District 1 and Tualatin Rural Fire Protection District merged to form TVF&R in 1989 (Pitz, 2012). The culmination of the three chiefs' vision was realized in 1996 when the Beaverton Fire Department annexed into TVF&R. The fire district has continued to take shape over the past three decades as several additional small departments annexed and merged into what is a full-service fire district that includes technical rescue, water rescue, and hazardous materials response teams as well as a 911 transport division and a self-supporting health and wellness clinic (Pitz, 2012). With dedication and perseverance, TVF&R has become a respected and sought-after department leader in customer service, professionalism, safety, and performance. The fire district now focuses on targeting efforts to understand and mitigate common hazards.

Between 2016 and 2020, TVF&R responded to an average of 48,665 calls for service per year, utilizing 27 career stations to deploy 120 apparatus (TVF&R, 2020a). TVF&R is staffed with 447 professional firefighters and certified paramedics and 119 administrative staff,

including support services, fleet services, supply services, and executive staff. TVF&R provides services for fire suppression, technical rescue, hazardous material, water rescue, incident management team, medical emergency, and medical transport needs within its service area while operating on a $147,417,096 budget (TVF&R, 2020a).

TVF&R identified a need to advance a high-performing organization and workforce, focusing on the core functions that improve fast and effective emergency response, as noted in the 2022-23 TVF&R Strategic Plan (TVF&R, 2020b). Within Strategic Goal II, entitled Performance, the expectation is that: (a) organizational performance improves as a result of an exemplary individual and team performance; (b) sustained, targeted efforts aim to understand and mitigate common hazards; (c) business tools and technology inform performance targets and strategic decision-making; and (d) ongoing, data-informed deployment modeling identifies optimal system and infrastructure modification (TVF&R, 2020b). The noted strategy to accomplish this is Strategy 2b stated, “Develop or refine tools and processes to monitor and evaluate performance to ensure data-informed resource management and service delivery,” and captured in Strategy 2c as, “Advance performance with an emphasis on consistency, predictability, and accountability to achieve and deliver effective services” (TVF&R, 2020b).

With the TVF&R’s Strategic Plan, Section 3, titled “Opportunities,” defines its goal as “carefully evaluate and then execute, or dismiss, emerging opportunities.” The expectation in Strategy 3a is TVF&R will “advocate for system improvements in cooperation with partner agencies” and in Strategy 3d, “apply lessons learned from past events and engage in planning initiatives to maximize organizational resiliency and continuity during crises and emergencies” (TVF&R, 2020b). The problem remains that TVF&R is experiencing the issue of not having a program for structural triage and preplanning of residents within the WUI.

Since January 2017, TVF&R has responded to 2,808 fires coded (a) 140 – Natural vegetation fire, (b) 141 - Forest woods or a wildland fire, (c) 142 - Brush or brush-and-grass mixture fire, or (d) 143 - Grassfire. Of the 2,808 fires, 13 directly impacted structures, resulting in a total loss of $314,220 to content and property (see Appendix A). The largest of these incidents, the Chehalem Mountain Fire, occurred during the 2020 Oregon wildfire season, one of the most devastating fire seasons in Oregon State history.

The "2020 Oregon Wildfire Spotlight, Documenting impacts and support provided for the 2020 Oregon wildfire event," created by the Oregon Office of Emergency Management (OOEM) to provide context for the disaster occurring in Oregon stated, "beginning September 7th, multiple fires ignited under critically hot and dry conditions and spread dramatically during multiple days of high winds (average sustained winds of 20-30 mph with 50-60 mph gusts). The result was multiple large fires burning across the state, and over one million acres burned twice the 10-year average. Over 500,000 Oregonians were under an evacuation notice (Level 1, 2, or 3) and 40,000 had to evacuate their homes" (Oregon Office of Emergency Management, 2020).

The OOEM report continues, "Two pre-existing fires in Oregon were exponentially aggravated by the high-wind event: Lionshead, which the wind pushed over the crest of the cascades from Warm Springs, and Beachie Creek. Of the dozen fires that started throughout the wind event, three grew into megafires (+100,000 acres), pushed by tropical-storm-force winds" (Oregon Office of Emergency Management, 2020). Additionally, the OOEM report declares that 21 fires burned 1,004,562 acres during the historic 2020 Oregon wildfire season.

On the week of September 28th, 2020, the Joint Preliminary Damage Assessment (PDA) was conducted and validated significant damage to nine of Oregon's 36 counties. From the

individual assistance PDA assessments, it is estimated that over 4,000 homes were destroyed, and the estimated costs for this disaster were categorized as follows:

- Category A (Debris Removal): $310,878,021
- Category B (Emergency Protective Measures): $16,453,378
- Category C (Roads and Bridges): $12,365,999
- Category D (Water Control Facilities): $1,398,564
- Category E (Public buildings): $4,845,916
- Category F (Utilities): $24,724,250
- Category G (Parks/Other): $9,562,820

For a total estimated cost of roughly $380,228,948 (Oregon Office of Emergency Management, 2020). Although the Chehalem Mountain Fire did not equate to one of the megafires in Oregon, it did have a significant impact on TVF&R and surrounding agencies.

This research is directly relative to unit four of the Executive Analysis of Fire Service Operations in Emergency Management Student Manual, "Community Hazards Emergency Response-Capability Assurance Process." Specifically, in identifying three areas of focus:

1. Conducting a community Critical Infrastructure and Key Resource (CIKR) vulnerability assessment.
2. Determine the public and private key resources in a community available to provide specific infrastructure protection both internally and externally.
3. Perform CIKR mapping in a particular community as part of a Community Hazards Emergency Response -Capability Assurance Process (CHER-CAP) (Federal Emergency Management Agency, 2016).

Unit four explains the concepts of CHER-CAP and the comprehensive efforts in addressing community all-hazard planning by (a) assessing community hazards, (b) improving emergency plans, (c) assessing response capabilities, and (d) continuing to improve preparedness (Federal Emergency Management Agency, 2016). Additionally, unit four of the Executive Analysis of Fire Service Operations in Emergency Management Student Manual establishes the method of applying the CHER-CAP to critical infrastructure by (a) assisting local communities, (b) identifying planning deficiencies, (c) updating plans, (d) training first responders, and (e) simulating and testing the system for strengths and needed improvements (Federal Emergency Management Agency, 2016). Implementing the CHEP-CAP aligns itself with the United States Fire Administration's (USFA) goals one and two.

This research supports the USFA's first and second strategic goals of the 2019-2023 Strategic Plan. Goal one is to "build a culture of preparedness in fire and emergency medical services" and illustrates critical initiatives to enhance fire and EMS's ability to identify, prevent, prepare for, and mitigate community risk (U.S. Fire Administration, 2019). Goal two is to "ready the nation's fire and emergency medical service for all hazards" and is further outlined by the USFA, stating that its goal is to "encourage data-driven decision making and information sharing" (U.S. Fire Administration, 2019). By enhancing the ability to identify, prevent, and prepare for WUI events by utilizing data-driven decisions making, TVF&R will be able to reduce the risk of significant WUI events and better protect the communities we serve.

## Literature Review

Literature related to emergency preparedness in the WUI was assessed to understand the analysis of others logically, recognize opportunities in existing research, and provide a summation of this knowledge. Academic articles and peer-reviewed material were utilized, and literature was limited to fire service and governmental pamphlets. Relevancy was maintained in defining the recency of publications due to the quickly changing nature of the WUI. A majority of the literature reviewed was submitted within the last ten years.

The literature review conducted by the researcher focused on (a) defining the risks in the WUI, (b) WUI risk reduction strategies, and (c) structural triage initiatives in the WUI environment. To accomplish this, the researcher began gathering information at the National Fire Academy's (NFA) Learning Resource Center in November 2021. NFA staff aided the researcher in gathering material for the identified focus areas. Although subject matter material was ample, limited time on campus led to additional library resources at Washington State University's Vancouver Campus and George Fox University utilizing Google Scholar. Keywords and phrases used in the research included: climate change in Oregon, emergency management, internships in government, pre-incident, preplanning, risk analysis, structural triage, wildfire, wildland, wildland urban interface, and urban interface. Selected literature was summarized to advance related research efforts as the WUI continues to be explored and evaluated.

The devastating September firestorms of 2020, the worst fire season, affected Oregon, Washington, and California. California wildfires burned 4,257,863 acres in 2020, damaged or destroyed more than 10,000 structures, and killed more than 30 people. Five of California's six most extensive fires since 1932 occurred in 2020 (Robbins, 2021). Oregon's catastrophic 2020 fire season killed 11 people and burned over 1,000,000 acres across the state, twice the 10-year

average. Costs estimates were over $380,228,948 in public damages and destroyed 4070 homes (Covey, 2021). Like California and Oregon, Colorado experienced an extraordinary fire season, 700,000 acres burned before the end of October, including the largest fire in state history, the 208,000 acre Cameron Peak blaze. In 2020, California, Colorado, and Oregon, experienced their highest and most devastating wildfire seasons on record (Robbins, 2021).

The WUI is where houses meet or intermingle with undeveloped wildland vegetation. The WUI is thus a focal area for human–environment conflicts, such as the destruction of homes by wildfires, habitat fragmentation, the introduction of exotic species, and biodiversity decline (Radeloff, et al., 2005). The WUI is generally defined as where the forest meets the community. Different WUI conditions vary based on 'perimeter interface' and 'intermix.' A perimeter interface condition is generally a clean transition from urban development to forestlands. Smaller, more isolated developments embedded within the forest are called intermixed areas (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

In the article titled "Rapid Growth of the US Wildland-Urban Interface Raises Wildfire Risk," Radeloff, et al. (2018) concur in stating, "there are two main types of wildland fires, wildland urban intermix, and wildland urban interface. The area where houses and wildland vegetation directly intermingle in the intermix while the areas that abut wildland vegetation is the wildland interface."

In interface and intermixed communities, fire can spread from the forest into the community or from the community out into the forest. Although these two scenarios are quite different, they are equally important when considering interface by risks. Regardless of which scenario occurs, there will be consequences for the community, which will impact how the

community plans and prepares for interface fires (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

It has been shown that aggressive fire suppression has changed vegetation fuel structures over many years producing fuel accumulations and arrangements that have enhanced the potential for the extensive areas of high-intensity wildland fires experienced in recent years (Cohen J. , 2008). Across the conterminous United States, the WUI covers 9.4% of the land area and contains 44,348,628 housing units, equating to 38.5% of all housing units. All 48 states contain WUI areas, but the eastern United States has the greatest extent, especially in northern Florida, the southern Appalachians, and the coastal regions of the Northeast. Major WUI areas are also located along the West Coast, the Colorado Front Range, southeast Texas, and the northern Great Lakes States. WUI is common at the fringe of major metropolitan centers such as Los Angeles, San Francisco, Seattle, Denver, Dallas, Atlanta, Washington DC, New York, and Boston (Radeloff, et al., 2005).

Increases in houses and people were also substantial, with 12.7 million more homes and 25 million more people in the WUI in 2010 compared with 1990. The overall combination of more WUI area, 7.2% of the conterminous United States in 1990 versus 9.5% in 2010 (Radeloff, et al., 2018). High growth rates for both houses and people increased the percentage of dwellings from 30.3% to 33.2% and people from 29.4% to 31.9% in the WUI from 1990 to 2010. Even though the WUI occupies less than one-tenth of the land area of the conterminous United States, 43% of all new houses were built there, and 61% of all new WUI homes were made in the areas that were already in the WUI in 1990 (Radeloff, et al., 2018). Radeloff, et al., (2018) conclude that the new WUI areas totaled 189,000 square kilometers, larger than the state of Washington.

When houses are built close to forests or other types of natural vegetation, they pose the following problems related to wildfires (a) there will be more wildfires due to human ignitions, (b) wildfires that do occur will pose a greater risk to lives and homes, (c) they will be hard to fight, (d) and letting natural fires burn becomes impossible (Radeloff, et al., 2005). This statement is later quantified by Radeloff, et al. (2018). The area burned annually nearly doubled from 18,000 square kilometers in 1985 through 1994 to over 33,000 square kilometers in 2005 through 2014. These increases meant federal wildfire suppression expenditures would triple from $0.4 billion per year to $1.4 billion yearly and exceeded $2 billion in 2017 (Radeloff, et al., 2018).

With the federal wildfire suppression expenditures nearly tripling and the recent increase in the number of structures destroyed and the area burned annually, the WUI has received considerable attention (National Interagency Fire Center, 2004). Urban and suburban development in or near wildland vegetation poses a significant threat to the environment and the residences within them (Johnson, 2001). WUI residential fire losses differ from typical residential fire losses. Whereas residential fires usually involve one structure with a partial loss, WUI fires can result in hundreds of destroyed homes. In the WUI, protecting structures from wildland fires is most challenging, and human-caused fire ignitions are the most common (Cohen J. D., 2000).

Fire spreading into the WUI from the forest can impact homes differently. First, sparks or burning embers carried by the wind or convection can start new fires beyond the zone of direct ignition and alight on vulnerable construction materials or adjacent flammable landscapes. Second, fire can spread through direct flame contact, convective heating, conductive heating, radiant heating along the edge of the burning fire front, or simply through structure-to-structure

contact. Fire can ignite a vulnerable structure when the structure is nearby (within 10 meters of the flame) either the forest edge or burning house (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

Research by Cohen (2008) shows a home's ignition potential during extreme wildfires is determined by the characteristics of its exterior materials and design and their response to burning objects within 100 feet, as well as their susceptibility to firebrands. This area, a home, and its immediate surroundings is called a home ignition zone. Reducing WUI fire losses in the context of home ignitability involves mitigating the fuel and heat components sufficiently to prevent ignitions (Cohen J. D., 2000).

By definition, WUI fire disasters depend on homes igniting during wildfires. If homes do not ignite and burn during wildfires, the WUI fire problem essentially does not exist. We would then have extreme wildfires without WUI fire disasters. Disasters do not occur during most conditions when standard fire protection capabilities can limit the residential fire spread. Wildland fire suppression operations successfully control 97% to 99% of all wildfires at the initial attack. Structural firefighters typically limit a fire within a single structure or prevent the fire from spreading beyond that structure (Cohen J. , 2008).

Preventing WUI fire disasters requires that the problem be framed regarding home ignition potential. Because this principally involves the home ignition zone, and the home ignition zone primarily falls within private ownership, the responsibility for preventing home ignitions largely falls within the authority of the property owner. Preventing wildfire disasters thus means fire agencies helping property owners mitigate the vulnerability of their structures (Cohen J. , 2008). Cohen (2008) states that if homes are sufficiently resistant to ignition and do not ignite during the extreme wildfire exposure, then the houses survive without firefighter

protection. We have an intense wildfire but not a WUI fire disaster. The key to reducing WUI home fire loss is to reduce home ignitability.

Homeowners who live in fire-prone locations can minimize the risk their house will burn by altering building characteristics and the vegetation around their homes (Kramer, Mockrin, Alexandre, Stewart, & Radeloff, 2018). Fuel management, also called vegetation management or fuel treatment, is a critical element of a FireSmart approach. The objectives for fuel management are to (a) to reduce wildfire threats on private and public lands through shovel-ready fuel management projects, (b) establish landscape-level fuel breaks, (c) enhance community protection, (d) establish a long-term monitoring program, and (e) to develop and maintain a schedule for those areas that have been treated. Fuel treatments are designed to reduce the possibility of uncontrollable fire by reducing surface fuels and ladder fuels and creating a crown and fire separation (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

Without fuel management, piloted ignition may occur. Piloted ignition is when the wood is sufficiently heated; it decomposes to release combustible volatiles. A small flame or hot spark can ignite a sufficient volatile air mixture to produce flaming, thus, a piloted ignition. Additionally, firebrands are a significant ignition source during WUI fires, particularly when flammable roofs are involved. Fire cannot spread to homes unless the homes and their adjacent surroundings meet the basic requirements for combustion. The fire triangle represents these requirements: fuel, heat, and oxygen (Cohen J. D., 2000).

The focus for fuel modification and the interface is not to stop the fire but to ensure the fire intensity is low enough to fight a wildfire on the ground. For example, FireSmart activities around a home may prevent structure ignition due to direct flame contact. The ability of a home

to survive the fire would come down to whether construction materials can withstand an ember shower (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

WUI home losses can be reduced by focusing on homes and their immediate surroundings. Loss reduction may necessarily involve a community at higher densities where neighboring houses may occupy the immediate surroundings. If homes have sufficiently low home ignitability, a community exposed to a severe wildfire can survive without significant fire destruction (Cohen J. D., 2000). While it is intuitive that homeowners want to reduce the risk of wildfire damage to their property, it is crucial to estimate how they value this reduction considering increases in future projected wildfire frequency and severity and continuous fuel accumulation (Molina, Little, Drury, & Jandt, 2021).

One of the constraints with fuel management is a lack of funding. The best approach to mitigate fuels on private lands is to promote FireSmart. A FireSmart approach to fuel management improves defensible space around structures and reduces the likelihood of a house fire spreading to adjacent forests (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018). Another way to encourage change is through education and increased awareness of fire hazards on private property using tools such as the Home Partners Program or the FireSmart Home Assessment. The reduction of wildfire hazards on private lands generally depends on the homeowner. This includes (a) choices in exterior building materials, (b) setbacks from forest edges, and (c) landscaping (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

There is increased support and interest in reducing fire risk in communities where the danger of wildfire is understood. Establishing tools to reduce fire risk is one of the keystones to building a FireSmart community. Without the community's support, the efforts of public officials, fire departments, and others to reduce wildfire will be hindered. In many communities,

there is generally a lack of understanding about WUI fire and the simple steps that can be taken to minimize risk. Additionally, public perception of fire is often underdeveloped due to public confidence and reliance on local and provincial fire rescue services (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

Homeowners who live in and adjacent to the wildland fire environment must take primary responsibility for ensuring their homes have sufficiently low home ignitability. Homes should not be considered simply as potential victims of wildland fire but as possible participants in continuing the fire within their community (Cohen J. D., 2000). Spending on private risk mitigation is tied to amenity values like (a) privacy, (b) shade, (c) visual appeal, (d) wind abatement, and (e) the social norms of contribution. While homeowners saw neighboring mitigation as beneficial, excessive amounts of this activity were less preferred. This level of neighbor involvement may have been seen as removing too much vegetation in the neighborhood (Molina, Little, Drury, & Jandt, 2021).

To reduce wildfire impacts, communities can (a) coordinate fuel reduction efforts, (b) educate homeowners, (c) train firefighters, and (d) establish wildfire management plans. Insurance companies can offer reduced premiums for communities taking mitigation action to incentivize community-level efforts to reduce wildfire losses. Communities and local jurisdictions could anticipate wildfires and environmental impacts more explicitly when planning future land use to avoid housing expansion in high-risk wildfire areas (Radeloff, et al., 2018). In the article titled “Influences on the Adoption and Implementation of a Wildfire Mitigation Program in an Idaho City,” Paveglio and Kelly (2017) state their study supports existing research stressing the importance of early public involvement and consideration in the adoption or adaptation of formal hazard mitigation programs.

Land Management professionals and academics have long recognized that the risk to private property or other human values contributes significantly to the complexity of wildfire management, including fire suppression. For those reasons, a significant focus of wildfire science and management centers around fostering private citizens' responsibility for mitigations, planning efforts, or collective actions that help reduce the risk that wildfire can pose to private property (McCaffery, 2015).

With the devastation of the 2020 wildfires still in the public memory urging development of solutions in the aftermath of the problems that occurred, several new emergency management tools and services have been rolled out to the public in Oregon for the 2021 summer wildfire season, including (a) the new statewide Oregon Alert (OR-Alert) program and notification system, (b) the regional USGS ShakeAlert system on the Cascadia fault line, and (c) interactive maps at the city and county level (Covey, 2021). These projects take advantage of ESRI's arc GIS online (AGOL), as well as its Hub platform to provide a "one-stop-shop" for damage assessments, including shareable Survey123 templates using standard FEMA schema that can be customized (Covey, 2021).

The primary tool for addressing wildfire risk nationally remains fire outreach programs. Kramer et al. (2018) found that these programs were typically near recent fire perimeters, especially for fires that threatened many buildings. Fires threatening 1000 or more buildings almost always had a nearby national fire outreach program. Notably, in Colorado Springs, Colorado, programs to increase awareness of fire hazards and spur homeowner action have been implemented successfully. In this jurisdiction, fire hazard assessments were completed for homes in the WUI. The result of the evaluations was shared with the homeowner/property owner at the time of the assessment. The development of the hazard assessments was compiled into a geo-

spatial database and made available to the public. Each home and property owner could look to see the hazard of their property, as well as their neighbors. The database provided helpful to the Fire Department in targeting educational efforts, suppression planning, and triage assessments (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018). Triage assessments are dependent on five main factors that include:

1. Firefighter safety
2. Structural design and material
3. Fuels around the structure
4. Fire behavior
5. Available resources

Conducting housing assessments in the WUI before a fire can assist in suppression efforts. The reviews can also be used to educate homeowners on what protection they might receive during a fire event and what changes they can make to improve the probability of their home surviving a fire event (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

In the article titled “Living with Wildfire in Archuleta County, Colorado: 2015 Data Report,” Meldrum et al. (2019) highlight how a wildfire specialist assessed parcels for 11 characteristics that affected wildfire risk. These characteristics relate to the structure’s wildfire-survivability and response considerations, such as firefighter access and evacuation potential. Each parcel was assigned an overall wildfire risk rating based on these 11 characteristics. This rating reflects a property’s risk relative to its community’s general level of risk rather than an absolute risk rating. The wildfire specialists assessed properties primarily from public roadways and onsite when permission was offered. When permission to enter was not granted, the roadside

assessment was supplemented with information from the county's website and publicly accessible aerial and satellite imagery (Meldrum, et al., 2019).

The 11 characteristics as detailed by Meldrum et. al. (2019) are:

1. Structure address posted at the driveway
2. Ingress and egress
3. Width of the driveway
4. Roofing material
5. Building exterior
6. Location of woodpiles and combustibles
7. Balcony deck or porch
8. Slope
9. Distance to dangerous topography
10. Predominant background fuel type in the neighborhood
11. Defensible space

Again, though, as Molina et al. (2021) stated, we consider that residents are not willing to pay for wildfire risk reduction when at least a few neighbors aren't pursuing the same activity. Results suggest that surveyed homeowners wanted community-level participation in fuel reduction but did not want to change vegetation within the landscape to the point of diminishing the aesthetic value of the neighborhood (Molina, Little, Drury, & Jandt, 2021).

One enduring effort to foster personal responsibility for wildfires is the FireWise Communities Program, which advocates voluntary action residents can take around their homes or property to reduce potential damage from wildfires and lessen the need for active fire suppression. FireWise measures include building with fire-resistant materials, reducing or

replacing wildland vegetation in the home ignition zone that significantly influences structure flammability (100-200 feet around structures), regularly clearing needles or leaves from gutters, and keeping firewood away from structures (National Fire Protection Association, 2017).

Voluntary efforts are promoted through fire outreach programs, including FireWise, Fire Adapted Communities, and the Fire Learning Network. The Firewise program was established by the National Fire Protection Association (NFPA) in 1986. FireWise partnered with United States Forest Service and State Forestry Departments, and FireWise communities were officially recognized in the United States in 2002. The Firewise program informs residents about the danger of living in fire-prone areas and detail steps individuals, and neighbors can take to reduce the likelihood of wildland fire damaging or destroying homes. The Fire Adapted Communities program, launched in 2012 through a partnership between the NFPA and the United States Forest Service, encourages individuals, neighborhoods, and communities to create and maintain FireWise principles (Kramer, Mockrin, Alexandre, Stewart, & Radeloff, 2018).

The FireWise program can help establish common norms, standards, or practices that reinforce the importance of private mitigation, build collective commitment to wildfire planning, and enable opportunities for grant funding or other mitigation assistance from state or federal agencies (Paveglio & Kelly, 2017). In many cases, the FireWise community's establishment occurred after a fire had burned buildings, not before, with a higher rate of destruction near these reactive communities. The majority, 76%, of destroyed buildings were located closest to a FireWise community centroid established after that building was destroyed (Paveglio & Kelly, 2017).

Among buildings nearest to these FireWise communities that were later exposed to wildfire, there was an average destruction rate of 7.3%, with the lowest destruction near

FireWise communities centroids at 1.2% (Kramer, Mockrin, Alexandre, Stewart, & Radeloff, 2018). FireWise should reflect the scale of potential collective actions and may be more appropriate initially amongst smaller populations or communities that share common values, relationships, and commitment to place (Jakes, Kruger, Monroe, Nelson, & Sturtevant, 2007).

In his article "FireWise forever? Voluntary community participation and retention in FireWise programs," Steinberg (2011) list that the FireWise program advocates formal recognition of communities as FireWise if they complete the following:

1. Obtain or conduct a wildfire risk assessment
2. Form a FireWise board or committee
3. Create a Community Action plan that addresses findings of the risk assessment
4. Conduct a FireWise day event
5. Invest a minimum of $2 per capita on FireWise actions each year
6. Apply to the state FireWise liaison

In their article titled "Adapting western North American forests to climate change and wildfires: 10 common questions," Prichard et. al ask, "Is the scale of the problem too great? Can we ever catch up?" They found that the current pace and scale of treatments is decidedly inadequate to restore fire resilient and adaptive climate landscapes (Prichard, et al., 2021).

Approximately 95% of western states face drought and dry conditions. According to the National Oceanic and Atmospheric Administration, June 2021 was the hottest month recorded in the United States since record-keeping began. The year to date was among the planet's top-ten warmest, with arctic sea ice coverage the sixth smallest on record (Covey, 2021). The abatement of extreme climate events seems unlikely. Research has shown that the warming climate is

making heat waves, droughts, floods, and tornadoes more frequent and intense leaving a broader trail of damage to assess (Covey, 2021).

The extremes have been alarming even for scientists who study climate phenomena. In addition to one of the earliest wildfire seasons in 2021, the Pacific Northwest spent several days of high summer under an oppressive heat dome that reached 116 degrees in Portland and killed hundreds of people in the area (Covey, 2021). WUI fire commonly originates in wildland fuels. During dry, windy conditions in areas with continuously fine fuels, wildland fires can spread rapidly, outpacing the initial attack of firefighters (Cohen J. D., 2000).

In the summer of 2020, Oregon's persistent drought and high temperatures led to epic wildfires driven by coastal straight-line winds that ravaged multiple counties. On the heels of the devastation, the wildfire is still fresh in Oregonians' minds, with officials anticipating more summers of the same to come, the Oregon Damage Assessment Project Emerged (Covey, 2021). Covey goes on to declare, "standardization of damage assessment data is crucial during a compilation process. Consistency in what data sets are drawn upon during an event ensures that all partners utilize the same data sets for visualization and analysis purposes. When collecting damage assessment data, there should be consistency in the templating and how the data are created, reviewed, and approved for use by the response in recovering partners" (Covey, 2021).

A development permit should be established to address the risk of WUI fires. Using the threat mapping from a Community Wildfire Protection Plan, a Wildfire Hazard Development Permit area could be defined. Within this area, guidelines could be developed for building materials. The scope of the guidelines could be expanded to include landscaping and building siting to strengthen this permit process (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018). Additionally, the Wildfire Hazard Development Permit process can effectively

advance the objective of developing Fire Smart Communities through the following strategies (a) increase the number of homes and properties in the interface that are FireSmart compliant and are thus less vulnerable to ignition through radiant heat or ember spotting, (b) ensure that future development is completed with public safety and property protection in mind, (c) ensure that natural lands turned over and adjacent to new development are a moderate threat rating or lower, and (d) ensure that the natural lands turned over are accessible to fire crews as well as for future maintenance activities to keep the areas at a moderate or low threat rating (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

## Procedures

The descriptive research method was used to answer the following questions:

1. What components of a structural triage and preplanning program currently exist within TVF&R?
2. What structural triage and preplanning initiatives are used by similar agencies with a WUI?
3. What are the barriers to implementing a structural triage and preplanning program at TVF&R?
4. What strategy would TVF&R employ in developing, implementing, and maintaining a structural triage and preplanning program?

The purpose of this applied research project is to identify a process in which TVF&R can capture and maintain preplanned data of residences within the WUI environment. Procedures utilized for this research included: (a) a literature review; (b) personal interviews with TVF&R Lieutenant Travis Kanoff (see Appendix C), TVF&R Apparatus Operator Carl Horning (see

Appendix D), and Telluride Fire Protection District's (TFPD) District Chief John Bennett (see Appendix E); and (c) a departmentwide internal questionnaire (see Appendix B).

The literature review was conducted utilizing online sources of relevant materials acquired at (a) the National Fire Academy's (NFA) Learning Resource Center, (b) Washington State University's Vancouver Campus Library, and (c) the George Fox University Library. Utilizing Google Scholar, keywords and phrases used in the research included: climate change in Oregon, emergency management, internships in government, pre-incident, preplanning, risk analysis, structural triage, wildfire, wildland, wildland urban interface, and urban interface. In addition to literature reviews, historical and demographic information was acquired regarding Beaverton Fire Department, Tualatin Rural Fire Protection District, Washington County Fire District No. 1, West Linn Fire Department, and TVF&R.

Upon completion of the literature review, personal interviews with Lieutenant Travis Kanoff (see Appendix C), TVF&R Apparatus Operator Carl Horning (see Appendix D), and TFPD's District Chief John Bennett (see Appendix E), were scheduled. Lieutenant Kanoff and Apparatus Operator Horning serve as tenured members of TVF&R's Wildland Team and are responsible for training on TVF&R's Wildland Team members as well as department-wide wildland training. They recently delivered a wildland refresher course covering the topic of structural triage in the WUI environment and were chosen for this interview because of their knowledge of fire district-recognized processes related to the WUI and current structural triage trends.

These interviews were designed to gain insight into current TVF&R structural triage methodology and practices. Additionally, the interviews addressed potential areas for improvement within a preplan type system of structural triage and how this system could be

implemented and maintained. An in-person format was used to conduct an eight-question interview during the month of December 2021.

Question one asked each person to identify their name and position within the department. Question two asked what they feel is the WUI risk at TVF&R. Question three asked what areas do they see need improvement. Question four asked them to identify the components of TVF&R's structural triage program. Question five asked if TVF&R uses preplans for the WUI. Question six was a multipart question that asked them if they know of any agencies using a structural triage preplanning system in the WUI, who is the agency, and what is the system. Question seven was another multipart question asking the interviewee if they have had an opportunity to use a structural triage preplanning system in the WUI, what were their thoughts, and would it benefit TVF&R. Lastly, question eight asked what they felt are the barriers TVF&R would face in implementing a structural triage preplanning system.

Information from the literature review identified TFPD's District Chief John Bennett as a person of interest for the researcher. A phone interview was scheduled with District Chief Bennett to discuss TFPD's use of a structural triage preplanning system. The interview was designed to determine how Chief Bennett utilizes a structural triage preplanning program and implementation steps. Additionally, the interview addressed potential areas for improvement, unforeseen challenges, and unexpected successes. A phone consultation was used to conduct a five-question interview during the month of December 2021.

Question one asked Chief Bennett to give a brief summary of the "My Wildfire Risk" program. Question two asked if Chief Bennett knew of any other agencies using a similar program and if so, what are they. Question three asked what the strategy for implementing and maintaining the relevancy and accuracy of the "My Wildfire Risk" program was and was

followed with question four asking Chief Bennett what he felt were some of the barriers to implementing and maintaining the program. Lastly, question five asked Chief Bennett to look back and describe what pearls he would offer to other agencies looking to implement a similar system or program.

Upon completion of the researcher's interviews with Lieutenant Kanoff TVF&R Apparatus Operator Carl Horning, and TFPD's District Chief John Bennett, steps were taken to identify the content of an internal questionnaire to be delivered to all TVF&R line employees. An online questionnaire (see Appendix B) was developed using SurveyMonkey due to the format it offers to collect and analyze data (Survey Monkey, 2022). The questionnaire, distributed through interdepartmental email, was intended to reach all line employees as data points for analysis.

The IQ (see Appendix B) consisted of nine questions covering four areas of interest (a) the use and confidence in TVF&R's current pre-plan program and software, (b) the individual's comfortability and confidence in basic wildland interface skills and responsibilities in assignments, (c) the crew's availability for additional pre-plan work and assignments, and (d) the individual's perception of the value of preplanning the WUI environment. Each of these nine questions was designed to analyze a specific focus and data set valuable to the researcher's purpose.

Question one asked respondents if they regularly utilize TVF&R's current pre-plan system, EGIS/Intterra. Question two and three were intended to gauge respondents' availability and capacity to verify current preplans while developing and maintaining additional preplans for structures not represented in TVF&R's current systems. Question four and five were aimed to measure the respondent's confidence in their wildland firefighting skill set and assigned

responsibilities. Question six and seven were intended to assess the respondent's view on the importance of preplanned structural triage in the WUI environment while question eight asks the respondent if they feel confident in the accuracy and accessibility of current preplans within the EGIS/Intterra. Lastly, question nine asks the respondent their rank with the intent of being able to sort data amongst TVF&R's rank structure.

The questionnaire was administered for 14 days, ending February 21, 2022. The process for selecting the sample was to determine the total amount of line personnel responsible for WUI firefighting along with the total amount of line personnel who would be involved in the management of a WUI incident. The population size determined for the questionnaire was 440, the amount of line staff fitting the sample criteria. The final number of questionnaires returned was 128 (the sample size). A 7% margin of error was achieved when calculating the internal questionnaire results at a 95% confidence level. The 7% margin of error was a less than ideal result using a web-based survey instrument that was distributed to 440 personnel and was well short of the 220 responses required to achieve a 5% margin of error.

The limitations of the research were numerous. First, the literature review was restricted within the realm of the fire service, "WUI" is a specific term used within the fire service, and although "WUI" as a term was widely available to search in scholarly literature when combined with "preplanned structural triage" it revealed modest results. Second, the questionnaire has its disadvantages. The questionnaire assumed the respondents had a basic understanding of TVF&R's preplan system and were trained in wildland firefighting. Respondents, if unsure of an answer, could not skip a question, therefore resulting in a "best guess" while submitting responses. A third limitation of the research was the low number of questionnaires returned. A higher number of responses would have validated at a higher confidence level the data provided.

Lastly, time was a significant limiting factor to the research. The compressed allotted time to complete this applied research project due to the early scheduling of the Executive Fire Officer year four-course limited the amount of research and analysis completed by the researcher.

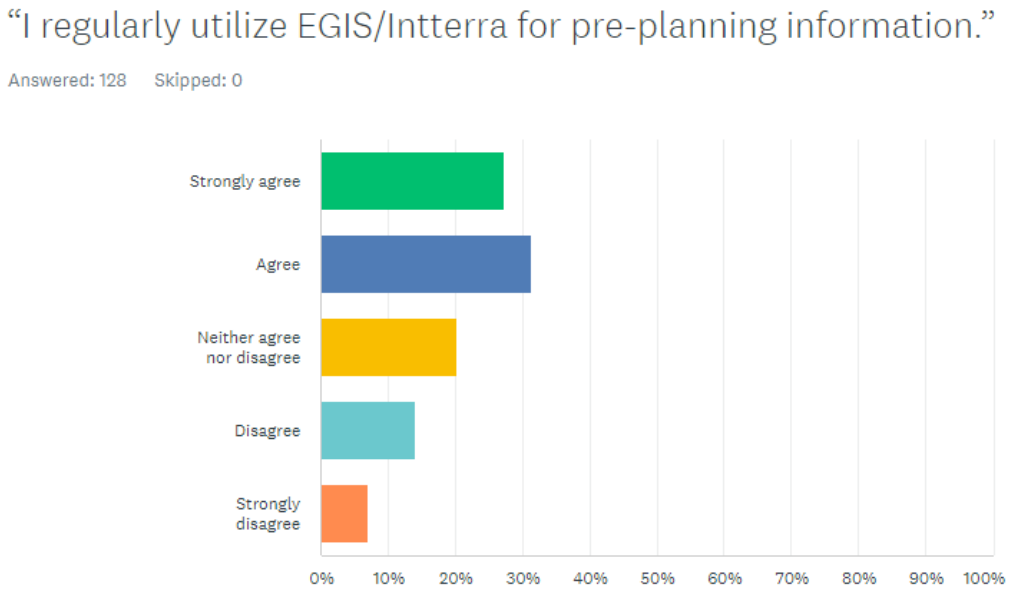
## Results

The results of this applied research project are a product of: (a) an internal questionnaire titled "Preplanning Structured in the Wildland Urban Interface" (see Appendix B); (b) interviews with TVF&R Lieutenant Travis Kanoff (see Appendix C), TVF&R Apparatus Operator Carl Horning (see Appendix D), and Telluride Fire Protection District's (TFPD) District Chief John Bennett (see Appendix E). These interviews were completed in an attempt to develop a means of providing a system for preplanned, structural triage, within TVF&R's WUI environment. Industry experts' thoughts, theories, and concepts are captured and guide each research question to its conclusion.

The first research question asks, "What components of a structural triage program currently exist within TVF&R?" Regarding this research question, TVF&R Lieutenant Kanoff and TVF&R Apparatus Operator Horning concluded (see Appendices C and D) that (a) TVF&R utilizes an Oregon State Fire Marshall (OSFM) Structural triage form, (b) the OSFM form is used across the state of Oregon and used by the Oregon Department of Forestry, and (c) the form utilizes the "triage, prep, and defend" verbiage.

Material obtained from the IQ (see Appendices B and F) returned two measurables. First, ask the respondent if they regularly utilize EGIS/Intterra for preplanning information within question one. Respondent choices were (a) Strongly agree, (b) Agree, (c) Neither agree nor disagree, (d) Disagree, or (e) Strongly Disagree. Slightly more than 31% of respondents agreed

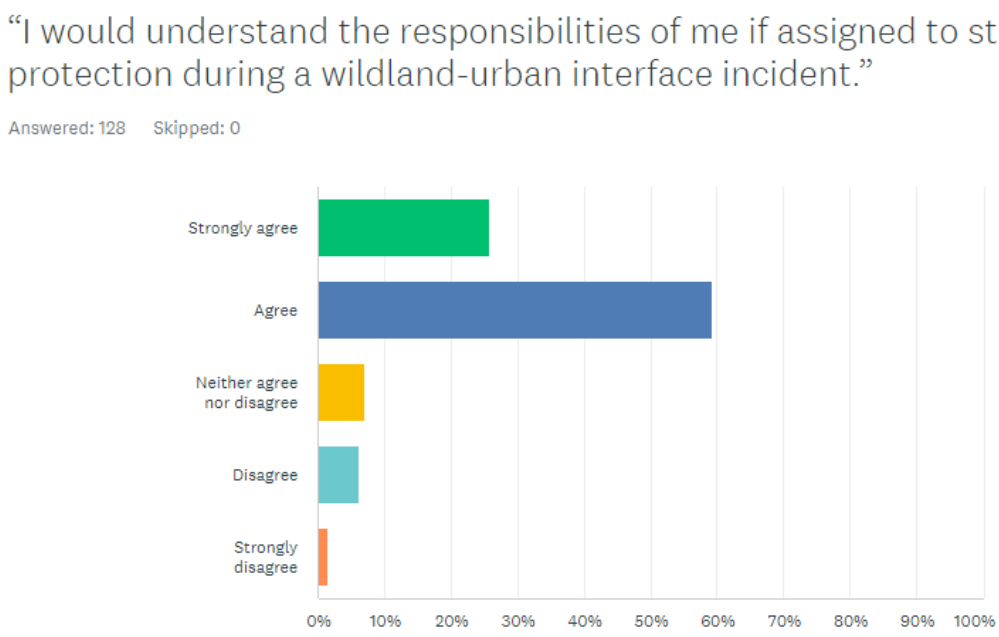
with this statement, while 27.34% strongly agreed and only 21.09% either disagreed or strongly disagreed. Figure 1 shows additional results and ranks by respondents.




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 27.34% | 35 |
| Agree | 31.25% | 40 |
| Neither agree nor disagree | 20.31% | 26 |
| Disagree | 14.06% | 18 |
| Strongly disagree | 7.03% | 9 |
| TOTAL | | 128 |

Figure 1. IQ Question 1

Second, as outlined by question five, "I would understand the responsibilities of me if assigned to structural protection during a WUI incident" respondents again chose between (a) Strongly agree, (b) Agree, (c) Neither agree nor disagree, (d) Disagree, or (e) Strongly Disagree. More decisively than the results of question one, 85.16% of respondents either strongly agreed or agreed with this statement, while only 7.81% were in the form of disagreement. Figure 2 shows additional results and ranks by respondents.



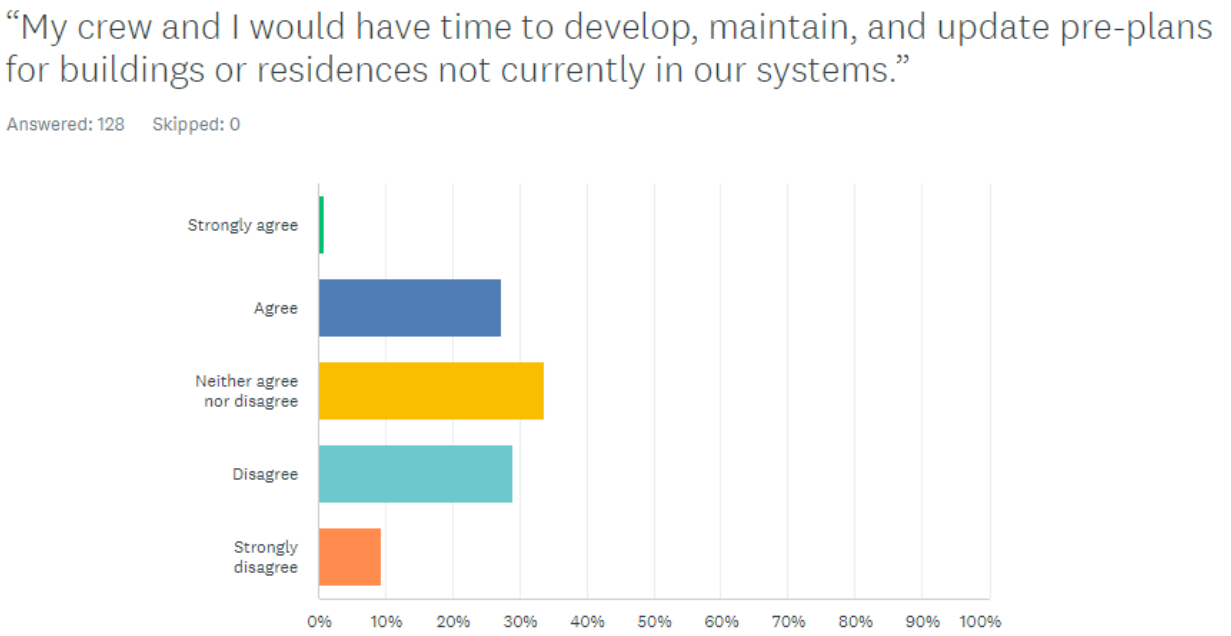

| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 25.78% | 33 |
| Agree | 59.38% | 76 |
| Neither agree nor disagree | 7.03% | 9 |
| Disagree | 6.25% | 8 |
| Strongly disagree | 1.56% | 2 |
| TOTAL | | 128 |

Figure 2. IQ Question 5

The second research question asked, "What structural triage and preplanning initiatives are used by similar agencies with a WUI?" Personal communications with Telluride Fire Protection District's District Chief Bennet (see Appendix E) along with information from Lieutenant Kanoff and Apparatus Operator Horning revealed that the Oregon Department of Forestry and CalFire utilize structural triage programs. Within the fire service Survey123, My Wildfire Risk, and a placard system are currently used. Apparatus Operator Horning stated, "I have used Survey123; it works well and does not need much training to use. You can give descriptions and pictures" (see Appendix D).

The third research question asks, “What are the barriers to implementing a structural triage and preplanning program at TVF&R?” Again, Telluride Fire Protection District’s District Chief Bennet (see Appendix E) along with Lieutenant Kanoff and Apparatus Operator Horning provide their thoughts on three barriers of implementing a structural triage preplanning program (a) the yearly changing of the WUI environment, (b) the system would have to be easily updated, and (c) time allotted for the triage of structures.

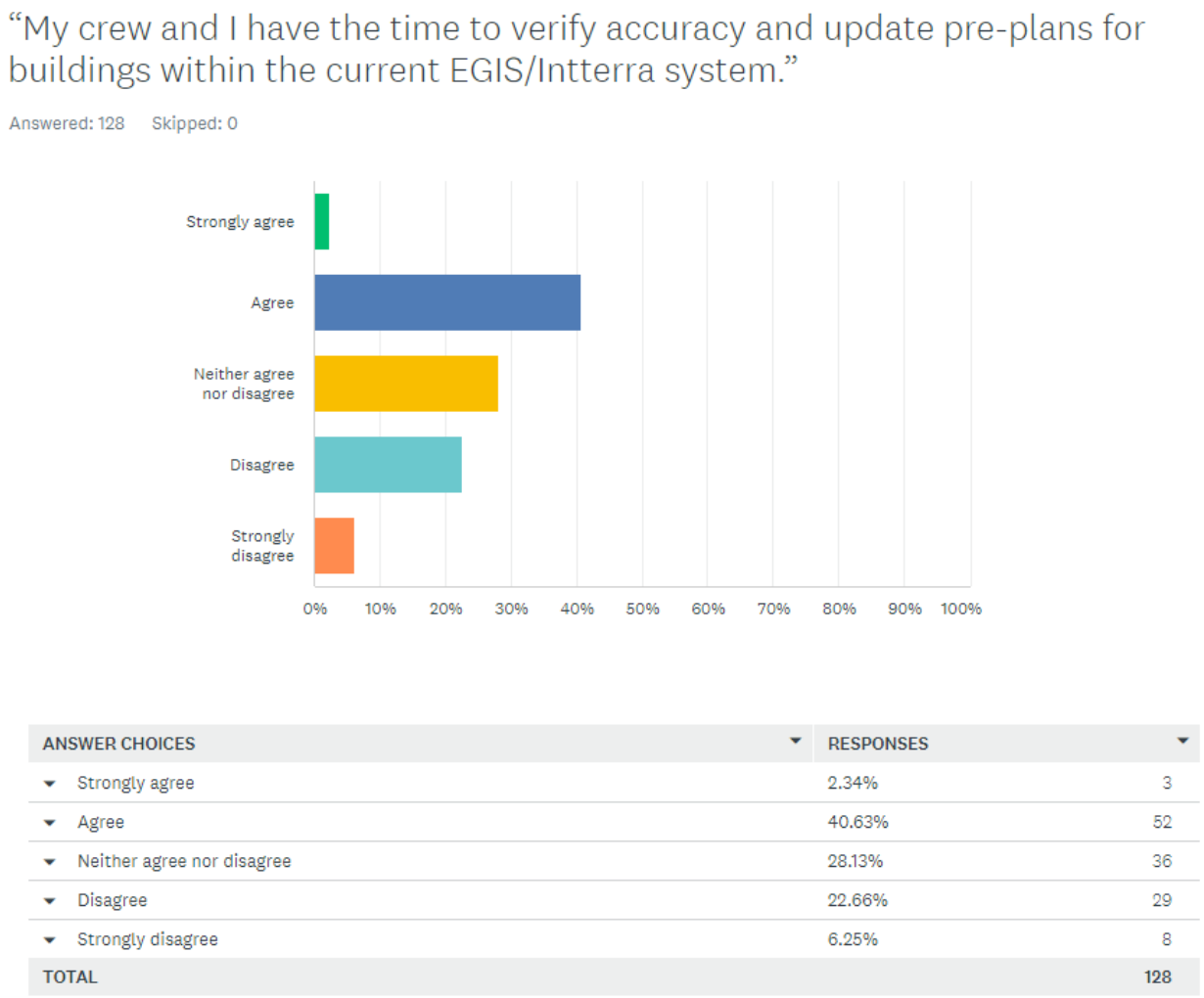
Coincidently, question three of the IQ (see Appendix B) addresses the barrier of time by asking, “My crew and I would have to develop, maintain, and update preplans for buildings or residences not currently in our system.” Only 36 of the 128 respondents agreed with this statement, while 43 respondents neither agreed nor disagreed, and the remaining 49 respondents disagreed with the idea. Figure 3 shows additional results and ranks provided by respondents.




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 0.78% | 1 |
| Agree | 27.34% | 35 |
| Neither agree nor disagree | 33.59% | 43 |
| Disagree | 28.91% | 37 |
| Strongly disagree | 9.38% | 12 |
| TOTAL | | 128 |

Figure 3. IQ Question 2

Continuing to address the barrier of time, question two of the IQ asked respondents, "My crew and I have the time to verify accuracy and update preplans for buildings within the current EGIS/Intterra system." Of the 128 respondents, 55 agreed with this statement, while 36 respondents neither agreed nor disagreed, and the remaining 37 respondents disagreed with the idea. Figure 4 shows additional results and ranks provided by respondents.



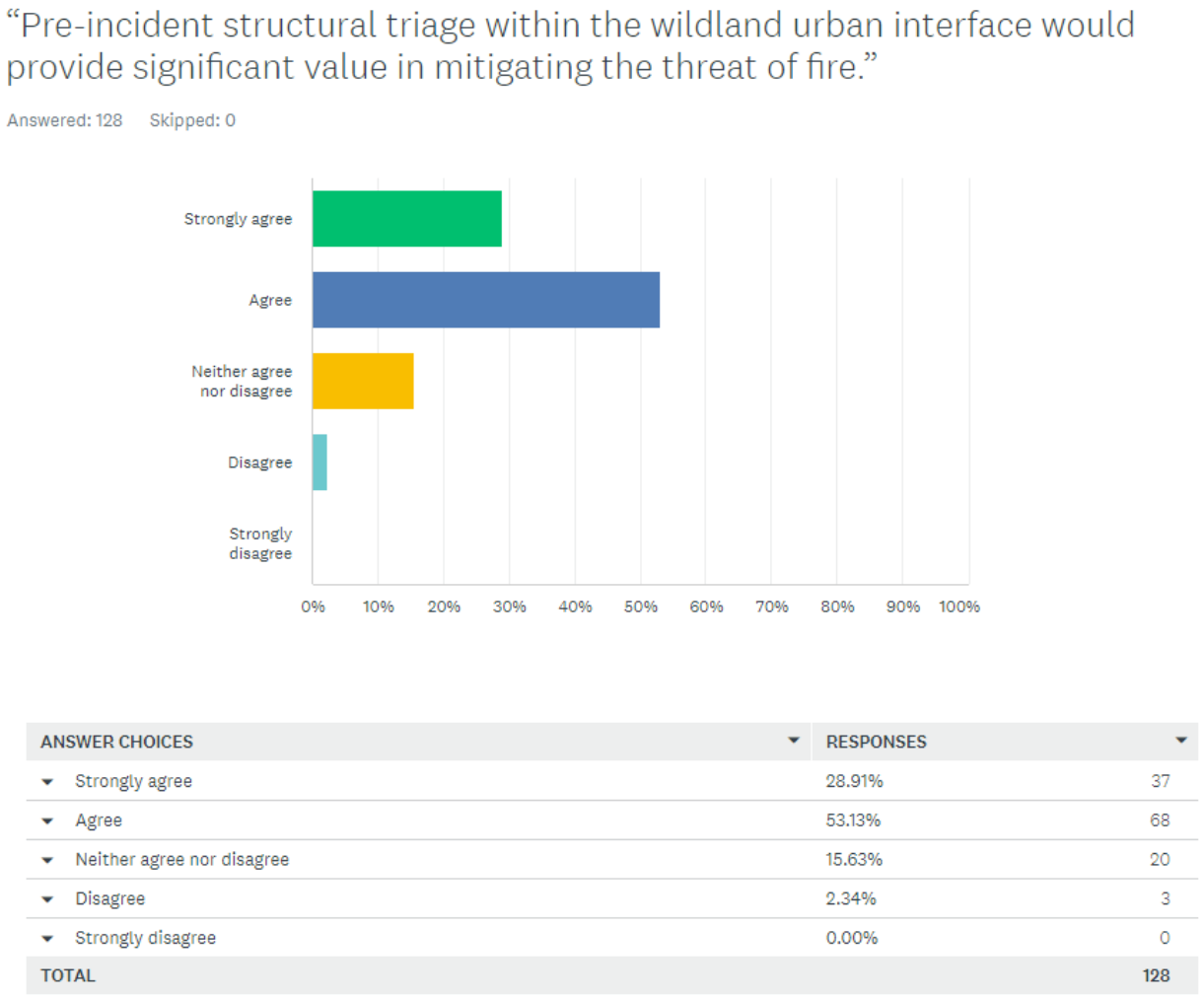

| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 2.34% | 3 |
| Agree | 40.63% | 52 |
| Neither agree nor disagree | 28.13% | 36 |
| Disagree | 22.66% | 29 |
| Strongly disagree | 6.25% | 8 |
| TOTAL | | 128 |

Figure 4. IQ Question 3

The fourth research question asked, "What strategy would TVF&R employ in developing, implementing, and maintaining a structural triage and preplanning program?" Lieutenant Kanoff and Apparatus Operator Horning recommend (a) identifying areas or regions of concern and focus efforts there first, (b) creating a program where the public can request a site visit and a property evaluation, and (c) engaging in open communication with fire district stakeholders.

Information acquired from the IQ (see Appendices B and F) returned two measurables. First, within question six, asking the respondent if pre-incident structural triage within the WUI

would provide significant value in mitigating the threat of fire. Respondent choices were (a) Strongly agree, (b) Agree, (c) Neither agree nor disagree, (d) Disagree, or (e) Strongly Disagree. Results exhibited, 53.13% of respondents agreed with this statement, while 28.91% strongly agreed and only 2.34% either disagreed or strongly disagreed. Figure 5 shows additional results and ranks provided by respondents.




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 28.91% | 37 |
| Agree | 53.13% | 68 |
| Neither agree nor disagree | 15.63% | 20 |
| Disagree | 2.34% | 3 |
| Strongly disagree | 0.00% | 0 |
| TOTAL | | 128 |

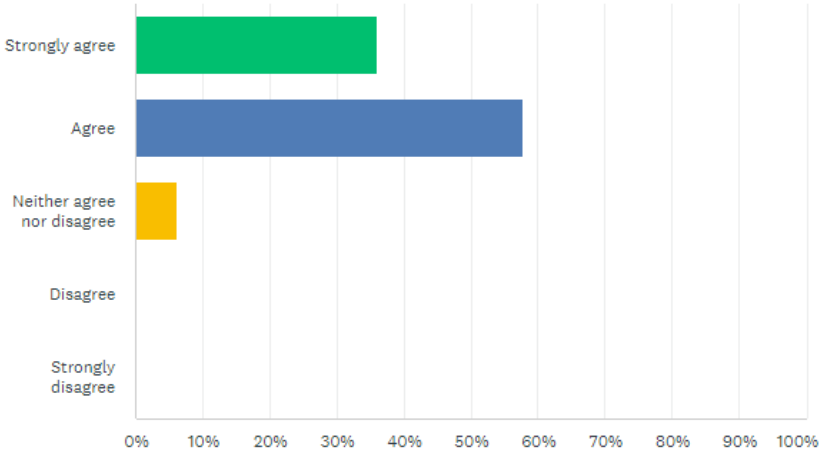
Figure 5. IQ Question 6

Second, as delineated by question seven, "Pre-planning within the WUI would provide valuable information for tactical and strategic decision making if a fire was to occur within the

WUI" respondents once more indicated a selection of (a) Strongly agree, (b) Agree, (c) Neither agree nor disagree, (d) Disagree, or (e) Strongly Disagree. Results showed that 93.75% of respondents strongly agreed or agreed with this statement, while none disagreed. Figure 6 shows additional results and ranks provided by respondents.

"Pre-planning within the wildland urban interface would provide valuable information for tactical and strategic decision making if a fire was to occur within a wildland-urban interface."

Answered: 128 Skipped: 0




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 35.94% | 46 |
| Agree | 57.81% | 74 |
| Neither agree nor disagree | 6.25% | 8 |
| Disagree | 0.00% | 0 |
| Strongly disagree | 0.00% | 0 |
| TOTAL | | 128 |

Figure 6. IQ Question 7

## Discussion

Information obtained from the literature review, interviews, and the internal questionnaire provided understanding into the current challenge TVF&R is experiencing; TVF&R does not

have a program for structural triage and preplanning residents within the WUI. As the researcher reviewed the literature gathered for this applied research project, it was apparent that preplanning in the WUI is only one step in creating an effective means to prevent wildfire disasters. TVF&R needs to understand the WUI within its service area and what defines the WUI. As Radeloff, et al. (2018) describe, "there are two main types of wildland fires, wildland-urban intermix, and wildland urban interface. The area where houses and wildland vegetation directly intermingle in the intermix while the areas that abut wildland vegetation in the wildland interface" (Radeloff, et al., 2018). The urban intermix and the urban interface areas within TVF&R's service area can become problematic in the right conditions.

TVF&R Lieutenant Kanoff explains (see Appendix C), "TVF&R has a significant WUI problem. With the acquisition of Fire District 2 and Newberg rural, we have brought on more of the interface. The geographic region brings forth grasses and brush with crops of wheat and clover." His sentiments are echoed by TVF&R Apparatus Operator Horning (see Appendix D), describing, "as we travel around the fire district, we can find higher risks of a wildland incident. We can name the areas quickly, but if we want to look at the WUI of TVF&R, honestly, your eyes will usually be drawn to stations 17, 19, and 20. This is due to the houses spread out in the forest lands, lack of hydrants, narrow roads, and topography of these areas."

TVF&R continues to face growth challenges; with recent mergers and the expansion of neighborhoods into the urban intermix and abutting urban interface, TVF&R replicates the national growth trends. As mentioned previously, Radeloff et al. (2018) assimilate in their research, increases in houses and people were also substantial, with 12.7 million more homes and 25 million more people in the WUI in 2010 compared with 1990. The overall combination of more WUI area, 7.2% of the conterminous United States in 1990 versus 9.5% in 2010 (Radeloff,

et al., 2018). High growth rates for both houses and people increased the percentage of dwellings from 30.3% to 33.2% and people from 29.4% to 31.9% in the WUI from 1990 to 2010. Even though the WUI occupies less than one-tenth of the land area of the conterminous United States, 43% of all new houses were built there, and 61% of all new WUI homes were made in the areas that were already in the WUI in 1990 (Radeloff, et al., 2018). In his earlier research, Radeloff et al. (2005) found that when houses are built close to forests or other types of natural vegetation, they pose the following problems related to wildfires (a) there will be more wildfires due to human ignitions, (b) wildfires that do occur will pose a greater risk to lives and homes, (c) they will be hard to fight, (d) and letting natural fires burn it becomes impossible (Radeloff, et al., 2005). It is the researcher's analysis that the threat of WUI fire will continue to grow within the service area of TVF&R. These fires require well-trained and experienced wildland firefighters. The organization's impact of a growing WUI and increased WUI training is directly tied to budgetary forecasting within TVF&R's training and community risk reduction departments.

Results from question four of the IQ (see Appendix F) showed that TVF&R's line personnel do not feel their wildland firefighting skill set is equal to their structure firefighting skill set. Of the 129 personnel responding to the questionnaire, only 12.5% strongly agreed that their firefighting skill sets were identical. In contrast, 51.56% of respondents declared that their wildland firefighting skill set was not equal to their structure firefighting skill set. This data shows a need for additional training in the wildland environment and will be discussed in the recommendation section.

As TVF&R personnel continue training and gain experience in wildland firefighting, some circumstances may fall out of the initial response and extinguishment model set forth by first responders. Cathro Consulting Ltd. and B.A. Blackwell & Associates Ltd. (2018) found that

fire spreading into the WUI can impact homes in two distinctive ways. First, sparks or burning embers carried by the wind can start new fires beyond the zone of direct ignition and alight on vulnerable construction materials or adjacent flammable landscapes. Second, fire can spread through direct flame contact, convective heating, conductive heating, radiant heating along the edge of the burning fire front, or simply through structure-to-structure contact. Fire can ignite a vulnerable structure when the structure is nearby (within 10 meters of the flame), to either the forest edge or burning house (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018). TVF&R's urban intermix and urban interface areas are susceptible to the two distinct ways of fire spread described by Cathro Consulting Ltd. and B.A. Blackwell & Associates Ltd. requires efforts to decrease a home's ignition potential.

According to Cohen (2008), preventing WUI fire disasters requires framing the problem in terms of home ignition potential. Because this principally involves the home ignition zone, and the home ignition zone primarily falls within private ownership, the responsibility for preventing home ignitions largely falls within the authority of the property owner. Preventing wildfire disasters thus means fire agencies helping property owners mitigate the vulnerability of their structures. Cohen continues that if homes are sufficiently resistant to ignition and do not ignite during the extreme wildfire exposure, the houses survive without firefighter protection. We have an intense wildfire but not a WUI fire disaster. The key to reducing WUI home fire loss is to reduce home ignitability (Cohen J. , 2008).

Interviews with TVF&R Lieutenant Kanoff and Apparatus Operator Horning (see Appendices C and D) described a lack of pre-incident planning in the WUI environment. Horning states, "Currently, the only preplan we use is when we have an active fire in the area, we do have some driveways marked as not accessible for our engines, but that's about it."

Kanoff offers, “I believe that pre-planning is done to a point at a station level. One problem we face is that we move around quite a bit, so there is always a lack of knowledge for certain areas from crew to crew, and pre-plans offer much information.” Their perspective is valuable; they both see and understand the need for pre-incident planning and structural triage in the WUI, and they are not alone as TVF&R personnel agrees with them.

Question seven, of the IQ (see Appendix F) asked line personnel if pre-planning within the WUI would provide valuable information for tactical and strategic decision making if a fire were to occur within the WUI. Agreeing with Kanoff and Horning, 93.75% of respondents strongly agreed with this statement, while none disagreed. The data compiled from this question alone shows that TVF&R’s line personnel understand the importance of pre-incident planning and structural triage related to tactical and strategic decision-making in the WUI.

The researcher’s analysis of pre-incident triage and planning agrees with the thoughts and ideas of Lieutenant Kanoff and Apparatus Operator Horning. Furthermore, TVF&R line personnel, as evident in the IQ, understand that pre-incident planning would be a valuable tool in making tactical and strategic decisions. Organizationally, the implications of a pre-incident program to provide structural triage would need upper management and community support as similar programs are described as “labor-intensive.” Although, with community partners and concise communication with fire district stakeholders, the challenge of a “labor-intensive” program can be mitigated to ensure success.

While pre-incident planning is imperative, programs educate and support community efforts. Homeowners who live in fire-prone locations can minimize the risk their house will burn by altering building characteristics and the vegetation around their homes (Kramer, Mockrin, Alexandre, Stewart, & Radeloff, 2018). Fuel management is a critical element of a program

called FireSmart. The objectives of FireSmart are (a) to reduce wildfire threats on private and public lands through shovel-ready fuel management projects, (b) establish landscape-level fuel breaks, (c) enhance community protection, (d) establish a long-term monitoring program, and (e) a maintenance schedule for those areas that have been treated (Cathro Consulting Ltd., B.A. Blackwell & Associates Ltd., 2018).

A similar initiative was founded at Telluride Fire Protection District. In an interview with TFPD District Chief John Bennett (see Appendix E), he describes his program, "My Wildfire Risk," as a program "intended to provide parcel-level owners with a detailed report of their risk levels and suggested ways to change their risks. Each homeowner is provided with an individual URL to make changes, document. Afterward, staff can confirm these changes with a drive-by." Chief Bennett continues, "the strategy is to provide the parcel level owners with as much information and education to encourage them to make changes in their risk profiles." The level of community preparedness, risk assessment, and stakeholder partnership described in the My Wildlife Risk program can serve as a foundation for TVF&R to follow as they develop FireSmart communities and collect pre-planned structural triage data.

Lastly, despite the current global pandemic, the researcher believes that TVF&R personnel will continue involvement in various programs and initiatives to better the citizens they serve, although the additional time for further initiatives or programs may be limited. As previously mentioned, in the IQ (see Appendix F), questions two and three, the researcher asked line personnel about their time. Question two asked if they have time to verify accuracy and update pre-plans for buildings within the current EGIS/Intterra system. Respondents split in their responses; 55 respondents agreed with this statement, 37 disagreed, and 36 were non-committal.

Conversely, when asked in question three if they would have time to develop, maintain, and update pre-plans for buildings or residences not currently in our systems, respondents disagreed at a rate of 38.29%. In comparison, 27.34% agreed, and 33.59 % did not agree or disagree. Time again is at a premium in the fire service, which holds at TVF&R. The organizational implications of added initiatives or programs can decrease morale if communications are not clear, the intent is not established, and value is not created. TVF&R must recognize the organizational necessity to understand "why."

## Recommendations

The following three recommendations are a result of the data obtained and analyzed from interviews with TVF&R Lieutenant Travis Kanoff, TVF&R Apparatus Operator Carl Horning, Telluride Fire Protection District District Chief John Bennett, an internal questionnaire, and the utilization of the literature review in substantiating vital information that is reflected in research gathering tools.

The first recommendation is for TVF&R's Global Information System (GIS) department to identify the WUI fire risk. Due to the compressed time frame of this applied research project, GIS data could not be gathered to identify the WUI areas and render associated risks and values. It is recommended that GIS data be utilized to (a) determine the boundaries of urban-intermix and urban-interface areas within TVF&R, (b) utilizing the urban-intermix and urban-interface data vegetation overlays should be developed to identify risk potential, and (c) combine these GIS data point to produce relative wildfire hazard fuel modeling.

The second recommendation is for TVF&R's operations and training division staff to continue supporting WUI training and certifications processes. During the analysis of line personnel, it was evident that they did not feel confident in their wildland firefighting skill set

compared to their structural firefighting skill set. The increase in WUI areas within TVF&R demands a professional training and certification program for its firefighters to operate predictably and reliably as they serve the community. These training and certification programs exist within the wildland firefighting community and must be utilized at TVF&R in a broader scope to ensure all line personnel are trained.

The third recommendation is for TVF&R's operations division to explore existing wildfire preventative programs and initiatives. The programs noted in this research were (a) FireWise, (b) FireSmart, and (c) My Fire Risk. FireWise is sponsored by the National Fire Protection Agency, while FireSmart is developed by the U.S. Department of Agriculture and the U.S. Forest Service. My Fire Risk is a product and program established in Telluride, Colorado, used by the Telluride Fire Protection District. All three of these programs and initiatives have value for TVF&R, and the implementation, adoption, or adaptation of one would create safer WUI communities for the citizens served by TVF&R.

TVF&R will see the organizational benefit directly correlates to Strategic Goal II(b), sustained, targeted efforts aim to understand and mitigate common hazards (TVF&R, 2020b). Additionally, TVF&R will see the organizational benefit in: (a) Strategy 2c, as "Advancing performance with an emphasis on consistency, predictability, and accountability to achieve and deliver effective services;" (b) Strategy 3a, as TVF&R will "advocate for system improvements in cooperation with partner agencies;" and (c) in Strategy 3d, "apply lessons learned from past events and engage in planning initiatives to maximize organizational resiliency and continuity during crises and emergencies" (TVF&R, 2020b).

In repeating this study, the researcher recommends that: (a) a national questionnaire be developed and distributed to gather data on industry standards in pre-incident structural triage

programs; (b) utilize local GIS data to develop risk assessment mapping for further risk/value analysis; (c) interview additional program experts from FireWise, FireSmart, or My Fire Risk to gain additional knowledge for analysis; and (d) explore successes within communities utilizing FireSmart, FireWise, or My Fire Risk.

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# Appendices

# Appendix A

## District Incident Counts – Vegetation Fires for TVFR Service Area 1/1/2017 – 12/31/2021

Vegetation Fires (Situation Found = 14x and 17x) | 01/01/2017 - 12/31/2021 | Run Date: 2/7/2022

| Situation Found | Total Incidents | Total Exposures | Contents Loss | Property Loss |
|---|---|---|---|---|
| 140 - Natural vegetation fire, other | 28 | 4 | $20.00 | $19,600.00 |
| 141 - Forest, woods or wildland fire | 28 | 0 | $75.00 | $5,550.00 |
| 142 - Brush or brush-and-grass mixture fire | 2,640 | 3 | $24,032.50 | $98,717.50 |
| 143 - Grass fire | 112 | 6 | $13,125.00 | $153,100.00 |
| Total | 2,808 | 13 | $37,252.50 | $276,967.50 |

Dispatched As

| | BARK | BARN | BRUSH | BURN | CAR | CFIRE | ELEC | EXT | GRASS | MISC | MISCF | MISCN | ODOR | PA | RFIRE | SERV | SINV | SMOKE | TAU | WIRES | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | | 2 | 21 | 3 | 1 | 6 | 3 | 20 | 19 | 4 | 455 | | 2 | | 8 | | 7 | | | 1 | 552 |
| 2018 | 343 | | 73 | 4 | | 7 | | | | | 185 | 11 | | 2 | 6 | 2 | | | | 1 | 634 |
| 2019 | 368 | | 34 | 5 | | 3 | | | | | 143 | 3 | 1 | | 7 | 1 | | 7 | | | 572 |
| 2020 | 259 | | 53 | 1 | 1 | 3 | | | | | 157 | 5 | 2 | | 5 | | | 12 | | | 498 |
| 2021 | 324 | 1 | 51 | 3 | 2 | 4 | | | | | 141 | 8 | 2 | | 10 | | | 5 | 1 | | 552 |
| Total | 1,294 | 3 | 232 | 16 | 4 | 23 | 3 | 20 | 19 | 4 | 1,081 | 27 | 7 | 2 | 36 | 3 | 7 | 24 | 1 | 2 | 2,808 |

Incidents within TVFR boundary with valid 14x or 17x incident type code.
A:_DataAnalystReference\Fire Data Analysis\Queries\Fires - Analysis update with NFPASurvey 12-31-18 New Station.sql
A:_DataAnalystReference\AdHoc\Fire Academy\[Veg Fire Data Petracca.xlsx]pvt1

## Appendix B

## Questionnaire - Preplanning Structures in the Wildland Urban Interface

Line Personnel,

As part of my research project for the Executive Fire Officer Program, I am attempting to understand the preplanning of structures within the wildland-urban interface. Please take a moment to complete this short questionnaire. Your responses will provide considerable insight with the potential to benefit TVF&R as we work to prepare for and mitigate the threat of wildland-urban interface fires. Electronic responses can be submitted via the following link.

https://www.surveymonkey.com/r/QXJRF25

Survey responses will be accepted through January 25th, 2022. Thank you in advance for your time; it is appreciated.

Cheers,

Robert Petracca | Battalion Chief
Battalion 7
Tualatin Valley Fire & Rescue
Direct: 503.259.1727
Cell: 360-609-5956
www.tvfr.com

1. I regularly utilize EGIS/Intterra for Pre-planning information.
    a. Strongly Agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

2. My crew and I have the time to verify accuracy and update pre-plans for buildings within the current EGIS/Intterra system.
    a. Strongly Agree

   b. Agree
   c. Neither agree nor disagree
   d. Disagree
   e. Strongly disagree

3. My crew and I would have time to develop, maintain, and update pre-plans for buildings or residences not currently in our systems.
   a. Strongly Agree
   b. Agree
   c. Neither agree nor disagree
   d. Disagree
   e. Strongly disagree

4. I feel confident that my wildland firefighting skill set equals my structural firefighting skill set.
   a. Strongly Agree
   b. Agree
   c. Neither agree nor disagree
   d. Disagree
   e. Strongly disagree

5. I would understand my responsibilities if assigned to structural protection during a wildland-urban interface incident.
   a. Strongly Agree
   b. Agree
   c. Neither agree nor disagree
   d. Disagree
   e. Strongly disagree

6. Pre-incident structural triage within the wildland-urban interface would provide significant value in mitigating the threat of fire.
   a. Strongly Agree
   b. Agree
   c. Neither agree nor disagree
   d. Disagree
   e. Strongly disagree

7. Pre-planning within the wildland-urban interface would provide valuable information for tactical and strategic decision-making if a fire was to occur within a wildland-urban interface.
   a. Strongly Agree
   b. Agree
   c. Neither agree nor disagree
   d. Disagree
   e. Strongly disagree

8. I feel confident that pre-planned information is current, accurate, and accessible.
    a. Strongly Agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

9. Please identify your current rank.
    a. Captain
    b. Lieutenant
    c. Apparatus Operator
    d. Firefighter

## Appendix C

## Interview with Tualatin Valley Fire & Rescue Lieutenant Travis Kanoff

December 10, 2021

1. *What is your name and position within the department?*

   My name is Travis Kanoff, and I am a Lieutenant/Paramedic within the fire district and a qualified Engine Boss in the wildland community.

2. *What do you feel is the WUI risk at TVF&R?*

   Tualatin Valley Fire and Rescue has a significant Wildland Urban Interface problem. With the acquisition of Fire District 2 and Newberg rural, we have brought on more of the interface. The geographic region brings forth grasses and brush with crops of wheat and clover. Some forested areas are within the fire district boundary, but "forest fire" is not our greatest threat. Residences, farms, and wineries are scattered throughout the landscape, and residential developments are becoming more and more common as we push the urban-growth boundary. That being said, taking a City Department like Beaverton, Tualatin, Wilsonville, etc., and training them to operate safely and effectively in the Urban Interface environment is a challenge. Washington County's urban interface creates challenges with the increasing residential construction on the fire district's Eastside, like West Linn and West. Where services are being taxed enough, through increased call volume, staffing, and overall costs to operate, being able to manage and be prepared for fires in the interface is even more challenging. That being said, I believe the WUI at TVF&R is considered a high risk to the fire district and its citizens, especially considering the change in climate and drought.

3. *What areas do you see need improvement?*

   I believe training is key to starting the transition. Our company needs to be comfortable managing these incidents with fewer resources. Wildfire management is a different thought process in comparison to structure fire operations. The key to effective wildfire management is resource allocation, effective and efficient tactics and strategies, and utilizing barriers. Crews need to be at a competent level and understand basic firing operations. Upper-level management has to know how to deal with larger fires. Officers need to be comfortable with Initial Attack Operations, Structure Triage, and Protection and build and maintain situational awareness. Communication is key, understanding Divisions and Groups and establishing incident priorities and objectives. Crews need to understand that mitigation of an incident sometimes involves line construction and hard work.

4. *What are the components of TVF&R's structural triage program?*

   The fire district has utilized an OSFM Structural triage form in the past. The current triage is annotated in the WUI protocol. Components of the triage include construction, defensible space, time to prep, geography, aspect, weather conditions, ingress/egress, fire conditions, ROS, resources. Check sheets are generally used, but officers must be competent enough to determine the triage after a quick assessment.

5. *Does TVF&R preplan for the WUI?*

   I believe that pre-planning is done to a point at a station level. One problem that we face is that we move around quite a bit, so there is always a lack of knowledge for certain areas from crew to crew. Pre-plans offer much information. Teams do "drive-by" and

discuss tactics and strategy, some more than others. I cannot answer as to IMCT pre-planning and logistics.

6. *Do you know of other agencies using a preplanned system for WUI, what are the agencies, what is the system they use?*

   I would be curious as to what Clackamas Fire District 1 is doing. I am not aware of a "system" utilized in the local area. Cal Fire has a placard system they use that identifies structure needs, water sources, and evacuation status.

7. Have you had the opportunity to use a structural triage preplanning system in the WUI?

   Yes. I have used Intterra and Survey123.

8. *What were your thoughts?*

   I believe that the idea offers a benefit when done ahead of a firefront. The idea is that it will be placed in a system on a map for the next operational period. It gives you an idea of the resource needs for the following operating active period and familiarizes crews with the job at hand.

9. *Would it benefit TVF&R?*

   I think there would be a benefit. The benefit would be increasing the crews' competencies and creating discussions on strategies and tactics. As far as the long-term piece is concerned, I would question the accuracy of the assessment after two years or so, in that conditions of the house change, new tenants, some may have an increase in yard debris, and vegetation grows fast in the pacific northwest. A Pre-plan system would need to be re-evaluated periodically.

10. *What do you see as barriers to TVF&R using a similar structural triage preplanning system?*

    I don't see any barriers other than time. If it were a focused evaluation of development, that is one thing, but to try and triage every single house in the interface, is a lot of time and work and would require some type of re-evaluation. If one were to identify areas or regions of concern and focus on that, I could see it beneficial. The knowledge alone, getting out and seeing what is in your first due, and having a plan before an incident would be helpful. Another idea would be to create a program to request a site visit and a property evaluation. Crews or individuals could make recommendations to make their property more defensible. It would give the crews the pre-plan information, assist the homeowner, and create good Public Relations.

## Appendix D

## Interview with Tualatin Valley Fire & Rescue Apparatus Operator Carl Horning

December 10, 2021

1. *What is your name and position within the department?*

   Carl Horning Engineer & EMT-I

2. *What do you feel is the WUI risk at TVF&R?*

   High. I don't come by this answer just at a whim; I have worked in the wildland realm for over 22 years now have fought wildland fires in Oregon, Washington, California, Idaho, and Alaska. Trained, certified, and have worked in multiple positions from digging line as a Firefighter on a hand crew to commanding large fires as an IC type 3 and Division supervisor. I have also lived in the WUI my entire life and not just on the outskirts of a town but miles away from anyone in the forests of Oregon. Including the location I live and all the places I have worked/traveled to, I have seen homes and structures being built closer together; years ago, you had to own 80+ acres to build a house. But the lot size needed has fallen and keeps falling to this day, to the point where you can now build several homes on the original acreage space that you used to need just for one. Just looking at that alone, you could say the risk is higher because of the number of homes built in the WUI. Something to think of also is that these smaller lot sizes homes are now being placed in not ideal locations for fire protection, on slopes, box canyons, and right on the front of a ridge for the "perfect vie." With any of these locations, what do people also want? To live in nature. Usually, two things happen when they build homes they don't always cut down and create great defendable space, or when they do build the house, they make defensible space by trimming trees and cutting brush. Still, this upkeep

gets too much for the homeowner over the years, and they just let it go. As you look across our fire district, the west hills jump out as potential with the volume of homes, people, and value, but due to hydrants and roads in this location, it might be easier to manage, that is, if the water keeps flowing. As we travel around the fire district, we can find higher risks of a wildland incident. We can name the areas quickly stations 68, 64, 17, 19, 20, 21, 52, and a few other outlying stations. But if we want to look at the WUI of TVF&R, honestly, your eyes will usually be drawn to 17, 19, and 20. This is due to the houses spread out in the forest lands, lack of hydrants, narrow roads, and topography of these areas.

3. *What areas do you see need improvement?*

   I believe training is key to starting the transition. Our company needs to be comfortable managing these incidents with fewer resources. Wildfire management is a different thought process in comparison to structure fire operations. The key to effective wildfire management is resource allocation, effective and efficient tactics and strategies, and utilizing barriers. Crews need to be at a competent level and understand basic firing operations. Upper-level management has to know how to deal with larger fires. Officers need to be comfortable with Initial Attack Operations, Structure Triage, and Protection and build and maintain situational awareness. Communication is key, understanding Divisions and Groups and establishing incident priorities and objectives. Crews need to understand that mitigation of an incident sometimes involves line construction and hard work.

4. *What are the components of TVF&R's structural triage program?*

TVF&R has always had WUI, but with the merger of WCFD#2 and Newberg Fire, the WUI has grown exponentially. An area that people don't think about is our partners to the west, Forest Grove, Banks, and ODF. Before the merger, TVF&R had a buffer of WCFD#2 to mutual aid to these departments on the wildland fires, but now, since the merger, we as TVF&R must be prepared to respond. When I think of needed improvements, training jumps out with equipment and apparatus not far behind, but an area that we must also talk about public outreach. Public outreach is probably the first important step; when the fire starts, we may not have enough personnel and equipment to reach out to every home affected. Homeowners in the WUI need to be made aware of the dangers and the things they need to take care of to help protect themselves and their neighbors. Training always needs improvement, but the growth of TVF&R's coverage area and the lack of drive from some personnel to take wildland seriously has left a hole and has not helped out firefighters or departments for the future.

An example of this is when new firefighters go through the academy; they are given classes to cover the entry-level wildland position of firefighter two and the classroom portion of firefighter one. These classes and task books are essential to finish, but some FTOs did not see that and told the firefighter not to worry about finishing the FF1 task book. But now, years later, we have personnel that has been promoted to higher-ranking officers that need these wildland classes completed for their position. So what we do today will always affect our department in the future. We used to have a group in the area called Western Washington County Training Association; this group was made up of multiple agencies in Washington County and used instructors from these agencies to

teach classes from the FF2 up to the Division Supervisor. We also pulled in outside agencies to help with this; the Oregon Department of Forestry was our expert in this field and willing to help with what we needed. Our equipment is ok, but a few different hand tools should be looked at to help improve the performance and safety of our personnel. Our wildland apparatus should be overhauled entirely once again; safety and performance need to be addressed. Our Type 3's needs to be addressed, the four-door is a must, and I recommend looking at BME model 34/35 Cal fire specs. Our Type 5's should also be addressed. Currently, we have units with different capabilities from pump size to tank size, diesel or gas, front remote nozzles to only outlets off the rear. Having the same style and power in a brush rig will make it safer and more effective when operated. I do believe we can change these units in the future with the personnel we have in the positions they hold.

5. *Does TVF&R preplan for the WUI?*

   TVF&R uses the OSFM Structure Protection Plan, the same triage program that the Oregon Department of Forestry Services uses. Triage, Prep, and Defend.

   Triage is broken down into four areas

   1. Low Risk - Stand Alone. Reinforce and ensure prepped for standalone defense
   2. Moderate risk - Prep/Hold. Time-sensitive, structures provide the most significant gains
   3. High Risk – Prep/Go. Time-sensitive
   4. Extreme Risk - Check/Go

Prep has two general levels of structure-prep are identified: Surface Prep and Full Prep. The three critical factors of time, resources, and fire condition will determine which level and priority should be accomplished.

Defend will always consider and coordinate LCES and PACE (Primary, Alternate, Contingency, Emergency) planning upon initiating tactical action. We will always have an exit strategy: Employing tactical maneuvers to avoid heat injury, Moving to a Temporary Refuge Area (TRA), and Withdrawing along Escape Routes.

6. *Do you know of other agencies using a preplanned system for WUI, what are the agencies, what is the system they use?*

   Currently, the only preplan we use is when we have an active fire in the area, we do have some driveways marked as not accessible for our engines, but that's about it. We are currently working on preplanning secondary water sources in the WUI.

7. *Have you had the opportunity to use a structural triage preplanning system in the WUI?*

   Yes, ODF uses Survey123

8. *What were your thoughts?*

   I have used Survey123. It works well and does not need much training. You can give descriptions and pictures. The thing I do not like about it is that it scores the structure in a rating to show if it's defensible or not and does not leave room for the experience of personnel to adjust this score.

9. *Would it benefit TVF&R?*

   Yes, I believe using it would be good for our department.

10. *What do you see barriers to TVF&R using a similar structural triage preplanning system?*

    A short-term triage plan has no barriers as long as you have cell service; it can easily communicate your needs with the command. But if you are looking at a long-distance forecast system like I think we need, the biggest problem is that things change in the WUI all the time. Homes get sold, and the new owners may not keep up on the defensible space. Trees and bushes grow; what might be ok one year could be drastically different in a few. I have seen homes in the WUI that you would immediately consider red, and within a few months later, it was logged and cleaned up and easily a stand-alone structure. Any long-distance forecast system will need to have the ability to be updated easily; for example, if we go on a call to an address and notify the homeowner that has done work around the place, we can update the home's triage classification.

## Appendix E

### Interview with Telluride Fire Protection District, District Chief John Bennett

December 12, 2021

1. *Give a summary of your My Wildfire Risk program.*

   My wildfire risk is intended to provide parcel-level owners with a detailed report of their risk levels and suggested ways to change their risks. Each homeowner is provided with an individual URL to make changes, document, and afterward, WRWC staff can confirm with a drive-by. Telluride Fire District is also moving forward with Community Connect through First Due so homeowners and business owners can update their information and stay connected.

2. *Do you know of any agencies using similar programs? What are they?*

   I am uncertain. I think Eagle County Wildfire uses a product, just not aware of what.

3. *What was your strategy for implementing and maintaining the relevancy and accuracy of your program?*

   The strategy is to provide the parcel level owners with as much information and education to encourage them to make changes in their risk profiles. We continue to navigate some sort of certification program to go along with the program to encourage participation and compliance. We have used nudges and continue to partner through WRWC and TFPD to promote work on the ground.

4. *What were some of the barriers to implementing and maintaining your program?*

   The significant barrier is interest and partnering. We continue to reach out and have some great advocates, yet some still love their trees and don’t have any interest in participation. When there is smoke in the air, interest often is renewed.

5. *Looking back, what pearls would you offer to other agencies looking to implement a similar system?*

   Get the community involved. Partner with organizations that have similar interests and desired outcomes. Develop neighborhood advocates to help with momentum. Find those in the public that have an interest in sharing their stories. Use success stories to the best of your ability. Document before and after projects and monitor how they do when wildfire events occur.

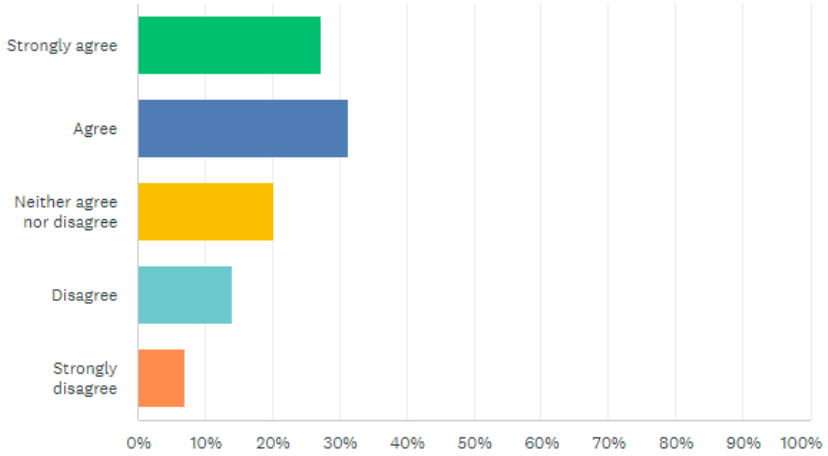
## Appendix F

## Questionnaire Results - Preplanning Structures in the Wildland Urban Interface

Question 1:

"I regularly utilize EGIS/Intterra for pre-planning information."

Answered: 128 Skipped: 0

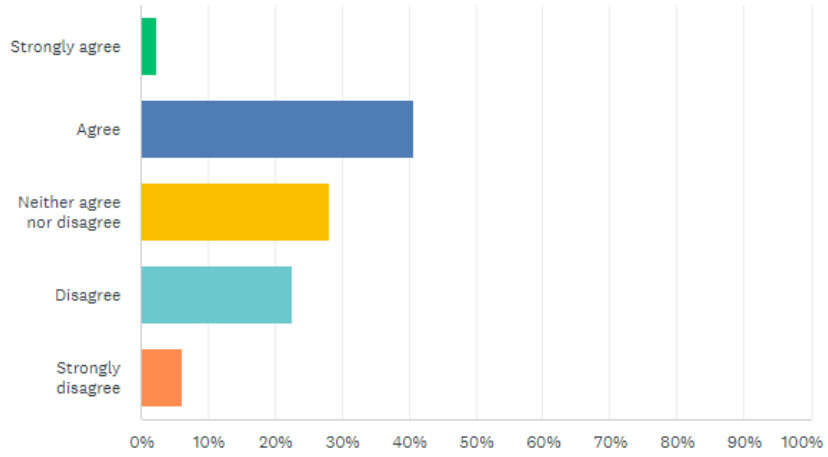



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 27.34% | 35 |
| Agree | 31.25% | 40 |
| Neither agree nor disagree | 20.31% | 26 |
| Disagree | 14.06% | 18 |
| Strongly disagree | 7.03% | 9 |
| TOTAL | | 128 |

Question 2:

"My crew and I have the time to verify accuracy and update pre-plans for buildings within the current EGIS/Intterra system."

Answered: 128 Skipped: 0

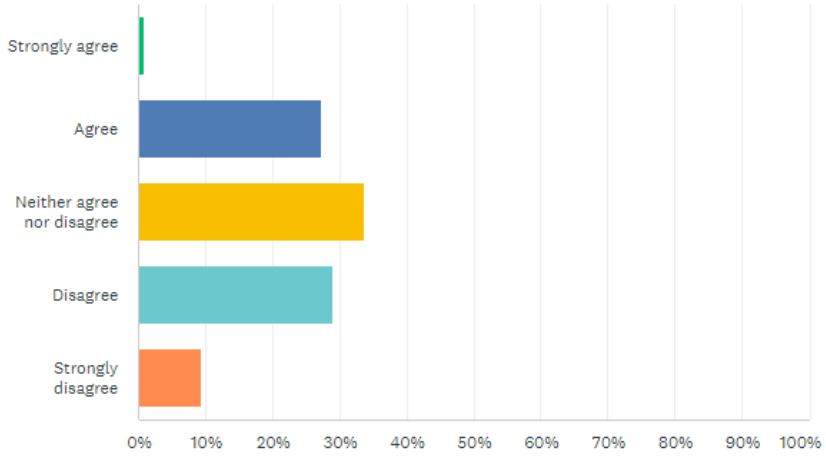



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 2.34% | 3 |
| Agree | 40.63% | 52 |
| Neither agree nor disagree | 28.13% | 36 |
| Disagree | 22.66% | 29 |
| Strongly disagree | 6.25% | 8 |
| TOTAL | | 128 |

Question 3:

"My crew and I would have time to develop, maintain, and update pre-plans for buildings or residences not currently in our systems."

Answered: 128 Skipped: 0

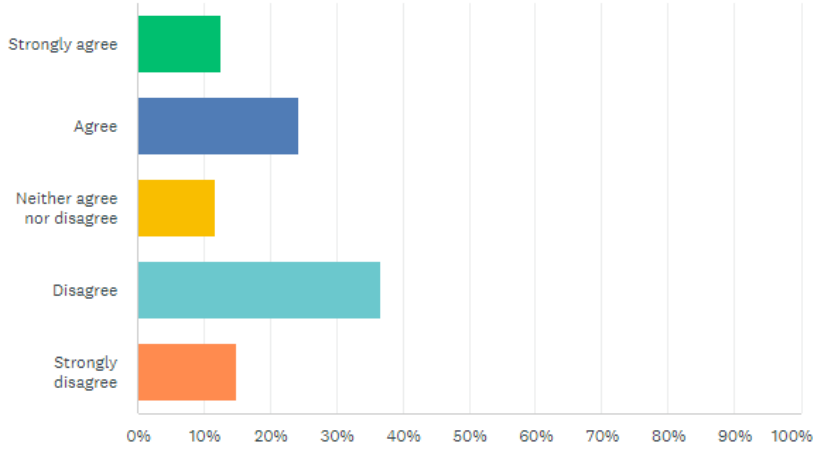



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 0.78% | 1 |
| Agree | 27.34% | 35 |
| Neither agree nor disagree | 33.59% | 43 |
| Disagree | 28.91% | 37 |
| Strongly disagree | 9.38% | 12 |
| TOTAL | | 128 |

Question 4:

"I feel confident that my wildland firefighting skillset is equal to my structural firefighting skillset."

Answered: 128 Skipped: 0

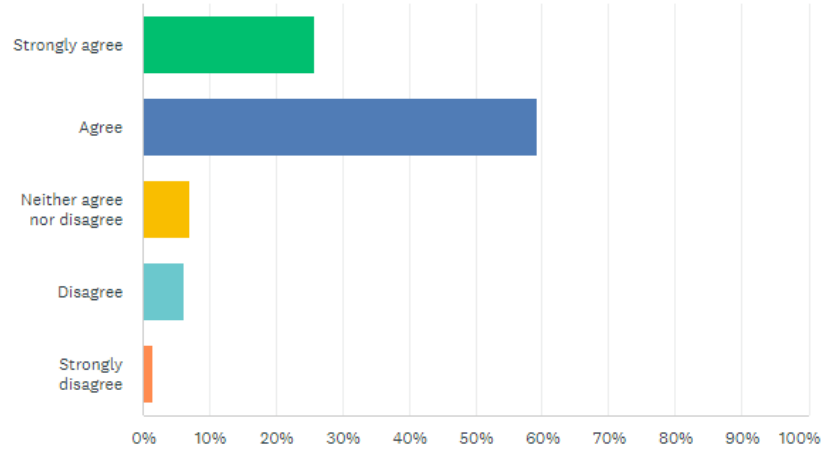



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 12.50% | 16 |
| Agree | 24.22% | 31 |
| Neither agree nor disagree | 11.72% | 15 |
| Disagree | 36.72% | 47 |
| Strongly disagree | 14.84% | 19 |
| TOTAL | | 128 |

Question 5:

"I would understand the responsibilities of me if assigned to structural protection during a wildland-urban interface incident."

Answered: 128 Skipped: 0

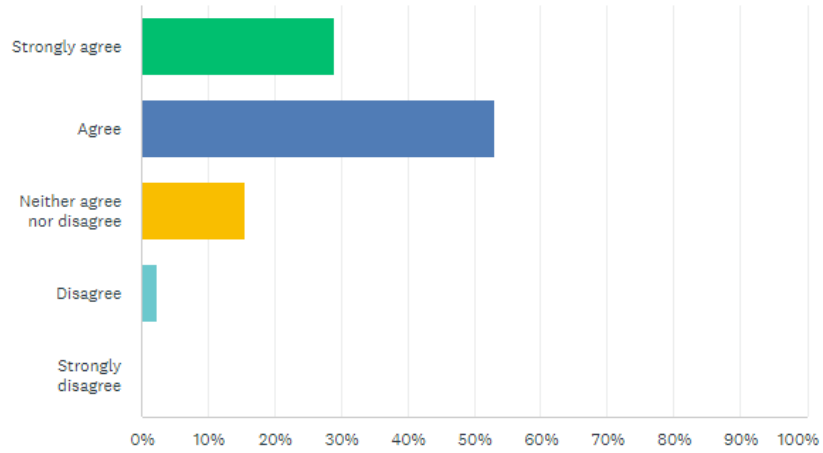



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 25.78% | 33 |
| Agree | 59.38% | 76 |
| Neither agree nor disagree | 7.03% | 9 |
| Disagree | 6.25% | 8 |
| Strongly disagree | 1.56% | 2 |
| TOTAL | | 128 |

Question 6:

"Pre-incident structural triage within the wildland urban interface would provide significant value in mitigating the threat of fire."

Answered: 128 Skipped: 0

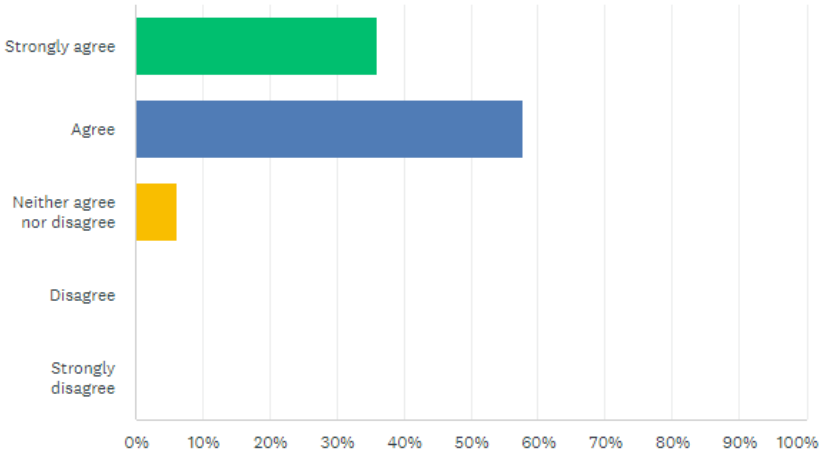



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 28.91% | 37 |
| Agree | 53.13% | 68 |
| Neither agree nor disagree | 15.63% | 20 |
| Disagree | 2.34% | 3 |
| Strongly disagree | 0.00% | 0 |
| TOTAL | | 128 |

Question 7:

"Pre-planning within the wildland urban interface would provide valuable information for tactical and strategic decision making if a fire was to occur within a wildland-urban interface."

Answered: 128 Skipped: 0

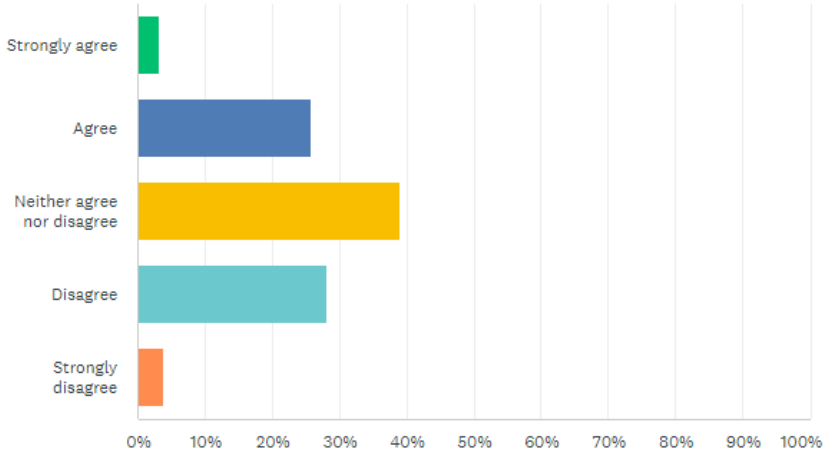



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 35.94% | 46 |
| Agree | 57.81% | 74 |
| Neither agree nor disagree | 6.25% | 8 |
| Disagree | 0.00% | 0 |
| Strongly disagree | 0.00% | 0 |
| TOTAL | | 128 |

Question 8:

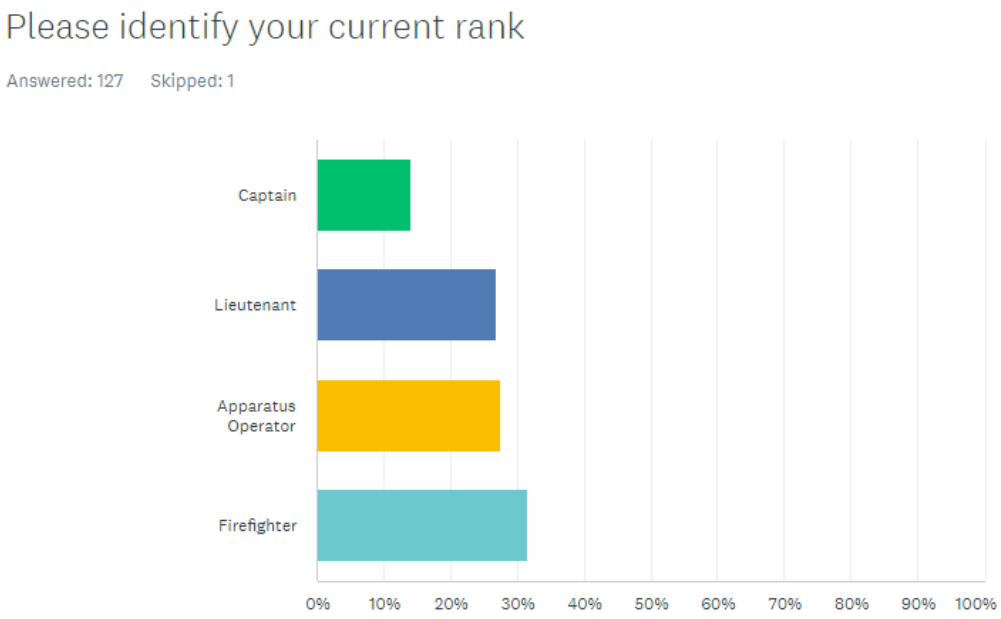
"I feel confident that pre-planned information is current, accurate, and accessible."

Answered: 128 Skipped: 0




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Strongly agree | 3.13% | 4 |
| Agree | 25.78% | 33 |
| Neither agree nor disagree | 39.06% | 50 |
| Disagree | 28.13% | 36 |
| Strongly disagree | 3.91% | 5 |
| TOTAL | | 128 |

Question 9:




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Captain | 14.17% | 18 |
| Lieutenant | 26.77% | 34 |
| Apparatus Operator | 27.56% | 35 |
| Firefighter | 31.50% | 40 |
| TOTAL | | 127 |