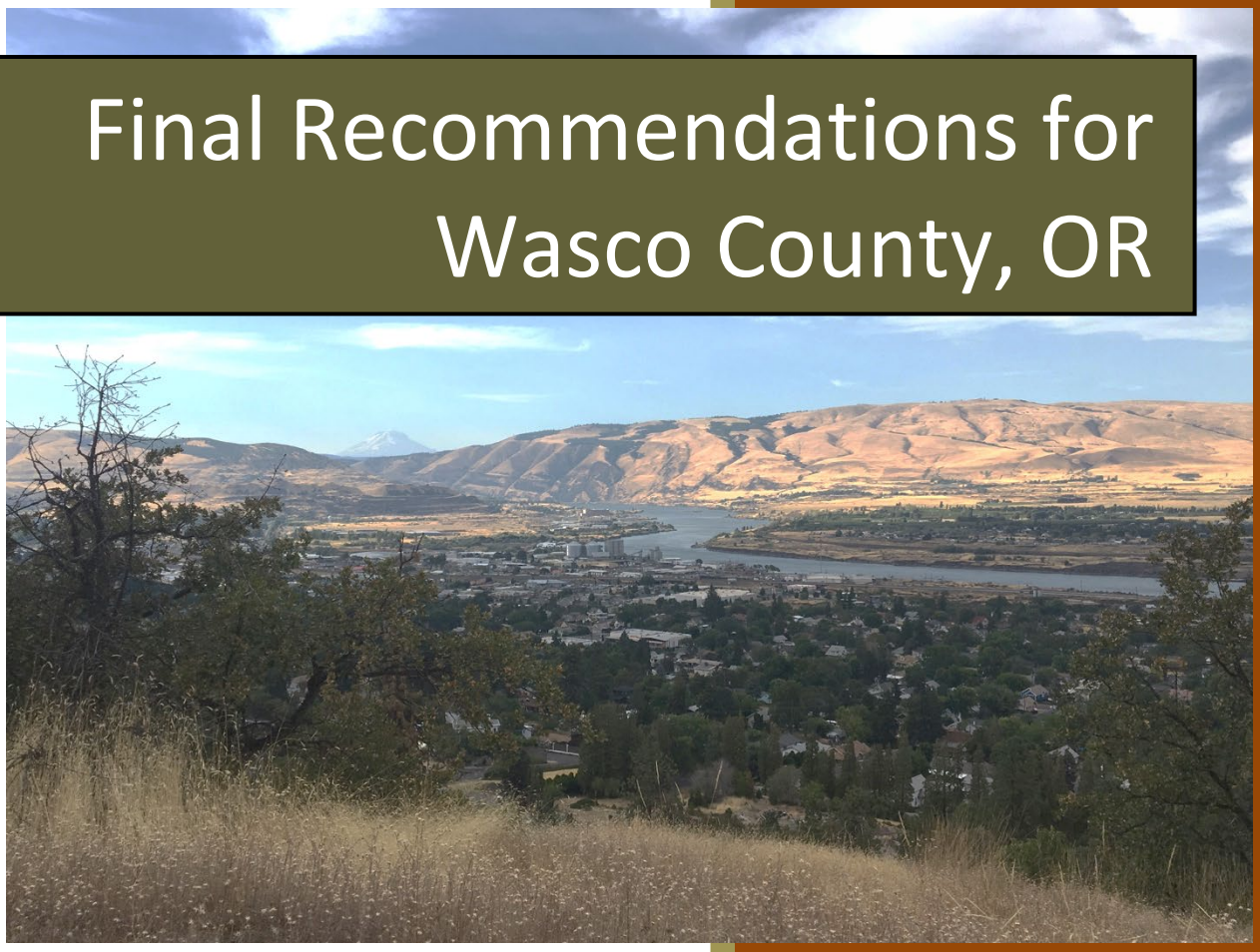
COMMUNITY PLANNING ASSISTANCE FOR WILDFIRE

2018

Final Recommendations for Wasco County, OR



Prepared by:

Wildfire Planning International, LLC

Wildland Professional Solutions, Inc.

12/17/2018

About the Community Planning Assistance for Wildfire Program

The Community Planning Assistance for Wildfire (CPAW) program works with communities to reduce wildfire risks through improved land use planning. It is supported through grants from the U.S. Forest Service and other private foundations. It is a program of Headwaters Economics and Wildfire Planning International.

Author Contact Information

CPAW engages consultants with relevant training and expertise in land use planning, forestry, risk modeling, and fire behavior. This report was written by the following CPAW consultants:

- Molly Mowery, AICP – Wildfire Planning International, LLC
- Kelly Johnston, RPF, FBAN – Wildfire Professional Solutions, Inc.
- Eva Karau – USDA Forest Service, Rocky Mountain Research Station

For questions related to this report, please contact: info@wildfireplanning.com

Acknowledgments

CPAW relies on collaboration with local stakeholders to provide meaningful feedback throughout the process. Our team would like to thank everyone who contributed their time to our CPAW activities in Wasco County, including: Wasco County Planning Department, Mid-Columbia Fire and Rescue Department, Oregon Department of Forestry, and the U.S. Forest Service Mt. Hood National Forest staff. Any omissions are solely the responsibility of the authors and are not intended to reflect the value of other participants.

P.O. Box 7059

Bozeman, MT 59771

https://planningforwildfire.org

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Contents

Introduction

Each year, wildfires affect communities across the United States. These wildfires—both human- and lightning-caused—can have a variety of impacts on communities' built and natural environments. Some of these impacts bring positive ecological outcomes, such as improved forest health and habitats. Other wildfires, however, can have devastating social, economic, and environmental consequences to communities' public and first responder safety, homes and businesses, parks, roads, watersheds, forests, hospitals, and more.

Communities have many options to address and reduce their wildfire risk. The Community Planning Assistance for Wildfire (CPAW) program offers a unique approach to help community stakeholders identify what's at risk in the "wildland-urban interface" (WUI, pronounced "WOO-EE") and determine ways to address this risk through improved land use planning strategies.

❖ Community Planning Assistance for Wildfire

CPAW was established by Headwaters Economics and Wildfire Planning International in 2015, and is funded by the U.S. Forest Service (USFS) and other private foundations. Since its inception, CPAW has worked with communities of varying sizes, capacities, and geographical locations across the United States.

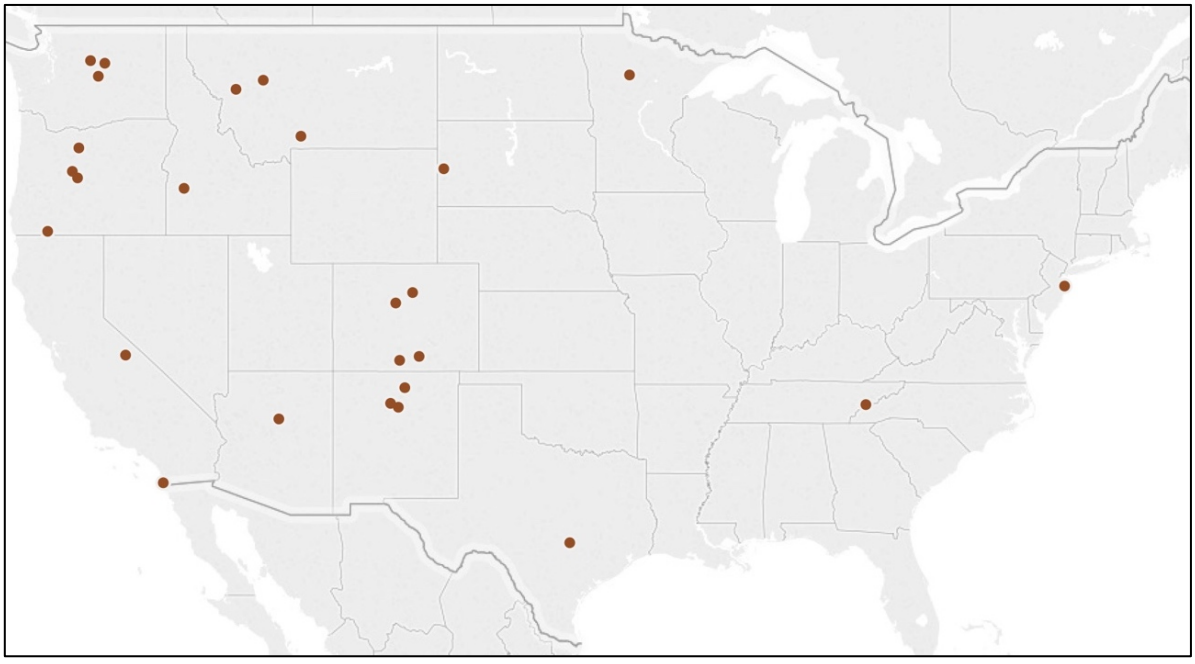

Figure 1. Map of communities that have been engaged in the Community Planning Assistance for Wildfire program.

Community Selection and Services

Each year, communities voluntarily apply and are competitively selected to participate in the program. Communities must show commitment and engagement from both local planning and fire departments to reflect the collaborative nature required for CPAW success. If selected, communities receive customized technical consulting services from CPAW's team of professional land use planners, foresters, risk modelers, and researchers. Specific services vary based on community needs, and may include capacity-building trainings on WUI planning topics, risk modeling and spatial analysis, guidance on wildfire mitigation plans and policies, and other strategies to address local wildfire risk.

Stakeholder Engagement

Community members engaged in the CPAW process play a critical role to project success. While services are provided at no charge to the community, each community signs a Memorandum of Understanding with CPAW to outline its mutual understanding of roles and responsibilities and project commitments. CPAW teams engage with a variety of local stakeholders who may serve as steering group members, local experts, or interested parties. These stakeholders provide valuable input and feedback, represent diverse wildfire and community development interests, and act as communication channels to other local groups.

CPAW Process

The CPAW community planning process typically occurs over the course of one year (Figure 2). During that time, CPAW team members meet with stakeholders to discuss local issues, conduct several field tours to learn about unique wildland-urban interface and wildfire mitigation challenges, and provide presentations to help the community understand CPAW's program goals. Team members also thoroughly review community planning documents to analyze gaps and opportunities for strengthening wildfire policies and regulations. At the end of the process, team members provide the community with a set of voluntary recommendations to more effectively address the WUI through appropriate land use planning strategies. Follow-up implementation assistance may also be available to communities depending on their unique needs and CPAW's program funding.

Figure 2. The CPAW processes engages with stakeholders through meetings, field tours, and other facilitated opportunities.

CPAW Recommendations

There are many planning tools available to communities to help address challenges associated with the wildland-urban interface. These tools include plans and policies (e.g., growth management plans, neighborhood plans, open space management plans), and codes and regulations (e.g., subdivision regulations, landscaping ordinances, steep-slope ordinances, zoning codes, building codes, and wildland-urban interface codes). See Figure 3 for more examples.

CPAW expertise builds on research, science, and national best practices to customize recommendations for each local community. Additional inputs include community observations and stakeholder feedback. Recommendations focus on the nexus between land use planning, forestry, hazard mitigation, and wildfire risk-reduction strategies. Implementation of CPAW recommendations is voluntary; local governments retain sole authority for the decision to move any recommendations forward.

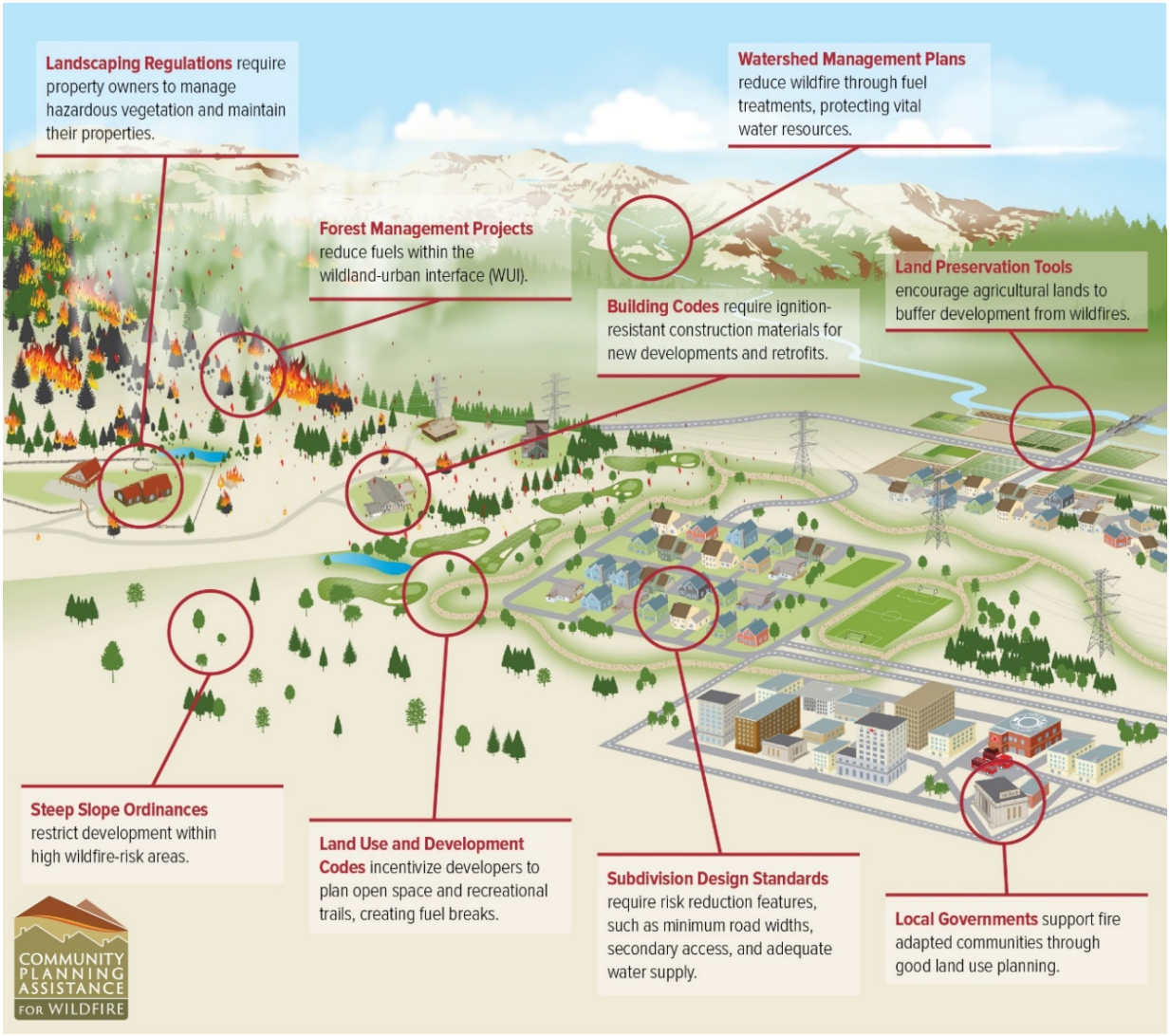

Figure 3. Community planning tools for wildfire.

❖ Community Planning Context

Geographic Location and Significant Features

Wasco County lies east of the Cascade Range along the Columbia River. Significant land features that are in or near the county include the Mt. Hood National Forest (to the west), Columbia River (to the north), and the Deschutes and John Day Rivers (to the east). A portion of the southern half of the county is within the Warm Springs Indian Reservation, and a portion of the northern county is within the Columbia River Gorge National Scenic Area. Steep rolling hills, sharp cliffs, and canyons are characteristic landforms in Wasco County.[1]

Land Area and Ownership

Wasco County has a total land area of 1,533,069 square miles.[2] More than half (53.4%) of county land is privately owned. Significant landowners include Weyerhaeuser and several large agricultural companies. Remaining lands are owned or managed by federal agencies (primarily the USFS and the Bureau of Land Management), Confederated Tribes of the Warm Springs, and state, county, or other agencies.[3] See Figure 4.

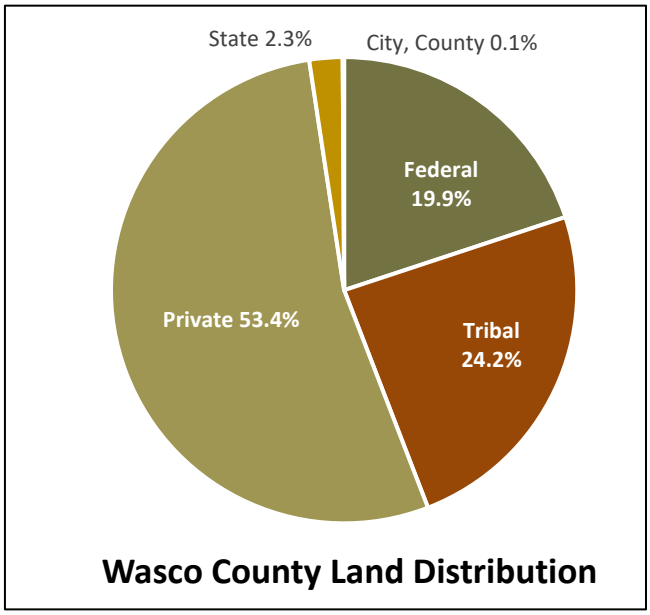

Figure 4. Distribution of land ownership/management in Wasco County (by percentage).

Key Demographics

In the last fifteen years, there has been slow but steady population growth in the county. Population growth is expected to continue; it is also worth noting that Wasco County's population is aging.[4]

Median house sale prices in the county are lower than other regions in the state, but trends toward rising housing costs are expected to continue creating local gaps of housing affordability. There is already a deficit in lower-income housing availability in Wasco County.[5] Stakeholders are particularly concerned about future spillover from the Portland region and its potential effect on rising housing costs.

[1] Wasco County, Oregon. "Wasco County Comprehensive Plan" *Wasco County.* 2017. http://www.co.wasco.or.us/Planning/Comp_Plan/02Physical_Characterist.pdf. 2-2p.
[2] U.S. Census Bureau. 2010.
[3] Headwaters Economics Economic Profile System (Land Use): U.S. Geological Survey, Gap Analysis Program. 2016. Protected Areas Database of the United States (PADUS) version 1.4
[4] Portland State University. 2016. Coordinated Population Forecast for Wasco County, its Urban Growth Boundaries (UGBs), and Area Outside UGBs 2016-2066. March (Draft only, final report not available).
[5] Wasco County 2040: https://wasco2040.com/2017/11/16/oregon-statewide-housing-plan/

Employment and wages increased in 2015 and 2016 by 5.5% and 4.1%, respectively.[6] More than 5,000 residents live and work within the county; more than 6,000 residents live in the county but work elsewhere (popular destinations include Portland and Hood River). The largest percentage of workers is in The Dalles.[7]

Table 1: Overview of Demographics in Community

Topic	Key Statistic	Notes
Current population	25,657[a]	The Dalles population is 15,175[a]
Population density	10.6 ppl/sq. mile[b]	4.8 housing units/sq.mile[b]
Median age	41.6[a]	Compared to 39.1 statewide average[a]
Total number of housing units	11,410[a]	86.6% of housing units are occupied[a]
Housing units for seasonal, recreational or occasional use	724[b]	n/a
Median home price	$182,300[a]	Compared to $247,200 statewide average[a]
Median household income	$46,814[a]	Compared to $53,270 statewide average[a]
Workforce employment	11,117[a]	Largest sectors of the workforce are in management, business, science, and arts[a]
Poverty rate	14.5%[a]	Compared to 15.7% statewide average

Data Sources:
a. U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates.
b. U.S. Census Bureau. 2010.

Fire Environment and Wildfire History

Wildland fire has been an ecologically important and frequently occurring natural disturbance process throughout the terrestrial ecosystems within Wasco County and the surrounding area since before human settlement. Since human development on this landscape, wildfire is now a hazard that has regularly impacted property and public safety. Wildfire conflagration declarations are enacted when fires are expected to overwhelm local resources' ability to protect human development and these occur on a regular basis in Wasco County. Continued development, climate change, and land use policy changes are all factors that are increasing the impacts of wildfire on the county's developed areas. Table 2 (below) summarizes some of the most significant recent wildfires that have occurred in Wasco County.

[6] Wasco County 2040: https://wasco2040.com/2017/08/09/wasco-county-payroll-and-employment-growth-2016/
[7] Wasco County 2040: https://wasco2040.com/2017/08/11/locations-of-employment/

Table 2: Overview of Community Significant Fires (1998to 2018)				
Fire Name	**Year**	**Size (acres)**	**Evacuations**	**Significant effects**
Rowena	1998	2208	yes	conflagration declared
Antelope	2000		yes	conflagration declared
Sheldon Ridge	2002	12,261	yes	conflagration declared
White River	2002		yes	conflagration declared
Microwave	2009	1225	yes	conflagration declared
Government Flats Complex	2013	11,450	yes	conflagration declared, 4 homes destroyed, $15 mil damage
Rowena	2014	3,680	yes	conflagration declared
Nena Springs	2017	68,000	yes	conflagration declared
Wasson Pond	2017	123	yes	conflagration declared
Jack Knife	2018	15,000		
Box Car	2018	100,207	yes	
Substation	2018	78,425	yes	conflagration declared, one fatality, four homes and 48 other structures destroyed
Long Hollow	2018	33,451		
South Valley	2018	20,026	yes	conflagration declared, three homes and 12 other structures destroyed
Memaloose 2	2018	167	yes	conflagration declared
Data Sources: 2012 Wasco County NHMP; Oregon Department of Forestry Fires List http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/fires/FIREStlist.asp				

❖ Community Analysis

In addition to understanding the local planning context, CPAW team members gather information through facilitated conversations and meetings with stakeholders, field tours, and internal research. CPAW team members also review and analyze community plans, policies, and regulations to determine their level of effectiveness for community wildfire mitigation. This information is compiled into an internal audit and reviewed with the local CPAW steering group. Based on the outcomes from this process, the CPAW team identified local planning challenges and opportunities.

Local Planning Challenges

- **Historic and current wildfire activity.** This year's wildfire activity in Wasco County underscored the past and ongoing threat of wildfires in the region. Fires such as the Substation and Boxcar spread quickly due to gusty winds, low relative humidity, fuel continuity, and other factors that are increasingly common during summer months in Central Oregon. In addition, climate change projections for Wasco County show a 38% increase in very high fire danger days per year.[8]
- **Changes to agricultural practices.** Many ranches and farms throughout the county maintain active fire management and response equipment to ensure they are prepared for wildfires that may affect their property. However, new agricultural best practices promoting non-crop fields to maintain vegetation cover year-round have resulted in unintended consequences: non-crop field cover has created continuous wildland fuels instead of previously fallow fields which served as natural "fuel breaks" that interrupted grass fires occurring on agricultural lands.
- **Potential for WUI growth.** The county has many large ranches and agricultural tracts (Figure 5). Although there are many limits to allowing new residences, some areas could be subject to future partitioning or subdivision. The combination of new structures and changes to vegetation would result in increased WUI areas in the county. This would require additional enforcement to ensure fire protection standards are appropriately implemented to reduce wildfire risk to properties.

Figure 5. Changes to land use and agricultural practices are potential challenges to the WUI in terms of water supply and availability, structure density, and service coverage.

- **Limited fire response and suppression capabilities.** The county's fire protection districts mirror challenges and trends seen across the West: some unincorporated areas of the county are currently not under the protection of any fire district; fire protection districts have limited resources to support the large land area of the county under their protection; and a shrinking and aging volunteer force has reduced the number of capable first responders available for wildfire suppression activities. These factors must be considered when approving new development in the county.

[8] Dalton, M., and Rupp D. 2018. Oregon Climate Change Research Institute. Future Climate Projections: Wasco County.

Local Planning Opportunities

- **Growing awareness of wildfires.** Given the 2018 wildfire season, community stakeholders engaged in CPAW shared that elected officials and residents expressed a sharp interest in how the county is planning for future wildfires. This provides a helpful setting for discussions related to land use planning, future development decisions, and wildfire risk.
- **Multiple planning updates in the near-term.** Wasco County is in the midst of updating its Comprehensive Plan (Wasco County 2040) and Natural Hazards Mitigation Plan. Within the next year, the county will also embark on an update of its CWPP. The alignment of these plan updates makes it easier to reorganize and revise content to ensure plans are synergistic and mutually reinforce long-term goals related land use, wildfire risk, and the WUI.
- **New countywide wildfire assessment products.** The USFS Rocky Mountain Research Station is providing the county with new countywide assessment products that comprehensively assess wildfire hazard and the local WUI. These products incorporate local stakeholder expertise and will be used to improve decision support for planning policies and regulations countywide. They can also be used to inform the future Community Wildfire Protection Plan. This process used the same base data as the Oregon Wildfire Risk Explorer project; however, it was further refined with local stakeholder input and is presented in a format that better supports land use planning tools.
- **Existing Fire Safety Standards.** Many communities face public or political resistance when proposing wildfire regulations for the first time. It is typically easier to revise existing regulations because they are already embedded in the planning process. In this case, Wasco County has an advantage when modernizing its fire protection standards because they are already in place.
- **State adoption of WUI building code regulations.** The state of Oregon is working with stakeholders from across the state to receive input on the adoption of an optional WUI Code appendix to the state building code. If this effort moves forward, it would enable local adoption of this appendix for any jurisdiction seeking to regulate its WUI through building construction and materials.

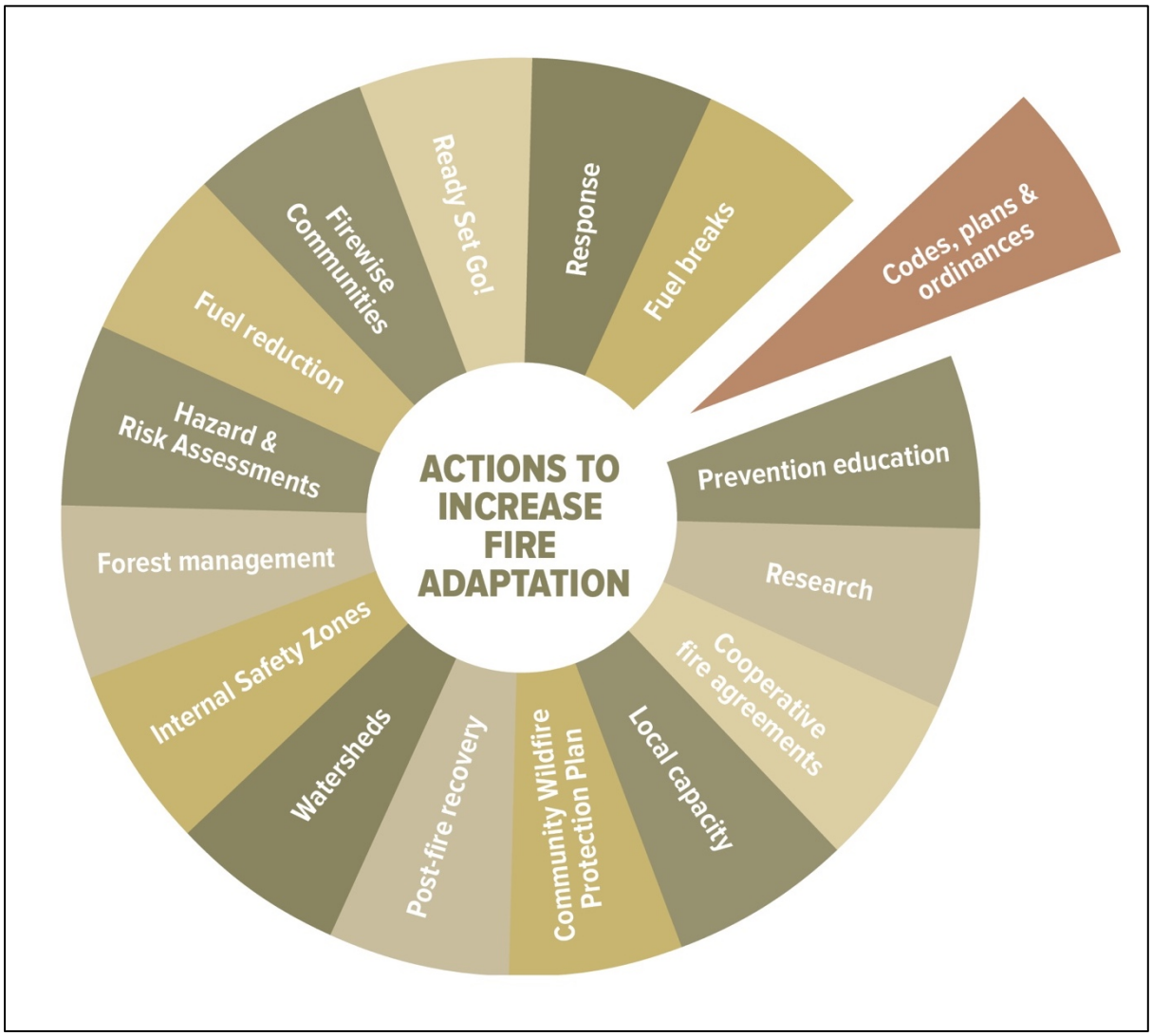

Figure 6. Community fire adaptation requires a multi-pronged approach. Wasco County has many of these pieces in place already, and updates to its Comprehensive Plan, Hazard Mitigation Plan, and Community Wildfire Protection Plan will help coordinate future activities.

Summary of Recommendations

Table 3. Overview of Recommendations		
Recommendation	**Summary**	**Key Points**
RECOMMENDATION 1: Update the Wildland-Urban Interface (WUI) and Update the WUI Risk Assessment	The current risk assessment used in the Community Wildfire Protection Plan was developed in 2005. An update can make use of new data and assessment methodology which can provide land use planning decision support.	• An update can provide a countywide scale and resolution- appropriate assessment that can be used for land use planning decision support. • The county and local agency partners have an opportunity to re-engage in parcel-level assessments to determine susceptibility.
RECOMMENDATION 2: Include Wildfire Goals in Wasco County 2040 to Support Hazard Plan Implementation	Wasco County is currently updating its Comprehensive Plan, providing a timely opportunity to re-evaluate how wildfire is addressed in its long-term goals and policies.	• Future wildfire-related content in Wasco County 2040 should be kept general; for detailed information, readers should be directed to the Community Wildfire Protection Plan. • General goals and policies should consider wildfire by acknowledging its role in shaping the natural environment and linking future development decisions with long-term planning outcomes that support safe and resilient communities.
RECOMMENDATION 3: Update Wasco County Community Wildfire Protection Plan	Wasco County developed its first CWPP in 2005 and it has not been updated since that time. CWPPs are central to communities' ability to plan for and mitigate against the threat of wildfires. A CWPP update aligns well with the timing of Wasco County 2040.	• A CWPP update requires a dedicated Wildfire Coordinator position and wildfire steering committee to facilitate a collaborative, stakeholder-oriented process. • Updated CWPP content will ideally reflect national best practices and incorporate local information that addresses resilient landscapes, fire-adapted communities, and response and suppression capabilities.
RECOMMENDATION 4: Update Wasco County Fire Safety Standards to Reflect Current Best Practices	The current Wasco County Fire Safety Standards provide a strong foundation for updates to current best practices and alignment with a defendable hazard assessment.	• Update the standards to align with the most current best practices. • Adopt the Oregon State Building Code Section 327. • Use the CPAW wildfire hazard assessment to guide mitigation requirements. • Implement a program to ensure compliance.

RECOMMENDATION 1: Update the Wildland-Urban Interface (WUI) and Update the WUI Risk Assessment

❖ Why This Recommendation Matters

Overview of Wasco County Wildfire Risk Assessment History

The most current county wildfire risk assessment was conducted in 2005 as part of developing the Wasco County Community Wildfire Protection Plan (CWPP). The assessment is based on the requirements of the Oregon Forestland-Urban Interface Fire Protection Act (SB 360) and was conducted at a "zone" and community level, where the county was divided into five zones and the zones and communities within the zones were assessed. The zone boundaries are based on similar topographic, land use, and jurisdictional characteristics with the portion of the Warm Springs Reservation in Wasco County as one zone. The five zones that were established within the county are:

- **Zone 1:** Northwest Wasco County
- **Zone 2:** Northeast Wasco County
- **Zone 3:** West-Central Wasco County
- **Zone 4:** South-East Wasco County
- **Zone 5:** Confederated Tribes of the Warm Springs Indian Reservation

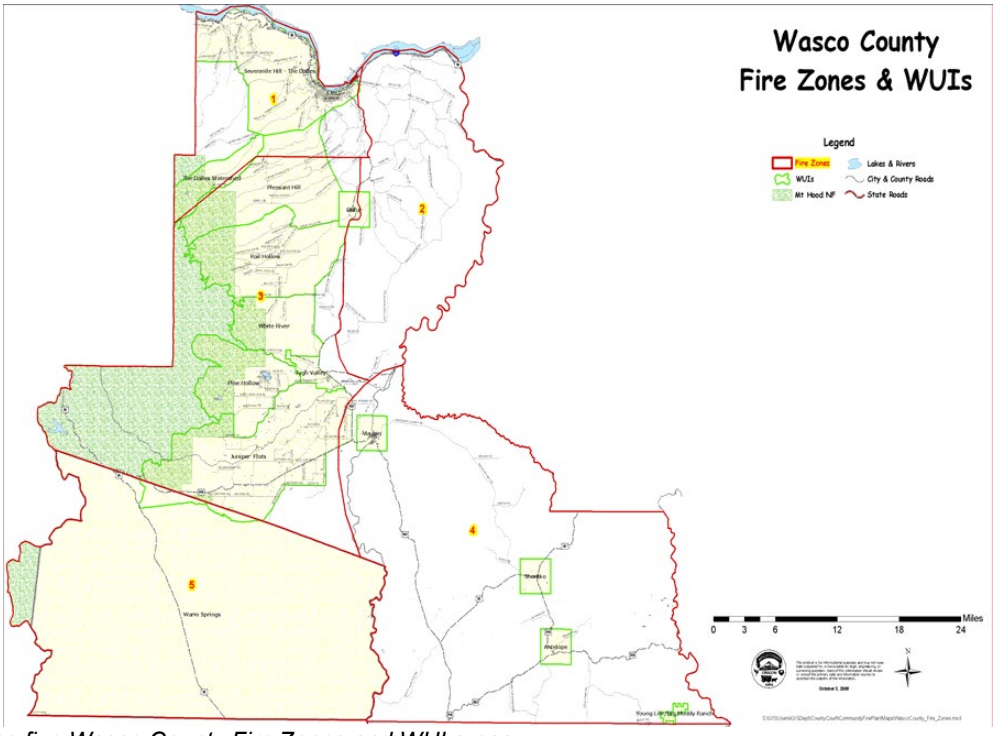

Figure 7. The five Wasco County Fire Zones and WUI areas.

The forestland-urban interface areas within the zones were classified by a five-member classification committee according to state definitions of "suburban," "urban," or "rural" lands within the county. The methodology for the risk assessment within these zones was developed by the Oregon Department of Forestry (ODF) and involved the four factors: Ignition Risk, Hazard, Values Protected, and Protection Capability.

Ignition Risk

This factor represents the likelihood of a wildfire occurring. The assessment for Ignition Risk looks at three criteria: historic fire occurrence (number of fires per 1,000 acres per 10 years), density of homes per 10 acres, and other risk factors.

Hazard

This factor represents the resistance to control once a wildfire starts. It includes weather, topography, and vegetation (fuel) that adversely affects suppression efforts.

Values Protected

This factor represents the human and economic value associated with communities or landscapes. Protection of life is the number-one priority with all agencies and is measured by the density of homes. In addition, the presence of community infrastructure is another consideration.

Protection Capability

This factor includes the capacity and resources to undertake fire suppression and prevention activities. It involves a combination of capacities of the fire protection agencies, local government and community organizations. A high score represents a high risk/low protection capability.

Structure Vulnerability (Not Included in the Final Assessment)

The 2005 CWPP indicates that the document does not include an intended fifth factor—structure vulnerability (based on the National Fire Protection Association 1144 Standard) because the data collection for this factor has not been completed yet.

Final Overall Rating

The above factors were given weighted scores established by ODF. Each individual factor was delineated into weighted criteria scores. Criteria scores were added for a total score for the factor. The scores for the factors were added and used to establish the overall rating of Low, Moderate, and High for each zone or community.

Table 4. Wasco County 2005 CWPP Zone-Level Wildfire Risk Ratings	
Zone	**Overall Wildfire Risk Rating**
1. Northwest Wasco County	High
2. Northeast Wasco County	Moderate
3. West-Central Wasco County	High
4. Southeast Wasco County	Moderate
5. Confederated Tribes of the Warm Springs Indian Reservation	Localized Assessment Completed (see 2005 Wasco County CWPP for details)

Advanced Oregon Wildfire Risk Explorer

In 2018, the Oregon Department of Forestry (ODF) released an online mapping platform called the Advanced Oregon Wildfire Risk Explorer.[9] This new tool uses updated wildfire risk data generated during the the multi-agency (federal and state) Region 6 risk assessment, which was completed in 2017. The online viewing platform provides a number of spatial layers that can be used by wildfire planning professionals and residents alike. It also offers defensible space, wildfire history, and local contact resources to residents based on their address inputs. Further development of this platform to provide additional layers appropriate for decision support of land use planning policy and regulation would be a desirable addition.

The Need for an Updated Risk Assessment

Current research and best practices typically describe the wildland-urban interface as a "set of conditions"[10] in which both vegetation (wildland fuels) and the built environment (built fuels) are influenced by weather and topography to create an environment where fire can ignite and spread through this combined fuel complex (the combination of wildland and built fuels). Although the ODF assessment used for the 2005 CWPP was comprehensive at that time, changes to vegetation (e.g., growth, fire occurrence, forest health, mitigation projects, agricultural practices), the built environment (e.g., development, urban growth), and climate conditions will affect local wildfire hazard.

The updated data and outputs within the Oregon Wildfire Risk Explorer address most of the above issues; however, the product is not refined to the county level using local stakeholder input and does not (yet) include a layer that provides the appropriate format, scale, and resolution to best inform land use planning policies and regulations. Therefore, an updated countywide risk assessment and spatial definition of the WUI is necessary to provide decision support for land use decisions.

[9] http://tools.oregonexplorer.info/OE_HtmlViewer/Index.html?viewer=wildfireplanning
[10] Cohen, Jack D. 2000. Preventing disaster: Home ignitability in the wildland-urban interface. Journal of Forestry 98(3): 15-21 https://www.fs.fed.us/rm/pubs_other/rmrs_2000_cohen_j002.pdf

What is Wildfire Risk?

Wildfire risk can be visualized as a triangle consisting of three components:

1. Likelihood of a wildfire occurring based on topography, weather, and ignition patterns; this can also include ignition sources from hazardous land uses (e.g., sawmills or propane storage facilities);

2. Predicted intensity of a wildfire (usually measured in flame length) based on vegetation type and weather conditions;

3. Susceptibility of values (for land use planning purposes, values consist of communities, structures, and infrastructure).

Together, these components complete the wildfire risk triangle (Figure 8).

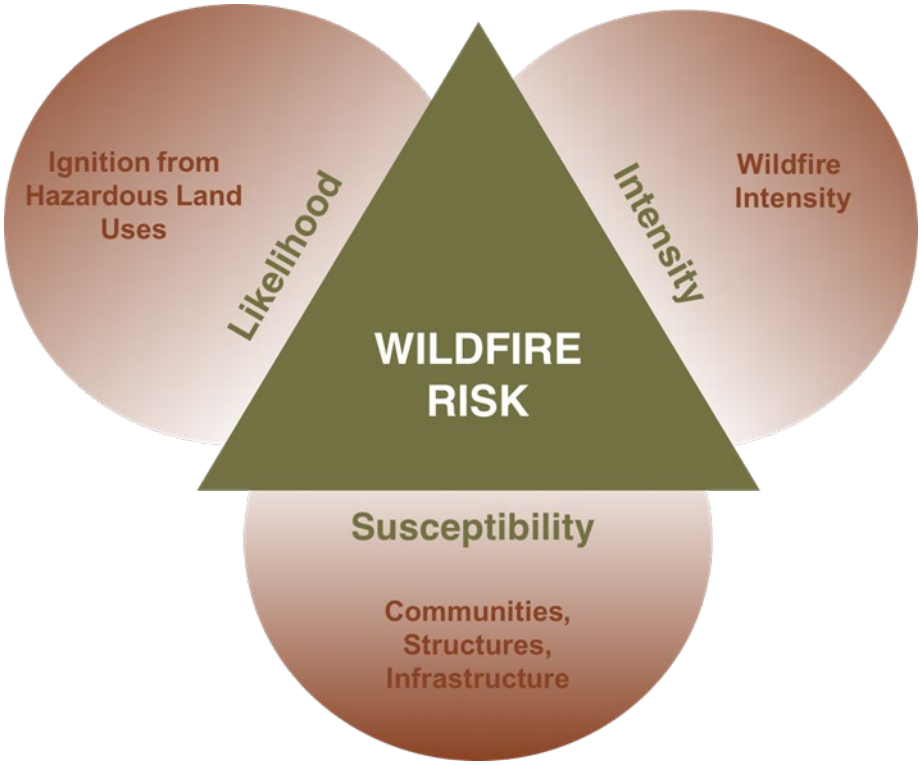

Figure 8. Components of the wildfire risk triangle.

Land use planning largely focuses on mitigating the susceptibility portion of the wildfire risk triangle. There are two important susceptibility inputs that should be evaluated to appropriately determine wildfire risk in the context of land use planning:

- The location and density of structures and infrastructure;
- The ignition potential of individual structures and infrastructure.

Implementing this recommendation will provide clear definition of Wasco County's wildland-urban interface and integrate a hazard assessment map as a component of the decision support tool for land use policies and regulations. The further incorporation of a property-specific assessment system to complement the hazard assessment with a built environment susceptibility component will provide a comprehensive risk assessment.

USFS Risk and Hazard Assessment

As part of the CPAW program, the USFS Rocky Mountain Research Station (RMRS) provides wildfire risk and hazard assessment support. After assessing the current need, the CPAW team engaged the RMRS to undertake an updated and refined countywide hazard assessment (likelihood and susceptibility) to support this project. As a component of the hazard assessment, the RMRS is also undertaking the SILVIS lab's approach to spatially defining the WUI in Wasco County. The data used to undertake this assessment is based on the same Region 6 data used in the Oregon Wildfire Risk Explorer, further refined using specific local stakeholder input.

Parcel-Level Susceptibility Assessments

Individual Parcel-Level Assessments complete the risk triangle by providing the susceptibility component. This focuses on assessing each structure and the immediate surroundings, or Structure Ignition Zone (SIZ). The 2005 CWPP indicates that these type of assessments were undertaken but not completed. The county and stakeholders should consider re-engaging in parcel-level assessments by providing susceptibility data for individual structures and infrastructure to complete the susceptibility component of the risk triangle.

❖ Implementation Guidance

As part of the CPAW process, RMRS staff engaged with local wildfire risk subject matter experts to achieve three main objectives:

1. Validate the RMRS spatial fuels layers.
2. Explore RMRS tools that can be used to develop a countywide hazard map to complement the Region 6 Risk Assessment process and better support land use planning and other wildfire risk reduction efforts.
3. Spatially define the WUI.

This collaborative engagement was undertaken in the form of a workshop in which local subject matter experts worked with RMRS staff and CPAW team members to determine the appropriate parameters and tools that would be useful in supporting local risk-reduction efforts.

As a result of this collaborative work, RMRS has calibrated the spatial fuel layer and developed a methodology to provide spatial hazard assessment support to the development and implementation of land use planning policy and regulations.

Wildfire Hazard Assessments and Mapping

To provide an effective decision-support tool for the county and its partners, RMRS developed the following wildfire hazard mapping outputs. Three maps are provided at two scales; the Landscape-Level Wildfire Hazard (270 m pixels), Local Wildfire Hazard (30 m pixels which includes ember zones), and Mitigation Potential (30 m). A summary of the methodology used to develop these outputs can be found in Appendix A.

Landscape-Level Wildfire Hazard

This scale (120 m pixel resolution) represents the likelihood (probability) of a fire occurring and the intensity of the fire at the landscape level based on the inherent landscape characteristics including broad existing vegetation, biophysical settings, fire regimes, and fire histories. To provide the assessment in a format that is easily interpreted by the expected users (public, developers, land use planners), the pixelated display was summarized to polygon boundaries based on the U.S. Geological Survey Hydrological Unit Code (HUC) 12 (sub-watershed) boundaries. The landscape-level hazard assessment is delineated into the following rankings:

- **MODERATE**
- **HIGH**
- **VERY HIGH**

The factors influencing these rankings can be used to determine the potential landscape-level exposure that a development will be subject to. The ranking at this scale is difficult to change at the local/parcel level. Mitigation affecting change at this scale is typically done by large-scale disturbances such as insect mortality, fires, or landscape-level mitigation.

Land Use Planning Application: This informs land use planners on the general areas where fires are most likely to occur and where collaborative, multi-agency, large-scale fire management planning and mitigation is necessary.

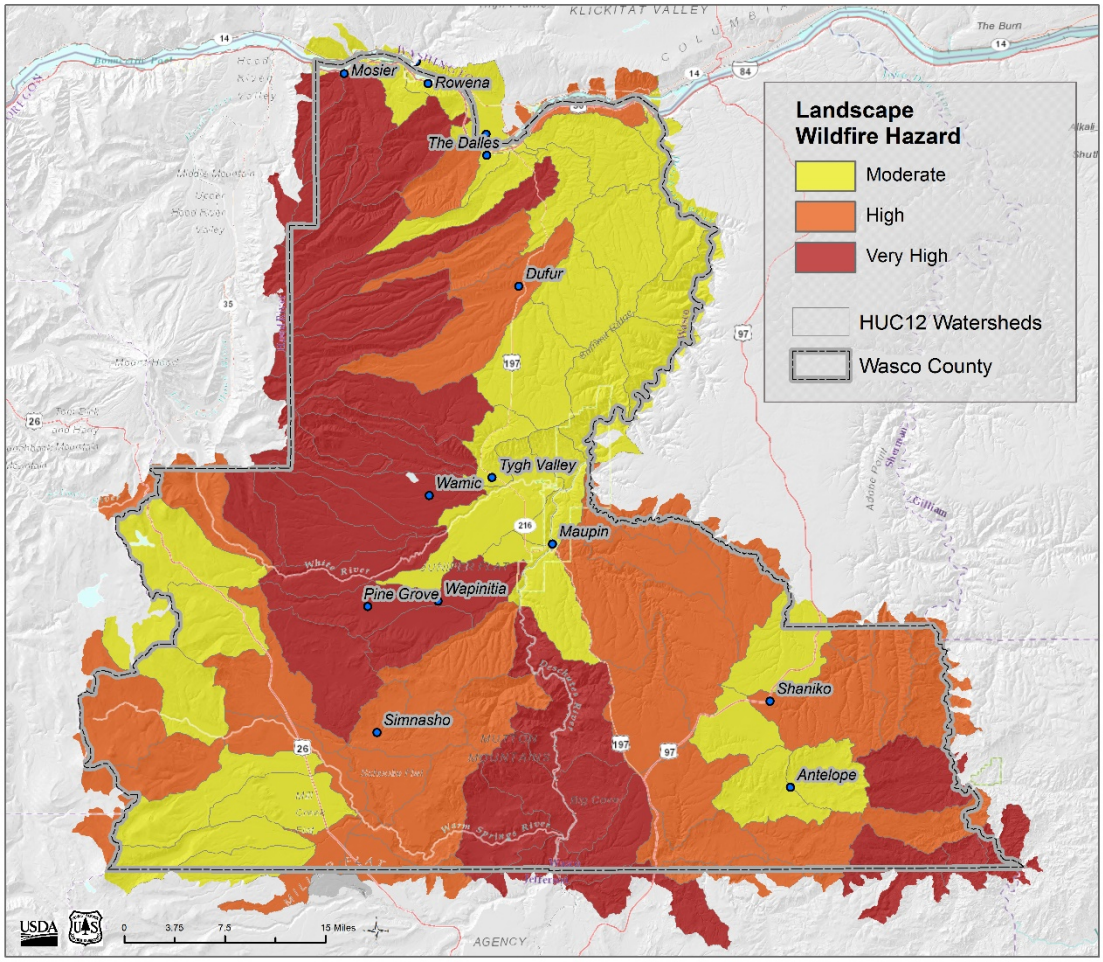

Figure 9. Wasco County Landscape Wildfire Hazard Map

Local-Level Wildfire Hazard

This scale (90 m pixel resolution) is based on an extreme event (worst fire days). To provide the assessment in a format that is easily interpreted by the expected users (public, developers, land use planners), the pixelated display was summarized to polygon boundaries based on the catchment boundaries within the HUC 12 boundaries. This does not show the likelihood of a fire occurring but does shows where fires are likely to burn at high intensity. For example, a fire that starts in an area where the local hazard is high can spread fast and burn at high intensity creating significant wildfire exposure to any structures in the area. The same rankings used at the landscape scale are used at this local scale:

- **MODERATE**
- **HIGH**
- **VERY HIGH**

Land Use Planning Application: This informs land use planners on the relative worst-case (hottest, driest, windiest days during a fire season) wildfire exposure (radiant, convective, and ember) that can be expected in any given polygon where development exists or is planned.

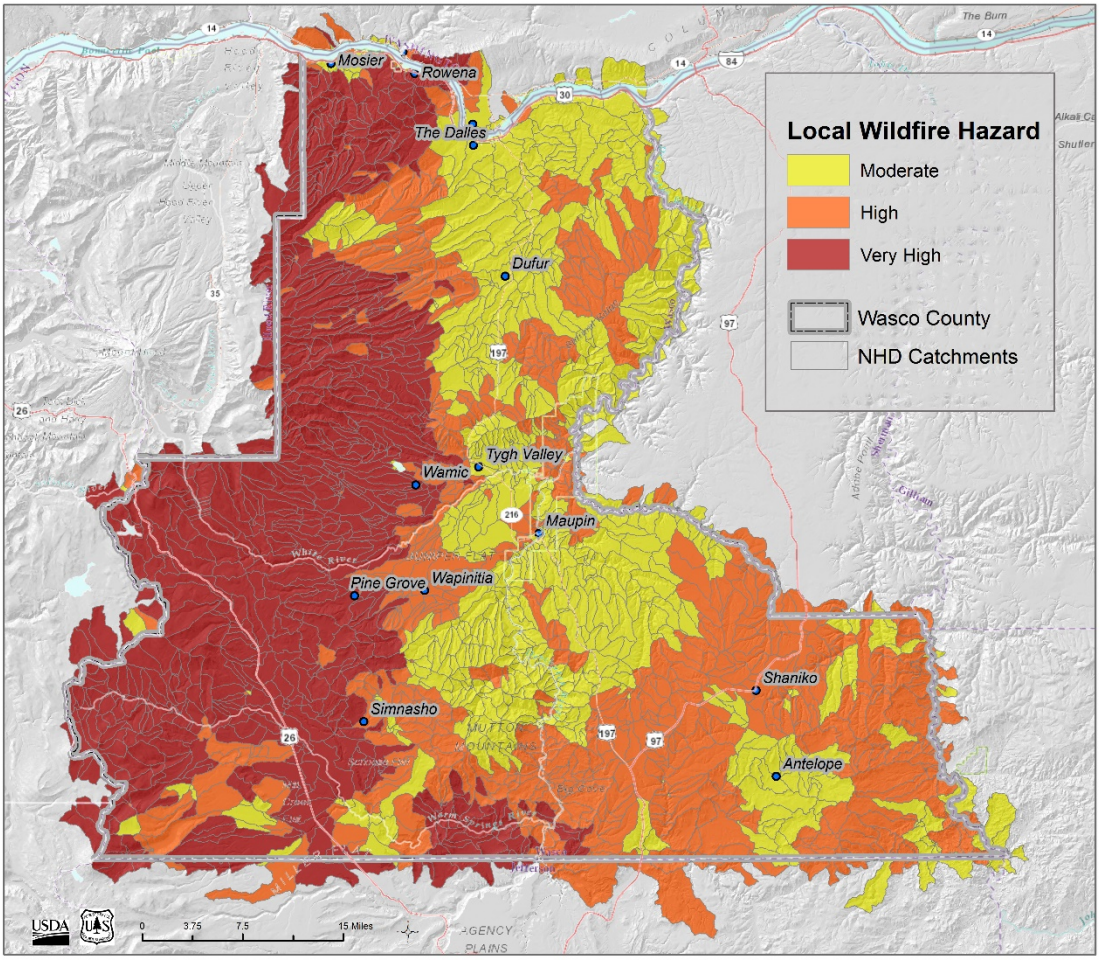

Figure 10. Wasco County Local Wildfire Hazard Map

Mitigation Difficulty

The Mitigation Difficulty component (30-meter resolution) uses the life form (grass, shrubs, trees), slope, and crown fire potential to classify the potential mitigation success of any given 30-meter pixel on the map. This is represented by six categories.

Table 5. Mitigation Difficulty Classes and Descriptions		
Class	**Characteristics**	**Mitigation Discussion**
1	Non-vegetated, with potential for ember impact	Barren ground/water/sparse vegetation or land that lies within potential spotting distance of a wildfire. Mitigation will involve appropriate structure ignition zone and structure construction.
2	Herbaceous on a shallow slope (< 15%)	Fires are typically easier to suppress in these areas. However high winds combined with dry conditions leads to potentially dangerous fast moving high intensity fires. Mitigation may involve a combination of irrigation, mechanical (mowing) treatment, frequent burning, and fuel breaks in conjunction with appropriate structure ignition zone and structure construction.
3	Herbaceous on moderate slope (15≤ to <30%)	Harder to construct fuel breaks, increased difficulty in mechanical (mowing) treatment, increased potential for erosion, increased rate of spread and intensity may make frequent burning and other mitigation more difficult. Focus should be on appropriate slope setbacks, structure ignition zone and structure construction mitigation.
4	Herbaceous on steep slope (≥ 30%)	Significant challenges in fuel break construction, unlikely option for mechanical (mowing) treatment, significant potential for erosion, high rate of spread and intensity potential may make frequent burning and other mitigation difficult. High winds combined with short-term drying conditions leads to potentially dangerous fast-moving fires with fire fighter access concerns. Mitigation potential may involve a combination of frequent burning, and fuel breaks in conjunction with slope set-back along with appropriate structure ignition zone and structure construction.
	Shrub on shallow slope (< 15%)	Fires are typically harder to suppress than grassfires in these areas. High winds combined with dry conditions lead to potentially dangerous fast moving high intensity fires with fire fighter access concerns. Mitigation may involve a combination of frequent burning, and fuel breaks in conjunction with appropriate structure ignition zone and structure construction.
5	Shrub on moderate slope (15≤ to <30%)	Harder to construct fuel breaks, increased difficulty in mechanical (mastication) treatment, increased potential for erosion, increased rate of spread and intensity may make burning more difficult. Focus should be on a combination of appropriate mechanical treatment and burning, slope set-backs, structure ignition zone and structure construction mitigation.
6	Shrubs on steep (≥30%) slopes	Significant challenges in fuel break construction unlikely option for extensive mechanical (mastication) treatment. Significant potential for erosion or slope instability resulting from treatments is a likely mitigation challenge. Increased rate of spread and significant intensity may make burning more difficult. Focus should be on a combination of appropriate mechanical treatment and burning, slope set-backs, structure ignition zone and structure construction mitigation.
	Tree on shallow slope (< 15%)	Open canopy must be maintained to prevent increased crown fire potential. Surface fuels must be treated/maintained in a state that reduces the chances of fast moving surface fires. Mitigation should also include appropriate slope set-backs, structure ignition zone and structure construction mitigation.
7	Tree on moderate slope (15≤ to <30%)	Open canopy must be maintained to prevent increased crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated/maintained in a state that reduces the chances of fast moving surface fires. Increased potential for erosion or slope instability resulting from treatments can be a mitigation challenge. Mitigation should also include appropriate slope set-backs, structure ignition zone and structure construction mitigation.
	Tree on shallow slope (< 15%) with potential for crown fire	Dense canopy needs to be thinned to reduce crown fire potential. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate structure ignition zone and structure construction mitigation.
8	Tree on moderate slope with potential for crown fire (15≤ to <30%)	Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. Increased potential for erosion or slope instability resulting from treatments can be a mitigation challenge. Mitigation should also include appropriate slope setbacks, structure ignition zone and structure construction mitigation.

Table 5. Mitigation Difficulty Classes and Descriptions		
Class	**Characteristics**	**Mitigation Discussion**
8	Tree on steep slope (≥ 30%)	Open canopy must be maintained to prevent increased crown fire potential, which can be significantly difficult due to the slope. Surface fuels must be treated/maintained in a state that reduces the chances of fast-moving surface fires. Significant potential for erosion or slope instability resulting from treatments is a likely mitigation challenge. Mitigation should also include appropriate slope set-backs, structure ignition zone and structure construction mitigation.
9	Tree on steep slope (≥ 30%) with potential for crown fire	Dense canopy needs to be thinned to reduce crown fire potential, which may be extremely difficult, if not prohibitive due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. A very high potential for erosion or slope instability resulting from treatments is a likely mitigation challenge. Mitigation should also include appropriate slope setbacks, structure ignition zone and structure construction mitigation.

Land Use Planning Application: This informs land use planners on the general potential success and challenges of mitigation when aligning with the mitigation requirements of the Wildland-Urban Interface regulatory requirements.

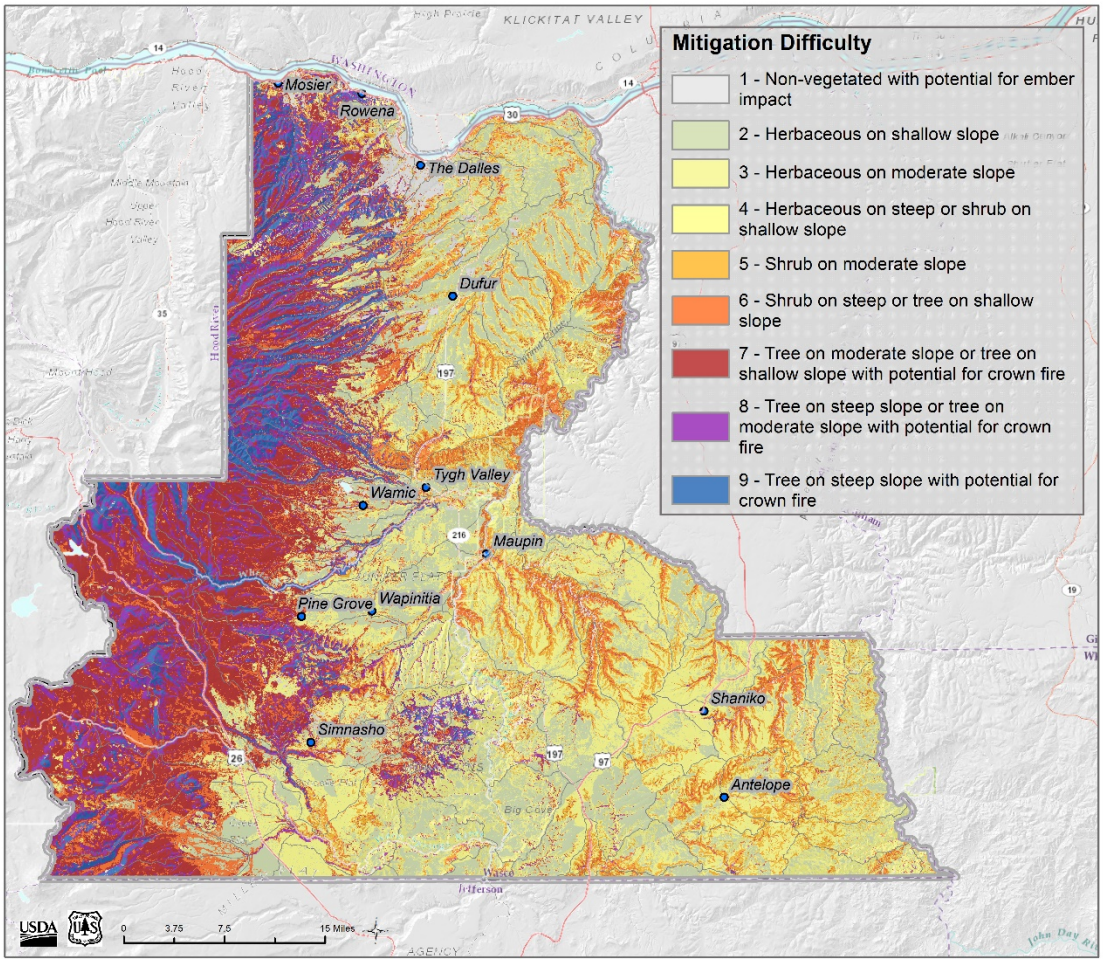

Figure 11. Wasco County Mitigation Difficulty Map

Parcel-Level Assessment

Parcel-level wildfire assessment requires a "boots on the ground" approach. Some fire districts within the county are already engaging in parcel-level assessments using a variety of assessment tools.

CPAW recommends the county re-engage with local stakeholders to gain a better understanding of the current data available and the gaps where a collaborative approach can facilitate the coordinated collection of countywide parcel-level assessment information.

Defining the WUI

A general WUI definition used across all policies, plans, and regulations should account for the "set of conditions" where vegetation (wildland fuels) and structures or infrastructure (built fuels) are influenced by weather and topography to allow fire to ignite and spread through the WUI environment. To provide the basis for a true understanding of the risk that Wasco County faces, the WUI should be more accurately defined as:

Any developed area where conditions affecting the combustibility of both wildland and built fuels allow for the ignition and spread of fire through the combined fuel complex.

In order to provide a spatial reference in defining the WUI, the SILVIS lab's approach should be used. The SILVIS lab approach originated in the Federal Register[11] report on WUI communities at risk from fire, and Tie and Weatherford's 2000 report to the Council of Western State Foresters on WUI fire risk. This approach focuses on the following inputs:

1. Housing density
2. Landcover[12]
    a) **WUI Intermix**: Areas with ≥16 houses per square mile and ≥50 percent cover of wildland vegetation
    b) **WUI Interface:** Areas with ≥16 houses per square mile and <50 percent cover of vegetation located <1.5 miles of an area ≥2 square miles in size that is ≥75 percent vegetated
    c) **Non- WUI Vegetated (no housing):** Areas with ≥50 percent cover of wildland vegetation and no houses (e.g., protected areas, steep slopes, mountain tops)
    d) **Non-WUI (very low housing density):** Areas with ≥50 percent cover of wildland vegetation and <16 houses per square mile (e.g., dispersed rural housing outside neighborhoods)
    e) **Non-Vegetated or Agriculture (low and very low housing density):** Areas with <50 percent cover of wildland vegetation and <128 houses per square mile (e.g., agricultural lands and pasturelands)

[11] USDA and USDI. 2001. Urban wildland interface communities within vicinity of Federal lands that are at high risk from wildfire. Federal Register 66:751–777.
[12] Schlosser, W.E. 2012. Defining the Wildland-Urban Interface: A Logic-Graphical Interpretation of Population Density. Kamiak Ridge, LLC.

f) **Non-Vegetated or Agriculture (medium and high housing density):** Areas with <50 percent cover of wildland vegetation and ≥128 houses density per square mile (e.g., urban and suburban areas, which may have vegetation, but not dense vegetation**)**

CPAW and RMRS have modified the above approach by removing the < 1.5 mile reference in b) and considering the entire county as an "ember zone." Due to this outcome and for simplicity, the categories have also been modified into the following categories:

g) **WUI Intermix**: Areas with houses present and ≥50 percent cover of wildland vegetation

h) **WUI Interface:** Areas with ≥16 houses per square mile and <50 percent cover of vegetation.

i) **Vegetated- Uninhabited**: Areas with ≥50 percent cover of wildland vegetation and no houses (e.g., protected areas, steep slopes, mountain tops)

j) **Non-Vegetated:** Areas with <50 percent cover of wildland vegetation

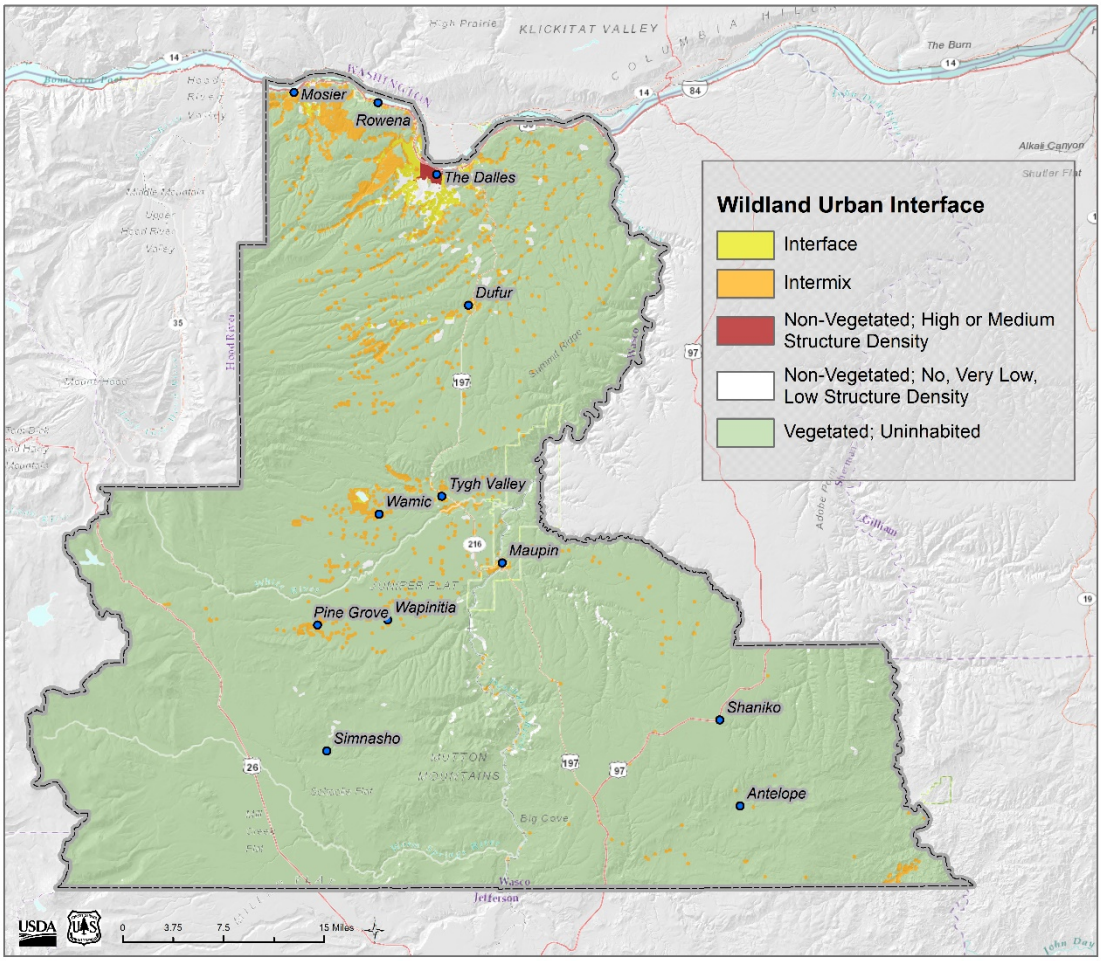

Figure 12. Wasco County Map of the Wildland Urban Interface and Wildland Urban Intermix

Using the Risk Assessment to Support Land Use Policy and Regulation

The landscape- and local-scale maps, as well as the mitigation potential wildfire exposure maps, will be supplied as a geodatabase to the county. This will allow the user to explore a hierarchy of hazard/exposure metrics including all of the elements described above. For example, if a user clicks on a watershed polygon or mitigation pixel, they will see the elements that contribute to the calculation of the final hazard rating. The display of pixel-level model outputs at finer display scales will also provide the ability for end-users to examine the spatial variability of factors contributing to hazard and exposure with any watershed. The local-scale map and mitigation-potential map will provide the opportunity for planners to appropriately assess a future or existing development area for wildfire exposure and require the appropriate mitigation. It will also provide a ranked scale to guide implementation of a wildland-urban interface code with regards to the degree of standards that must apply based on exposure and mitigation and whether the area is within the branding zone.

❖ Tips and Additional Resources

The resulting risk-assessment tool will be provided in the form of a geodatabase for addition to the county's geomatics servers for use as an ESRI ARC GIS layer. For the data to be made available to land use planners and the development community, the expertise of a GIS specialist will be required to ensure it is in the appropriate format for access and consumption by these groups.

The risk assessment tools must be kept up to date to be relevant. A minimum default 5-year update schedule is recommended, with recommended updates to occur based on the following:

- Significant wildland fire activity;
- Significant fuel management activity;
- Significant forest health impacts, or other disturbances that alter large-scale vegetation structure;
- Significant urban growth.

A best practices document (Appendix A) provides guidance to the county on the methodology for updating the assessment. The risk-assessment outputs should be strongly linked as a decision support tool for implementing the proposed WUI requirements and planning policies.

RECOMMENDATION 2: Include Wildfire Goals in Wasco County 2040 to Support Hazard Plan Implementation

❖ Why This Recommendation Matters

Wasco County is currently updating its Comprehensive Plan, which was first adopted in 1983. Since its initial adoption, the Comprehensive Plan has undergone multiple revisions—most recently in 2010—and is now in need of a full revision. The planning update process, known as Wasco County 2040, began in 2015 and final adoption of the plan will occur by 2020. The purpose of the update is to provide a long-term planning horizon for the next 20 years of anticipated growth and change. It also gives county staff an opportunity to engage the public in shaping the future of Wasco County.

Wasco County 2040 policies will lay the groundwork for an update to the Land Use and Development Ordinance and other local plans, implementation tools, and strategies.[13] Following discussions with Wasco County planning staff, Wasco County 2040 will relate to hazard plans, including the Wasco County Multi-Jurisdictional Natural Hazards Mitigation Plan and the Wasco County Community Wildfire Protection Plan (CWPP), by providing high-level goals and/or policies to support long-term implementation of hazard risk reduction. The most detailed information on wildfire and corresponding mitigation actions will be contained in the Wasco County CWPP. Wasco County 2040 therefore presents an important opportunity to support wildfire risk reduction across the county by providing a solid foundation of resilience-oriented community goals and policies upon which future hazard activities can be built.

❖ Implementation Guidance

Background on Current Comprehensive Plan

Wasco County's current Comprehensive Plan contains information on wildfire topics dispersed throughout the plan. References include:

- Detrimental effects of fire on local habitat and/or communities and other associated impacts (e.g., poor air quality);
- Fire disturbances on the land, including effects on rangeland and vegetation types;
- Detailed information on fire protection capabilities and fire protection districts;

[13] https://Wasco2040.com/faq/

- Wildfire-related policies to implement Goals #4 (Forest Lands) and #11 (Public Facilities and Services), including: fire safety standards for developments, requirements for on-site water supply, coordination with fire protection agencies on development approvals, and fire protection for rural areas.

Per staff discussions, many of the county's wildfire-related policies related to development are implemented through the fire safety standards required for developments and enforced through a self-certification process (see Recommendation 4). As part of the Comprehensive Plan update, planning staff intends to keep wildfire goals and/or policies at a high level and move detailed information into the CWPP, such as fire protection capabilities and specific mitigation actions to reduce structural ignitability. The CWPP will also be supported by several overarching goals and actions in the Natural Hazards Mitigation Plan, primarily focused on protection of life and property and emergency services enhancement. Figure 13 illustrates the relationship of these three plans.

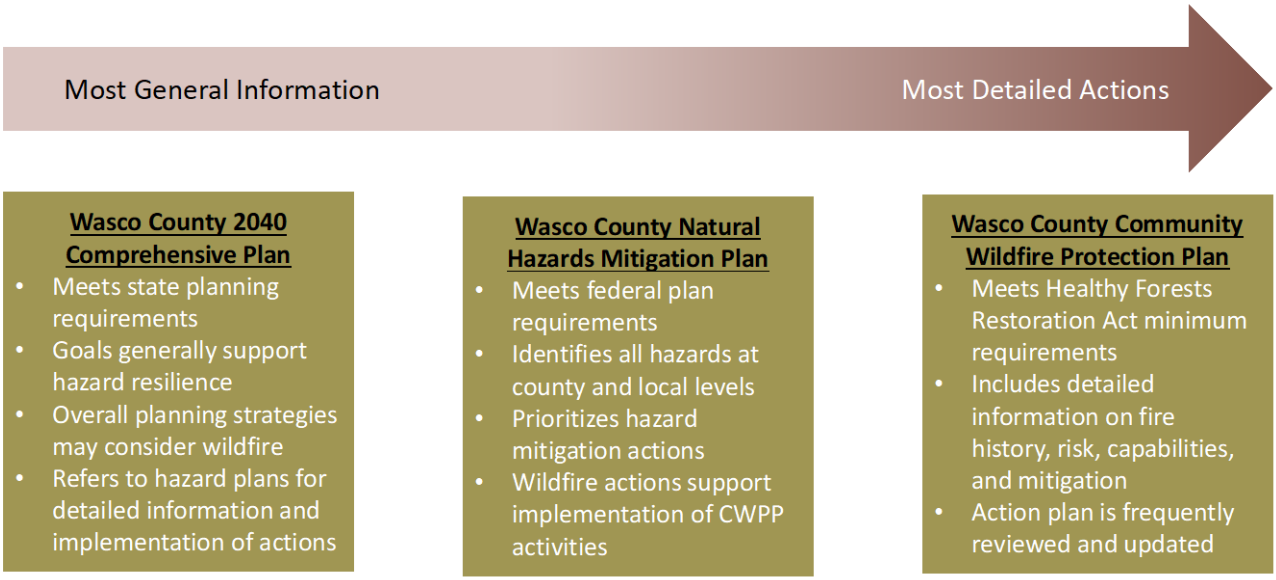

Figure 13. Relationship between Wasco County's three primary plans that link land use and hazard planning goals, data, priorities, and actions.

Moving Forward

In recognizing that Wasco County 2040 will address natural hazards at a more general level, there are several ways in which wildfire should be considered during the goal-setting and policy development process:

1. Recognize the Role of Fire on Natural and Built Environment

Wildfire is an ecological disturbance that has, and will, continue to shape the county's natural and built environments. While some wildfires have many negative consequences, others provide benefits to the environment—in many cases, it's a mix of both. Including a goal that acknowledges fire's roles (both positive and negative) sets the stage for implementation of

activities to mitigate negative outcomes, protect life and property, and, where appropriate, utilize fire as a land management tool.

2. Consider Wildfire Hazard As Part of Future Development Decisions

Wasco County is expected to grow in the next 20 years. New development will likely be considered in areas that are not currently in the WUI (see Recommendation 1 for an analysis on the county's WUI). As the county develops goals or policies related to future growth, planners should consider how development may result in an expanded WUI. Considerations for new development that will affect the county's WUI, such as increased exposure to wildfire, inadequate water supply, and limited suppression resources, are discussed below.

Figure 14. New development may reshape the county's WUI and should be considered in future growth discussions.

Housing and Population Density

Based on a recent inventory and analysis conducted by the county for A-1 (160), A-1 (40), F-1 (80), and F-2 (80) zones, a large number of parcels in these farm and resource zones have the *potential* for being partitioned or subdivided into smaller lots.[14] If areas are re-zoned to allow for an increased number of parcels that also allow for new housing units or other structures, this may expand the WUI. Without strict enforcement of fire protection standards, any additional unmitigated structures and properties in the WUI will strain response and suppression resources during a wildfire event. This is because WUI protection is regarded as the highest priority in suppression efforts after protection of human life, and is a main driver behind aggressive and expensive suppression efforts.[15] The county should carefully consider how and where it allows increases in structure density to avoid an additional resource burden associated with WUI suppression activities.

Water Supply and Availability

A 2018 report prepared by the Oregon Climate Change Research Institute projects that drought conditions, as represented by low summer soil moisture, low spring snowpack, and low summer runoff, will become more frequent in Wasco County by the 2050s. Groundwater levels in parts of the county are already declining due to unsustainable pumping rates, leakages, and long-term

[14] More information on the analysis is available at Wasco County 2040: https://wasco2040.com/2017/03/22/new-lots-in-resource-zones-farm-forest/

[15] Ellison, A., Moseley, C., and Bixler, P.R. Winter 2015. Drivers of Wildfire Suppression Costs – Literature Review and Annotated Bibliography. Accessible at http://www.nwfirescience.org/sites/default/files/publications/Suppression%20synthesis.pdf

climate variations.[16] Coupled with current and projected decreases of water supply is the net *increase* in demand by changing agricultural practices for more water-dependent crops, as reported by the Oregon Water Resources Department in its recent Integrated Water Resources Strategy (2017). Changes to both water supply and availability can have detrimental effects on the WUI and wildfire hazard. For example, drought conditions can lead to increased wildfire severity and intensity, which may put more residents at risk; response and suppression capabilities may be less effective without proper water resources due to decreased predictability of on-site and off-site water supplies, which limits the ability to protect lives and property.

Response Capabilities

Infrastructure and county services, including fire response and protection, are already limited in many rural areas, with some areas of the county not being under the protection of a rural fire protection district (except where mutual aid agreements are in place). Limited fire protection services are a result of many factors, including the geographic size of the county, ongoing challenges with volunteer recruitment and retention, and economic constraints. New development will further strain response capabilities unless adequate fire protection resources are also considered as a condition of growth. It is also important for residents to understand what they can expect in terms of service levels in their area.

To address these concerns, CPAW recommends that any applicable Wasco County 2040 goals that address new development and growth also consider wildfire and/or the WUI as an important criterion for evaluation. Actual policy implementation can reference the CWPP and hazard assessment map, but the Wasco County 2040 should establish an overarching goal to consider multiple factors, including wildfire hazard, when planning for future development.

❖ Tips and Additional Resources

Soliciting Public Input

As part of Wasco County 2040, the Wasco County planning staff and a Citizen Advisory Group have developed multiple public outreach opportunities, including local meetings and online surveys. These communication channels can be leveraged when doing goal-setting activities related to natural hazards (including wildfire), resilience, and natural resources.

Relevant Examples

The following examples may provide helpful language related to wildfire goals and policies for Wasco County to reference during its Comprehensive Plan update:

[16] Burns, E.R., Morgan, D.S., Lee, K.K., Haynes, J.V., and Conlon, T.D., 2012, Evaluation of long-term water-level declines in basalt aquifers near Mosier, Oregon: U.S. Geological Survey Scientific Investigations Report 2012–5002, 134 p.

- Jefferson County, CO's Master Plan, last amended in 2017, contains multiple references to wildfire that are integrated through the plan. There is one primary wildfire goal (page 35) to ensure that proposed land use is managed to decrease wildfire hazards. The first policy states: "New development should implement the mitigation recommendations outlined in the local Fire Protection District's Community Wildfire Protection Plan." There are additional policies that reference wildfire to support environmental stewardship, protection of wildlife habitats, forest management, and emergency management activities
- Missoula County, MT's Growth Policy, updated in 2016, contains an overarching goal (#11, pages 2-18) to reduce the safety risks and costs associated with wildland fire, flooding, and other hazards. The first objective discourages development in hazardous areas and identifies multiple actions to support this goal. Similar to Wasco County, the Growth Policy is intended to provide high-level guidance and looks to the CWPP to share more detailed information on wildfire mitigation.

RECOMMENDATION 3: Update Wasco County Community Wildfire Protection Plan

❖ Why This Recommendation Matters

Wasco County adopted its first Community Wildfire Protection Plan (CWPP) in 2005. The next anticipated CWPP update will occur in 2019. The timing of the update aligns well with other activities, including the county's participation in CPAW, Wasco County 2040, and completion of the Wasco County Natural Hazard Mitigation Plan update.

As part of these plan updates, the county intends to move much of the detailed information and policies for addressing wildfire from the current Comprehensive Plan to the next iteration of the Community Wildfire Protection Plan. This will streamline the planning process to ensure that wildfire activities are centrally located in one document; however, it also requires a thoughtful approach to the CWPP update to ensure that actions, including land use strategies to mitigate wildfire impacts, are well-designed for successful implementation.

❖ Implementation Guidance

Designate a Wildfire Coordinator

One of the highest priority actions called for in the CWPP is assigning a Wasco County Wildfire Coordinator (Part VI. Mitigation Strategy). This coordinator position was tasked with leading the implementation of the CWPP.

Based on discussions with staff, there is no one officially designated as the Wildfire Coordinator for Wasco County. By default, the responsibilities associated with this type of position are currently with Mr. Will Smith (Senior Planner, Wasco County). This is based on Mr. Smith's unique expertise in planning and wildfire. Formalizing a coordinator position ensures that the CWPP implementation duties are part of a staff member's job description.

This should occur before the CWPP update officially gets underway. Formalizing this role now ensures a smoother process for coordinating with other stakeholders, and designates a primary point of contact during the update. It is not to say that this position is tasked with implementing all of the activities, rather there is someone to manage the plan.

Create Wildfire Steering Committee

The Wasco County Wildfire Coordinator position was also tasked with working with a Steering Committee on future CWPP updates (Part VII. Continuing Actions). Similar to the coordinator

position, the steering committee plays an essential role in the CWPP development process by providing expertise, feedback, and long-term implementation support.

Some counties have formalized steering committees by creating a Wildfire Council through a county resolution that meets on a regularly-scheduled basis to check in on CWPP activities. CPAW recommends that Wasco County take a similar approach to ensure that the Wildfire Coordinator is developed through a collaborative process that includes a multi-disciplinary group of local experts.

Update Content to Reflect Current Best Practices

The 2005 CWPP provides a tremendous amount of helpful detail. However, much has changed at the local, state, and national level since the CWPP was written. Wasco County will likely have to consider a full re-write of its CWPP due to the extensive number of revisions required to incorporate new information.

As part of this re-write, CPAW recommends that Wasco County take an approach that aligns with the three three goals of the National Cohesive Wildland Fire Management Strategy ("Cohesive Strategy"): Creating Resilient Landscapes; Promoting Fire Adapted Communities; and Improving Response and Suppression Capabilities. This will update the content to reflect national best practices and provides for easy organization of a variety of wildfire concepts and mitigation activities.

To support the county's revision process, CPAW suggests the following outline for the CWPP update:

Table 6. Recommended Outline for Wasco County CWPP Update

Front Matter/ Introduction	
Acknowledgments and Signature Page	• Shows collaboration and required agency signatures per Healthy Forest and Restoration Act requirements
Executive Summary	• Provides overview of CWPP. • Confirms CWPP goals and requirements of the Healthy Forest Restoration Act. • Summarizes key topics and takeaways, such as priority actions, highest risk areas; notable achievements from prior CWPP. • Identifies other plans, policies, and regulations that support the implementation of CWPP.
Part 1: Understanding the Local Environment	

Area Description of Wasco County, Key Demographics	• Provides information to help readers understand broad influences on the planning area, including:
	  ○ Narrative description of geographic location and significant features.
	  ○ Local land ownership.
	  ○ Key demographics to consider when planning for local/vulnerable populations.

Table 6. Recommended Outline for Wasco County CWPP Update	
Defining the Wildland-Urban Interface	• Provides a formal definition and spatial delineation of WUI areas within the county that reflects the set of conditions resulting in negative wildfire impacts on communities.
Fire Environment, Fire Weather, Fire History	• Include inputs to the CPAW hazard assessment to illustrate the fire environment and explain these with interpretations and general implications for the county. • Reference other planning documents, such as the county and state hazard mitigation plans, which provide additional information on local fire history.
Part 2: Risk Assessment	
Risk Assessment	• Explains wildfire risk triangle to ensure readers understand the three primary components that drive risk: likelihood, intensity, susceptibility. • Describes the potential wildfire risk, and explains outputs with interpretations and general implications for the county. • Use the CPAW hazard assessment to provide the basis of risk assessment.
Part 3. Taking a Cohesive Strategy Approach	
Resilient Landscapes	• Introduces resilient landscape concepts, including local fire ecology and ecosystems, habitat types, watersheds, and primary stakeholders engaged in resilient landscape activities: o Synthesizes risk assessment outputs for landscapes o Identifies prioritized recommendations for mitigation o Ecology/Ecosystem-based fire management o Fuel treatments for landscapes (public and private) o Role of prescribed fire and smoke management o Post-fire effects and recovery o Land management planning (state, national forest)
Fire Adapted Communities	• Introduces fire adapted community concepts, including recent development trends and anticipated future growth in the WUI, and primary stakeholders engaged in fire adapted community activities: o Synthesizes risk assessment outputs for communities o Identifies prioritized recommendations for mitigation o Structural ignitability, property management and maintenance o Community values at risk (critical infrastructure, water supplies, cultural/tribal/historical sites, open space/recreation) o Public education/outreach programs (Firewise, Ready, Set, Go!) o Local government land use planning tools (policies, regulations, codes)
Response and Suppression Capabilities	• Introduces response and suppression capability concepts, including fire response topics, challenges and opportunities, and primary stakeholders engaged in response and suppression activities: o Synthesizes risk assessment outputs for response agencies o Identifies prioritized recommendations for mitigation o Response and suppression capabilities o Limitations in the county (fire flow, ingress/egress) o Emergency management/evacuation planning o Interagency cooperation o Existing coverage gaps

Table 6. Recommended Outline for Wasco County CWPP Update	
Part 4: Implementation and Action Plan	
Implementation Strategy and Action Plan	• Provides an action table to identify all CWPP actions. • Actions include assigned lead agency, timeframe for implementation, funding or resources required, potential sources of funding, and other applicable notes for implementation.
Implementation and Plan Monitoring	• Identifies frequency of plan updates and other monitoring mechanisms (e.g., if CWPP update is associated with other plan updates).
Appendices	
Definitions	• May include a glossary of definitions.
Additional Materials	• TBA (based on staff discussions/feedback).

Additional best practices to keep in mind during the revision process include:

- Reference other hazard plans, such as the county and state hazard mitigation plans, which may provide additional information on wildfire history, response capabilities, and land management activities.
- Reference other local planning documents, such as Wasco County 2040, to support the implementation of the CWPP and direct readers to other sources of community information.
- Include maps and visuals within the relevant sections throughout the plan for ease of reference by the reader.
- Consider providing spatial files of the maps as an online resource so readers can review the maps in detail.
- Include an introduction and summary for each major section to help readers quickly understand the purpose of each section and key takeaways.

❖ Tips and Additional Resources

Additional Resources and Local Examples

The Oregon Department of Forestry maintains a Community Wildfire Protection Plans page on its website.[17] This website includes state and national resources for CWPP development and evaluation, and links to available county CWPPs from across the state.

[17] https://www.oregon.gov/ODF/Fire/Pages/CWPP.aspx

Funding Opportunities for CWPP Implementation

Title III – County Funds (The Secure Rural Schools Act) was reauthorized by P.L. 115-141 and signed into law by the President on March 23, 2018. Authorized uses of Title III funds include developing and carrying out Community Wildfire Protection Plans. More information on authorized uses and funds is available here: https://www.fs.usda.gov/main/pts/countyfunds.

Sharing Project Outcomes

Many communities are creating public-facing webpages or story maps to make CWPPs easily accessible to a wide local audience. This eliminates the need for readers to download or print large documents and quickly conveys key points about the plan. For example, CPAW recently worked with Missoula County, MT to create a Missoula County CWPP Story Map that shared the primary takeaways of the plan, including benefits for updating the CWPP, local values at risk to wildfire, components of wildfire risk, and an overview of the county's wildland-urban interface. The project website can be accessed here.[18]

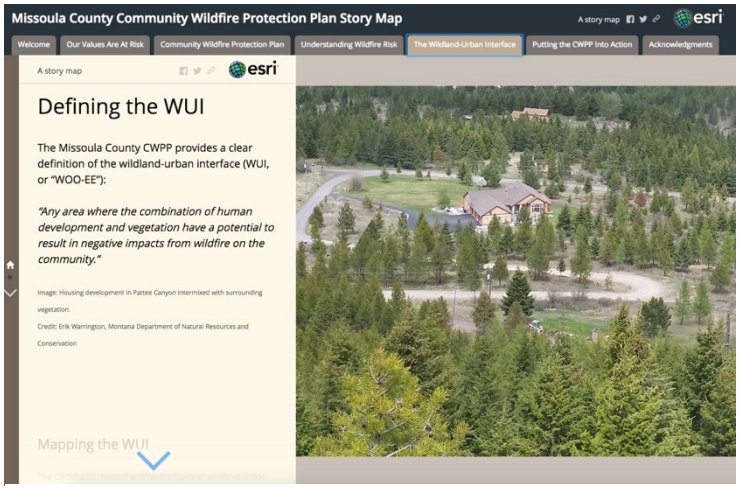

Figure 15. The Missoula County CWPP Story Map provides an accessible online resource for the public to learn more about the recently updated plan.

[18] Website: http://mcgis.maps.arcgis.com/apps/MapSeries/index.html?appid=29b21eb849db408c8b36960fff3cb3e6

RECOMMENDATION 4: Update and Strengthen the Wasco County Fire Safety Standards to Reflect Current Best Practices

❖ Why This Recommendation Matters

Overview of Current Wildfire Regulations

Wasco County regulates its wildland-urban interface through its Fire Safety Standards (Chapter 10) of the Land Use Development Ordinance. Standards address specific defensible space and structure mitigation requirements.

Summary of Fire Safety Standards

The following is a summarized list of the sections and topics covered in the current Wasco County Fire Safety Standards:

- Section 10.110 Siting Standards (including slope setback)
- Section 10.120 Defensible Space (to 50 feet)
    - Require modification of vegetation; modified “healthy” trees can remain.
- Section 10.130 Construction Standards
    - Chimney screening and clearance to trees
    - Fire resistant roof requirements (class A or B fire rated)
    - Projections (balconies, decks, gables, etc.)
        - encouraged to build with fire rated materials
        - clear of combustibles
        - screened with minimum ¼” or smaller non-combustible corrosion resistant screening.
    - Roof, wall or foundation vent—screened with minimum ¼ or smaller non-combustible corrosion resistant screening
    - Stand pipe—fire water supply
- Section 10.140 Access Standards

  - Driveway—surface, width, grade, turnouts, turnarounds, clearance, bridge and culvert widths and load capacity.
  - Private roads—meet county road standards or minimum standards of the 2004 Oregon Fire Code - Chapter 5

- Section 10.150 Fire Protection or Onsite Water Requirements
  - Inside Fire Protection District
    - Onsite water required to be supplied where structures are greater that 3,500 square feet
  - Outside Fire Protection District
    - NFPA Fire Sprinkler system
    - Forest Zone- Year-round onsite 4,000 gal water source, or creek or spring flowing at 1 cubic foot per second
      - Driveway (meeting standards) to within 10 feet of water source

Application of Fire Safety Standards

The Fire Safety Standards are in effect for all Rural Zones outside of the Urban Growth Boundary, however specific requirements vary based on zoning and use. The applicant can request a modification to specific standards if he/she is not in compliance.

Fire Safety Standards Review Process

Section 10.210- Fire Safety Review Process of the Fire Safety Standards provides the following requirements:

A. Compliance with applicable fire safety standards is required by the ordinance for new, replacement, and modified structures in all rural zones.

1. *Fire standards shall be made a part of the conditions of approval when a conditional use permit, site plan or subject to standards review, partition, subdivision, or other land use action is required prior to construction.*
2. *Structures or alterations to structures that are subject to ministerial review must also comply with all applicable fire standards prior to receiving zoning approval on a building permit application.*
3. *In all cases compliance with applicable fire standards shall be self-certified prior to receiving zoning approval on a building permit.*
4. *Certifications shall be verified within one year of approval and may be verified by staff site visits at any time.*

B. Continued compliance with fire safety standards is required.

Fire Safety Mitigation Plan

Section 10.230 of the Fire Safety Standards outlines the requirement for a Fire Safety Mitigation Plan when an applicant requests modification to one or more fire safety standards listed on the self-check list, or for any land division that creates lots for accommodating dwellings. The Fire Safety Mitigation Plan must address the standards within the checklist, demonstrate why the listed standards cannot be met, include a risk assessment, and include additional actions that will be taken to mitigate the increased risk.

Oregon State Building Code

The City of Ashland has been spearheading an initiative to adopt a Wildfire Hazard Mitigation Appendix (Appendix W) to the Oregon State Building Code. This initiative was reviewed by the Oregon Residential Specialty Code (ORSC) committee with a recommendation to proceed to rulemaking with the provisions inserted in Section R327 within the body of the code. It is yet to be determined whether this code will apply to every home built in wildfire hazard zones, or only to subdivisions of five or more homes. Once adopted by the state, Section R327 will become optional for local adoption by jurisdictions that will apply within their identified wildfire hazard areas.

When the Oregon Building Code Section R327 becomes available, CPAW recommends that the county adopt it. This will effectively address the second component of wildfire mitigation for individual structures in all new construction (possibly restricted to subdivisions of five homes or more). The county's spatial identification of the WUI (Recommendation 1) can provide the delineation of the wildfire hazard area.

Opportunities for Improvement

Develop Updated and Consistent Fire Safety Standards

Since the development of the existing fire safety standards, wildfire mitigation best practices have evolved and improved, based on new research and findings. Additionally, the use of zoning and use to determine the application of the standards creates a potentially complex and confusing process for the applicant and does not align with defendable wildfire mitigation science and best practices. Finally, the self-certification process leaves significant uncertainty as to a measure of whether the standards are being met and the goal of overall wildfire risk reduction within the county is being achieved.

Fire Safety Standards that are based on scientifically driven best practices, applied consistently across the county, and informed by a robust, scientifically based risk assessment (Recommendation 1) are both easy to follow and defendable. Updates to the current Fire Safety Standards will align with the current science and best practices. This provides an opportunity for the county to update current standards and apply them across the county. This will allow the county to:

- **Appropriately mitigate structure vulnerabilities to wildfire.** Based on the most up to date and defendable science and subsequent best practices.
- **Increase public and first responder safety.** Requiring updated and consistent siting, defensible space, construction, access and water supply standards across the county reduces likelihood of ignitions and increases ability for the public to safely evacuate and improves response capabilities.
- **Ensure consistency of standards.** Applying consistent standards to future development, building replacements, relocations, or property improvements provides a measurable way to address one of the county's most significant hazards.

Resolve Conflicts Between Regulations

Several existing standards in other sections of the county's Land Use Development Ordinance potentially conflict with wildfire mitigation efforts. This may impede or discourage developers and residents from taking action to reduce the wildfire risk to structures and infrastructure. To minimize barriers to wildfire risk reduction, staff should consider reviewing and updating other existing standards to resolve these potential conflicts.

❖ Implementation Guidance

To adequately plan for and address wildfire in the built environment, CPAW recommends Wasco County update the existing fire safety standards to reflect the most current best practices, as provided below.

1. Define the Wildland-Urban Interface

The existing Fire Safety Standards do not reference a spatial delineation of the WUI. **CPAW recommends that the county include a reference to the newly developed hazard assessment to define the WUI hazard area that the fire safety standards apply where the county has jurisdictional responsibility. Within this WUI hazard area, CPAW further recommends that the stringency of many of the requirements (Table 7) align with the local hazard rating.** This information will provide for a more accurate reflection of the local WUI. Refer to Recommendation 1 for more information on the assessment.

2. Update the Existing Fire Safety Standards to Align with Current Science and Best Practices

The existing Fire Safety Standards do not accurately reflect the most current science and best practices in WUI wildfire mitigation. Current best practices involve mitigation of the dwelling (structure) *and* the immediate surrounding area (defensible space). Together, the structure and defensible space is most commonly referred to as the "Structure Ignition Zone" (SIZ).

CPAW recommends that the county update the existing Fire Safety Standards with the changes and additions outlined in Table 7 (below).

TABLE 7: Recommended Changes to Fire Safety Standards		
Reference	Existing Requirement	Proposed Change
10.110 A.	**CHANGE FROM:** 40% grade	**CHANGE TO:** 30% grade to align with critical slope thresholds that affect fire behavior changes.
		ADD: **In Moderate, High and Very High Hazard Areas:** 15% To Less than 30% Slope, building setback must be at least 30 feet.
10.120	**CHANGE FROM:** 50-foot-wide fuel break • ground cover maximum 4 inches tall; • trees limbed up approximately 8 feet from the ground, • trees kept free from dead, dry, or flammable material; • ladder fuels must be removed; • no shrubs or tall plants under trees; • shrubs only in isolated groupings that maximize edges of ornamental beds to avoid continuous blocks of fuel; • keep shrubs and ornamental beds 15 feet away from edge of buildings and drip line of tree canopy; and • use well irrigated or flame resistant vegetation (See OSU Extension Service publication called "Fire Resistant Plants for Oregon Home Landscapes")	**CHANGE TO:** **In Moderate, High and Very High Hazard Areas:** 0-5 feet (slope adjusted) from furthest extent of dwelling and projections: • non-combustible surface; • no combustible vegetation; • no combustible materials; and • no landscape timbers. 5-30 feet (slope adjusted) from dwelling and projections (or to property line, whichever is less): • ground cover maximum 4 inches tall; • isolated deciduous or conifer trees limbed to height of roof; • trees kept free from dead, dry, or flammable material; • ladder fuels must be removed; • no tall shrubs or plants; • keep shrubs and ornamental beds 15 feet away from edge of buildings and drip line of tree canopy; • use only low flammability vegetation (See OSU Extension Service publication called "Fire Resistant Plants for Oregon Home Landscapes"); and • low growing shrubs only in isolated groupings that maximize edges of ornamental beds to avoid continuous fuels. **In High and Very High Hazard Areas:** 30-100 feet (slope adjusted) from dwelling and projections, or to property line (whichever is less): • Trees limbed up approximately 8 feet from the ground, • Trees kept free from dead, dry, or flammable material;

TABLE 7: Recommended Changes to Fire Safety Standards		
Reference	Existing Requirement	Proposed Change
		• Ladder fuels must be removed; • No shrubs or tall plants under trees.
Section 10.130	**CHANGE FROM:** • Fire resistant roofing installed to the manufacturers specification and rated by Underwriter's Laboratory as Class A, B, or its equivalent (includes but not limited to: slate, ceramic tile, composition shingles, and metal) • All chimneys and stove pipes be capped with spark arresters meeting NFPA standards (e.g., constructed of 12 USA gauge wire mesh with half-inch openings) • All structural projections such as balconies, decks and roof gables *should* be built with fire resistant materials equivalent to that specified in the uniform building code. • All openings into and under the exterior of the building including vents and louvers, be screened with noncombustible corrosion resistant mesh screening material with quarter inch or smaller openings. • Structural fire proofing (thermal windows, smaller windows, fire retardant building materials on all sides) **from Section 10.110**	**ADOPT THE OREGON STATE BUILDING CODE SECTION 327 to apply to all areas where the county has administrative responsibility.**

3. Apply the Fire Safety Standards Based on the Wildfire Hazard Assessment

The existing Fire Safety Standards reference zoning and use to determine appropriate mitigation requirements. This method does not account for applying the appropriate standards based on the expected local fire environment conditions. The use of a wildfire hazard assessment for guiding the application of Fire Safety Standards will link required mitigation actions to expected wildfire exposure (see Recommendation 1). **CPAW recommends that the county amend the existing Fire Safety Standards to instead reference the newly developed wildfire hazard assessment to determine the appropriate application of the standard:**

A. Determine the Local-Level Wildfire Hazard summarized ranking in which the proposed development is located to understand the likelihood of building exposure to wildfire.
B. Use the Mitigation Difficulty ranking (0 to 9) of the parcel in which the proposed development is located and immediately adjacent to for guidance during initial development application review on general mitigation difficulty to be expected.
C. Apply the appropriate requirements (including the requirement for a fire protection plan).
D. Review and approve submitted fire protection plan.

4. Align Existing Regulations with the Fire Safety Standards

Once the Fire Safety Standards are updated, the county should review other existing regulations to reconcile any potential conflicts with the updated fire standards and/or add appropriate references. For example, requirements for sight-obscuring fence, wall, evergreen or other suitable screening/planting features should be reviewed to ensure that developments (including mobile home parks) are not inadvertently adding to their WUI risk in order to meet other code provisions.[19]

To avoid unforeseen conflicts and inconsistencies between the Fire Safety Standards and other regulations, CPAW also recommends that the county include conflict resolution language to clearly state the relationship between regulations.

5. Coordinate with Local Communities and Other Land Managers

Updating and adoption of the Fire Safety Standards by the county will require collaborative discussions and working sessions with other incorporated communities, land managers, and local fire professionals to align WUI regulatory objectives and implementation. The county will also have to engage in discussions regarding the standards within the Columbia River Gorge National Scenic Area Management Plan. The current Gorge 2020 plan update underway provides a timely opportunity for this discussion. To the extent feasible, coordination should establish uniformity across landscape, building, and construction requirements to minimize the burden on developers and residents.

[19] Section 16.040 – General Design Standards (for mobile home parks); Section 3.256 – Standards for Establishment of a Dwelling and Accessory Structures

6. Implement a Compliance Process

Recognizing that capacity and resources are limited within the county, it is vitally important to have a program in place in which the level of compliance is ensured and understood. This increases the likelihood that applicants are actually implementing the actions required of them and it provides a measure of the success in the regulatory approach of wildfire risk reduction. CPAW recommends that the county implement an audit program in which the land use planning department uses both a complaints-based trigger or a randomized lottery system to conduct on-site compliance inspections.

❖ Tips and Additional Resources

Regulations are most successful when they are accompanied by education and outreach activities. Changes to fire safety standards may require development of new informational handouts and posters, and local workshops with the public and stakeholders (e.g., landscaping and development community). Existing resources can support these efforts, including those available from Oregon State University and Oregon Department of Forestry.

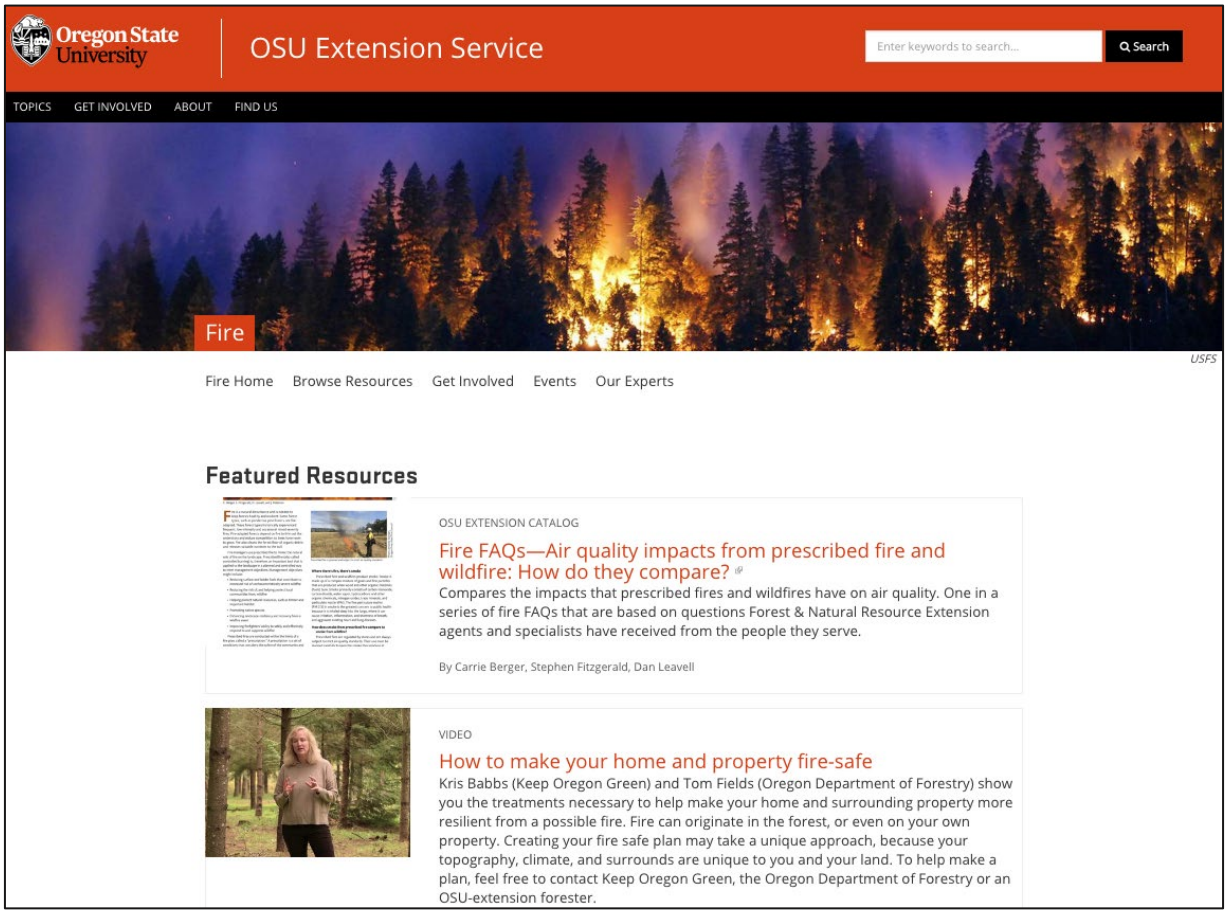

Figure 16. Wasco County can use free resources from the OSU Extension Service to support its public education and outreach activities.

Conclusion

CPAW identified four key areas where Wasco County can make a significant difference in reducing current and future wildfire risk to local communities and residents:

1. **WUI and Wildfire Risk.** Using an updated approach to identifying the county's WUI and assessing its risk forms the basis for land use planning decisions that relate to growth, development, land use changes, and other factors that may influence WUI risk.
2. **Wasco County 2040.** Including wildfire goals into Wasco County 2040 ensures that wildfire hazard and the WUI are considered as part of growth and development decisions. Conditions that may exacerbate WUI risk include increased housing density, long-term declines in water supply and availability, and limited capacity to provide fire protection services across the county.
3. **Community Wildfire Protection Plan.** Updating Wasco County's Community Wildfire Protection Plan to include the new WUI and risk assessment information from CPAW links wildfire risk-reduction activities to land use planning objectives.
4. **Fire Safety Standards.** Updating Wasco County's Fire Safety Standards aligns with current science and best practices for the Home Ignition Zone. In addition, implementing a compliance program ensures mitigation is meeting the regulatory objectives to reduce loss of life and property.

This report provides detailed guidance to assist the county in its voluntary implementation of each recommendation. As funding is available, CPAW can also offer limited supplemental support for long-term success. In addition, CPAW emphasizes local capacity-building throughout its year-long work, which included trainings and stakeholder workshops in Wasco County. These activities are designed to empower local stakeholders through relationship-building and development of resources to help move CPAW recommendations forward.

Addressing the WUI and wildfire risk requires long-term commitment. However, the timing of current and upcoming planning activities positions Wasco County for taking action to protect its residents from future harm.

Figure 17. CPAW worked with local stakeholders throughout the year-long process to support local activities in the future.

CPAW Definitions

The following list of definitions is intended to aid understanding of terms associated with CPAW recommendations.

Built Fuels - Man-made structures (buildings and infrastructure).

Burn Probability - The probability or effect of a wildland fire event or incident, usually evaluated with respect to objectives.

Burn Severity - A qualitative assessment of the heat pulse directed toward the ground during a fire. Burn severity relates to soil heating, large fuel and duff consumption, consumption of the litter and organic layer beneath trees and isolated shrubs, and mortality of buried plant parts.

Community Based Ecosystem Management - With an emphasis on local stakeholder participation, allowing the local community to manage their ecosystem based on the unique characteristics of an area.

Community Wildfire Protection Plan (CWPP) - Established by the 2002 Healthy Forest and Restoration Act, A CWPP is a plan that identifies and prioritizes areas for hazardous fuel reduction treatments on Federal and non-Federal land that will protect one or more at-risk communities and essential infrastructure and recommends measures to reduce structural ignitability throughout the at-risk community. A CWPP may address issues such as wildfire response, hazard mitigation, community preparedness, and structure protection.

Convection Heat - The movement caused through the rising of a heated gas or liquid.

Conduction Heat - Transfer of heat through direct contact of material.

Critical Facilities - FEMA defines critical facilities as “facilities/infrastructure that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police, fire stations, and hospitals”. In addition, CPAW recognizes emergency water pumping stations, egress routes, communication facilities, and backup power supplies as critical facilities.

Ecosystem Based Fire Management - The incorporation of the natural or desired ecological role of fire into the management and regulation of community’s natural areas.

Effects - The anticipated benefits and losses associated with exposure to a hazard or event, in this case fire.

Embers - A small piece of burning material that can be thrown into the air due to the convective heating forces of a wildfire. Larger embers and flammable materials have the ability to sustain ignition through transport.

Exposure - The contact of an entity, asset, resource, system, or geographic area with a potential hazard. Note: In incident response, fire responder exposure can be characterized by the type of activity.

Fire Adapted Communities - A group of partners committed to helping people and communities in the wildland urban interface adapt to living with wildfire and reduce their risk for damage, without compromising firefighter or civilian safety.

Fire Effects - The physical, biological, and ecological impacts of fire on the environment.

Fire Intensity - Commonly referred to as fire line intensity, this is the amount of heat energy that is generated by burning materials.

Firewise - Program administered by the National Fire Protection Association which teaches people how to adapt to living with wildfire and encourages neighbors to work together and take action to prevent losses. The program encourages local solutions for wildfire safety by involving homeowners and others in reducing wildfire risks by fostering defensible space and resilient structures for homes and communities.

Frequency - The number of occurrences of an event per a specified period of time.

Hazard - Any real or potential condition that can cause damage, loss, or harm to people, infrastructure, equipment, natural resources, or property.

Hazard Reduction - Coordinated activities and methods directed to reduce or eliminate conditions that can cause damage, loss, or harm from real or potential hazards.

Home Ignition Zone - The characteristics of a home and immediate surrounding area when referring to ignition potential during a fire event.

Infrastructure - The basic physical structures and facilities (e.g., buildings, roads, and power supplies) needed for the operation of a community.

Prescribed Fire - A planned controlled wildland fire that is used to meet a variety of objectives for land managers.

Radiation Heat - Transmission of heat through waves or particles.

Residual Risk - Risk that remains after risk control measures have been implemented.

Resilience - The ability to recover from undesirable outcomes, both individually and organizationally.

Risk - A measure of the probability and consequence of uncertain future events.

Risk Acceptance - A strategy that involves an explicit or implicit decision not to take an action that would affect all or part of a particular risk.

Risk Assessment - A product or process that collects information and assigns values (relative, qualitative, quantitative) to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making.

Risk Avoidance - A strategy that uses actions or measures to effectively remove exposure to a risk.

Risk Based Decision Making - A decision making process that relies on the identification, analysis, assessment, and communication of wildland fire risk as the principal factors in determining a course of action to improve the likelihood of achieving objectives.

Risk Communication - An exchange of information with the goal of improving the understanding of risk, affecting risk perception, or equipping people or groups to act appropriately in response to an identified risk.

Risk Management - A comprehensive set of coordinated processes and activities that identify, monitor, assess, prioritize, and control risks that an organization faces.

Risk Mitigation - The application of measure to alter the likelihood of an event or its consequences.

Risk Perception - Subjective judgment about the characteristics and magnitude of consequences associated with a risk.

Risk Reduction - A decrease in risk through risk avoidance, risk control, or risk transfer.

Risk Transfer - A strategy that uses actions to manage risk by shifting some or all of the risk to another entity, asset, resources, system, or geographic area.

Values-At- Risk - Those ecological, social, and economic assets and resources that could be impacted by fire or fire management actions.

Vulnerability - The physical feature or attribute that renders values susceptible to a given hazard.

Wildfires - Unplanned wildland fires resulting in a negative impact.

Wildland Fire - Any non-structure fire that occurs in vegetation or natural fuels. Wildland fire includes prescribed fire and wildfire.

Wildland Fuels - All vegetation (natural and cultivated).

Wildland Urban Interface (WUI) - Any developed area where conditions affecting the combustibility of both wildland and built fuels allow for the ignition and spread of fire through the combined fuel complex.

Wildland Urban Interface Hazard - Combustibility of the wildland or built fuels, fuel type or fuel complex.

Wildland Urban Interface Risk - The WUI hazard accounting for factors that contribute to the probability and consequences of a WUI fire.

APPENDIX A: RMRS Wildfire Hazard Mapping – Wasco County, OR

Eva Karau, USDA Forest Service, Rocky Mountain Research Station, Fire Modeling Institute

❖ 1. Overview

The U.S. Forest Service's Rocky Mountain Research Station collaborates with the group of planners and analysts leading the Community Planning Assistance for Wildfire (CPAW) effort for Wasco County, OR to perform assessments of spatial wildfire hazard to support CPAW's recommendations for wildfire planning codes and regulations. In this analysis and report we accomplish two objectives: 1) provide a realistic, localized representation of wildfire behavior in the township, including finely-tuned model parameters and landscape modifications that reflect stakeholder input; and 2) use methods that are transparent, based on the best available science, and appropriate for use with federal and state partners when planning for wildland fires. In this document we provide a brief background outlining wildfire hazard and risk terminology, a detailed explanation of our modeling and mapping methods, and descriptions of final Wasco County wildfire hazard maps.

Background – Wildfire Hazard and Risk

How likely is it that a place will burn? How hot is it likely to burn? And, at different fire intensity levels, what would the effects be on something we care about? These questions describe the three fundamental components needed to assess wildfire risk: likelihood, intensity, and effects (sometimes termed "susceptibility"). Scott et al. (2013) conceptualize this as the wildfire risk triangle (Figure A1). If we can gather quantitative information on all three legs of this triangle, then we can quantify the risk to the thing we care about.

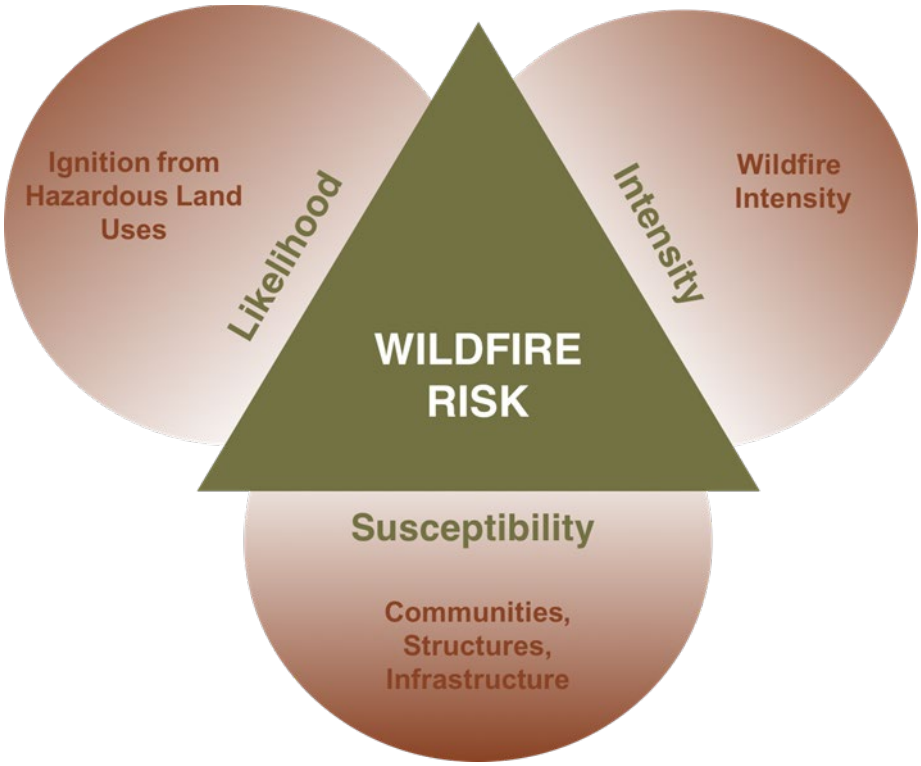

Figure A1. The wildfire risk triangle

For the purposes of this analysis, we focus on two sides of the wildfire risk triangle: *likelihood* and *intensity*. Together, those two pieces of information represent wildfire *hazard*. To map likelihood and intensity across a landscape, we use outputs from two different, but related, fire behavior models. The fire modeling application most often used for large-scale landscapes is called the Large Fire Simulator, or FSim (Finney et al. 2011). FSim draws upon weather and fire occurrence data from recent decades to generate statistically possible weather for 10,000 or more simulated fire seasons. Within each of these simulated years, ignitions are placed on the landscape informed by observed fire occurrence patterns, fires are spread using spatial data for fuels, topography, and simulated weather, and a set of many thousand possible fire perimeters are generated.

Whereas FSim provides a synoptic, "landscape scale" assessment of fire behavior and estimates annualized probabilities of the occurrence and intensity of large fires, another model, FlamMap (Finney 2006), computes a localized and specialized view of potential fire behavior under a specific set of environmental conditions. If a user parameterizes FlamMap for environmental conditions representative of when problem wildfires have occurred, fire behavior outputs represent a "problem fire" scenario at a "local scale." Including characterizations of wildfire hazard at both landscape and local scales affords a two-pronged assessment of potential fire behavior; we see what kind of fire behavior we could experience under a range of conditions that

have occurred in recent history, and we also get a picture of fire behavior that could occur under extreme conditions.

While we don't specifically address the susceptibility side of the triangle in this analysis, we combine fire behavior probability and intensity estimates to assess and map wildfire hazard at multiple spatial scales in Wasco County.

❖ 2. Wildfire Hazard Characterization for Wasco County

Wildfire hazard is a measure of the likelihood that an area will burn and the likely intensity of the burn, given that a fire occurs. For Wasco County, we present two evaluations of wildfire hazard: landscape level and local level.

Landscape-Level Wildfire Hazard - Modeling, Maps, and Figures

We used FSim modeling work completed for the Quantitative Wildfire Risk Assessment for OR and WA (Stratton 2017) for the purpose of evaluating wildfire likelihood and intensity for the landscape-level analysis. Pyrologix LLC, which conducted the modeling for that assessment, modified LANDFIRE data circa 2014 (LF 1.4.0) to reflect input from resource specialists during a fuels review workshop and also updated the fuelscape to incorporate wildfire disturbances through 2017. For our landscape wildfire hazard assessment, we acquired the 120m-resolution FSim modeling outputs, extracted for the spatial extent surrounding Wasco County.

Landscape-Level Summary Zone

To summarize the spatial metrics of likelihood, intensity, and hazard for the "landscape-level" analysis, we chose subwatersheds from the national USGS Watershed Boundary Dataset (https://nhd.usgs.gov/wbd.html) as the polygon summary unit. Subwatersheds are designated by 12-digit hydrologic unit codes and are often referred to as "HUC12" watersheds. The HUC12 summary unit is commonly used to summarize landscape attributes; is devoid of administrative boundaries; and is based on the areal extent of surface water draining to a point (Bureau of Land Management, Watershed Boundaries Washington, available at (https://nhd.usgs.gov/wbd.html, accessed 10-30-2017.) Using a summary unit is important because an individual spot on the landscape will have an individual value, but that one spot is inevitably impacted by the values of its neighbors; summarizing the raster FSim outputs and the derived hazard index to these polygons allows broad-scale patterns to emerge that may not be immediately visible in the raw pixel datasets.

Landscape Fire Likelihood

Landscape Fire Likelihood, or burn probability (BP), is the FSim-modeled annual likelihood that a wildfire will burn a given point or area. It is calculated as the number of times a pixel burns during a simulation, divided by the total number of iterations. The landscape-level burn probability map represents the average of all 120-m pixel values within each subwatershed,

classified into four classes, with the chance of a wildfire occurring during any given fire season increasing with each class level (Figure A2).

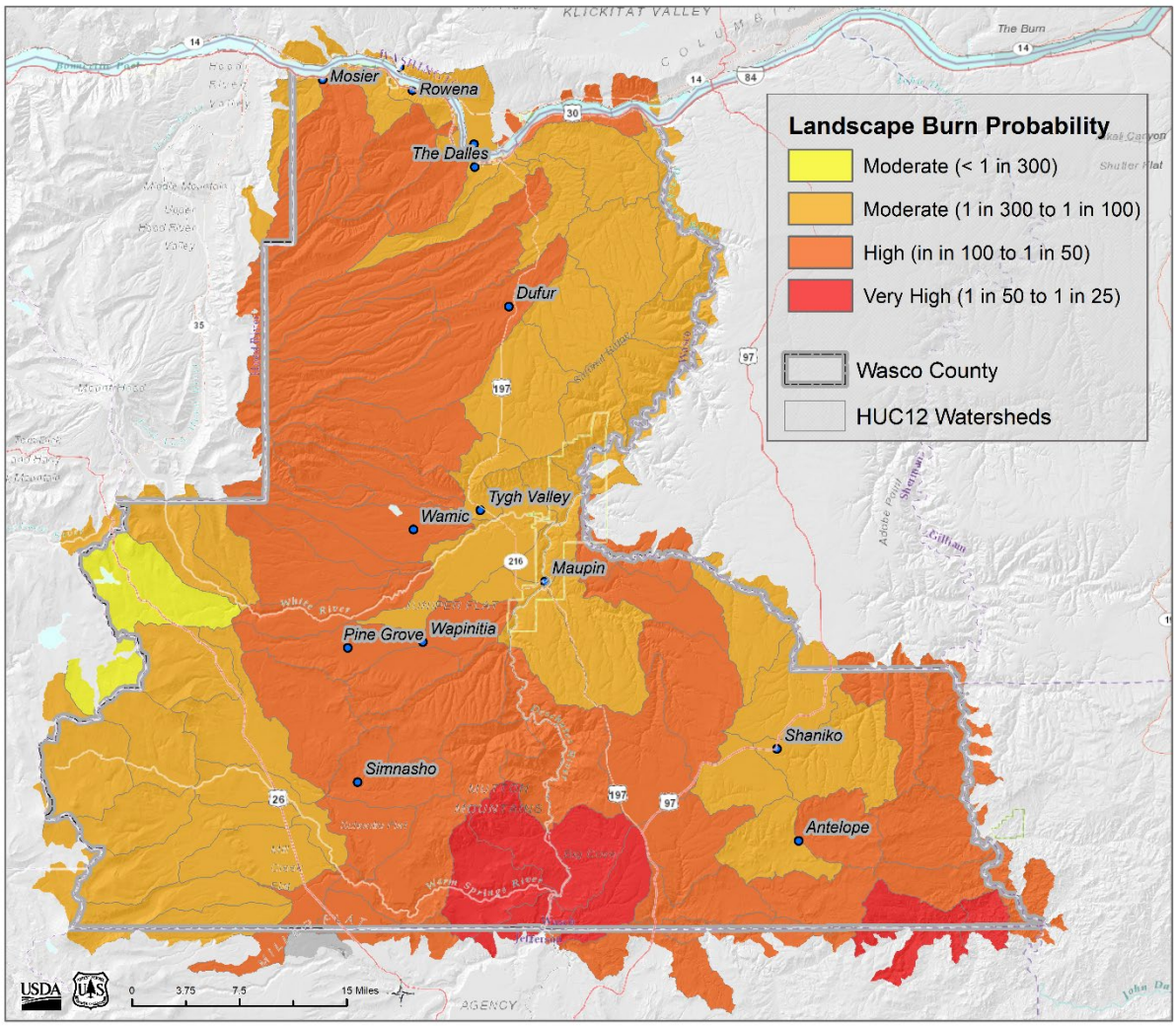

Figure A2. Landscape burn probability

Landscape Fire Intensity

FSim can apportion burn probability into wildfire intensity levels and produce estimates of the probability of a certain flame length level, given a fire burns a pixel. Conditional flame length (CFL) is the average of all flame length probabilities that FSim simulated for each 120-m pixel. We summarized the pixel-level CFL values within subwatersheds by calculating the average CFL for each subwatershed polygon. Map classes represent ranges of conditional flame length (in feet) (Figure A3).

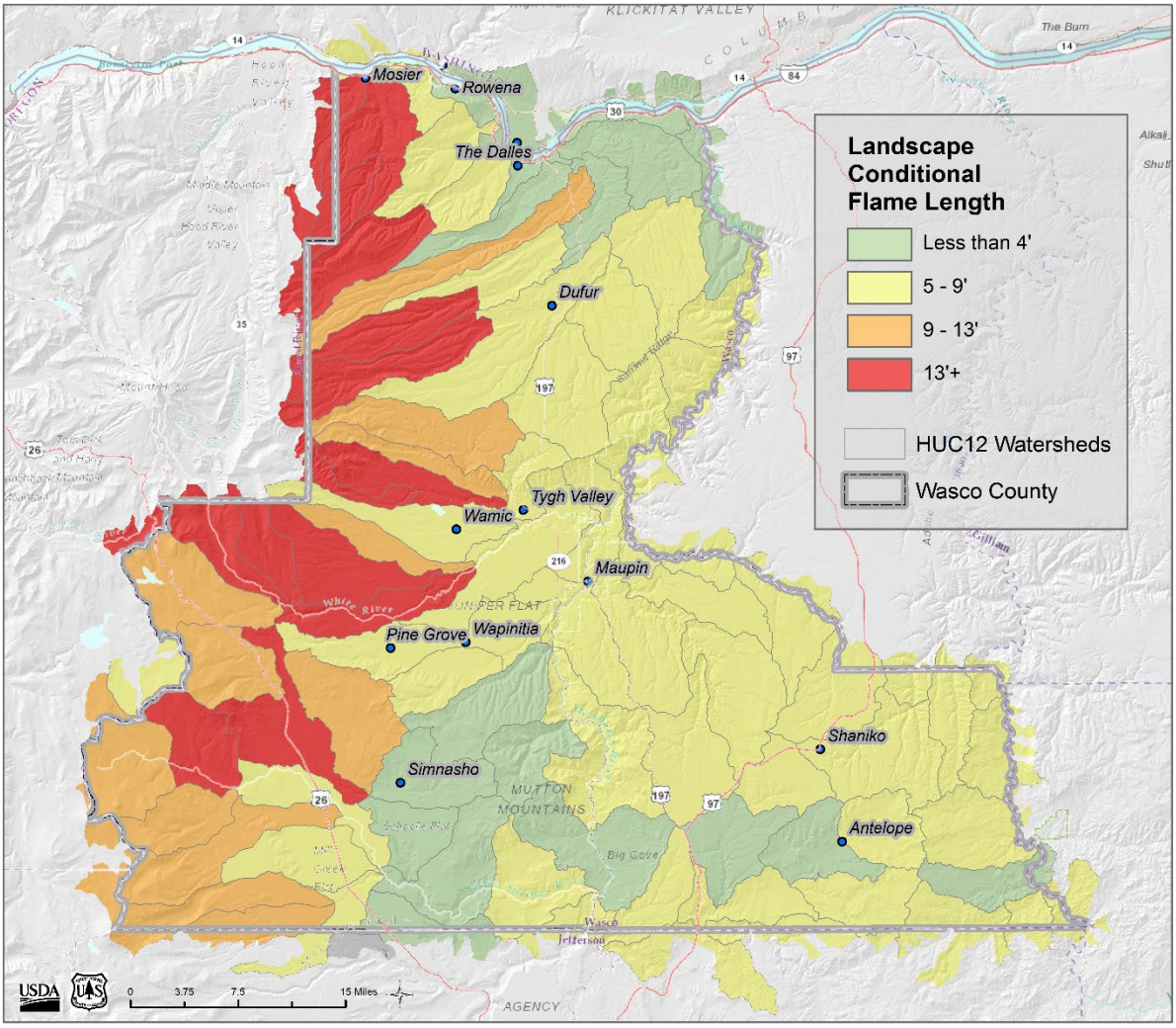

Figure A3. Landscape Conditional Flame Length for Wasco County.

Landscape Wildfire Hazard

Wildfire hazard is an integration of likelihood and intensity, quantified as the product of burn probability (BP) and conditional flame length (CFL). We calculated hazard at the pixel scale and then summarized values to the HUC12 subwatershed scale by calculating the mean hazard in each watershed polygon. We then classified the values into three classes (Moderate, High, and Very High) based on quantiles in the distribution of values in the analysis area (all subwatersheds that intersect with the Wasco County boundary) (Figure A4). The actual numeric values of hazard are less directly interpretable than BP or CFL. Instead, they provide a relative depiction of hazard across a landscape.

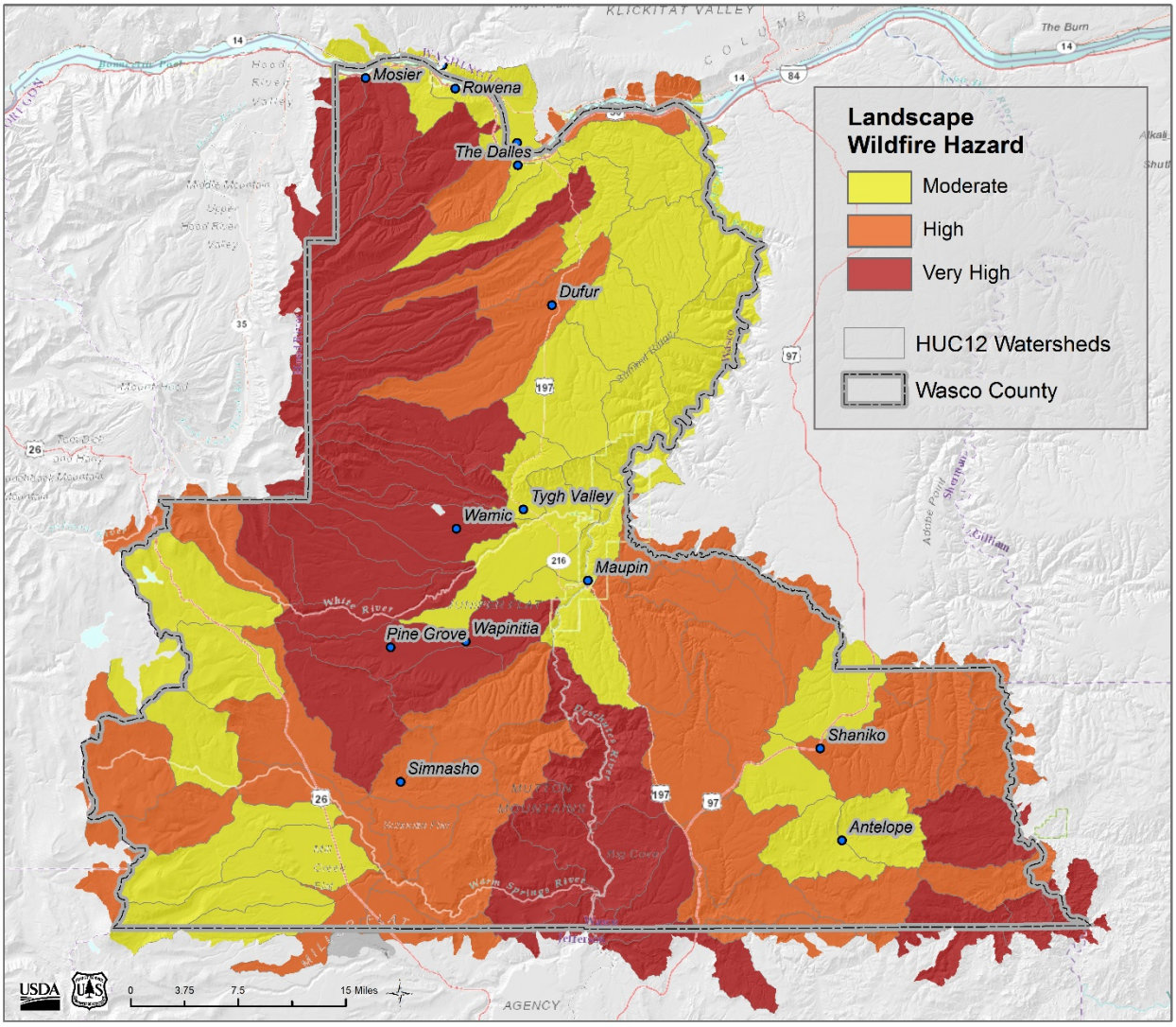

Figure A4. Summarized landscape hazard.

Local-Level Wildfire Hazard - Modeling, Maps, and Figures

For the local-level hazard assessment, we used FlamMap 6.0 to model wildfire behavior. We initialized the Minimum Travel Time (MTT) module within FlamMap with 40,000 fire ignitions: 20,000 had locations that were completely random, and another 20,000 were random but informed by locations where wildfires have occurred during the period of 1992 through 2015 (Short 2017). We used a maximum simulation time of 480 minutes per ignition (equating to an 8-hr burn period), a calculation resolution of 90 meters, an interval for Minimum Travel Paths of 500 meters, and a spot probability of 0.02. We chose to output burn probabilities, fire perimeters, flame length probabilities classed into 6 bins, and a fire size list.

Wind, Weather and Fuel Moisture Parameters

FlamMap needs information regarding fuel moisture, wind, and weather to parameterize a simulation. Based on information from subject matter experts (SMEs) gleaned during our site visits, as well as our own evaluation of records from weather stations in and around Wasco County, we chose to base our weather and wind-related modeling inputs on records from four Remote Automated Weather Stations (RAWS): Wasco Butte, He He1, Patjens, and Pollywog.

When choosing a single wind direction to parameterize the FlamMap simulation for the county, we wanted to make sure we evaluated data from weather stations in different areas throughout the entire modeling extent. Local SMEs reported that NW winds were common on active fire days and we identified signals of W, WNW, and NW winds in wind roses from RAWS for the hours of 1200 – 1500 (assumed to be the period of highest potential fire growth), and for the dates of June 15 through October 1 (assumed to encompass the "fire season") (Figure A5):

- Average winds recorded at Middle Mountain, in the northeast section of the modeling extent, included some E and ENE, but were predominantly from the West.
- Average winds recorded at Wasco Butte, in the northcentral area of the modeling extent, were mostly NW.
- At Patjens, located approximately in the center of the modeling extent, predominant wind directions varied from WNW to N.
- In the southwest section of the extent, winds at the He He 1 RAWS were predominantly from the WNW.

Considering SME input, combined with the wind rose information, we selected WNW as the wind direction with which to parameterize the FlamMap modeling. We chose 22 mph as the initialization wind speed, as SMEs reported that they have experienced 20 – 22 mph winds, and wind roses throughout the modeling extent indicate that average winds speed from the W, WNW, and NW do reach (and sometimes exceed) 19 – 25 mph (Figure A5).

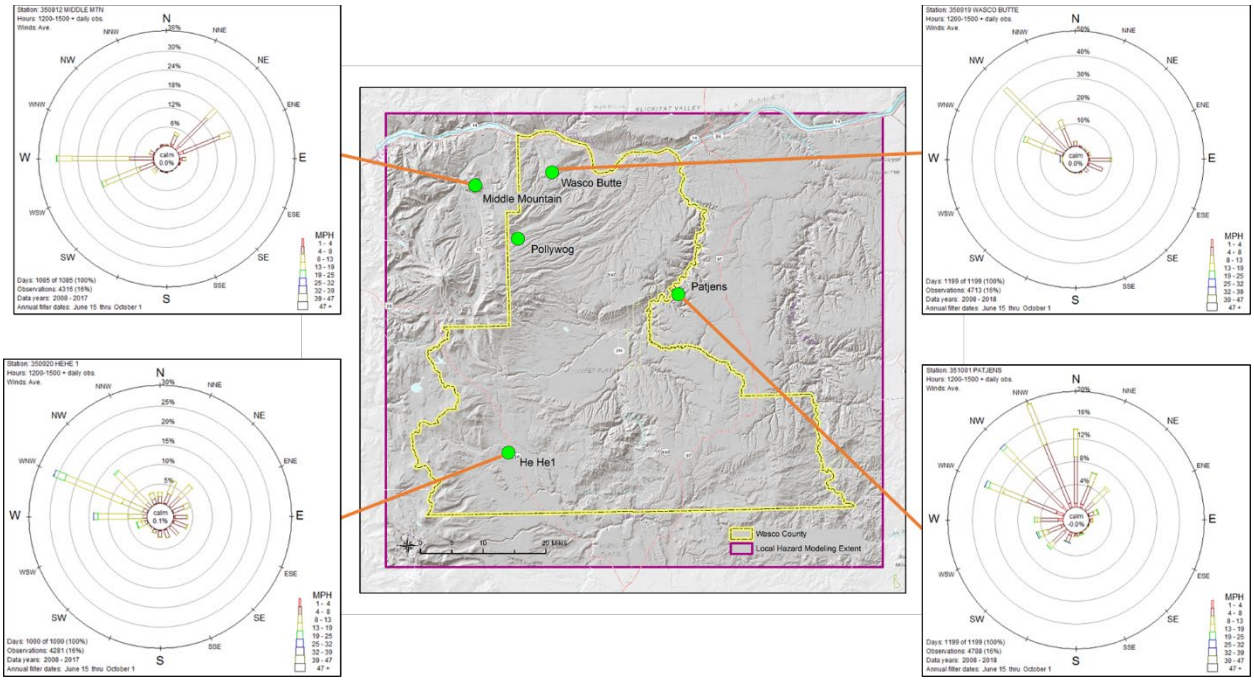

Figure A5. Remote Automated Weather Station wind directions

Our FlamMap modeling objective for the local wildfire hazard assessment was to represent a "problem fire" scenario. When choosing a time period for fuel moisture estimates and the weather records used for fuel moisture conditioning, it made sense to consider the summer of 2018, as six large fires (five larger than 30,000 acres) impacted Wasco County during that fire season. We selected July 23 – 26, 2018 as parameterization dates, as climatology analysis indicated peak values for seasonal dryness indices during that time period. For example, the Energy Release Component (a fire danger metric with higher values indicating seasonal dryness trends in large fuels, especially in timbered areas) achieved or exceeded 97th percentile values for the period of 2008-2018 at the Pollywog RAWS (Figure A6). This time period also represents the days just following large fire growth on the Substation fire and just preceding the start of the Long Hollow fire, both in the north central section of the modeling extent. Fuel moistures for the selected dates were estimated as 2, 3, and 5% for the 1-hr, 10-hr, and 100-hr dead fuel moistures, and 43% and 60% for herbaceous and woody live fuel moistures.

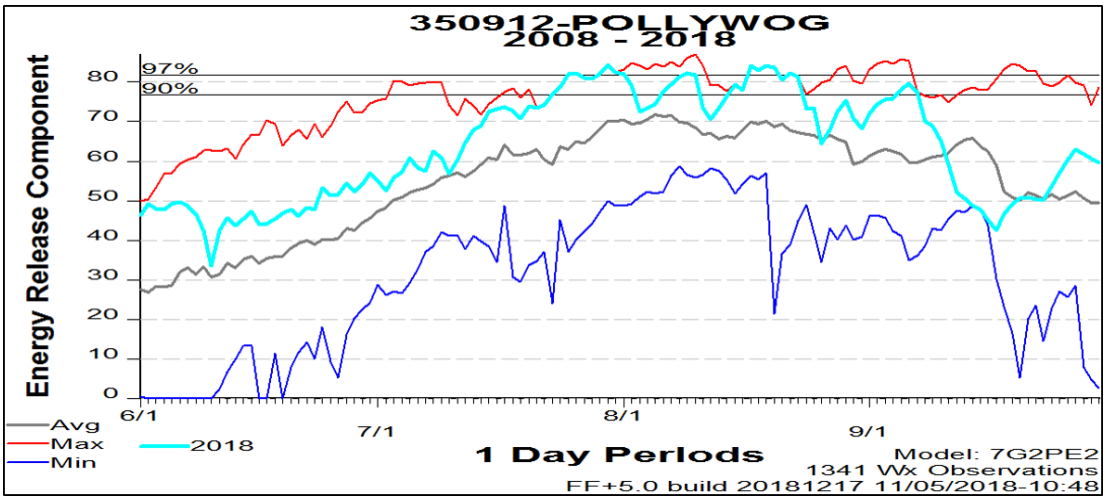

Figure A6. Pollywog RAWS Energy Release Component.

Spatial Input File Layers

Most fire modeling systems (including FSim and FlamMap) require a set of raster geospatial layers that characterize landscape topography (elevation, slope and aspect) and fuels attributes (fuel model, canopy cover, canopy height, crown base height, and crown bulk density). A local-level analysis allows for fine-scale modifications of the landscape file (surface and canopy fuel attributes) to reflect the current existing landscape as best as possible given the modeling assumptions of FlamMap. We obtained the 30-meter resolution geospatial layer set (or landscape file) that Pyrologix LLC had used to initialize their FSim modeling for Washington and Oregon.

During review of draft simulation results at the July 2018 stakeholder meeting, SMEs reported that much of the agricultural land in central and eastern Wasco County (predominantly wheat fields) burns readily in wildfires, and pointed to the 2018 Boxcar fire as clear evidence. Though our preliminary simulation did not produce fire behavior in those areas because the default fuel model for fallow wheat fields is non-burnable, we modified the fuels inputs for our final round of modeling. We used the CropScape data set (USDA 2017) to identify areas that were classified as crops that we thought would burn similarly to a moderately coarse continuous grass with a depth of about 1 foot, and we changed the input fuel model to a GR2 in those areas. We recognized that this would cause the model to over-predict fire behavior in the fields that were fallow, but to remain consistent with our objective of modeling the "problem fire" scenario, we made the assumption that all of the areas mapped with burnable crops could indeed burn. We made additional changes to the fuels input layer using the CropScape data set to represent orchards and vineyards as non-burnable surfaces, assuming that those areas are continuously irrigated.

Pyrologix updated the LF 1.4.0 fuels layers to represent wildfire disturbance through 2017, and we made further modifications to the Pyrologix 30-m landscape layers to render them current (to 2018) as accurately as possible given available local disturbance data. We delineated the following disturbances, as follows:

- Wildfires – We obtained 2018 fire perimeters from the National Interagency Fire Center FTP server (https://ftp.nifc.gov/). Because we did not have specific information about fire

severity for each fire, we made the assumption that all fires were moderate in severity and we modified the fuel model and canopy fuels models as follows:

  - Fuel models were generally changed to models that produce lower rates of spread and intensities within the broad category of the pre-disturbance model. For example, within the fire perimeter, if the pre-fire fuel model was a GS2 or GS3 (GS being the Grass/Shrub fuel category), we assigned a post-fire fuel model of GS1, which is within the same Grass/Shrub category, but a GS1 represents fuels that produce lower rates of spread and intensities, as compared with GS2 and GS3.
  - Within 2018 wildfires, we reduced canopy cover and canopy bulk density by 50%, and we set canopy base height to 100m.

- Mechanical treatments and prescribed fires – We obtained polygon data from the US Forest Service Forest Activity Tracking System to account for treatments that impacted US Forest Service Lands, and Oregon Department of Forestry provided polygons representing treatments on state and private lands. We included treatments completed between 2015 and 2018, as Pyrologix only included wildfire disturbances when editing the LANDFIRE 1.4.0 data. Because we did not have specific information about the intensity of each treatment, we made the assumption that all treatments were moderate in intensity. We included any treatment that removed material from the site, and made changes following the same rules established for landscape due to wildfires, intending to generally reduce fire behavior as compared with the pre-treatment landscape.

Local-Level Summary Zone

To summarize the spatial metrics of likelihood, intensity, and hazard for the "local-level" analysis, we chose to use catchments from the USEPA and USGS National Hydrography Dataset Plus V2 (https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus). Catchments are local-level drainage areas and typically subdivide HUC12 watersheds into smaller polygon units. Using a summary unit is important, because an individual spot on the landscape will have an individual value, but that one spot is inevitably impacted by the values of its neighbors; summarizing the raster FlamMap outputs and the derived hazard index to these polygons allows for broad-scale patterns to emerge that may not be immediately visible in the raw pixel datasets.

Local Fire Likelihood

Local Fire Likelihood, or burn probability (BP), is the FlamMap-modeled likelihood that a wildfire will burn a given point or area. It is calculated as the number of times a pixel burns during a simulation, divided by the total number of iterations. Because we parameterized FlamMap with a "problem fire" scenario as describe above, BP from our FlamMap run represents those specific conditions. The local-level burn probability map represents the average of all 90-m pixel values within each catchment, classified into four classes, with the chance of a wildfire occurring during any given fire season increasing with each class level (Figure A7).

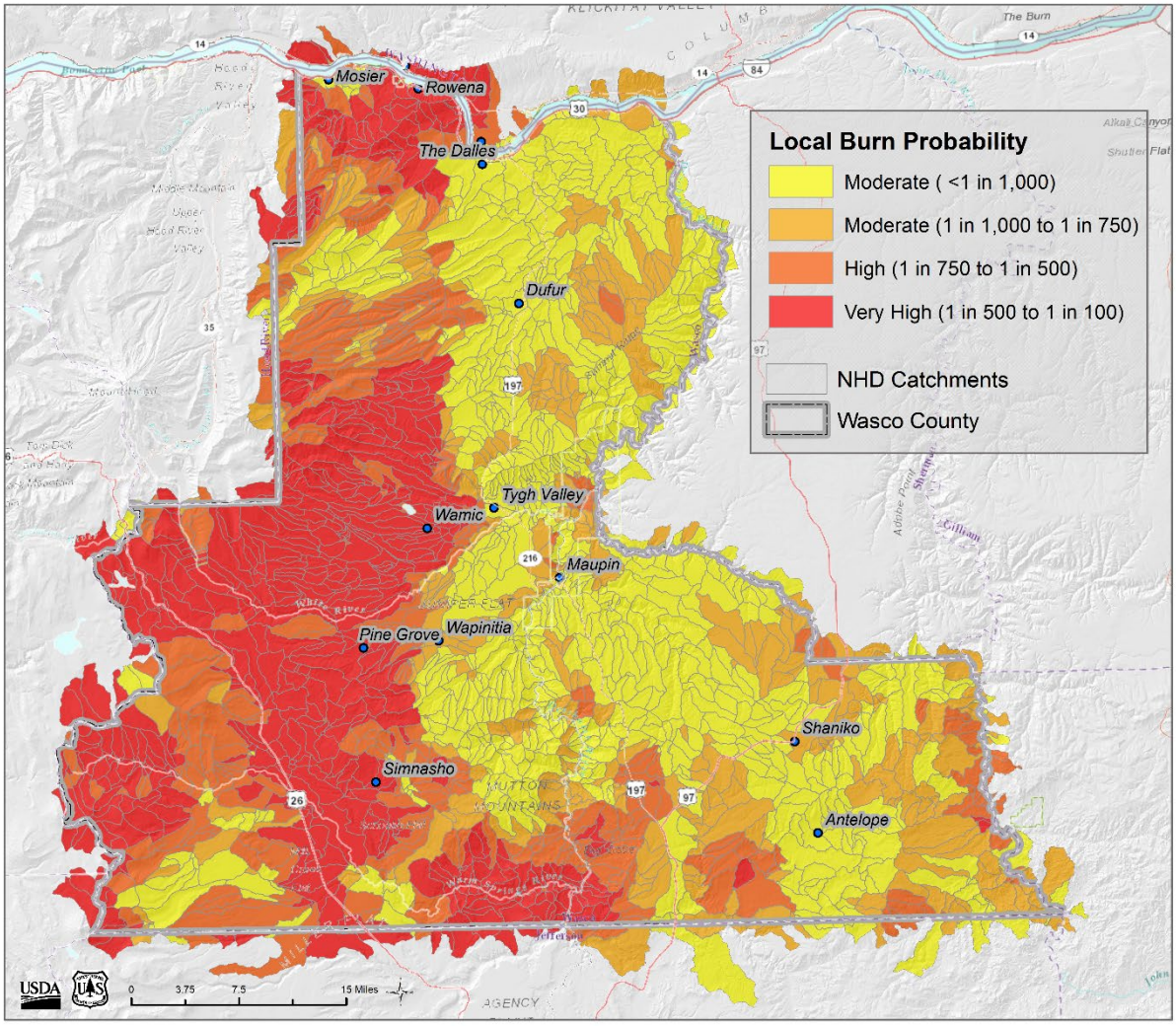

Figure A7 Local Burn Probability for Wasco County

Local Fire Intensity

Like FSim, FlamMap can apportion burn probability into wildfire intensity levels and produce estimates of the probability of a certain flame length level, given a fire burns a pixel. Local Conditional Flame Length (CFL) is the average of all flame length probabilities that FlamMap simulated for each 90-m pixel. We summarized the pixel-level CFL values within catchments by calculating the average CFL for each catchment polygon. Map classes represent ranges of conditional flame length (in feet) (Figure A8).

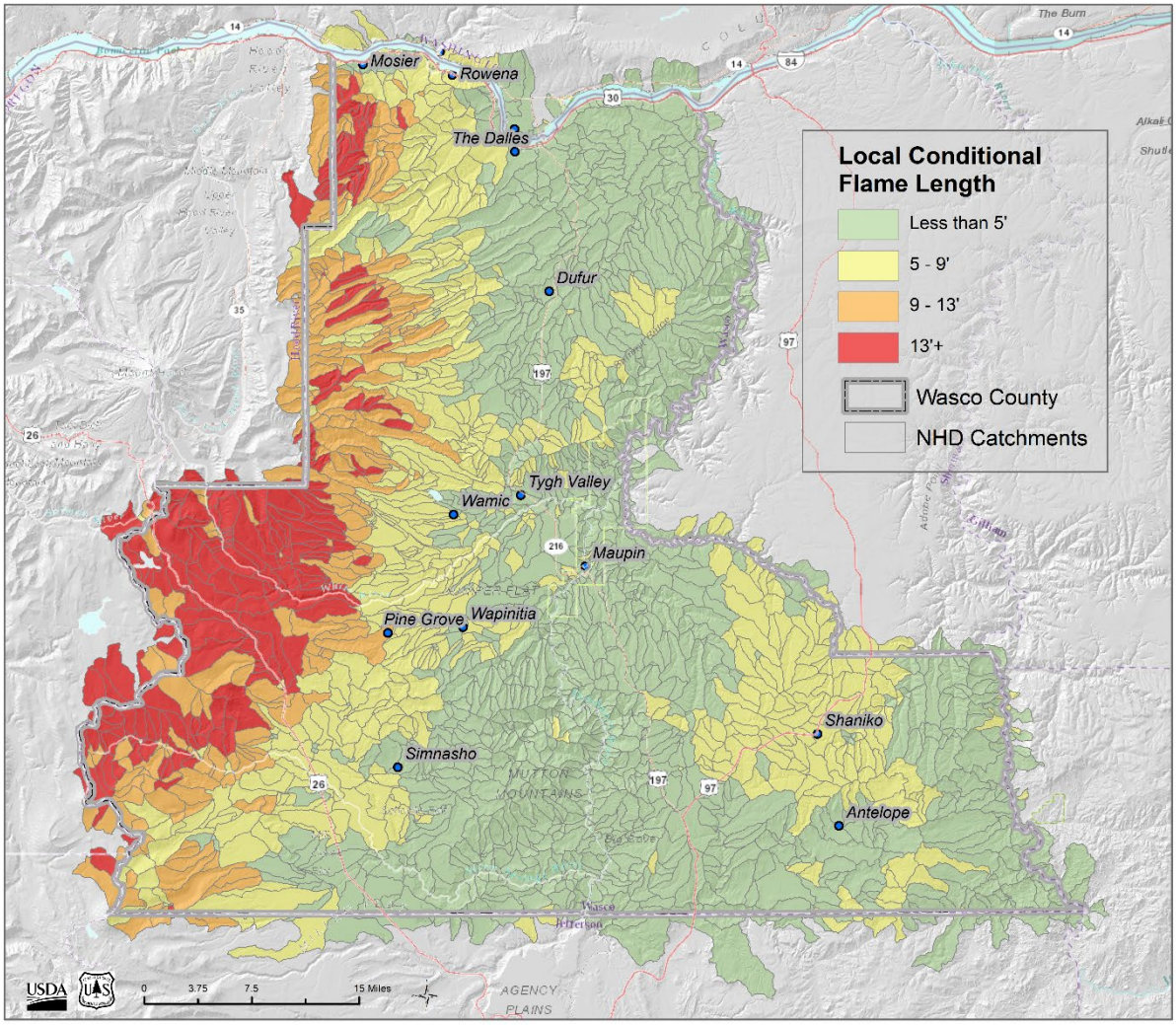

Figure A8. Local Conditional Flame Length for Wasco County

Local Wildfire Hazard

Wildfire hazard is an integration of likelihood and intensity, and we calculated it as the product of BP and CFL. We calculated local hazard at the pixel scale and then summarized values to the catchment scale by calculating the mean CFL in each catchment polygon. We then classified the values into three categories (Moderate, High, and Very High) based on quantiles in the distribution of values in the analysis area (county) (Figure A9). The actual numeric values of hazard are less directly interpretable than BP or CFL. Instead, they provide a relative depiction of hazard across a landscape.

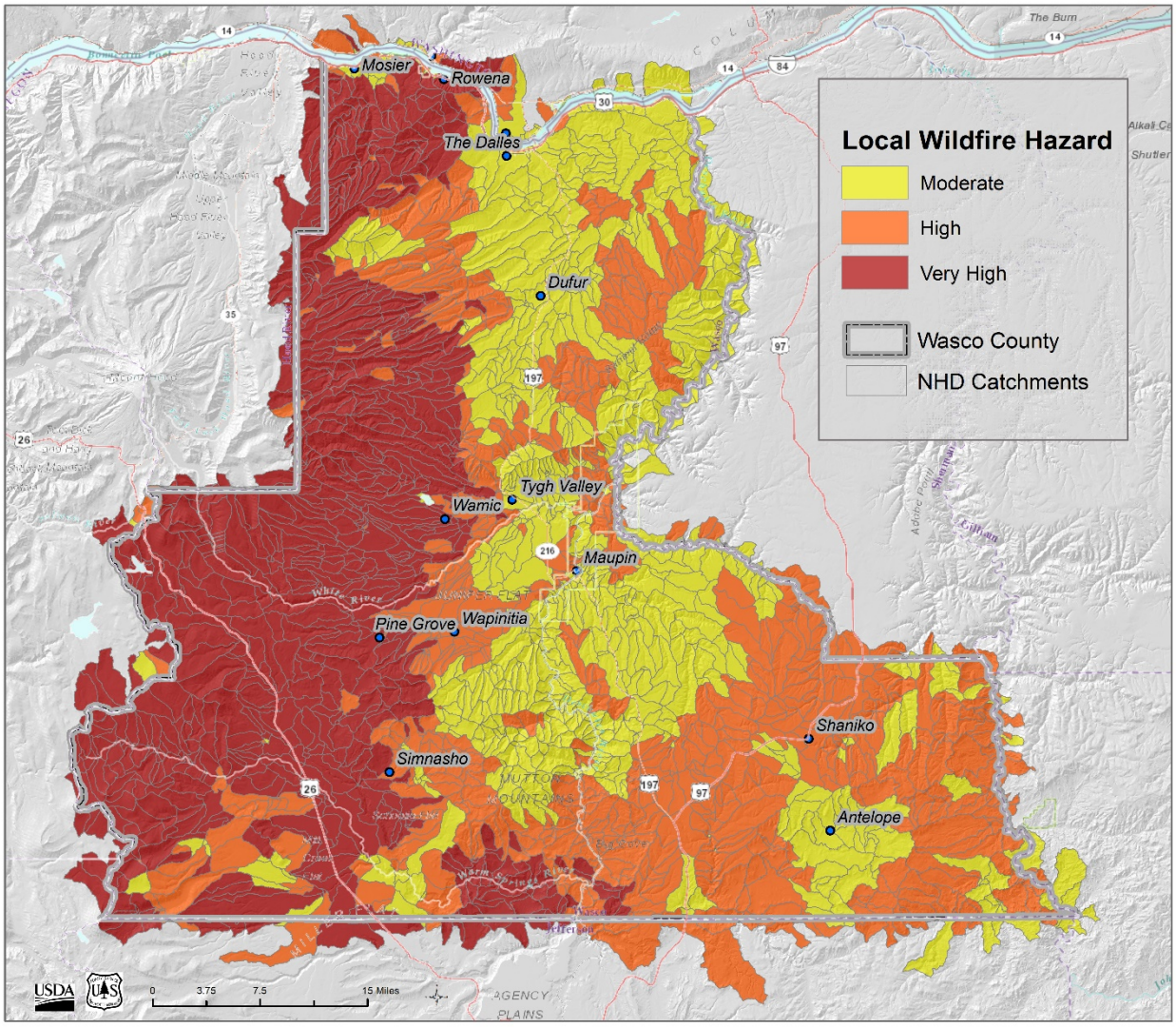

Figure A9. Summarized Local Wildfire Hazard for Wasco County

❖ 3. Wildland-Urban Interface Zones

We mapped categories of structure density integrated with wildland vegetation to characterize where structures are in or near burnable vegetation in Wasco County (Figure A10).

Though we generally followed methods that mimic Federal Register Wildland Urban Interface (WUI) definitions as adapted by Martinuzzi et al. 2015, we customized our WUI mapping to appropriately represent rural developed areas in the township. Since Wasco County has accurate and up-to-date address point data for structures in the county, we used these points instead of Census data to represent structures for our mapping efforts. Though we were unable to obtain address point data for the Warm Springs reservation in the southwestern part the county, we did acquire data delineating summer camp structures in the southeastern part of the county. We used the point data as input into the Point Density tool (ESRI 2015) to create a raster surface of

structure density, which we then sliced into the ranges of values needed to combine with vegetation categories to create WUI classes (Table A1).

We defined wildland vegetation as anything that is classed with a "burnable" fuel model in the same fuel model raster data that we used in our fire behavior modeling. Non-burnable fuel model categories include urban, snow/ice, agriculture, water, and barren. We also included orchards, as delineated in the CropScape layer, as non-burnable. To quantify the percentage of vegetation within an area, we used the Focal Statistics tool (ESRI 2015) to calculate the percentage of burnable fuel within a 40-acre moving window around each pixel, and assign that value to the center pixel.

Structure density and vegetation raster layers were combined to map the WUI, with the map categories described in Table A1. One modification that we made to rules outlined in Martinuzzi 2015 was to include the "Vegetated Very Low Density" category with the WUI Intermix category. This decision reflects the Federal Register statement that "intermix exists where structures are scattered throughout a wildland area" (USDA and USDOI 2001) and our intent to include isolated structures in rural areas as WUI.

Table A1. Description of mapping ruleset for Wildland-Urban Interface zones.

WUI Category	Structure Density Description	Structure Density Range (structures/ac)	Vegetation Description
Interface	Very Low to High Density	>= 1	Wildland vegetation <= 50% and within 1.5-mi of area with >= 75% wildland vegetation
Intermix	Very Low to High Density	>= 1	Wildland vegetation > 50%
Non-Vegetated	Medium or High Density	> 8	Wildland vegetation <= 50%
	No, Very Low, or Low Density	0 - 8	
Vegetated	Uninhabited	0	Wildland vegetation > 50%

Though the scientific community has not yet developed a way to quantify the *probability* of wildfire ember impact to structures, what we found within Wasco County is that virtually every address point is within a distance from wildland fuels that *could* produce embers. Since the entire community could possibly be impacted by embers, we chose not to include an "ember zone" which would add no informational value to the final WUI map.

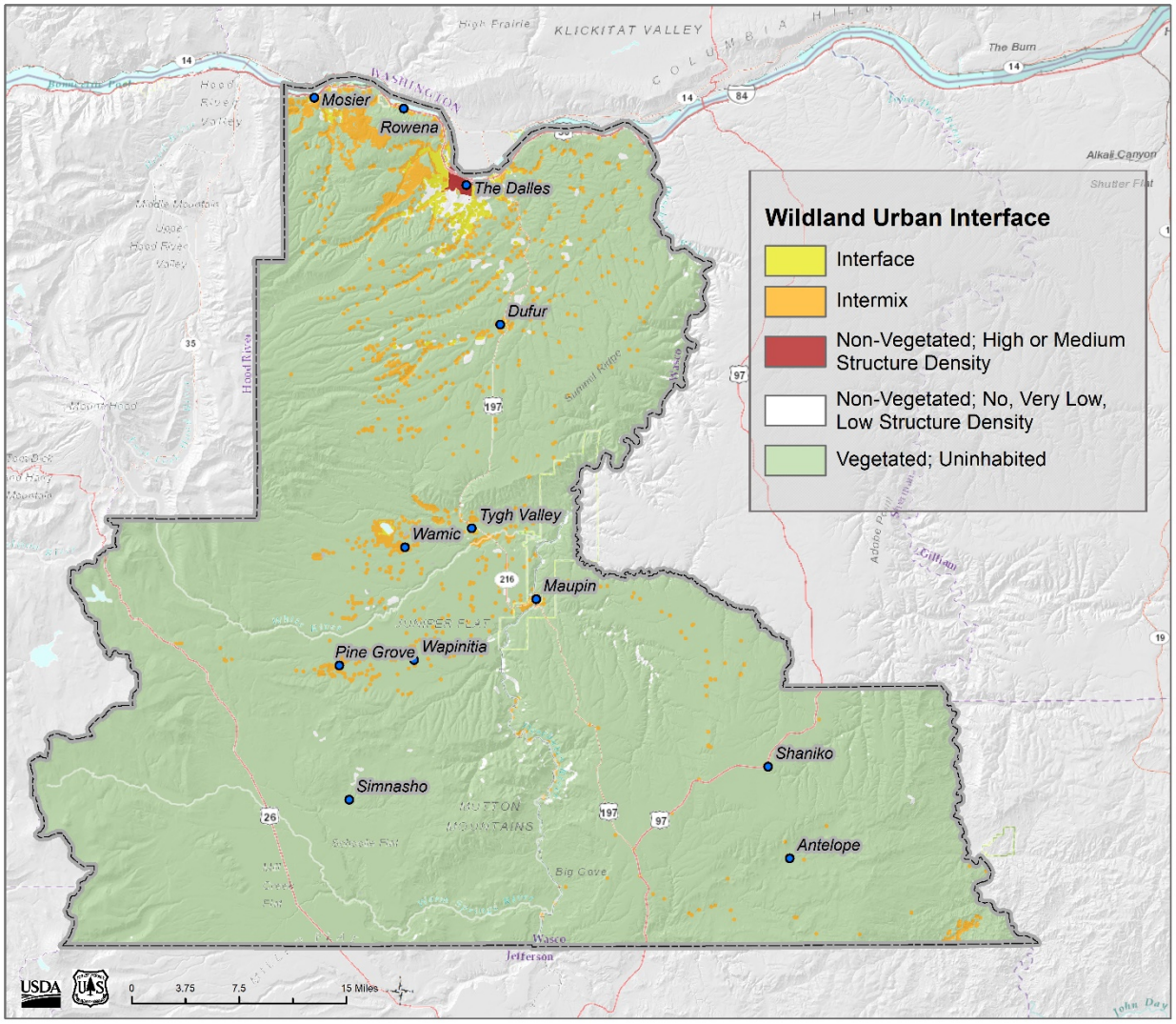

Figure A10. The spatially defined WUI for Wasco County

❖ 4. Mitigation Difficulty

As a complement to the landscape and local wildfire hazard assessments, we calculated an index that characterizes the relative difficulty or effort involved in modifying landscape characteristics in a way that could reduce wildfire hazard. To create the components necessary to map mitigation difficulty, we developed three 30-meter resolution spatial datasets, as follows:

Vegetation Life Form – We integrated the fuel model data set (initially built to parameterize our FlamMap modeling) with the Existing Vegetation Type (LANDFIRE 1.4.0) data set to produce four life form classes: 1. Barren/Developed/Sparsely Vegetated/ Irrigated Agriculture, 2. Grass, 3. Shrub, 4. Tree.

Slope – We classified the same slope dataset that was used to parameterize our fire behavior modeling landscape (LANDFIRE 1.4.0) into three classes: 1. Steep slopes -

Slopes greater than or equal to 30%, 2. Moderate slopes – slopes greater than or equal to 15% and less than 30%, and 3. Shallow slopes – slopes less than 15%.

Crown Fire Activity – We used the Crown Fire Activity (CFA) raster output layer from our Basic FlamMap modeling to represent potential for crown fire. The logic used in calculating CFA within FlamMap takes into account the potential for fires burning in surface fuels to transition into tree crowns, and then it uses mapped tree crown characteristics and modeled wind speeds to determine whether that pixel could experience passive (fire is limited to individual tree torching) or active (fire spreads through crowns from tree to tree) crown fire. For the mitigation index, we collapsed the CFA raster into two categories: 1. No crown fire potential, 2. Potential for either passive or active crown fire.

We integrated the spatial layers described above to create map categories representing the difficulty to mitigate wildfire hazard within Wasco County parcels (Figure A11). Map classes range from 0 to 9, increasing with difficulty to mitigate wildfire hazard:

1 – Non-vegetated, with potential for ember impact:
Barren ground/water/sparse vegetation or land that lies within potential spotting distance of a wildfire.

2 – Herbaceous on a shallow slope:
Fires are typically easier to suppress in these areas. However high winds combined with dry conditions leads to potentially dangerous, fast-moving, high-intensity fires. Mitigation potential may involve a combination of irrigation, mechanical (mowing) treatment, frequent burning, and fuel breaks in conjunction with appropriate structure ignition zone and IR structure construction.

3 – Herbaceous on moderate slope:
Harder to construct fuel breaks, difficulty in mechanical (mowing) treatment, increased potential for erosion, increased rate of spread and intensity may make frequent burning more difficult. Focus should be on appropriate slope setbacks, structure ignition zone, and IR structure construction mitigation.

4 – Herbaceous on steep slope:
Fires are typically harder to suppress than grassfires in these areas. High winds combined with dry conditions lead to potentially dangerous, fast-moving, high-intensity fires with firefighter access concerns. Mitigation potential may involve a combination of mechanical (mastication) treatment, moderately frequent burning, and fuel breaks in conjunction with appropriate structure ignition zone and IR structure construction.

4 – Shrub on shallow slope:
Harder to construct fuel breaks, difficulty in mechanical (mastication) treatment, increased potential for erosion, increased rate of spread and intensity may make frequent burning more difficult. Focus should be on a combination of appropriate mechanical treatment or burning, slope set-backs, structure ignition zone, and IR structure construction mitigation.

5 – Shrub on moderate slope:

Open canopy must be maintained to prevent increase crown fire potential. Surface fuels must be treated/maintained in a state that reduces the chances of fast-moving surface fires in conjunction with appropriate structure ignition zone and IR structure construction mitigation.

6 – Shrub on steep slope:

Open canopy must be maintained to prevent increased crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated/maintained in a state that reduces the chances of fast-moving surface fires. Mitigation should also include appropriate slope set-backs, structure ignition zone and IR structure construction mitigation.

6 – Tree on shallow slope:

Dense canopy needs to be thinned to reduce crown fire potential. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate structure ignition zone and IR structure construction mitigation.

7 – Tree on moderate slope:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

7 – Tree on shallow slope with potential for crown fire:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

8 – Tree on moderate slope with potential for crown fire:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

8 – Tree on steep slope:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

9 – Tree on steep slope with potential for crown fire:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

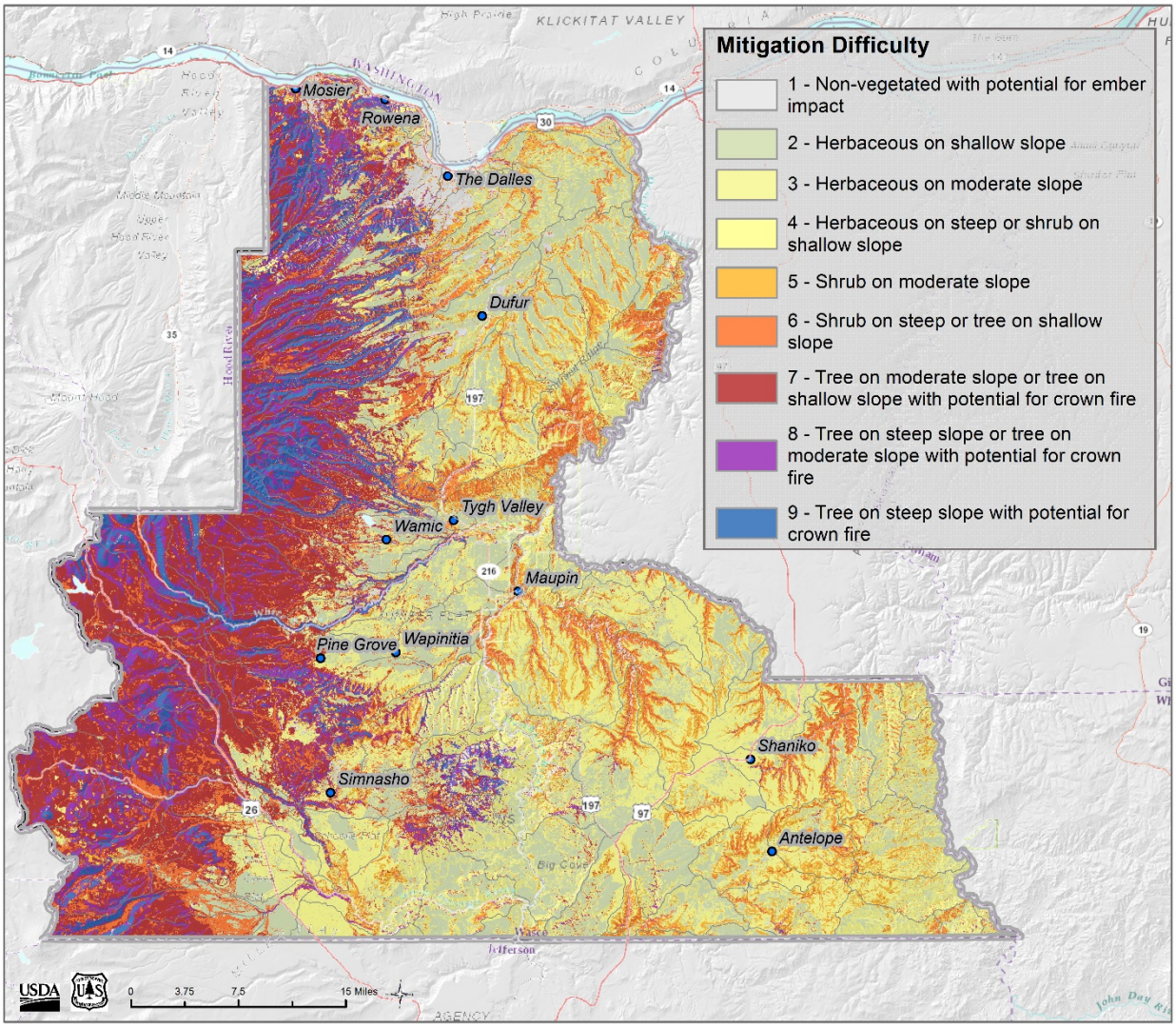

Figure A11. Summarized Mitigation Potential for Wasco County

❖ 5. Final Considerations

In this report, we presented two complementary representations of wildfire hazard for Wasco County, Oregon. The landscape-level assessment addresses the question of "What is the annual chance of a fire occurring?" anywhere on a landscape. As such, this part of the assessment sets the context for a broad picture of wildfire hazard. The local-level assessment used a more focused approach to model fire behavior under a "problem fire" scenario. It brings the benefit of integrating local stakeholder input that customizes the modeling landscape and represents local fire behavior at a finer spatial resolution. The local hazard map indicates where wildfire could cause a problem in a community, given a specific set of weather conditions.

❖ 6. References

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