SUMMARY OF REQUIRED AND PROPOSED CHANGES TO OREGON'S STATEWIDE WILDFIRE HAZARD MAP:

OPPORTUNITIES TO AMEND HAZARD MAPPING PROCESS DURING THE 2024 RULE-MAKING PROCESS

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PURPOSE

Following is a detailed summary of proposed and required changes to Oregon's statewide wildfire risk map in the development of an updated statewide wildfire hazard map. This summary is intended to provide members of the Rulemaking Advisory Committee (RAC) with an understanding of how the updated statewide hazard map will differ from the original statewide risk map as a result of changes required by Senate Bill 80 (2023). Likewise, a summary of proposed changes to the mapping process in response to public feedback is also included. What follows focuses only on proposed and required changes to the mapping including data and methods, and does not address important but unrelated issues related to insurance, defensible space regulation, etc.

WHAT WAS REQUIRED OF THE STATEWIDE WILDFIRE RISK MAP ACCORDING TO Senate Bill 762?

During Oregon's 2021 Legislative Session Senate Bill 762 was passed with bi-partisan support to facilitate Oregon's adaptation to a rapidly changing wildfire environment. Section 7 of Senate Bill 762 (Appendix I) required the Oregon Department of Forestry (ODF) to oversee Oregon State University's (OSU) development and maintenance of a comprehensive statewide map of wildfire risk. The legislation also required public access to the map via the Oregon Wildfire Risk Explorer[2], a product of the Institute for Natural Resources (INR) at Oregon State University.

Senate Bill 762 required the risk map to be based on "weather, climate, topography and vegetation," and that each tax lot must be classified into one of five risk classes ("extreme, high, moderate, low and no risk"). Subsequent rules were informed by consultation with a Rulemaking Advisory Committee (RAC) and then reviewed and adopted by the Board of Forestry. Those rules further defined how OSU was to build the statewide risk map. Based on the legislation and administrative rules, OSU developed a

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[2] https://tools.oregonexplorer.info/OE_HtmlViewer/index.html?viewer=wildfire

comprehensive statewide wildfire risk map which was made public on June 30, 2022. Specific methods and data are detailed in Appendix B.

HOW HAS THE MAPPING CHANGED SINCE THE RELEASE OF THE STATEWIDE WILDFIRE RISK MAP?

The Oregon Department of Forestry rescinded the statewide wildfire risk map on August 4, 2022, acknowledging the need for time to consider and respond to public concerns and Oregonians' need for time to learn about all aspects of Senate Bill 762, including the statewide risk map. Following the retraction of the statewide wildfire risk map, During Oregon's 2023 Legislative Session, the state legislature passed Senate Bill 80 which modifies specific aspects of how a future map will be developed (Appendix C). Public feedback has further identified additional opportunities to change how a future map is developed.

Changes Resulting from Senate Bill 80

As relates to the mapping criteria or methods, Senate Bill 80 made two significant changes. First, Senate Bill 80 directed OSU to develop a statewide wildfire hazard map as compared to the statewide wildfire risk map described in Senate Bill 762. Second, Senate Bill 80 requires the statewide wildfire hazard map to identify three hazard zones instead of five risk classes.

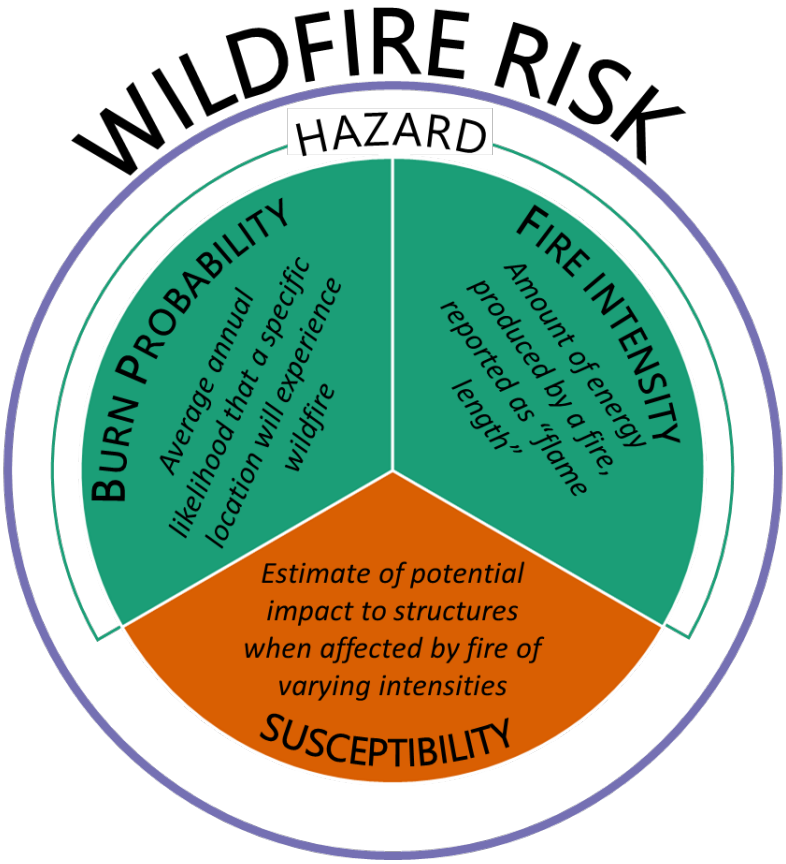


Figure 1. Representation of the three components of wildfire risk to structures. When combined together, burn probability and fire intensity represent wildfire hazard.

Although Senate Bill 762 directed OSU and ODF to develop a statewide risk map, that map was functionally the same as a wildfire hazard map. Experts and scientists define risk using three components: burn probability, fire intensity and susceptibility (Figure 1). Burn probability is the average annual likelihood that a specific location will experience wildfire, and fire intensity is the amount of energy produced by a fire, usually reported as "flame length." In the context of Senate Bill 762 and Senate Bill 80, susceptibility represents the effect of fires on structures. Burn probability and fire intensity together comprise wildfire hazard. Wildfire hazard at any one location represents how climate, weather, topography and vegetation all interact there to inform the likelihood of a fire occurring and expected fire behavior. As required by legislation, the statewide map must only be based on these four categories.

The susceptibility of structures is directly related to their defensible space and fire hardening characteristics. If we wanted to further understand the risk to structures in Oregon (i.e. how structures might be affected by fire based on the hazard level), we would need to be able to map all structures' defensible space and fire hardening characteristics. That data does not exist for many, and certainly not all, structures in Oregon. Not having accounted for structure level susceptibility, the Senate Bill 762 statewide risk map was functionally a wildfire hazard map and Senate Bill 80 made that clarification official.

Senate Bill 762 required ODF to identify five risk classes, and parcels characterized in the top two (i.e. "high" or "extreme" risk) could be subject to defensible space based on additional criteria. However, from the standpoint of regulation, the high and extreme risk classes were functionally identical. The change in Senate Bill 80 from five to three classes means that there will be only one class representing properties which will potentially be subject to defensible space and home hardening codes, the "high" hazard class. Senate Bill 80 also eliminated the "no risk" class to clarify that there are no locations in Oregon immune to wildfire hazard and risk.

Changes Resulting from Public Feedback

Following release of the original statewide wildfire risk map and continuing after its retraction, OSU and ODF collected feedback from across Oregon. At least half a dozen public listening sessions were hosted around the state during the summer of 2022 before the map was retracted. During that same time, both OSU and ODF staffed public emails set up to collect and respond to questions from the public. Before the statewide wildfire risk map was retracted, ODF received over 1,000 appeals from property owners in Oregon seeking to challenge their risk classification. In September 2023, ODF and OSU, along with other relevant state agencies, participated in nine regional listening sessions with county commissioners and their staff. Not all of the feedback was relevant to the mapping process (e.g. much of it focused on insurance issues), and some of the feedback is captured in changes required by Senate Bill 80. Following are two specific changes to the hazard modeling data which resulted from public feedback and which have already been put into effect. There was significant feedback regarding irrigated croplands which is addressed in the next section.

Public feedback in the weeks following the release of the statewide wildfire risk map raised concerns that risk was overstated in hay and pasturelands. To understand the problem, OSU and relevant state agencies visited with land managers and local planners in Burns, OR. In response to concerns regarding hay and pasture lands, we altered the way in which those hay and pasturelands are represented during

wildfire simulation models used to determine hazard. Specifically, we reduced the amount of fuel[3] available for burning which results in slower rates of fire spread and reduced intensity. And, we narrowed the seasonal window during which hay and pasturelands are considered burnable which has the effect of reducing burn probability.

We also made slight adjustments to fire modeling parameters in Oregon's northern Cascades in response to continued evaluation by fire scientists and analysts where there was some concern that burn probability was slightly overestimated. Together, the changes in the north Cascades and the updated representation of fuels in hay and pasturelands resulted in reduced hazard in many parts of Oregon (Figure 2).

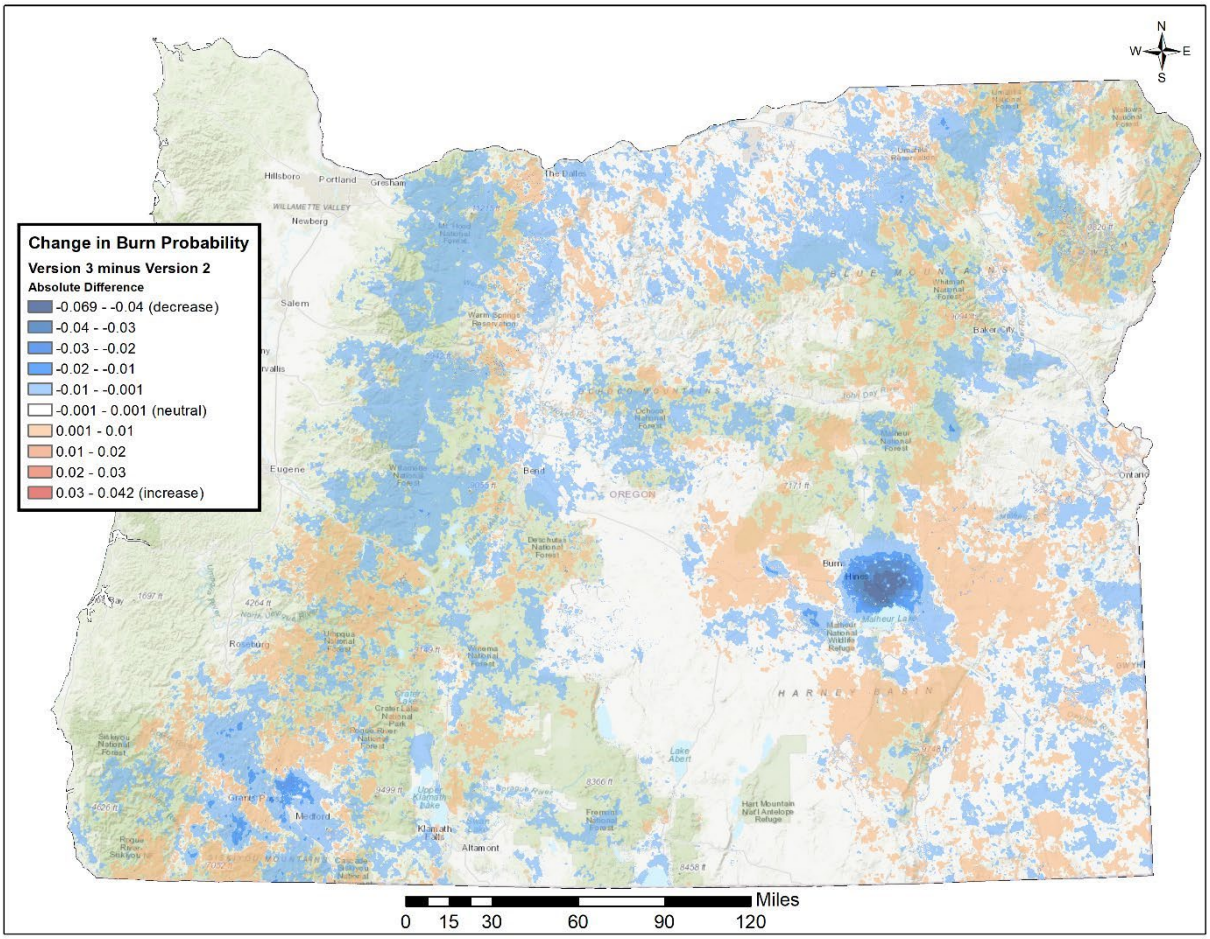


Figure 2. A map depicting change in burn probability resulting from fire behavior modeling updates in response to continued evaluation by the OSU science team and regional fire analysts, as well as public feedback. Cooler colors represent a decrease in burn probability while warmer colors represent an increase. The most obvious change is the hay and pasture lands southwest of Burns, OR and across the

[3] A distinction between "fuel" and "vegetation" is relevant. In this report, "vegetation" refers to descriptions of plant types and communities (e.g. hay and pastureland). The term "fuel" combines descriptors of vegetation with characteristics that influence potential fire behavior (e.g. amount of biomass available for burning). For instance, a hay and pastureland vegetation type could be characterized with either moderate or high fuel loading depending on site characteristics. In wildfire hazard and risk assessments, vegetation is represented as fuel.

Rogue Valley in SW Oregon. Increases in burn probability are a result of estimates of fire moving from valley hay and pasture lands into the forest since the same amount of fire is still simulated (calibration to occurrence data) within these areas.

WHAT ADDITIONAL, POTENTIAL CHANGES REQUIRE FURTHER ANALYSIS?

We heard from individuals across the state who felt the mitigating effects of irrigated cropland ought to be considered when characterizing vegetation in the risk assessment. Irrigated croplands are widespread across Oregon, often coinciding with otherwise high wildfire hazard landscapes. When evaluating risk, the original statewide risk map accounted for the type of vegetation present, including whether it was cropland or some other kind of vegetation. However, the risk assessment made no distinction between irrigated and non-irrigated croplands.

Whether and how to account for the hazard mitigating effects of irrigation in the determination of property-level wildfire hazard is ultimately a policy question to be addressed during the 2024 rule making process. It is not a question of whether irrigated cropland provides hazard mitigation (it frequently does), but whether or not irrigated croplands are a human mitigation action which, akin to defensible space and fire hardening, does not fit into the criteria of "climate, weather, topography and vegetation." Similar to defensible space, irrigated croplands are a human manipulation of vegetation.

If it is decided that the statewide map of wildfire hazard will consider the presence of irrigated croplands when determining hazard, there are two important considerations which will inform precisely how irrigated croplands are mapped and considered. First, irrigation practices are subject to interannual variation which likely contributes to interannual variation in wildfire hazard. The irrigation status of croplands varies from one year to the next, and during intermittent years when a field is not irrigated, hazard on and adjacent to the field will more closely resemble hazard of the surrounding landscape. Second, irrigation practices are subject to intra-annual variation and, in particular, throughout the summer when wildfire hazard is most relevant. In some cases, seasonal irrigation practices may keep a field irrigated, and thus hazard-mitigated, throughout the length of fire season. In other cases, crops are removed and irrigation is shut off during wildfire season, exposing the area to unmitigated hazard.

If the statewide wildfire hazard map considers irrigated croplands, sufficiently accounting for inter- and intra-annual variability in cropland irrigation is a limitation with available data. Oregon State University proposes to use IrrMapper[4] data to identify the spatial extent of irrigated cropland that can reasonably be presumed to be irrigated in any given year. IrrMapper estimates the distribution of irrigation for every year from 1986 to 2021 across all croplands in Oregon. We consider it the best available science for identifying irrigated croplands, particularly at a state-wide scale, which is why it is also used by Oregon's Water Resources Department.

Classifying a location as irrigated cropland and adjusting the wildfire hazard accordingly requires that we be confident the location will be irrigated most if not all years, and irrigated during the time of year when wildfire hazard mitigation is relevant. IrrMapper does not afford opportunities to safeguard against intra-annual variation, but it does provide opportunities to safeguard against interannual variability. IrrMapper provides annual data so to identify irrigated cropland that can reasonably be

[4] Ketchum, D.; Jencso, K.; Maneta, M.P.; Melton, F.; Jones, M.O.; Huntington, J. IrrMapper: A Machine Learning Approach for High Resolution Mapping of Irrigated Agriculture Across the Western U.S., Remote Sens. 2020, 12, 2328.

presumed to be irrigated in any given year, we would need to identify a minimum threshold for the number of years any location is irrigated in the data. For instance, if a specific location was classified as irrigated in only one of the last five years, we might not have confidence that it is likely to be irrigated in any given year. Identifying specific criteria will require additional analysis (Table 1).

Table 1. A summary of the extent of land identified as irrigated in Oregon by IrrMapper and the annual frequency of years in which it was identified as irrigated during the five-year period 2017 – 2021.

Number of years identified as irrigated (*out of five years*)	**Acres**	**Percent of Total (*from column A)***	**Cumulative acres**	**Cumulative Percent of Total**
5	2,409,351	55.2	2,409,351	55.2
4	717,970	16.5	3,127,321	71.7
3	426,561	9.8	3,553,882	81.5
2	393,224	9.0	3,947,106	90.5
1	414,319	9.5	4,361,425	100

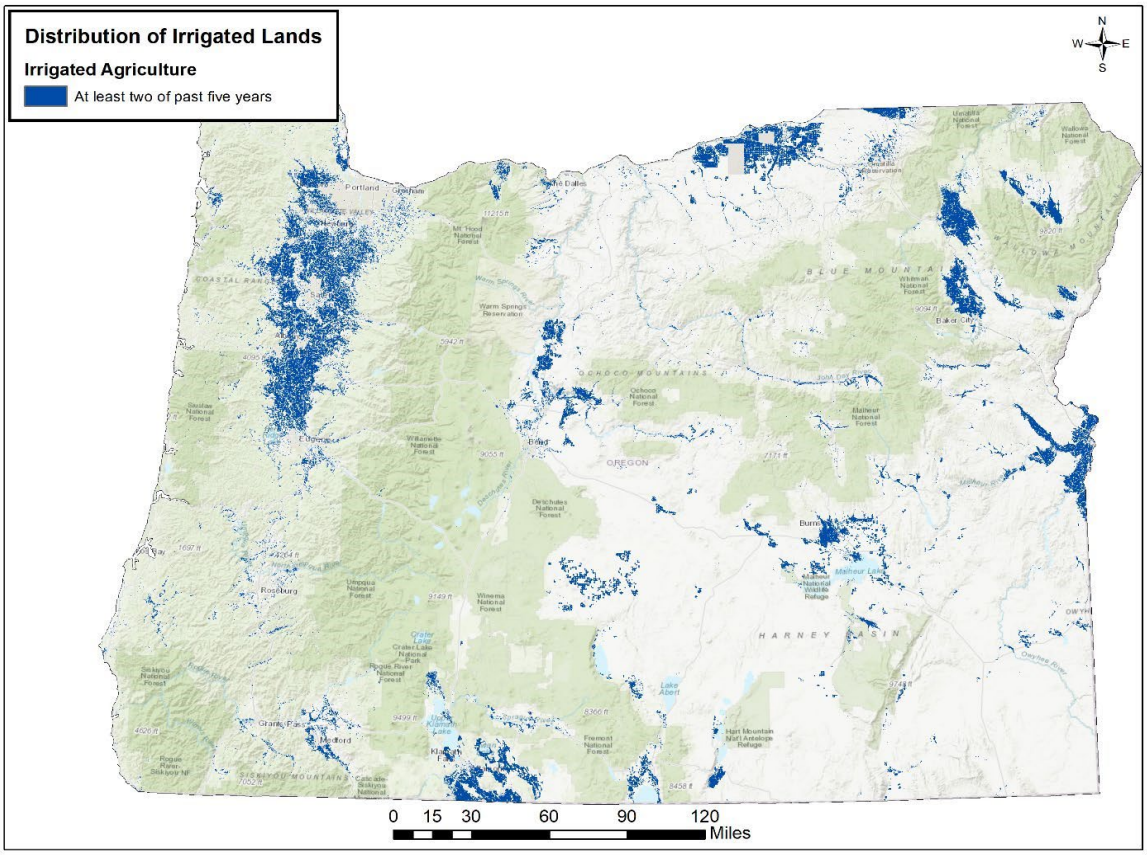


Figure 3. The extent of lands classified as irrigated in the hazard assessment if we used IrrMapper data and decided that all locations identified as irrigated in the data at least two of the most recent five years were to be classified as irrigated. Irrigated lands in this figure amount to about 3.9 million acres.

WHAT CAN BE EXPECTED FROM A DRAFT HAZARD MAP?

Following is an example representing new statewide hazard calculations which combine updates required by Senate Bill 80 with possible opportunities to respond to feedback from state, county and local governments and the public. The example is intended to inform discussion in the RAC about the possible impacts from required and proposed changes to the hazard mapping process, but it is does not represent an official draft statewide hazard map.

Changes in the fire behavior modeling (i.e. adjustments to modeling in hay and pasture lands and the Oregon north Cascades) described above have already been put into effect. However, details of the draft statewide wildfire hazard map will also depend on whether and how to consider the mitigating effects of irrigation. Figure 5 provides a summary of changes in county-level statistics assuming the following updates:

1. Updated fire behavior modeling to address concerns about hay and pasturelands, and the northern Cascades.
2. Classify data into three hazard classes as required by Senate Bill 80, including "Low," "Moderate," and "High" Hazard.
3. Classify all irrigated lands as low hazard, where irrigated lands include areas classified as irrigated in IrrMapper data in at least two of the last five years (2017 – 2021).

For purposes of this example, we made these three changes and calculated hazard across Oregon (Figure 5). Recognizing that only tax lots which are both high hazard and in the WUI will be subject to defensible space and fire hardening rules, we focus on changes in the number of tax lots in each county that meet these dual criteria. Across Oregon, the changes described above would result in a net reduction in 21,064 tax lots that meet the dual criteria, a 17.5% reduction compared to the original statewide wildfire risk map (Figure 4). Twenty-six counties would have a net reduction, eight would have no change, and two would have an increase in the number of taxes lots satisfying the dual criteria (Figure 5).

CONCLUSION

The failed rollout of the original statewide wildfire risk map in summer 2022 and the ensuing months of public feedback have helped to frame important changes to the mapping methods and data which need to be considered during the 2024 rule-making process and before ODF can release an official draft statewide wildfire hazard map for public comment. The draft statewide hazard map will not consider structure-level defensible space and home hardening characteristics when determining parcel-level hazard zones. However, the draft statewide wildfire hazard map will account for changes required by Senate Bill 80, and it will include other specific changes to the hazard modeling in response to public feedback. The most impactful decision in response to public feedback is whether or not to consider the effects of irrigated croplands when determining hazard zones. The public interest in doing so will have to be weighed against the policy intent of Senate Bill 762 and uncertainty in accurately accounting for annual variation in the presence of irrigated croplands. If the draft map also accounts for irrigated croplands, then it is likely that thousands of tax lots in Oregon previously subject to defensible space and fire hardening rules under Senate Bill 762's map will no longer be subject to those codes. The precise amount of change will depend on decisions made during the 2024 rulemaking process.

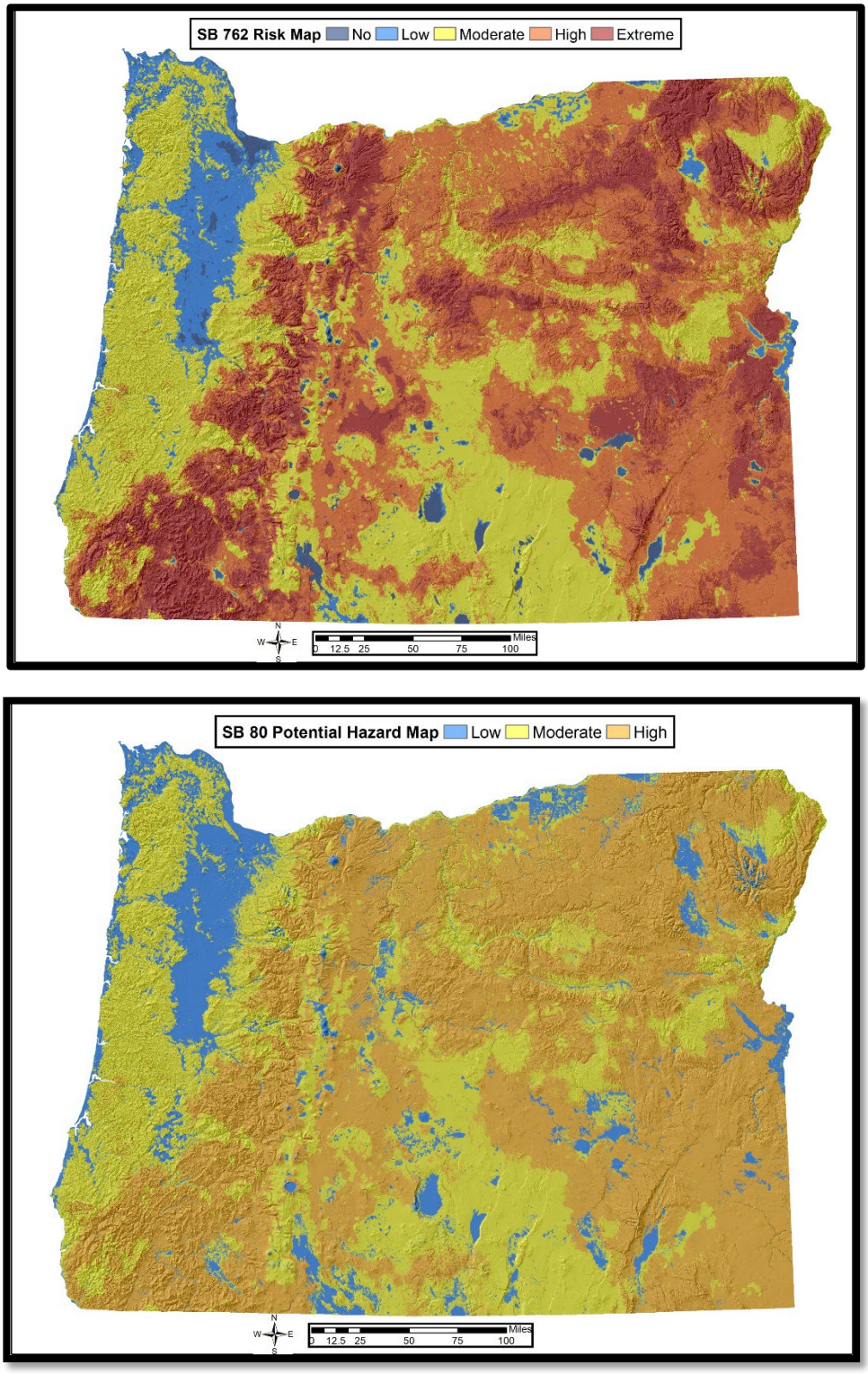
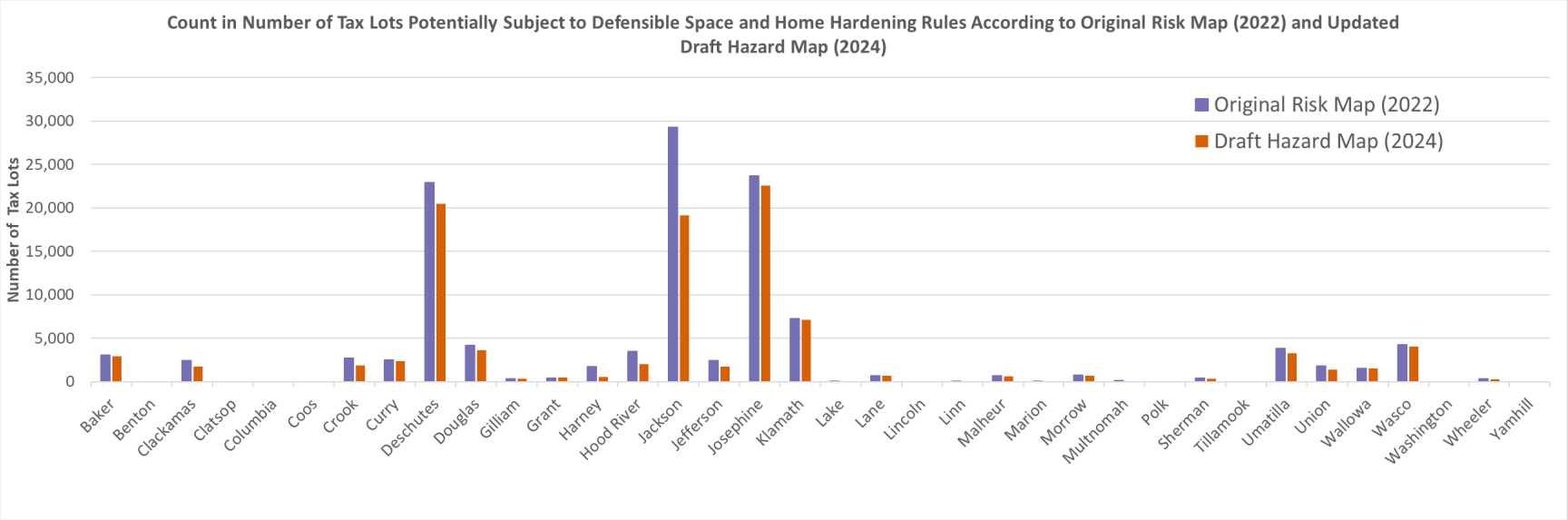


Figure 4. Comprehensive statewide wildfire risk map released on June 30, 2022 (top) and potential draft statewide wildfire hazard map including changes required by Senate Bill 80, updated fire behavior modeling and accounting for the mitigating effects of irrigation (bottom).



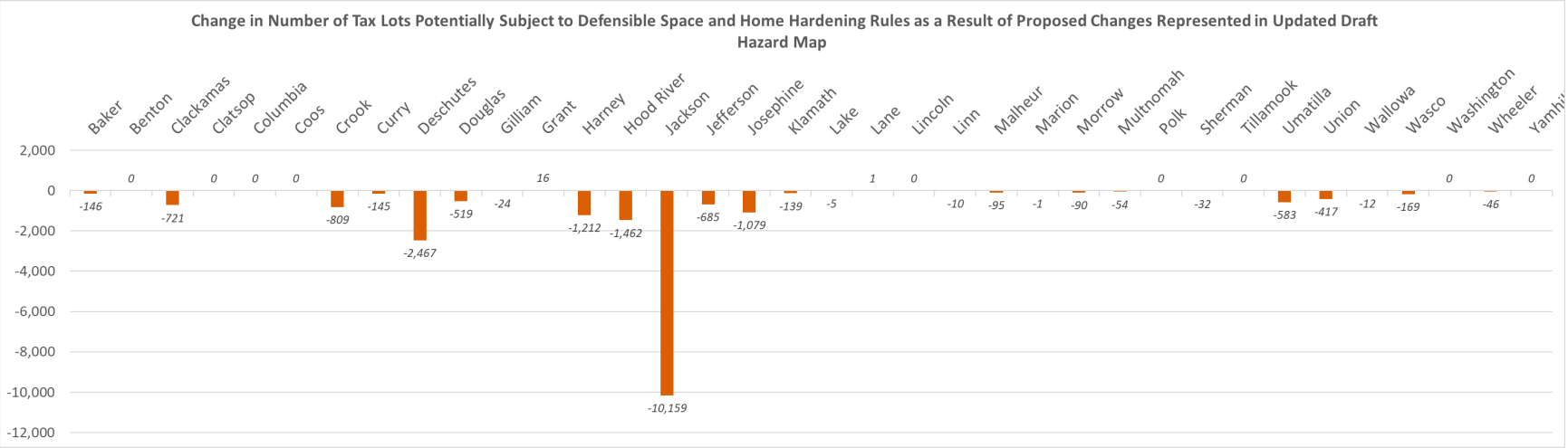


Figure 5. Comparison of total number of tax lots satisfying the dual criteria for potential defensible space and fire hardening regulations in each county under the original statewide wildfire risk map and the potential draft statewide wildfire hazard map.

Appendix A – Section 7 from Oregon's 2021 Senate Bill 762

SECTION 7. STATEWIDE MAP OF WILDFIRE RISK

(1) The State Forestry Department shall oversee the development and maintenance of a comprehensive statewide map of wildfire risk that displays the wildfire risk classes described in subsection (4) of this section and populates the Oregon Wildfire Risk Explorer.
(2) The Oregon Wildfire Risk Explorer must be the official wildfire planning and risk classification mapping tool for the State of Oregon.
(3) The State Board of Forestry shall establish by rule criteria by which the map must be developed and maintained, including criteria concerning the use of the most current wildfire assessments.
(4) In consultation with Oregon State University, the department shall establish five statewide wildfire risk classes of extreme, high, moderate, low and no risk. The classes must be:
    a. Consistent with ORS 477.027.
    b. Based on weather, climate, topography and vegetation.
(5) The department shall enter into an agreement with the university that provides that the university will develop and maintain the map and make the map publicly available in electronic form through the Oregon Wildfire Risk Explorer.
(6) The board shall adopt rules that:
    a. Provide opportunities for public input into the assignment of properties to the wildfire risk classes described in subsection (4) of this section.
    b. Require the department to provide notice and information about how a property owner may appeal an assignment of the property owner's property to the extreme or high wildfire risk classes.
    c. Allow affected property owners and local governments to appeal the assignment of properties to the wildfire risk classes after the map is developed, after any updates to the map and within a reasonably time after delivery of the notice and information described in paragraph (b) of this subsection.
    d. Establish a specific process for appeals through which a requested change in assignment is assessed based on:
        i. Whether the assignment is consistent with the criteria described in subsection (3) of this section;
        ii. Any pertinent facts that may justify a change in the assignment; and
        iii. Any error in the data the department used to determine the assignment, if the error justifies a change in the assignment.
(7) The map must:
    a. Be based on the wildfire risk classes.
    b. Be sufficiently detailed to allow the assessment of wildfire risk at the property ownership level.
    c. Include the boundaries of the wildland-urban interface, as defined in ORS 477.015, consistent with national standards.
    d. Include a layer that geospatially displays the locations of socially and economically vulnerable communities.

(8) To develop and maintain the map, the university shall collaborate with the department, the State Fire Marshal, other state agencies, local governments, federally recognized Indian tribes in this state, other public bodies and any other information sources that the university deems appropriate.

(9) In maintaining the map, the university shall make technical adjustments as needed and update the map consistent with the results of appeals described in subsection (6)(b) of this section.

(10) The university shall provide technical assistance to representatives of state and local government, and to landowners, that use the map.

SECTION 7a.

(1) On or before December 31, 2021, the State Forestry Department shall report to an interim committee of the Legislative Assembly related to wildfire, in the manner provided in ORS 192.245, to the State Wildfire Programs Director and to the Wildlife Programs Advisory Council on the progress of the department and Oregon State University in complying with the requirements of section 7 of this 2021 Act.

(2) On or before June 30, 2022, the department and university must finish all actions required of the department and university by section 7 of this 2021 Act.

(3) Notwithstanding any contrary provision of law, the State Board of Forestry may adopt temporary rules to help ensure the requirements described in subsection (2) of this section are met.

APPENDIX B - Statewide Wildfire Risk Mapping Technical Guide

Following is a technical guide which OSU produced for state agency partners during development of the original statewide wildfire risk map in 2022. The guide details the data and methods OSU used to create the original statewide wildfire risk map and how they meet the criteria of Senate Bill 762 and associated administrative rules. Senate Bill 80 (2023) requires that some of the following methods be altered during development of the new statewide wildfire hazard map. Other changes to the following methods could result from public feedback. The guide is included here to help describe how the original statewide risk map was developed and therefore illustrate how required and proposed changes to the updated statewide wildfire hazard map might be implemented.

PURPOSE

This document describes the process used by Oregon State University (OSU) scientists to quantify and map statewide wildfire risk to structures and other human development, as required by Section 7 of 2021 Senate Bill 762 (Senate Bill 762). It is intended to be a reference for state agencies and partners to aid development of communications products and support planning related to Senate Bill 762.

The methods, data and figures in this document are updated as of June 24, 2022. Questions about this document or any other data produced by OSU to support Senate Bill 762 can be directed to osuwildfirerisk@oregonstate.edu.

All of OSU's data products, including the statewide wildfire risk map, will be publicly available on the Oregon Wildfire Risk Explorer (https://oregonexplorer.info/wildfirerisk) by June 30, 2022. The public will be able to access a version of this document at http://osuwildfireriskmap.forestry.oregonstate.edu by June 30, 2022.

BACKGROUND

Under Senate Bill 762, OSU is responsible for developing three specific data products that will be used to support implementation of Senate Bill 762 (Figure 1). The three data products include:

1. Development and maintenance of a comprehensive statewide map of wildfire risk (Section 7(1-5)).
2. A map of the wildland urban interface, as defined in ORS 477.015, consistent with national standards (Section 7(7)(c)).
3. A map of the locations of socially and economically vulnerable communities (Section 7(7)(d)).

The purpose of the statewide wildfire risk map is to provide state agencies and the public with a consistent source of information as to where wildfire poses the greatest threat to structures[5] and other human development[6] (hereafter "buildings") across Oregon. Oregon's 2021 Senate Bill (Senate Bill 762) identifies several specific applications of the statewide wildfire risk map, notably:

[5] A permitted building on a lot that is used as a place where one or more people sleep.
[6] Essential facilities (ORS 455.447) that support community functions, public communication, energy and transportation in excess in size 400 square feet.

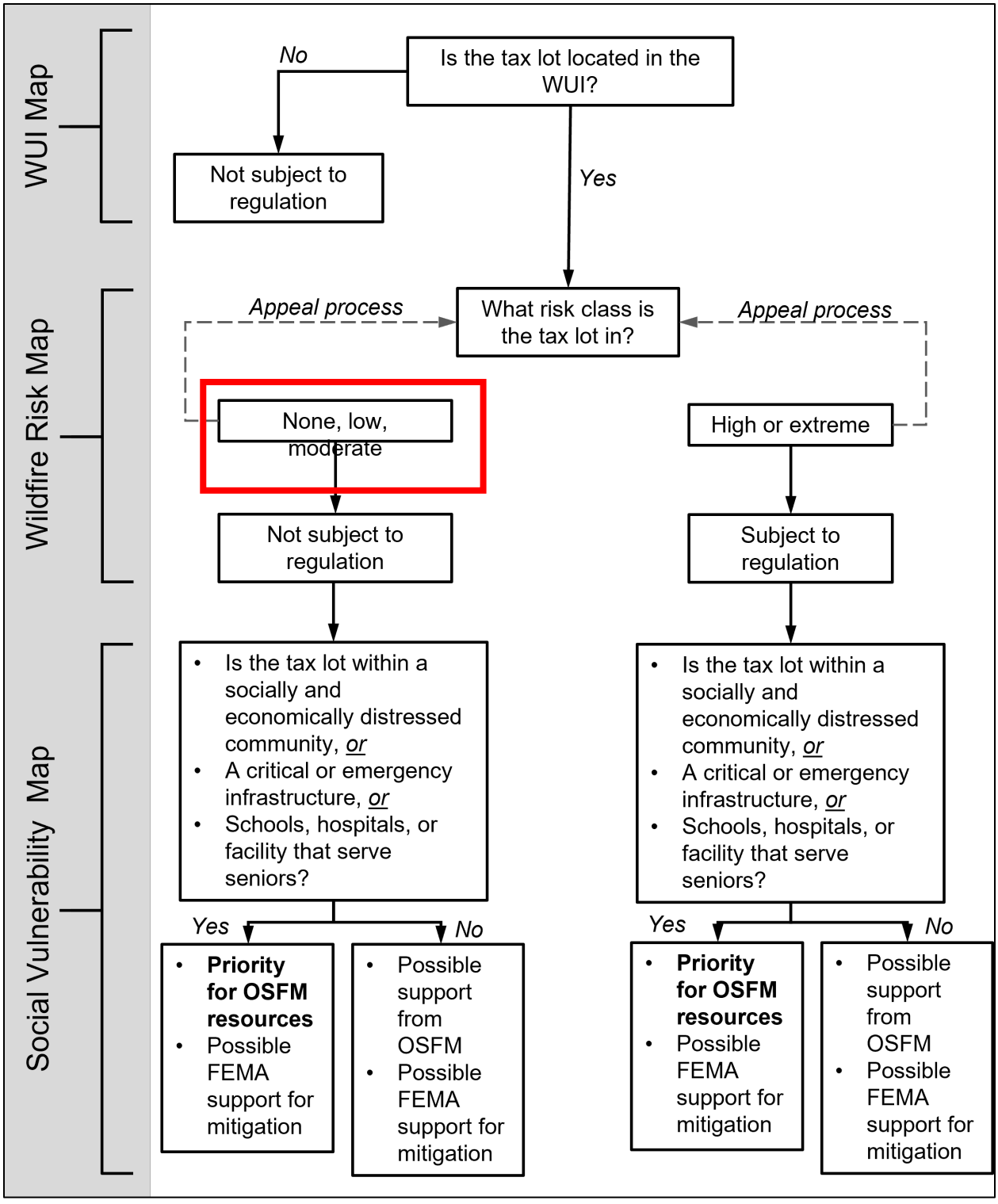


Figure 6. A simplified flowchart of how the three data products developed by OSU will be used together to develop and enforce defensible space rules established under Section 8 of Senate Bill 762. This is one example of how the three maps will be used in conjunction, but there are other examples from Senate Bill 762.

- Under Section 8a(1), “The State Fire Marshal shall establish minimum defensible space requirements for wildfire risk reduction on lands in areas identified on the statewide map of wildfire risk described in section 7 of this 2021 Act as within the wildland-urban interface.”
- Under Section 11(2), “the Department of Land Conservation and Development shall identify updates to the statewide land use planning program and local comprehensive plans and zoning codes that are needed in order to incorporate wildfire risk maps and minimize wildfire risk, including the appropriate levels of state and local resources necessary for effective implementation.”
- Under Section 12(1), “for extreme and high wildfire risk classes in the wildland-urban interface that are identified pursuant to section 7 of this 2021 Act, the Department of Consumer and Business Services shall adopt wildfire hazard mitigation building code standards that apply to new dwellings and the accessory structures of dwellings, as described in section R327 of the 2021 Oregon Residential Specialty Code.”

Perhaps the most public application will be to identify properties subject to defensible space and home hardening rules in the WUI, but the map will also be used to inform statewide zoning and land use. This document explains how risk to structures and other human development was calculated at every location in Oregon, regardless of whether or not a structure is currently present. This way, the map can be used in conjunction with the WUI map to guide defensible space and home hardening rules, but can also be used to guide decisions about changes to future land use and zoning rules where structures and other human development may exist in the future.

During more than 60 hours of planning, the Rules Advisory Committee (RAC), comprised of agency personnel OSU scientists and stakeholders, developed science-based guidance for development of the statewide wildfire risk map. We used peer-reviewed methods similar to those applied in state, regional and national risk assessments to create a statewide map of wildfire risk that meets the expectations of the RAC and rules adopted by the Board of Forestry on June 8, 2022 (Dunn et al., 2020; Gilbertson-Day et al., 2018; Oregon State University, 2019; Scott et al., 2013; Thompson et al., 2016; USDA Forest Service, 2021).

The most basic assessment we can make of wildfire risk is the likelihood of fire occurrence. Likelihood is extremely important component of assessing wildfire risk but only using burn probability assumes that all fires will have the same impact on structures and other human development, which we know is not true. For examples, wildfires across the sage-steppe of southeastern Oregon have high rates of spread but are generally lower intensity than those observed in the western Oregon Cascades. With respect to structures and other human development, lower intensity fires typically result in less damage and create more opportunities for control compared to high intensity fires. For those reasons, it’s important that the statewide structure risk map reflect all three factors that contribute to wildfire risk (Figure 2; Scott et al., 2013). The result is a map of wildfire risk to structures and other human development that satisfies the needs described in Senate Bill762, but which can further be integrated into statewide risk management planning (e.g. Dunn et al., 2020; Scott et al., 2013; Thompson et al., 2016).

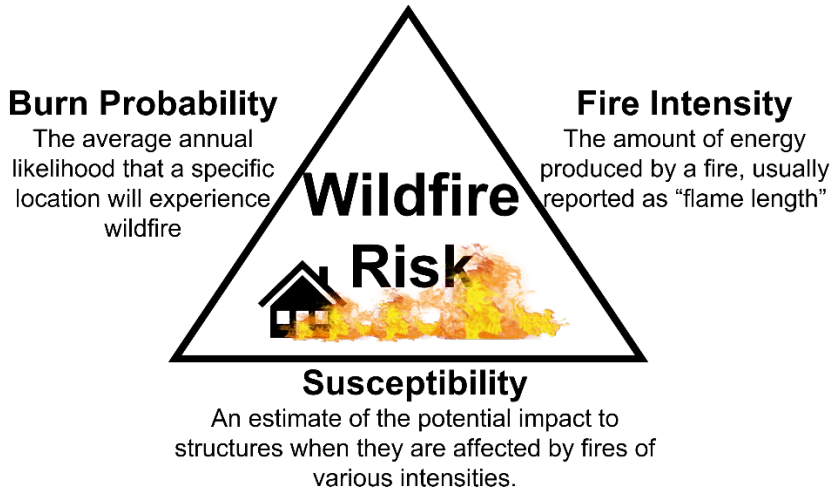


Figure 7. The fire risk triangle includes the three primary components of measuring and quantifying wildfire risk.

Methods for Mapping Statewide Wildfire Risk

We mapped statewide wildfire risk to structures and other human development in four steps:

1. Using fire behavior models to estimate burn probability and fire intensity
2. Determining response functions to reflect susceptibility
3. Quantifying risk
4. Grouping risk into five categories

Modelling Burn Probability and Intensity

Fire modelling was performed by Pyrologix LLC[7], a fire behavior modeling company that has been a leader in wildfire risk analytics for 20 years.

Burn Probability

In the context of Senate Bill 762 and the statewide risk map, burn probability is the average annual likelihood that a specific location will experience wildfire. In other applications and contexts, burn probability might not refer to an annual estimate, but in this document the term burn probability is always meant as an annual estimate of fire likelihood. Burn probabilities represent long-term averages and are not forecasts or predictions of where fire is going to occur in a specific year. Annual burn probabilities are primarily a reflection of regional climate patterns and vegetation types, but can be affected by land use, ignition patterns and other elements that are within human control.

Burn probabilities are reported as fractions which can be thought of as the percent chance of fire occurring in any given year (Figure 3). For example, a burn probability of 0.01 indicates that a fire is expected once every hundred years on average, or, alternatively, there is 1% chance of a fire occurring in any given year.

For the statewide risk map, we used the large fire simulator, FSim[8], to estimate annual burn probabilities (Finney et al., 2011). FSim has been the foundation of many regional and national wildfire risk applications (e.g. Day, 2020; Gilbertson-Day et al., 2018; U.S. Department of Agriculture, Forest Service, 2022). FSim is a spatially explicit fire behavior model that simulates plausible fires and fire seasons based

[7] http://pyrologix.com/
[8] https://www.firelab.org/project/fsim-wildfire-risk-simulation-software

on local weather records, landscape conditions, and historical patterns of fire occurrence and size. Before running the model, we updated the modeling landscape to reflect fires, other disturbances and fuel treatments that occurred between the release of the base Landfire fuel model data (released as a 2016 landscape) through 2021. In addition, the modelling landscape was adjusted based on feedback from regional wildfire and fuels specialists to reflect fire behavior as observed during fire suppression or prescribed fire operations. Scientists ran over 100,000 simulations across Oregon to account for the wide variability in factors that influence fire occurrence.

Wildfire Intensity

Wildfire intensity is a measurement of the amount of energy produced by a fire, frequently reported as "flame length." Fire intensity is driven by a number of factors including weather, topography, and fuel type. Fire intensity is an important component of risk because varying intensities can lead to different impacts to structures and other human development. For instance, fires with flame lengths less than two feet are less likely to damage structures because they can usually be controlled with hand tools and machinery and are less likely to cast large ember showers. In contrast, fires with flame lengths greater than eight feet are much more likely to damage and destroy structures and other human developments because they can only be engaged with aerial resources when weather conditions allow and are far more likely to cast far-reaching embers that spark new fires.

For the statewide risk map, we used FlamMap[9] to model wildfire intensity (Figure 4). As with burn probabilities, we used an updated landscape reflecting 2022 conditions and ran hundreds of iterations to account for how fire might behave at each location under a full range of plausible weather and fuel conditions (Scott, 2020). By using FlamMap instead of FSim, we simulated fire intensity at a finer spatial resolution and accounted for nuanced interactions between topography and wind which have important impacts on fire behavior.

[9] https://www.firelab.org/project/flammap

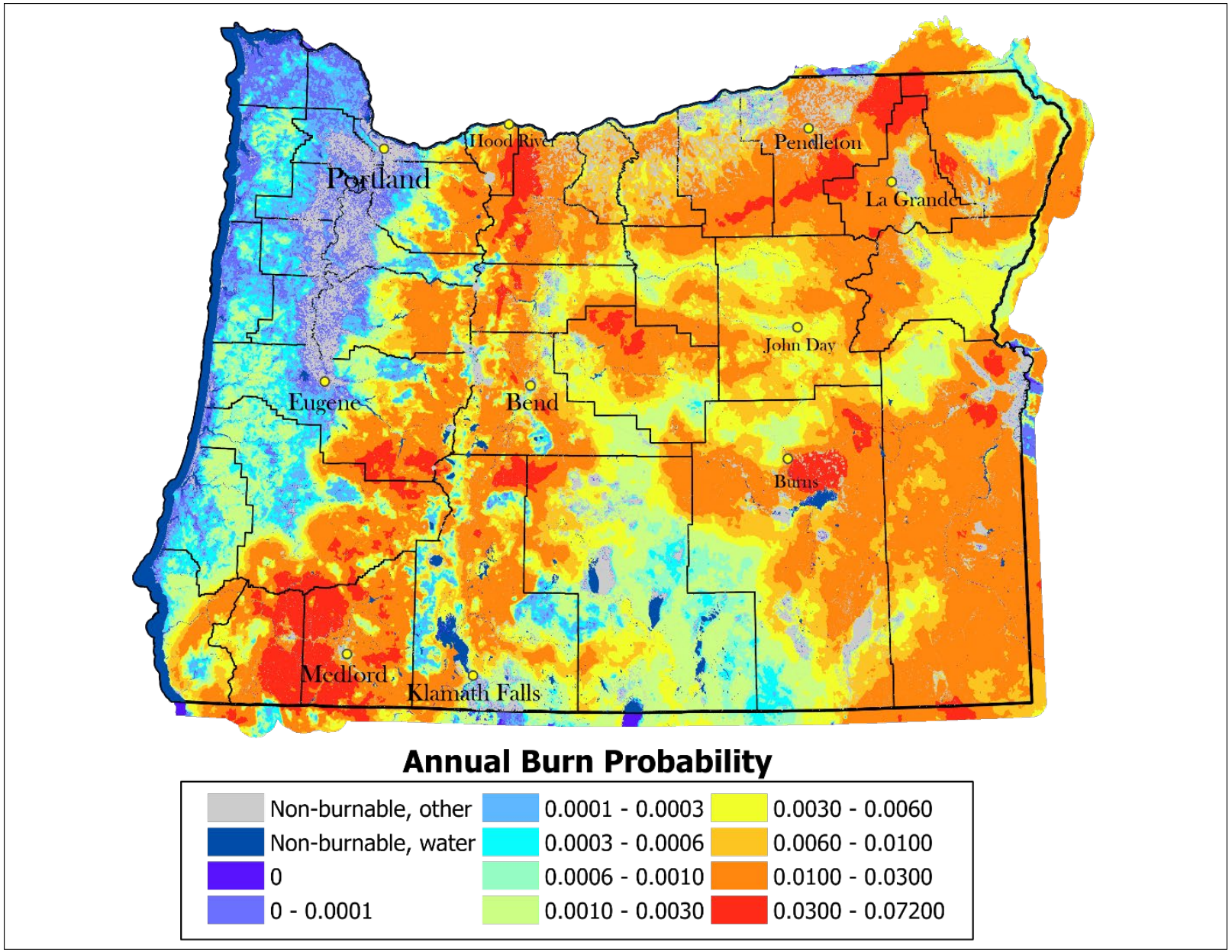


Figure 8. Modeled average burn probability across Oregon. Non-burnable areas include open water, barren ground, urban areas and some types of agricultural land.

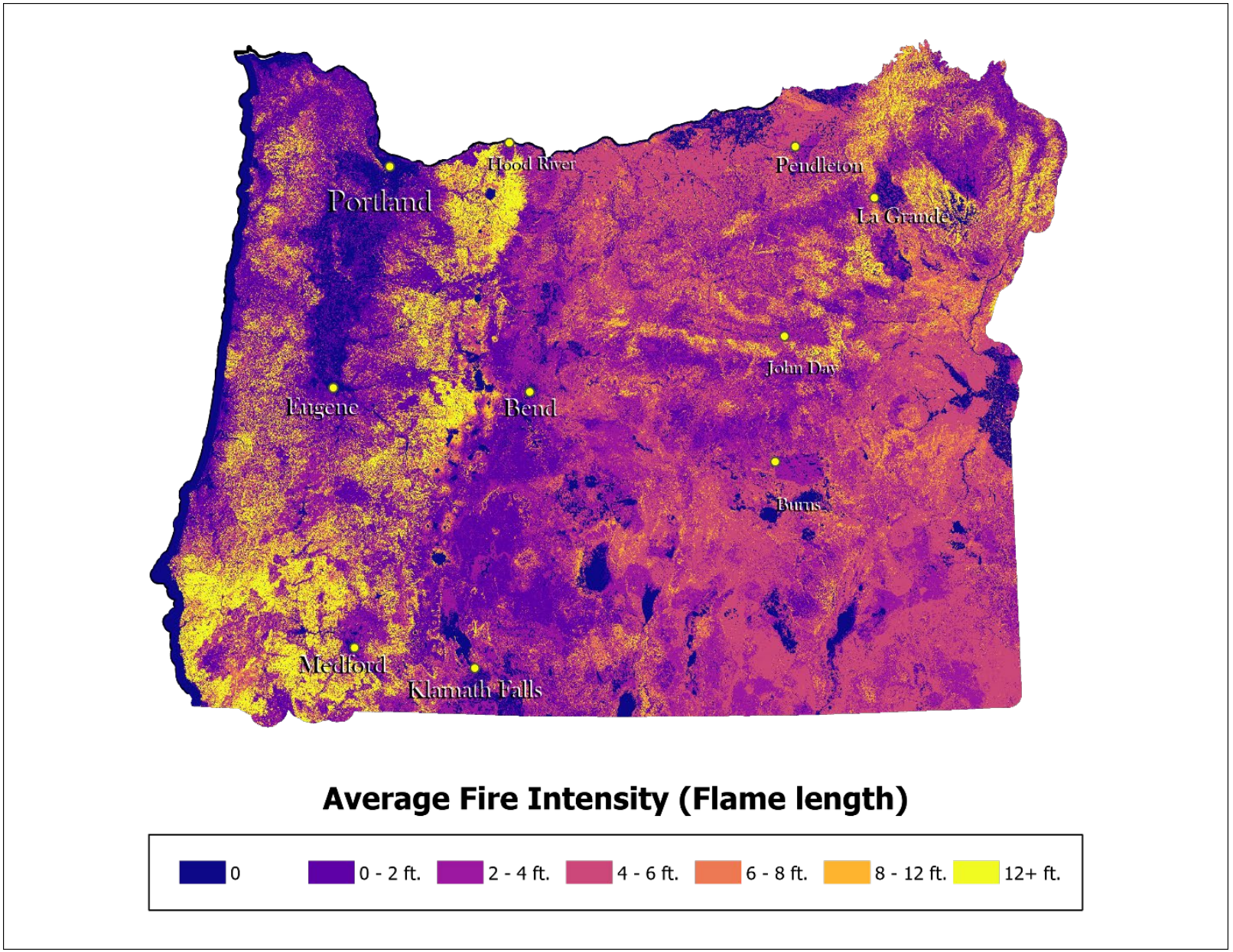


Figure 9. Modeled flame lengths across Oregon. Non-burnable areas include open water, barren ground, urban areas and some types of agricultural land.

Determining Response Functions to Reflect Susceptibility

Susceptibility is a measurement of the impacts to structures and other human development when they are affected by fires of varying intensities. The estimated damage to a structure is directly related to the expected intensity of a wildfire. In other words, the expected damage is a function of the expected flame length (Figure 6). However, the expected damage to structures is also a function to some degree of the kind of vegetation in which the fire is burning. For instance, if a fire is burning in forested vegetation and the flame length at the location of a structure is five feet, the structure is anticipated to suffer a 50% loss in value (Figure 6). The expected loss for each flame length category is called a "response function." In this context when we talk about the change in value it does not mean a change in the monetary value. Instead, the word "value" refers to a generalized, unitless concept of value that allows us to compare relative risk between structures in different locations.

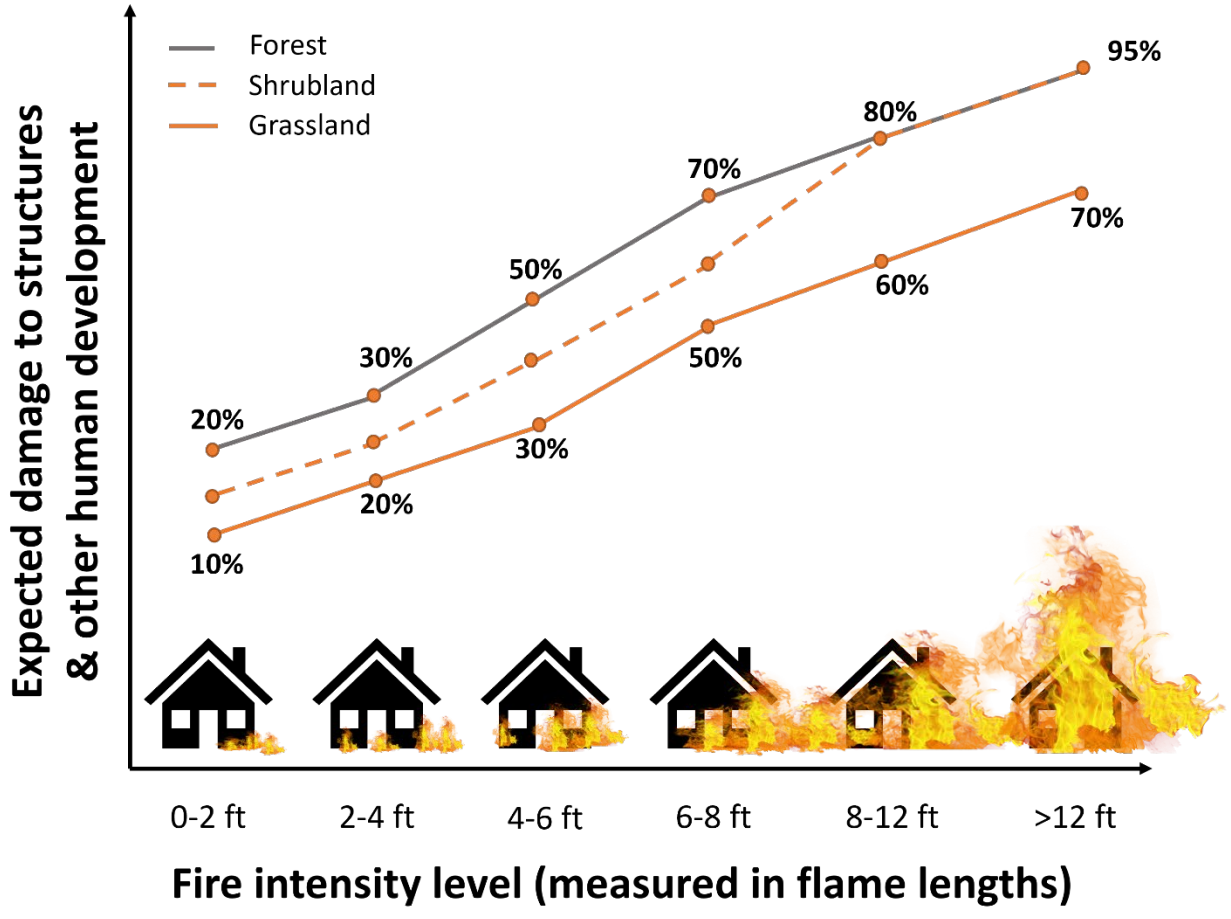


Figure 10. Illustration of generalized susceptibility framework.

Quantifying Risk

The final calculation of risk was performed by multiplying the burn probability by the susceptibility response function associated with the flame length and vegetation type at each location in Oregon (Figure

7). The final risk value, called “expected net value change” (eNVC), tells us the magnitude of the expected annual damage to any structures at that location. We calculated the eNVC at each location in Oregon and then averaged the eNVC within a 90-meter buffer. This last step, taking an average from the surrounding area, helps to account for any uncertainty in the spatial data inputs as well as account for the fact that local risk is to some degree a reflection of the adjacent surroundings on all sides.

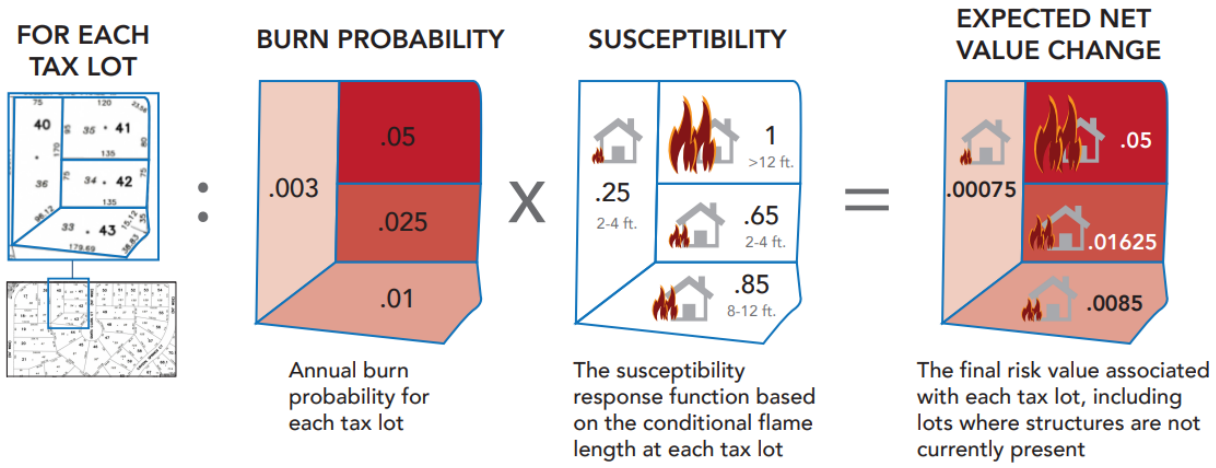


Figure 11. Generalized framework illustrating how burn probability, fire intensity, and susceptibility response functions are used to calculate expected net value change

Annualized eNVC is an abstract value intended to show us where damage is more likely to occur in relative terms; it is not a forecast of what will actually occur in any given year. The statewide risk map illustrates risk to all locations in Oregon, regardless of whether or not there is currently a structure or other human development present.

Grouping Risk into Five Categories

Senate Bill 762 stipulates that statewide risk will be grouped into five risk categories based on eNVC values: None, Low, Moderate, High and Extreme. During the RAC process we looked at several methods for creating statistically objective thresholds for these classes. Those efforts suggested approximately 25% of the WUI is at high to extreme risk. After going through this process, it became apparent that the final thresholds needed to be accurate and useful within the WUI, but also at a state-wide scale. To define thresholds objectively and accurately at multiple scales, we evaluated a couple scenarios based on this 25% threshold and observed that when approximately 25% of the geographic area of the WUI is in high and extreme risk categories, about 57% of the geographic area of the state is in high or extreme risk categories. In terms of parcels, when approximately 25% of the WUI area is classified as high or extreme, 10% of existing parcels in the WUI end up in the high or extreme risk classes.

- Extreme Wildfire Risk: eNVC value ≥ 0.522288. This range of eNVC values captures 8% of the area of the WUI and includes the 97th and above percentile of buildings in the WUI with the highest risk.

- High Wildfire Risk: eNVC value of 0.137872 - 0.522288. This range of eNVC values captures 15% of the WUI and includes the 90th – 97th percentile of structures in the WUI with the highest risk.

- Moderate Wildfire Risk: eNVC value of 0.001911 - 0.137872. This range of eNVC values captures 40% of the WUI and includes the 60^{th} – 90^{th} percentile of structures in the WUI with the highest risk.
- Low Wildfire Risk: eNVC value of > 0.0 - 0.001911. This range of eNVC values captures 35% of the WUI and includes the 0 – 60^{th} percentile of structures in the WUI with the highest risk.
- No Wildfire Risk: eNVC value of zero. Areas classified as having no risk include two general types of non-burnable areas. The first kind of non-burnable area includes some types of irrigated agriculture, barren areas, snow- and ice-covered areas, and open water. The second type of non-burnable area includes densely developed areas that are not expected to be exposed to potential ember showers.

MAPPING STATEWIDE RISK

The language of Senate Bill 762[10] is clear that OSU was to create a statewide map of wildfire risk, even though in many instances risk will only be considered in conjunction with the WUI to determine where actions are required (i.e. Section 8a; Figure 8). The statewide map of wildfire risk quantifies risk to buildings at every location in Oregon as if a building were present at all locations (Figure 9). In many locations (i.e. public lands) quantifying the risk to potential structures (structures that are not currently present) is irrelevant because either no structure will ever be present or Senate Bill 762 does not apply, as is the case with some tribal and federal lands. However, many locations across Oregon do not currently have a structure but could have one in the future. The map in Figure 9 is the statewide map required by Senate Bill 762 and is a useful planning tool for decisions about future land use and development.

[10] Section 7 (1): "The State Forestry Department shall oversee the development and maintenance of a comprehensive statewide map of wildfire risk that displays the wildfire risk classes described in subsection (4) of this section and populates the Oregon Wildfire Risk Explorer."

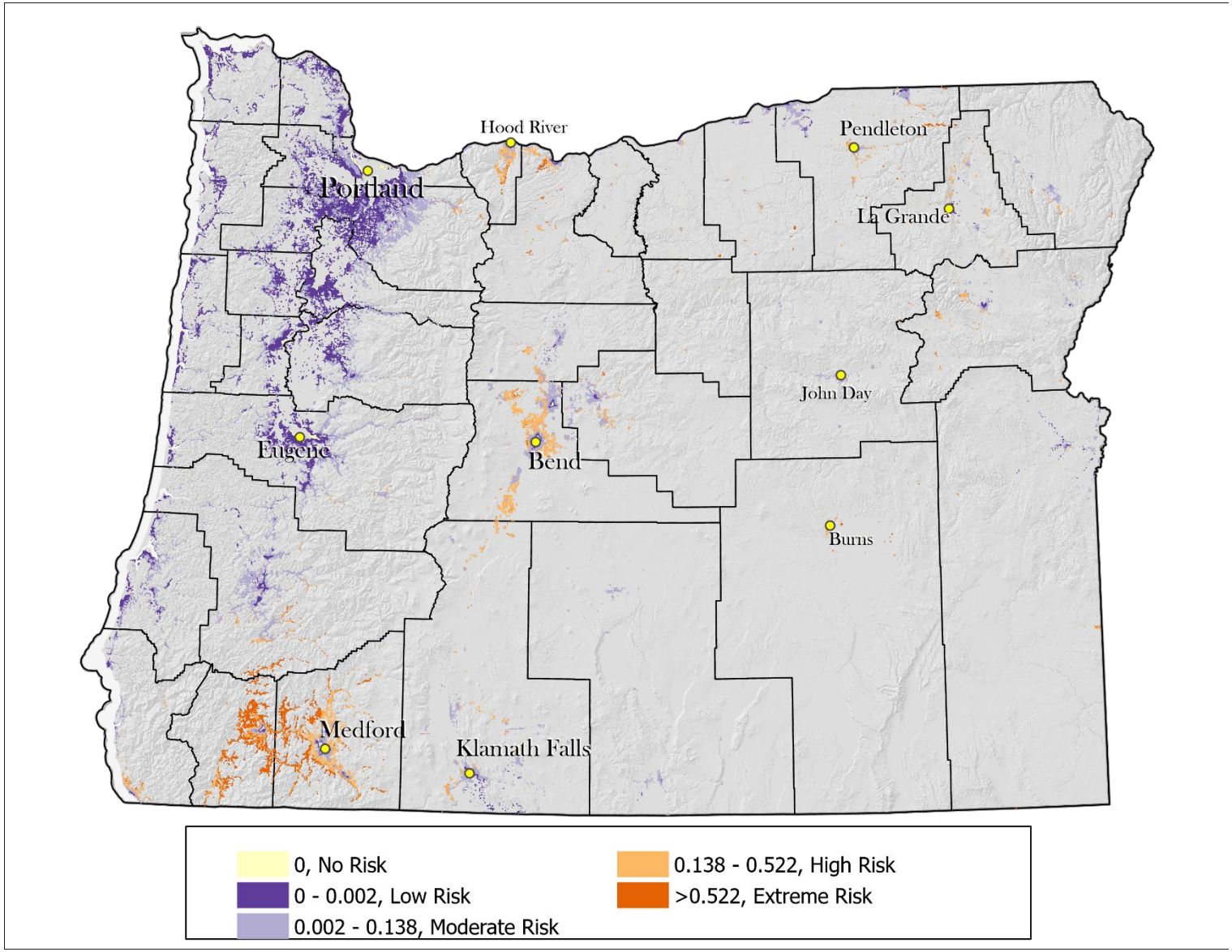


Figure 12. Wildfire risk within the WUI.

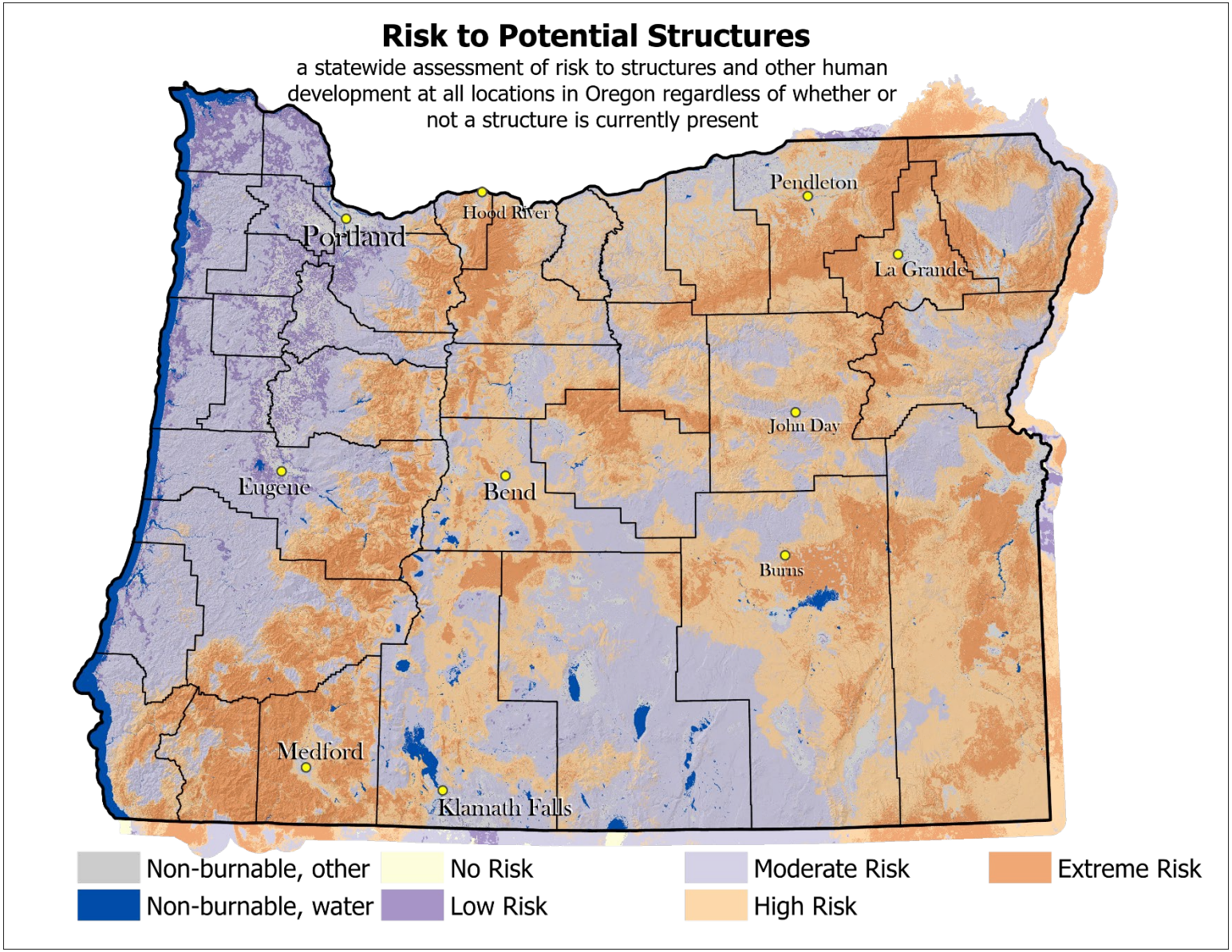


Figure 13. Statewide map of risk. This map satisfies the requirement for a statewide assessment of risk to structures and other human development, not just an assessment within the WUI. Risk values in this map assume that a structure is present at every location in Oregon which, of course is not the case. This map could be used to inform land use decisions on lands eligible for future development.

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APPENDIX C – Excerpt from Senate Bill 80, 2023

82nd OREGON LEGISLATIVE ASSEMBLY--2023 Regular Session

Enrolled

Senate Bill 80

Printed pursuant to Senate Interim Rule 213.28 by order of the President of the Senate in conformance with pre-session filing rules, indicating neither advocacy nor opposition on the part of the President (at the request of Senate Interim Committee on Natural Resources and Wildfire Recovery)

CHAPTER .....

AN ACT

Relating to wildfire; creating new provisions; amending ORS 215.495, 431A.410, 431A.412, 455.612, 476.392, 476.396, 476.690, 477.027, 477.490, 477.748 and 526.360 and sections 11 and 12d, chapter 592, Oregon Laws 2021; and declaring an emergency.

Be It Enacted by the People of the State of Oregon:

STATEWIDE WILDFIRE HAZARD MAP

SECTION 1. ORS 477.490 is amended to read:

(1) The State Forestry Department shall oversee the development and maintenance of a comprehensive [*statewide map of wildfire risk*] **statewide wildfire hazard map** that displays the wildfire [*risk classes*] **hazard zones** described in subsection [(4)] (**5**) of this section and populates the Oregon Wildfire Risk Explorer

(2) The purposes of the map are to:

(a) Educate Oregon residents and property owners about the residents' and property owners' wildfire exposure by providing transparent and science-based information.

(b) Assist in prioritizing fire adaptation and mitigation resources for the most vulnerable locations.

(c) Identify where defensible space standards and home hardening codes will apply.

[(2)] (**3**) The Oregon Wildfire Risk Explorer must be the official wildfire planning and [*risk*] **hazard** classification mapping tool for the State of Oregon.

[(3)] (**4**) The State Board of Forestry shall establish by rule criteria by which the map must be developed and maintained, including criteria concerning the use of the most current wildfire assessments.

[(4)] (**5**) In consultation with Oregon State University, the department shall establish [*five*] **three** statewide wildfire [*risk classes of*] **hazard zones that are titled** [*extreme*,] *high, moderate*[,] **and** low [*and no risk*] **hazard zones**. The [*classes*] **zones** must be:

(a) Consistent with ORS 477.027.

(b) Based on weather, climate, topography and vegetation.

[(5)] (**6**) The department shall enter into an agreement with the university that provides that the university will develop and maintain the map and make the map publicly available in electronic form through the Oregon Wildfire Risk Explorer.

[(6)] (**7**) The board shall adopt rules that:

(a) Provide opportunities for public input into the assignment of properties to the wildfire [*risk classes*] **hazard zones** described in subsection [(4)] (**5**) of this section.

(b) Require the department to provide notice and information **to a property owner whose property is assigned to the high hazard zone within the wildland-urban interface, as defined pursuant to ORS 477.027, about the fact that the property has been assigned to the high hazard zone, the effects of the assignment and** [*about*] how [*a*] **the** property owner may appeal [*an*] **the** assignment of the property owner's property to the [*extreme or*] high [*wildfire risk class*] **hazard zone**.

(c) Allow affected property owners and local governments to appeal the assignment of propertiesto the wildfire [*risk classes*] **hazard zones** after the map is developed, after any updates to the map and within a reasonable time after delivery of the notice and information described in paragraph (b) of this subsection.

[*(d) Establish a specific process for appeals through which a requested change in assignment is assessed based on:]*

[(A) Whether the assignment is consistent with the criteria described in subsection (3) of this section;]

[(B) Any pertinent facts that may justify a change in the assignment; and]

[(C) Any error in the data the department used to determine the assignment, if the error justifies a change in the assignment.]

(d) Provide that assignments of properties to the high hazard zone may be appealed asa contested case as described in ORS chapter 183.

(8) Before sending notices described in subsection (7)(b) of this section, the department shall seek review of the notices by the Wildfire Programs Advisory Council to receive council recommendations concerning tone, clarity of language and presentation of information.

[(7)] (**9**) The map must:

(a) Be based on the wildfire [*risk classes*] **hazard zones**.

(b) Be sufficiently detailed to allow the assessment of wildfire [*risk*] **hazard** at the property-ownership level.

(c) Include the boundaries of the wildland-urban interface, as defined in ORS 477.015, consistent with national standards.

(d) Include a layer that geospatially displays the locations of socially and economically vulnerable communities.

(e) **Be completed and released expeditiously, following the collaboration described in subsection (10) of this section.**

[(8)] (**10**) To develop and maintain the map, **the department and** the university shall collaborate with [*the department*,] the State Fire Marshal, other state agencies, local governments, federally recognized Indian tribes in this state, other public bodies and any other information sources that the university deems appropriate.

(11) In implementing subsections (7)(a) and (10) of this section, the department and the university shall provide for robust community engagement through a process that:

(a) Ensures, through the use of clear language, graphics, visuals and examples, that the underlying criteria for assigning hazard zones are publicly available and comprehensible to a public audience.

(b) Is interactive and does not consist solely of delivering information in a top-down manner.

(c) Is coordinated with local partners, including counties, relevant state agencies and the Wildfire Programs Advisory Council.

(12) In addition to the community engagement described in subsection (11) of this section, to ensure that local characteristics in each area of this state are considered in the mapping process and before the draft map is released, the department shall meet with county commissioners and the county commissioners' staff in eight in-person meetings throughout this state.

(13) When the draft map is released but before final publication of the map occurs:

(a) The department shall accept public comment on the map.

(b) After the meetings described in subsection (12) of this section, county commissioners, upon request by the county commissioners, must have one additional opportunity, arranged and scheduled by the Association of Oregon Counties, with either in-person attendance or a hybrid of in-person and remote attendance, to discuss concerns about the map and potential changes to the map.

[(9)] (**14**) In maintaining the map, the university shall make technical adjustments as needed and update the map consistent with the results of appeals described in subsection [(6)(b)] (7)(b) of this section.

[(10)] (**15**) The university shall provide technical assistance to representatives of state and local government, and to landowners, that use the map.

(16) Agencies of this state shall, as appropriate, use the map layer described in subsection (9)(d) of this section to:

(a) Direct resources for wildfire hazard reduction and wildfire resiliency to those mostin need; and

(b) Assist with identifying communities for extensive, targeted engagement and outreachrelated to wildfire hazard reduction and wildfire resiliency.

(17) Agencies that use the map layer described in subsection (9)(d) of this section shall conduct outreach:

(a) In partnership with community leaders and community-based organizations;

(b) By using different media;

(c) By disseminating information through local schools, stores, faith-based organizations and medical offices; and

(d) By offering all information in the languages spoken in the relevant community, as practicable.

WILDLAND-URBAN INTERFACE CRITERIA

SECTION 2. ORS 477.027 is amended to read:

477.027. (1) By rule, considering national best practices, the State Board of Forestry shall establish:

(a) A definition of "wildland-urban interface."

(b) Criteria by which the wildland-urban interface must be identified and classified.

(2) The criteria:

(a) Must recognize differences across the state in fire hazard, fire risk and structural characteristics within the wildland-urban interface.

(b) May not exclude a category of land from inclusion in the wildland-urban interface.

(3) Based on the criteria, the [board shall establish five classes of] wildland-urban interface[.] [(4) The classes] must be integrated into the comprehensive statewide map described in ORS 477.490.