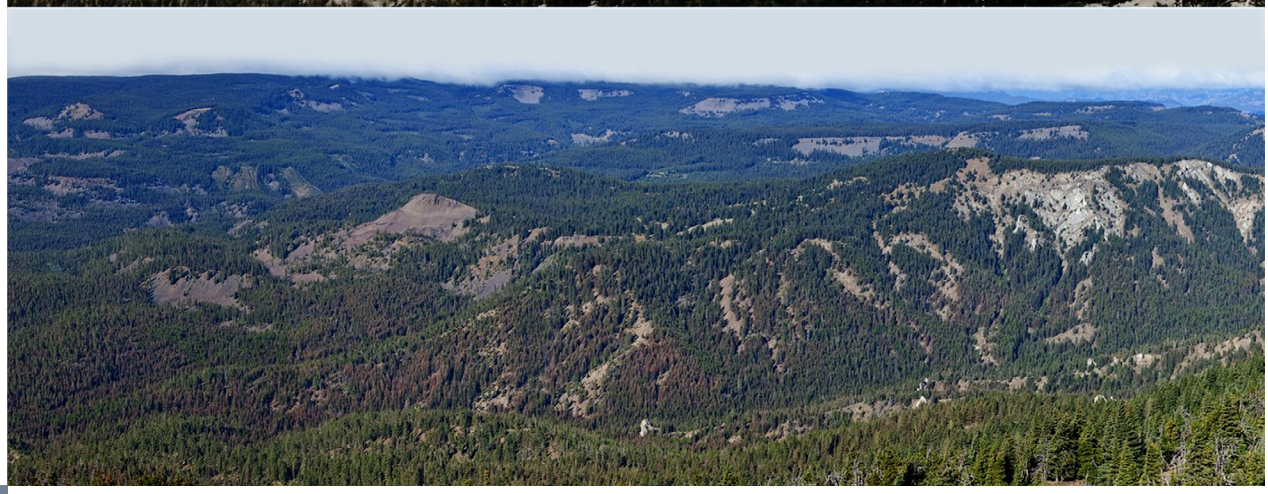
NATURAL RESOURCES



Forest Health Assessment and Treatment Framework (SB 5546)

December 2018

WASHINGTON STATE DEPT OF
NATURAL RESOURCES
HILARY S. FRANZ
COMMISSIONER OF PUBLIC LANDS

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Report to the Legislature

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Prepared by
Washington State Department
of Natural Resources

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Cover image: Upper photo taken in 1934 by Reino R. Sarlin/USDA Forest Service. Lower photo taken in 2010 by John F. Marshall.

Acknowledgements

The Washington State Department of Natural Resources would like to acknowledge and thank the following individuals and organizations that participated in the selection of the forest health planning areas, participated and reviewed the forest health planning areas landscape evaluations, and contributed to the review and development of this report:

Forest Health Advisory Committee Members

Josh Anderson, Vaagen Brothers
Steve Andringa, Tapash Sustainable Forest Collaborative
Kevin Arneson, Boise Cascade
Darcy Batura, The Nature Conservancy
Laura Berg, Washington State Association of Counties
Megan Birzell, The Wilderness Society
Jerry Bonagofski, Washington Contract Loggers Association
Matt Comisky, American Forest Resource Council
Cody Desautel, Confederated Tribes of the Colville Reservation
Mark Doumit, Washington Forest Protection Association
Robert Fimbel, Washington State Parks
Ross Frank, Chumstick Wildfire Stewardship Coalition
Dr. Paul Hessburg, U.S. Forest Service
Debbie Hollen, U.S. Forest Service
Lloyd McGee, North Central Washington Forest Health Collaborative
Jay McLaughlin, South Gifford Pinchot Collaborative
Dr. Elaine Oneil, Washington Farm Forestry Association
Andrew Spaeth, Northeast Washington Forestry Coalition
Jim Stoffer, Washington State School Directors' Association
Jamie Tolfree, Pinchot Partners
Jim Walkowski, Washington Fire Chiefs
Dave Werntz, Conservation Northwest
Cynthia Wilkerson, Washington Department of Fish & Wildlife

Washington State Department of Natural Resources

Myron Boles
Angus Brodie
Tom Bugert
Padraic Callahan
Derek Churchill
Scott Chambers
Dan Donato
Aleksandar Dozic
Scott Fisher
George Geissler
Josh Halofsky
Steve Harris
Chuck Hersey
Larry Leach
Wyatt Leighton
Stevie Mathieu
Robert McKellar
Ken McNamee
Heather McPherson
Danielle Munzing
Amy Ramsey
Julie Sackett

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Jake Anderson, Klickitat County
James Bagley, Washington Conservation Science Institute
David Cass, Washington State Parks
Chris Conklin, Washington Department of Fish & Wildlife
Paul Dahmer, Washington Department of Fish & Wildlife
Scott Downes, Washington Department of Fish & Wildlife
Bill Gaines, Washington Conservation Science Institute
Miles Hemstrom, Oregon State University
Emilie Henderson, Oregon State University
Sean Jeronimo, University of Washington
Mike Kaputa, Chelan County
Jonathan Kane, University of Washington
Van Kane, University of Washington
Melody Kreimes, North Central Washington Forest Health Collaborative
Reese Lolley, The Nature Conservancy
Lisa Naas Cook, South Gifford Pinchot Collaborative
Laura Potash, Tapash Sustainable Forest Collaborative
Pete Teigen, North Central Washington Forest Health Collaborative
Richard Tveten, Washington Department of Fish & Wildlife
Jen Watkins, Conservation Northwest

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Chelan County
Colville National Forest
Chumstick Wildfire Stewardship Coalition
Gifford-Pinchot National Forest
North Central Washington Forest Health Collaborative
Northeast Washington Forestry Coalition
Okanogan-Wenatchee National Forest
South Gifford Pinchot Collaborative
Tapash Sustainable Forest Collaborative
Umatilla National Forest
USDA Forest Service Region 6

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Executive Summary

Forest health is defined in state statute as "the condition of a forest being sound in ecological function, sustainable, resilient, and resistant to insects, diseases, fire and other disturbances, and having the capacity to meet landowner objectives" (RCW 76.06).

According to this definition, broad swaths of eastern Washington forestland are in an unhealthy state. An analysis by The Nature Conservancy and the United States Forest Service identified 2.7 million acres of forestland in Central and Eastern Washington requiring natural disturbance or active management to create forest structures more resilient against insects, diseases and wildfires (Haugo et al. 2015).

The Washington State Department of Natural Resources (DNR), the Washington State Legislature, the Washington Department of Fish & Wildlife, tribes, federal agencies, forest stakeholders and others have recognized for the last 15 years that eastern Washington forests are not in a condition to be resilient and resistant to wildfires and drought-related insect outbreaks and diseases. The 2014 and 2015 wildfire seasons crystalized the risks facing these Washington forests and made clear the need for action to address forest health issues on a meaningful scale. Scientists expect the impacts from climate change to greatly exacerbate these risks. The warm and dry conditions that occurred in 2015 are projected to be the new normal by mid to late century (USGCRP, 2018).

In 2016, the Legislature directed DNR to develop a forest health strategic plan to "treat areas of the state forestland that have been identified by the department as being in poor health." DNR determined that to meet the intent of the Legislature, and to address the forest health issue in a meaningful way, it was necessary to take a broad view of "treat areas of state forest lands," and to adopt a guiding philosophy of "all lands, all hands." This DNR guiding philosophy means the agency aims to address forest health issues at a landscape-scale and in coordination with all landowners to ensure forest health treatments advance in a coordinated, strategic fashion.

The 20-Year Forest Health Strategic Plan is the high-level framework guiding the State of Washington's work and investments to improve forest health, help forests adapt to projected climatic changes, and achieve forest-related ecological, economic, and social benefits in Central and Eastern Washington. The overarching strategy is to maximize the effectiveness of forest health treatments by coordinating, planning, prioritizing, and implementing forest management activities across large landscapes.

Washington's 20-Year Forest Health Strategic Plan sets a goal of treating 1.25 million acres over the next 20 years to improve the resilience of forests in eastern Washington. The authority and direction contained in SB 5546 guides DNR's efforts to improve forest health across all ownerships in large landscapes. SB 5546 requires DNR to create a Forest Health Assessment and Treatment Framework that assess a minimum of

200,000 acres of fire prone lands each biennium and identifies forest health treatment needs across all lands. SB 5546 also provides legislative direction and tools to help achieve the state's treatment goals across all lands. This report to the Legislature shows how DNR is working in partnership with landowners and stakeholders to accomplish these goals.

The creation of the 20-Year Forest Health Strategic Plan was a collaborative process that engaged agencies, tribes, landowners, and stakeholders in the development of a common vision, mission, and goals to create resilient forested landscapes in Central and Eastern Washington. Now that DNR is implementing the plan, the agency has continued that collaboration by expanding the engagement to even more stakeholders through the Forest Health Assessment and Treatment Framework process. First, DNR engaged with a broad array of federal and state agencies, tribes, forest collaboratives, and stakeholders to select the forest health planning areas. DNR invested a significant amount of time to ensure the proper alignment between state and local forest health priorities in selecting the forest health planning areas so there would be a long-term commitment to working together in these areas. Once the planning areas were selected, engagement at the local level continued to help inform the landscape evaluation and assessment process and continue to build buy-in and support for the process.

The first step of the Forest Health Assessment and Treatment Framework was to select which priority watersheds the state will analyze for forest health treatment needs across all lands and focus its forest health investments. DNR identified its priority planning areas based on a data-driven analysis of HUC 6 (Hydrologic Unit Code) watersheds in the region, as well as feedback from forest collaboratives, tribes, relevant federal and state agencies, the Forest Health Advisory Committee and other stakeholders. DNR selected 12 forest health planning areas for the 2018 planning cycle to analyze for forest health treatment need. An additional 21 forest health planning were selected for the 2020 planning cycle and will be analyzed in 2019 and 2020 (the 2020 planning cycle) with results reported by December 2020. The 2018 forest health planning areas contain over 1 million acres of forestland and the 2020 planning areas contain over 1.65 million acres of forestland.

For the 2018 planning areas, DNR conducted landscape evaluations to assess forest health conditions and determine treatment needs across all lands. A landscape evaluation is a data driven approach to understanding the current condition of a landscape and its level of resilience to future natural disturbances, including climatic change. A primary result of the landscape evaluation is a summary of vegetation changes relative to historical reference conditions, current fire and drought risk, and wildlife habitat needs. The information and data from a landscape evaluation is then synthesized into a landscape prescription that describes and quantifies the shifts in vegetation conditions and pattern that are needed to move the landscape into an ecologically resilient condition and significantly reduce fire risk to communities.

DNR is employing the landscape evaluation and prescription process to assess the forest health treatment needs in the forest health planning areas as required by SB

5546. The purpose of the landscape evaluation and prescription is to set high-level forest health treatment targets for each planning area so that the state, landowners, and stakeholders understand the level of treatment needed to create resilient forest conditions, work together to implement landscape-scale treatments, and provide a benchmark to track progress on achieving treatment goals. Landscape evaluations and prescriptions do not mandate treatment targets or types for specific landowners. Instead, they provide recommendations and benchmarks for the planning area as a whole. Individual landowners then conduct their own field assessment, planning, and decision-making processes to determine the treatments they can implement to achieve overall landscape goals while meeting their own management objectives and regulatory requirements.

Based on the landscape evaluations and prescriptions for the twelve 2018 planning areas, DNR estimates that 286,220 to 430,120 acres of treatments are needed to move these landscapes into a resilient condition (Table 1). Across all of the 2018 planning areas, this equates to treating approximately 30-40% of the forested area.

Table 1: Forest Health Treatment Needs for the 2018 Forest Health Planning Areas

Planning Area	Forest Structure Class (acres)		
	Small Dense[1]	Medium-Large Dense[2]	Large-Medium Open[3]
Chewelah A-Z	2,000 - 3,500	45,500 - 66,500	3,500 - 8,000
Mill Creek A-Z	1,000 - 2,000	54,000 - 72,000	2,000 - 6,000
Mt Spokane	500 - 1,000	21,000 - 29,000	4,000 - 8,500
Upper Wenatchee	-	15,000 - 25,000	500 - 2,000
Stemilt	-	6,200 - 7,900	3,000 - 5,700
Manastash-Taneum	3,500 - 6,500	11,000 - 19,000	2,000 - 4,000
Cle Elum	1,500 - 3,000	14,000 - 20,000	2,500 - 5,500
Ahtanum	2,000 - 2,500	13,000 - 18,500	4,000 - 8,000
Trout Lake	-	17,500 - 31,000	1,000 - 2,000
White Salmon	500 - 1,000	35,000 - 48,000	2,500 - 6,000
Total	11,000 - 19,500	232,200 - 336,900	25,000 - 55,700
Subtotal	**268,200 - 412,100 acres**		
Tillicum	7,614 acres		
Mission Maintenance	10,406 acres		
Grand Total	**286,220 - 430,120 acres**		
Anticipated Treatment Type	[1] Non-commerical thin + fuels treatment. May also be prescribed fire or managed wildfire in some areas.		
	[2] Commerical thin + fuels treatment where possible. May be non-commercial, prescribed fire, managed wildfire or regeneration harvest in some areas.		
	[3] Maintenance treatments: prescribed fire or mechanical fuels treatments.		

A combination of mechanical treatments, prescribed fire, and managed wildfire will be needed to accomplish the identified treatment needs. Based on tree size class and canopy cover information from the landscape evaluations, the majority of the acres needing forest health treatments are commercially viable, although commercial viability ultimately depends on multiple factors. This means the cost of mechanically treating the forest stand can be covered by the revenue generated from the trees removed from the stand and potentially generate some revenue to help cover some costs of follow-up treatments such as prescribed fire. However, individual landowners will determine treatment types by taking into account their on-the-ground conditions, objectives, and constraints.

The implementation of the forest health treatment needs identified through the landscape evaluation process for each planning area will likely take several biennia to accomplish. The pace and scale of forest health treatment implementation will be driven by some common and unique factors for each planning area such as: ratio of commercial versus non-commercial treatments, forest product markets, access, capacity of land managers and contractors to plan and implement treatments, and funding levels for non-commercial treatments.

The efforts of the 20-Year Forest Health Strategic Plan and the Forest Health Assessment and Treatment Framework are complimentary and additional to the substantial existing forest health work already underway by the U.S. Forest Service, other federal agencies, tribes, state agencies, private landowners and others. Significant forest health treatments have been completed or planned in the forest health planning areas prior to the creation of the 20-Year Forest Health Strategic Plan and prior to being designated as a forest health planning area. Being designated as a forest health planning area focuses additional resources to help address remaining forest health needs in a collaborative fashion and provides monitoring of forest health conditions to track achievement of landscape forest health goals over time.

Introduction

The purpose of this report is to meet the legislative reporting requirements of Senate Bill 5546. It will describe the forest health prioritization process undertaken by DNR across all lands as required by the bill, as well as the approach taken to evaluate forest health treatment needs across large landscapes. Additionally, it will share the results of the forest health landscape evaluations for the 2018 forest health planning areas.

Forest health is defined in state statute as "the condition of a forest being sound in ecological function, sustainable, resilient, and resistant to insects, diseases, fire and other disturbances, and having the capacity to meet landowner objectives" (RCW 76.06).

According to this definition, broad swaths of Central and Eastern Washington forestland are in an unhealthy state. An analysis by The Nature Conservancy and the United States Forest Service identified 2.7 million acres of forestland in this region that require natural disturbance or active management to create forests that are more resilient against insects, diseases and wildfires (Haugo et al. 2015).

The Washington State Department of Natural Resources (DNR), the Washington State Legislature, tribes, federal agencies, forest stakeholders and others have recognized for the last 15 years that these Washington forests are not in a condition to be resilient and resistant to wildfires and drought related insect and disease outbreaks. The 2014 and 2015 wildfire seasons crystalized the risks facing Central and Eastern Washington forests and made clear the need for action to address forest health issues on a meaningful scale. Scientists expect the impacts from climate change to greatly exacerbate these risks. The warm and dry conditions that occurred in 2015 are projected to be the new normal by mid to late century (USGCRP, 2018).

Washington state has employed a number of legal and policy tools over the last 15 years to address these forest health issues, including:

2004: The Commissioner of Public Lands was designated as the state's lead to improve forest health (RCW 76.06).

2012: The Commissioner of Public Lands designated the first Forest Health Hazard Warning Areas under RCW 76.06, which was the first statewide effort to prioritize forest health investments.

2016: ESHB 2376 (Sec. 308), provided direction and funding to DNR to develop a 20-Year Forest Health Strategic Plan to "treat areas of the state forestland that have been identified by the department as being in poor health."

2017: ESSB 5546 (Chapter 95, Laws of the 2017, Forest Health Assessment and Treatment Framework), directed DNR to develop an assessment and treatment

framework designed to proactively and systematically address the forest health issues facing the state. Specifically, the framework must endeavor to assess and treat 1 million acres of forestland by 2033. The framework must assess and treat acreage in an incremental fashion each biennium and consists of three elements: assessment, treatment, and progress review and reporting.

2017: ESHB 1711 (Chapter 248, Laws of 2017), directed DNR to develop and implement a policy for prioritizing forest health treatment investments on state trust lands to reduce wildfire hazards and losses from wildfire, reduce insect and disease damage, and achieve forest health and resilience at a landscape scale. The law also established a forest health revolving account that permitted depositing the revenue from forest health treatments on state trust lands and applying funds toward future forest health treatments on state trust lands.

20-Year Forest Health Strategic Plan: Eastern Washington

In 2016, the Washington State Legislature directed DNR to develop a forest health strategic plan to "treat areas of the state forestland that have been identified by the department as being in poor health." DNR determined that to meet the intent of the Legislature, and to address the forest health issue in a meaningful way, it was necessary to take a broad view of, "treat areas of state forest lands," and to adopt a guiding philosophy of "all lands, all hands." This DNR guiding philosophy of "all lands, all hands" was to address forest health issues at a landscape scale and in coordination with all landowners to ensure forest health treatments advance in a coordinated, strategic fashion.

The 20-Year Year Forest Health Strategic Plan was developed for Central and Eastern Washington in a collaborative manner with over 30 organizations participating in its creation. The organizations involved represented a diverse range of perspectives and expertise, including state and federal land management agencies, county government, members of the timber industry and environmental groups, and forest collaboratives. There was consensus among participants to advance a landscape-scale, cross-boundary strategy to achieve healthy, resilient forests through coordinated efforts. The overarching strategy is to maximize the effectiveness of forest health treatments by coordinating, planning, prioritizing, and implementing forest management activities across large landscapes.

The 20-Year Forest Health Strategic Plan vision and mission statements are:

Vision: Washington's forested landscapes are in an ecologically functioning and resilient condition and meet the economic and social needs of present and future generations.

Mission: Restore and manage forested landscapes at a pace and scale that reduces the risk of uncharacteristic wildfires and increases the health and resilience of forest and

aquatic ecosystems in a changing climate for rural communities and the people of Washington state.

The five major goals of the 20-Year Forest Health Strategic Plan are:

Goal 1: Conduct 1.25 million acres of scientifically sound, landscape scale, cross-boundary management and restoration treatments in priority watersheds to increase forest and watershed resilience by 2037.

Goal 2: Reduce the risk of uncharacteristic wildfire and other disturbances to help protect lives, communities, property, ecosystems, assets, and working forests.

Goal 3: Enhance economic development through implementation of forest restoration and management strategies that maintain and attract private sector investments and employment in rural communities.

Goal 4: Plan and implement coordinated, landscape-scale forest restoration and management treatments in a manner that integrates landowner objectives and responsibilities.

Goal 5: Develop and implement a forest health resilience monitoring program that establishes criteria, tools, and processes to monitor forest and watershed conditions, assess progress, and reassess strategies over time.

Relationship of 20-Year Forest Health Strategic Plan, SB 5546 and HB 1711

The 20-Year Forest Health Strategic Plan is the high-level framework guiding the State of Washington's work and investments to improve forest health and achieve forest related ecological, economic and social benefits in Central and Eastern Washington. SB 5546 (Forest Health Assessment and Treatment Framework) and HB 1711 (prioritizing forest health treatments on state trust lands) provide DNR with legislative direction and tools to achieve Goal 1 of the 20-Year Forest Health Strategic Plan, which focuses on implementing landscape-scale forest health treatments. SB 5546 focuses on evaluating and prioritizing forest health needs across all lands in a landscape, whereas HB 1711 focuses on prioritizing forest health treatments on state trust lands only. Figure 1 shows how the 20-Year Forest Health Strategic Plan, SB 5546, and HB 1711 all work together.

Figure 1: Relationship of the 20-Year Forest Health Strategic Plan, SB 5546, and HB 1711

SB 5546 Forest Health Assessment and Treatment Framework

The authority and direction contained in SB 5546 directs DNR to develop an assessment and treatment framework designed to proactively and systematically address the forest health issues facing the state. Specifically, the framework must endeavor to assess and treat 1 million acres of forestland by 2033 and must assess and treat acreage in an incremental fashion each biennium.

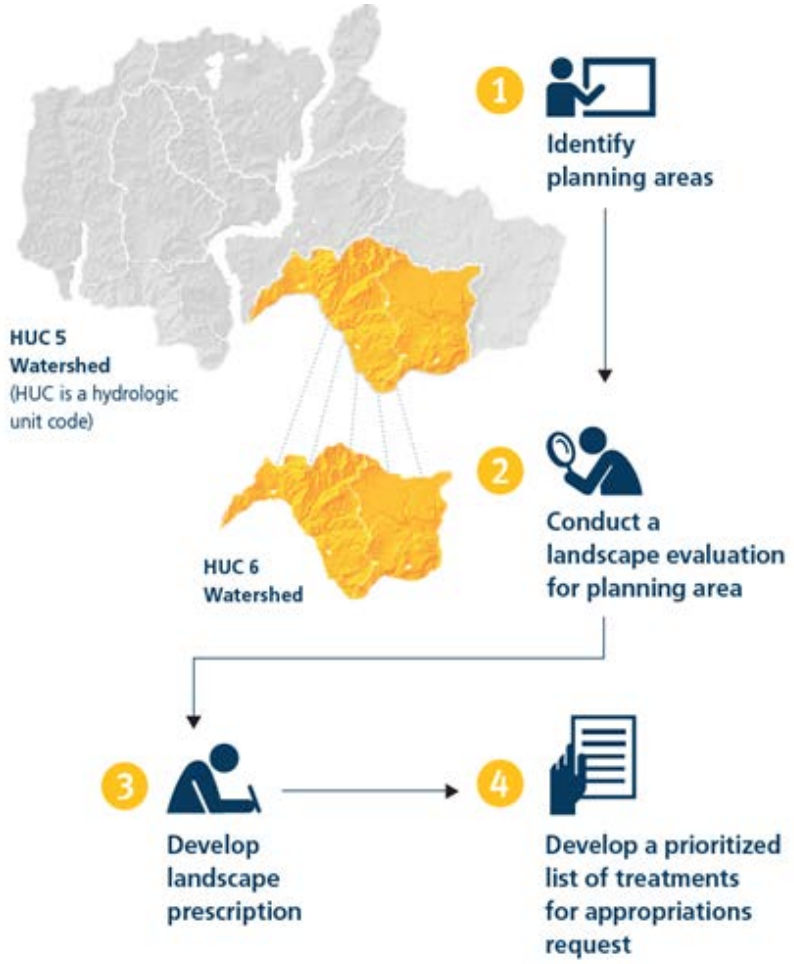
The framework consists of three elements:

1. Assessment of current forest health issues and conditions.
2. Treatment of areas with forest health and wildfire risks.
3. Progress review and reporting of lessons learned and accomplishments.

SB 5546 requires DNR to assess a minimum of 200,000 acres of fire prone lands each biennium to identify forest health needs. SB 5546 provides legislative direction and tools to help achieve the state's treatment goals across all lands.

Identifying forest health treatment needs and locations to accomplish the goals of the 20-Year Forest Health Strategic Plan and meet the requirements of SB 5546 Forest Health Assessment and Treatment Framework follow the general steps shown in figure 2 below. For more details on these steps, please see pages 22-23 and Appendix 1 of the 20-Year Forest Health Strategic Plan.

Figure 2: Major Steps of SB 5546 Forest Health Assessment and Treatment Framework to Accomplish the Treatment Goals of the 20-Year Forest Health Strategic Plan



The creation of the 20-Year Forest Health Strategic Plan was a collaborative process that engaged agencies, tribes, landowners, and stakeholders in the development of a common vision, mission, and goals to create resilient forested landscapes in Central and Eastern Washington. Now that DNR is implementing the plan, the agency has continued that collaboration by expanding the engagement to even more stakeholders through the Forest Health Assessment and Treatment Framework process. First, DNR engaged with a broad array of federal and state agencies, tribes, forest collaboratives, and stakeholders to select the forest health planning areas. DNR invested a significant amount of time to ensure the proper alignment between state and local forest health priorities in selecting the forest health planning areas so there would be a long-term commitment to working together in these areas. Once the planning areas were selected, engagement at the local level continued to help inform the landscape evaluation and assessment process and continue to build buy-in and support for the process.

HB 1711 Prioritizing Forest Health Treatments on State Trust Lands

Under the passed engrossed second substitute house bill (ESSHB) 1711, DNR's obligation is to prioritize state trust lands for forest health treatment according to its own values and goals and within the context of the 20-Year Forest Health Strategic Plan. The prioritization of state trust lands was a multi-step process that involved both modelling and on-the-ground assessments. The first step in this process was to divide forested state trust lands into individual landscapes, which are different and usually smaller than the 20-Year Forest Health Strategic Plan planning areas. The second step was to develop a GIS model and use it to prioritize each landscape in a way that reflects DNR's management objectives. More specifically, DNR designed a model that computed individual, weighted scores for forest health and for values at risk:

- Forest health scores were computed from individual, weighted scores for wildfire risk (includes both the probability of a wildfire occurring and the potential severity should it occur), risks from insects and diseases, restoration opportunities, and climatic change influences.
- Values at risk scores were computed from individual, weighted scores for the timber value of commercial forest products, proximity of public and private infrastructure, and ecosystem services, such as community watersheds, recreation opportunities, and fish-bearing waters.

Forest Health and values at risk scores were combined into a single score for each pixel in each landscape. These scores were then averaged to derive a final score for each landscape, enabling DNR to place all landscapes in order of priority.

The third step was to divide all of the landscapes in each of DNR's two Eastern regions (Northeast Region and Southeast Region) into three prioritization categories (high, medium, and low priority) based on their final scores and on the total acreage in each region.

The fourth step was to assess forest conditions to determine the highest priority areas for state lands treatment within each landscape. DNR assessed forest structure using forest metrics from its Remote Sensing – Forest Resource Inventory System (RS-FRIS) data. Gradient Nearest Neighbor (GNN) data was used for areas that lacked RS-FRIS data. This data enabled DNR to categorize state trust lands by forest type, such as open or closed canopy. Closed canopy stands were considered the highest priority for treatment because those stands are typically the most at risk of severe damage during a wildfire.

The final step was to prioritize treatment needs for the next 2, 6 and 20 years. The schedule of treatments for the next biennium (July 2019 through June 2021) was done using assessments of stand conditions along with the landscape and treatment needs prioritizations. Many of the state trust lands prioritized for treatment overlap with the 20-Year Forest Health Strategic Plan's planning areas and other high-priority watersheds.

For more detail on HB 1711 and forest health treatment prioritization on state trust lands, please see the full HB 1711 report.

2019-21 Biennium DNR Forest Health Capital Budget Appropriations Request

In the fall of 2018, DNR submitted a $17.7 million forest health capital budget appropriations request to the Legislature. The purpose of the request is to build on previous forest health capital budget investments made by the Legislature, invest in strategies and actions to achieve the goals of the 20-Year Forest Health Strategic Plan, and implement the SB 5546 Forest Health Assessment and Treatment Framework.

DNR's request is being made in collaboration with 2019-21 budget requests from Washington State Parks, the Washington Department of Fish & Wildlife (WDFW), and the Washington State Conservation Commission. Their requests will fund treatments in the 2018 and 2020 forest health planning areas and expand the treatment footprint in the planning areas, as well as support community wildfire-preparedness activities. Below is a description of the 2019-21 DNR forest health capital budget appropriations request and how it relates to implementing the SB 5546 Forest Health Assessment and Treatment Framework.

State Lands Forest Health Restoration ($3,000,000)

These funds will pay for commercial and non-commercial forest health treatments on state trust lands managed by DNR in Central and Eastern Washington. A total of 600 acres of commercial and 9,300 acres of non-commercial forest health treatments are anticipated. Approximately 40% of forest health treatments on state trust lands will be in the 2018 and 2020 forest health planning areas.

Private Lands Treatments, Firewise USA®, and Fire Adapted Communities ($6,000,000)

These funds will pay for small private forest landowner fuel reduction treatments such as thinning, prescribed burning, pruning, and slash-pile removal with 5,500 acres of treatments anticipated. Additionally, funds will support community wildfire preparedness outreach, education, and fuel-reduction work in neighborhoods and communities. The majority of these activities will be located in the 2018 and 2020 forest health planning areas.

Federal Forest and Watershed Health Restoration ($3,000,000)

The U.S. Forest Service (USFS) manages 43% of the forestland in Central and Eastern Washington. These funds will be used to pay for NEPA[1]-ready forest health and fuel-

[1] Going through the National Environmental Protection Act planning process is required for forest health treatments on federal lands.

reduction treatments, and pay for NEPA planning for forest health treatments, on USFS lands. Investing in forest health treatments on federal lands will help increase the pace and scale of forest health restoration efforts in and leverage additional federal forest health investments. A minimum of 9,000 acres of federal forest health treatments will be planned or implemented with these funds. All activities will occur in the 2018 and 2020 forest health planning areas.

Good Neighbor Authority Project Planning and Implementation ($2,000,000)

Half of this funding will be used for DNR-led planning and implementation of forest health and fuel reduction treatments on federal forest in Central and Eastern Washington. The other 50% will be allocated towards DNR-led watershed restoration activities on federal lands throughout Washington. Approximately 3,000 acres of forest health and fuel reduction activities will be completed on federal forests in Central and Eastern Washington, with the majority of the treatments occurring in the 2018 and 2020 forest health planning areas.

Landscape Collaborative Grant Programs ($2,000,000)

This money will fund two programs established by the 2017-19 capital budget that invest in forest treatment and outreach work being done by forest collaboratives in Washington state. Forest collaboratives are regional coalitions of groups and people representing timber and environmental interests alike, along with local, state and federal leaders – all working together to solve forest health issues.

These two programs enhance the ability of forest collaboratives to find agreement on the design and implementation of landscape-scale forest restoration and management in support of statewide forest health priorities by providing financial support for collaborative facilitation, technical analysis, and other activities. These programs will also provide funding for the planning, implementation, and monitoring of landscape-scale forest restoration and management activities. These are statewide programs, however all investments in Central and Eastern Washington projects will be in the 2018 and 2020 forest health planning areas with a minimum of 6,000 acres of federal forest health treatments that will be planned or implemented with these funds.

Forest Health Monitoring ($1,000,000)

Goal 5 of the 20-Year Forest Health Strategic Plan requires the development and implementation of a forest health resilience monitoring program that establishes criteria, tools and processes to monitor forest and watershed conditions, assess progress, and reassess strategies over time. Monitoring forest health conditions and tracking progress toward achieving the goals established in the plan is critical to ensuring the success of the plan and determining continued investments in forest health treatments. DNR would use these funds to implement a number of the strategies of Goal 5, including:

- Collect, map, analyze, and report on forest health conditions, forest restoration, and management activities, as well as trends in forest health and wildfire risk over time across all land ownerships.
- Create a comprehensive statewide forest-type dataset that can be used to assess forest health conditions and track changes over time.
- Acquire LiDAR data where LiDAR coverage is currently lacking in Central and Eastern Washington.
- Develop and implement project-level monitoring protocols to assess the effectiveness and benefits of forest health treatments.

Forest Health Treatment Tracking System ($500,000)

Throughout the history of the forest health crisis in Washington, multiple agencies have taken independent approaches to address the problem across all land ownerships. As a result, there is a broad mixture of complex sources of data, creating challenges for reporting and tracking of the accomplishments at a statewide level. Funds will be used for Phase 2 of a Forest Health Tracking System, which is a key Goal 5 strategy. The Forest Health Tracking System will include spatial and tabular data describing forest health treatments conducted by federal agencies, state agencies, tribes, and other willing landowners. The Forest Health Tracking System is critical to efficiently and effectively tracking and reporting on forest health treatment accomplishments in the state.

Forest Health Economic Study ($200,000)

Funds will be used for a comprehensive economic study to analyze the economic and ecological benefits of achieving the goals of the 20- Year Forest Health Strategic Plan, and assess the forest-management contracting capacity and infrastructure required to meet plan objectives. The assessment of forest-management contracting capacity is a key strategy of Goal 3 of the plan.

2019-21 Forest Health Operating Budget Request ($5,761,600)

To increase agency effectiveness and efficiencies in addressing escalating wildfires and poor forest health conditions across the state, and provide necessary capacity to fully implement the 20-Year Forest Health Strategic Plan, this request would realign DNR's organization to create a division solely committed to forest resiliency and health. This proposal adds needed capacity and additional expertise to successfully implement the 20-year plan, including shared goals within the Wildland Fire Protection Strategy (expected to be released January 2019) such as wildfire protection and preparedness. This funding will provide additional analytical capacity and expertise, capacity for technical guidance for communities and community forests, enable the development and implementation of a monitoring program, and better respond to forest insects and disease.

Forest Health Watershed Prioritization

The forest health and wildfire risks in Central and Eastern Washington are so widespread that it is logistically impossible to address them all at once. Thus, a prioritization process was essential to help focus state and partner resources in high priority areas and to successfully implement the SB 5546 Forest Health Assessment and Treatment Framework. Priority areas were identified at varying watershed levels, including HUC 5 (an average Hydrologic Unit Code 5 watershed is 150,000 acres in size) and HUC 6 (an average HUC 6 watershed is 20,000 acres), and were scored based on a variety of forest health, wildfire risk, and value-based variables. DNR then compared the HUC 5 and HUC 6 watersheds in Central and Eastern Washington, giving them a priority ranking of high, medium, or low.

HUC 5 Watershed Forest Health Prioritization

As part of the 20-Year Forest Health Strategic Plan, a forest health watershed prioritization process was developed at the HUC 5 watershed level using a variety of data sets to help describe forest health,/wildfire risk, and values at risk. The process to prioritize HUC 5 watersheds used two groups of metrics, or tiers. Tier 1 (Figure 3) included metrics that represent forest health and wildfire risks: fire risk (fire probability and fire intensity), insect and disease risk, forest restoration opportunity, and projected increase in drought stress (climate change impacts). Tier 2 (Figure 4) included metrics that represent values at risk: aquatic resources (cold-water stream miles in 2040, habitat condition, stream miles with threatened or endangered fish), wildlife habitat, whether the forest is in the wildland urban interface, clean drinking water, and timber. Scores for each metric were derived from one or more datasets that represent the best available current science.

Figure 3: Forest Health and Wildfire Risk Metrics (Tier 1)

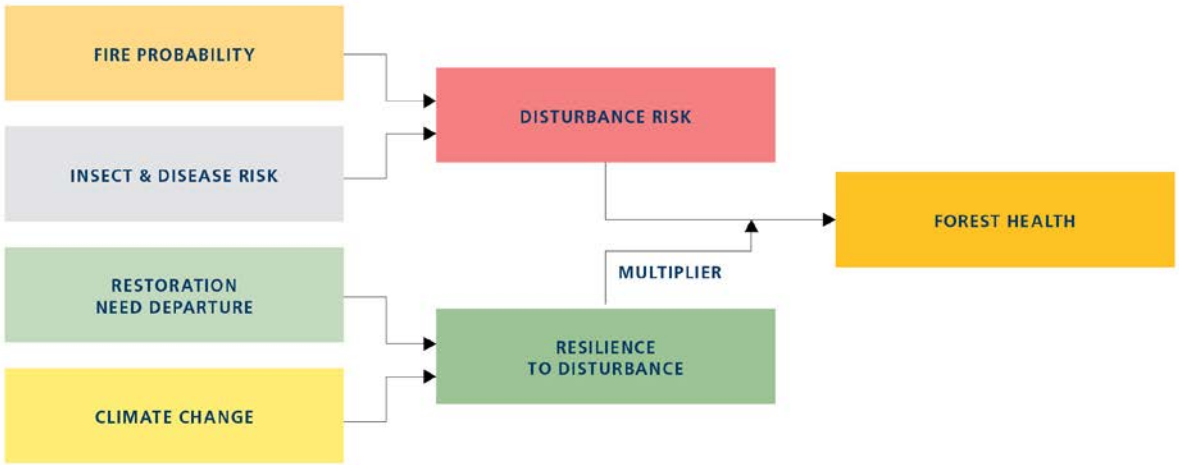
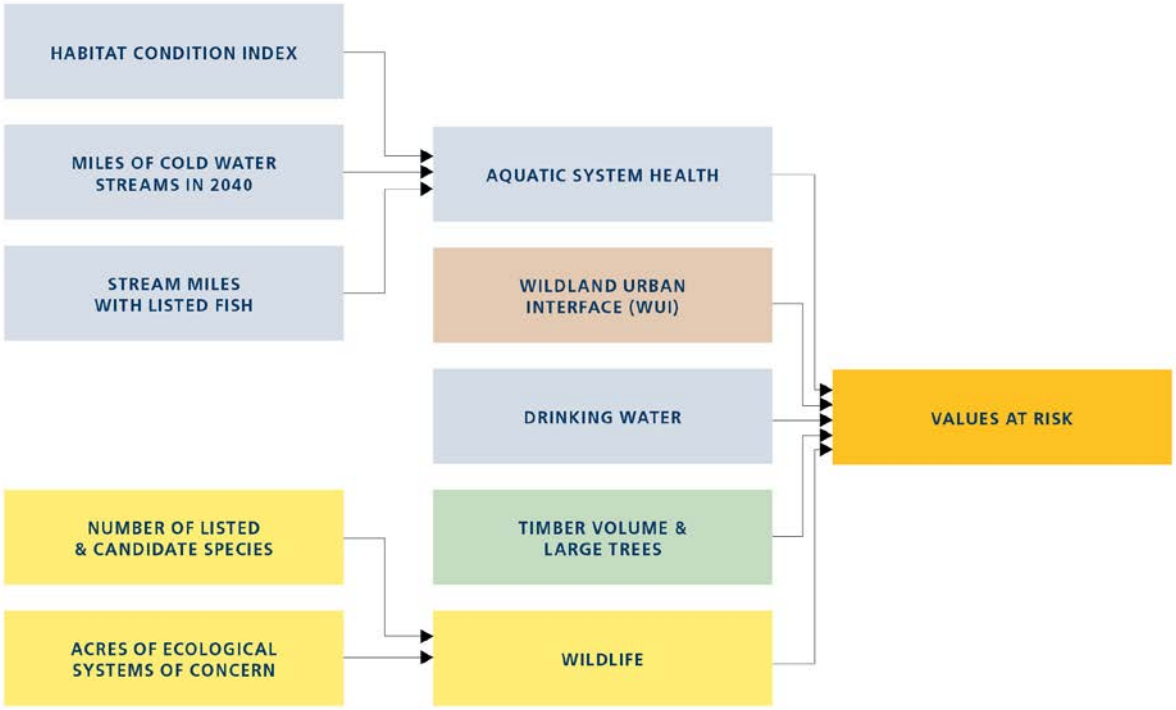


Figure 4: Values at Risk Metrics (Tier 2)



HUC 6 Watershed Forest Health Prioritization

After the HUC 5 forest health watershed prioritization was complete, DNR took a closer look by conducting a HUC 6 watershed level forest health prioritization using the same basic approach as the HUC 5 prioritization and many of the same datasets. DNR conducted the HUC 6 watershed prioritization to have a finer-scale target area to work with partners on the planning and implementation of forest health treatments. A number of updated datasets also were used in the HUC 6 prioritization compared to the HUC 5 prioritization. DNR used the results of the HUC 6 prioritization to identify watersheds that are high priority based on the combination of forest health and wildfire risk (Tier 1) and the values at risk (Tier 2).

The results of the HUC 6 forest health watershed prioritization can be seen in Figures 5, 6, and 7. Please note that all scores are relative. A low score does not mean that a watershed has no forest health issues or need for treatment. Instead, it means that metrics and overall needs are lower relative to other watersheds.

For more information about the HUC 6 forest health watershed prioritization methodology, please see Appendix A and Appendix B.

Figure 5: Tier 1 Prioritization for HUC 6 Forested Watersheds in Central and Eastern Washington

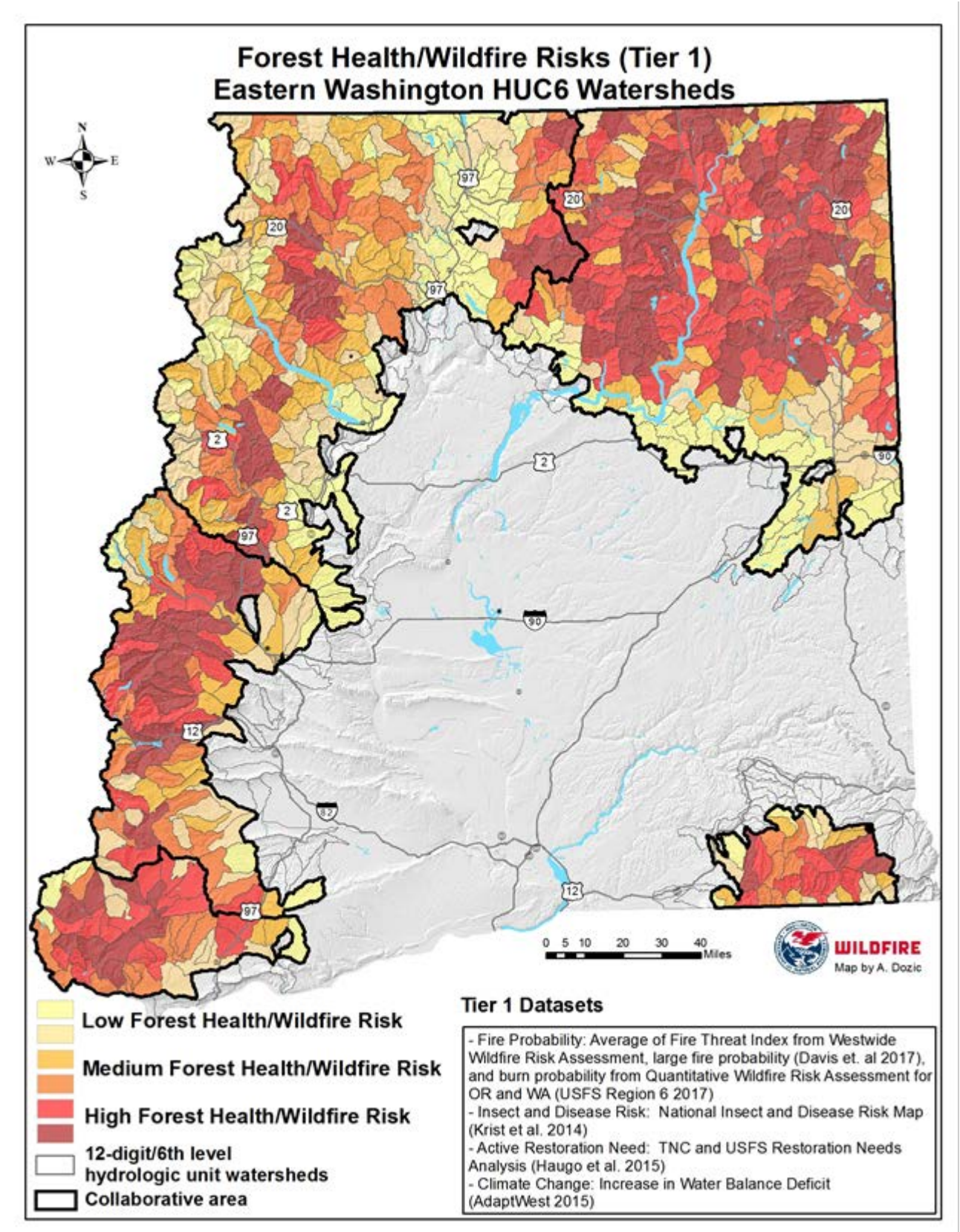


Figure 6: Tier 2 Prioritization for HUC 6 Forested Watersheds in Central and Eastern Washington

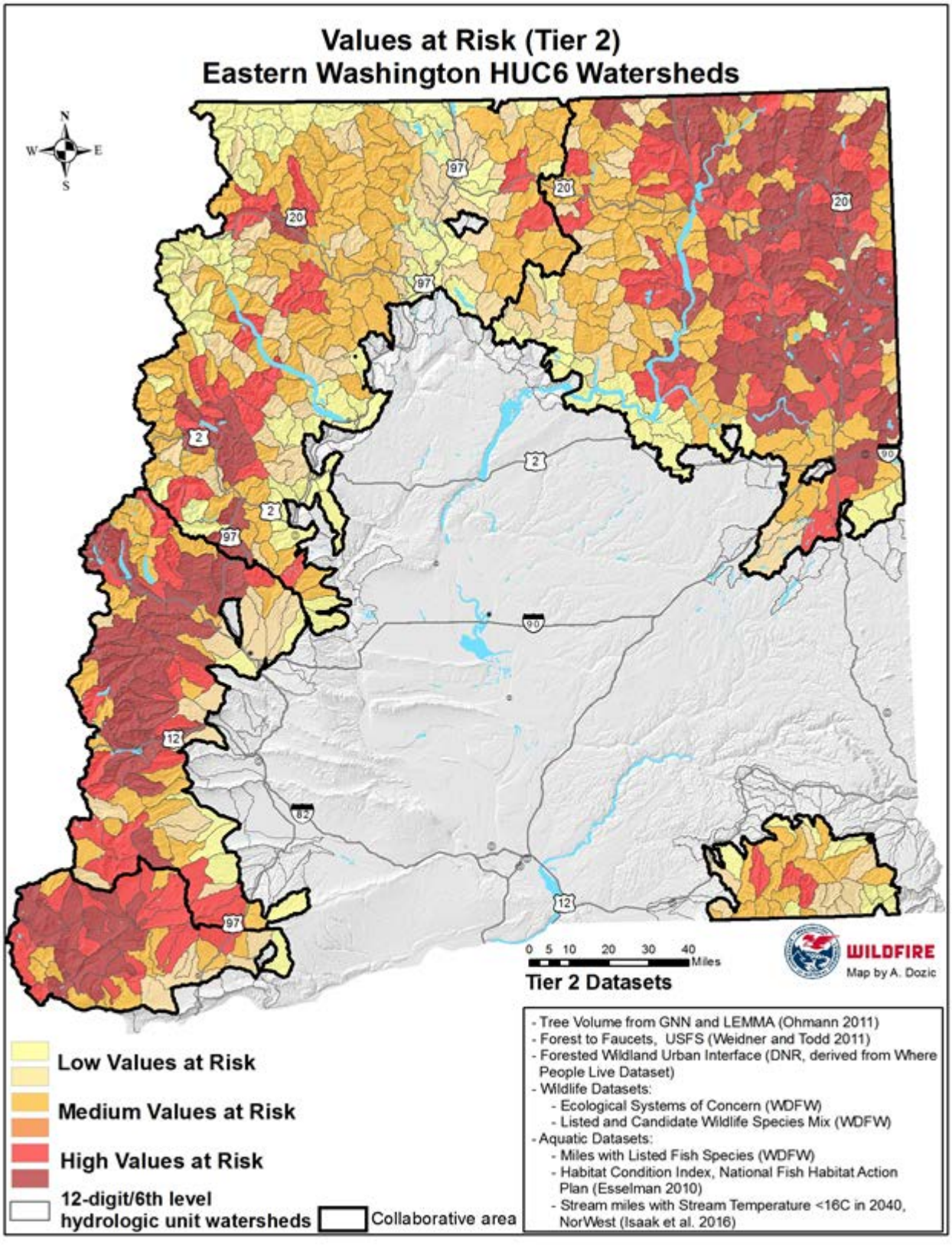
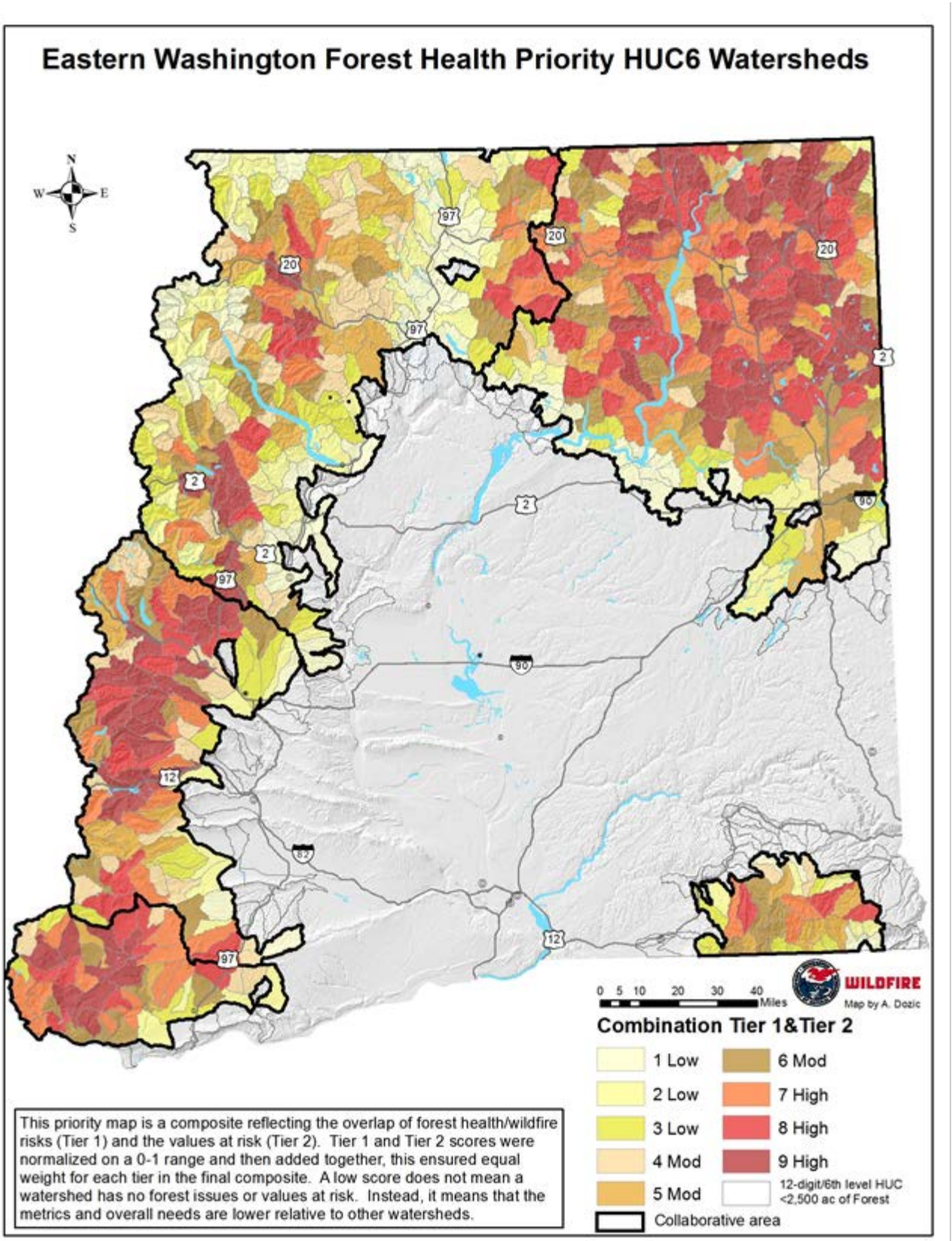


Figure 7: Combined Prioritization for HUC 6 Forested Watersheds in Central and Eastern Washington



2018 and 2020 Forest Health Planning Areas

Washington's 20-Year Forest Health Strategic Plan sets a goal of treating 1.25 million acres over the next 20 years to improve the resilience of forests in Central and Eastern Washington. To accomplish this ambitious target, DNR will work with landowners and stakeholders to select and treat 125,000 acres each biennium. The plan lays out a process for DNR to strategically identify planning areas where state funding for forest health and restoration projects will be focused[2]. The authority and direction contained in SB 5546 Forest Health Assessment and Treatment Framework directs DNR's efforts to improve forest health across all ownerships in large landscapes. SB 5546 also requires DNR to assess a minimum of 200,000 acres of fire prone lands each biennium to identify forest health needs.

The first step of the Forest Health Assessment and Treatment Framework is to select which priority watershed(s) will form the planning areas that the state will analyze for forest health treatment need across all lands and focus forest health investments. Planning areas will consist of one to seven HUC 6 watersheds, which equates to approximately 15,000-200,000 acres. DNR focused its large landscape analysis in priority planning areas as identified through a data driven prioritization of HUC 6 watersheds led by DNR that incorporated feedback from forest collaboratives, the timber industry, environmental groups, tribes, relevant federal and state agencies, the Forest Health Advisory Committee and other stakeholders.

In March of 2018, DNR finished the process of identifying planning areas to evaluate for forest health treatment needs for the 2018 and 2020 planning cycles. To guide this process, DNR first completed a data driven prioritization of HUC 6 watersheds in December of 2017. This prioritization assessed fire risk, restoration needs, aquatic function, economic potential, wildlife habitat, and other resources across all forested HUC 6 watersheds in Central and Eastern Washington. DNR staff then met with USFS staff, DNR regional staff, and other local stakeholders in Wenatchee, Colville, Moses Coulee, and Trout Lake in January of 2018 to present the HUC 6 watershed prioritizations and gather feedback on which watersheds would be good candidates for planning areas.

In February of 2018, DNR shared draft proposed planning areas with the Forest Health Advisory Committee, forest collaboratives, USFS, tribes, WDFW, and many other partners. DNR based the proposed planning areas on the HUC 6 prioritization and feedback received from the meetings and conversations with local stakeholders. DNR then solicited and received extensive feedback on the proposed planning areas from these same partners. DNR incorporated this feedback to produce the final list of planning areas for the 2018 planning cycle, as well as areas for 2020. DNR added two new 2020 planning areas in the Blue Mountains in Southeast Washington following an

[2] For a full description of this process, see Appendix 1-II of the 20 Year Forest Health Strategic Plan at https://www.dnr.wa.gov/ForestHealthPlan

October 2018 meeting in Dayton with Umatilla National Forest Staff and feedback from DNR and WDFW staff.

For the 2018 and 2020 cycles, DNR selected 33 priority planning areas to focus the all-lands forest health analysis, treatment, and coordination efforts for the next two biennia (See Figure 8 and Figure 9). These planning areas are in areas where there is alignment between state and local high-priority forest health needs, including the communities of Chewelah, Cle Elum, Dayton, Glenwood, Goldendale, Plain, Republic, Trout Lake, Twisp, and Winthrop.

As described above, these planning areas are based on extensive local stakeholder feedback and the HUC 6 watershed forest health prioritization conducted by DNR. For the 2018 planning cycle, the planning areas contain approximately 1 million acres of forestland. Evaluating 1 million acres of forestland to determine its treatment needs far exceeds the assessment of 200,000 acres required by SB 5546. Almost all of these planning areas consist of multiple HUC 6 watersheds. Also, as is evidenced by Figure 7, the vast majority of the HUC 6 watersheds contained in these planning areas are high priority watersheds based on DNR's HUC 6 prioritization. Table 2 on Page 37 describes some attributes of these planning areas including the acres of forestland, land ownership and priority score from the HUC 6 forest health watershed prioritization.

Forested landscapes are dynamic ecosystems, and the pace of change is increasing. Long-term plans are important to align resources and address forest health issues at the landscape-scale. However, we also recognize that change is inevitable, especially given the increasing frequency and intensity of wildfires in Central and Eastern Washington. The forest health planning areas that have been established as part of the 20-Year Forest Health Strategic Plan will need to be adjusted over time due to changes in forest conditions and alignment with local and state priorities.

DNR conducted landscape evaluations to assess forest health conditions and determine treatment needs across all land ownerships types in the 2018 planning areas. A landscape evaluation is a data driven approach to understanding the current condition of a landscape and its level of resilience to future disturbances and climatic change. The landscape evaluation provides the data necessary to make determinations on which treatments at a watershed scale will be effective in increasing overall forest health conditions and resilience to major disturbances such as wildfires and drought. DNR completed landscape evaluations for the 2018 planning areas, which comprise about 1 million acres of forestland, in the fall of 2018. The results of the landscape evaluations for the 2018 planning areas are described in the next section of this report. DNR will complete and report on the landscape evaluations for the 2020 planning areas, which comprise about 1.65 million acres of forestland, in the fall of 2020.

The implementation of the forest health treatment needs identified through the landscape evaluation process for each planning area will likely take several biennia to accomplish. The pace and scale of forest health treatment implementation will be driven by some common and unique factors for each planning area such as: ratio of

commercial versus non-commercial treatments, forest product markets, access, capacity of land managers and contractors to plan and implement treatments, and funding levels for non-commercial treatments.

The efforts of the 20-Year Forest Health Strategic Plan and the Forest Health Assessment and Treatment Framework are complimentary and additional to the substantial existing forest health work already underway by the U.S. Forest Service, other federal agencies, tribes, state agencies, private landowners and others. Significant forest health treatments have been completed or planned in the forest health planning areas prior to the creation of the 20-Year Forest Health Strategic Plan and prior to being designated as a forest health planning area. Being designated as a forest health planning area focuses additional resources to help address remaining forest health needs in a collaborative fashion and provides monitoring of forest health conditions to track achievement of landscape forest health goals over time.

Detailed landscape evaluation summaries are included in Appendix C.

Figure 8: 2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan and SB 5546

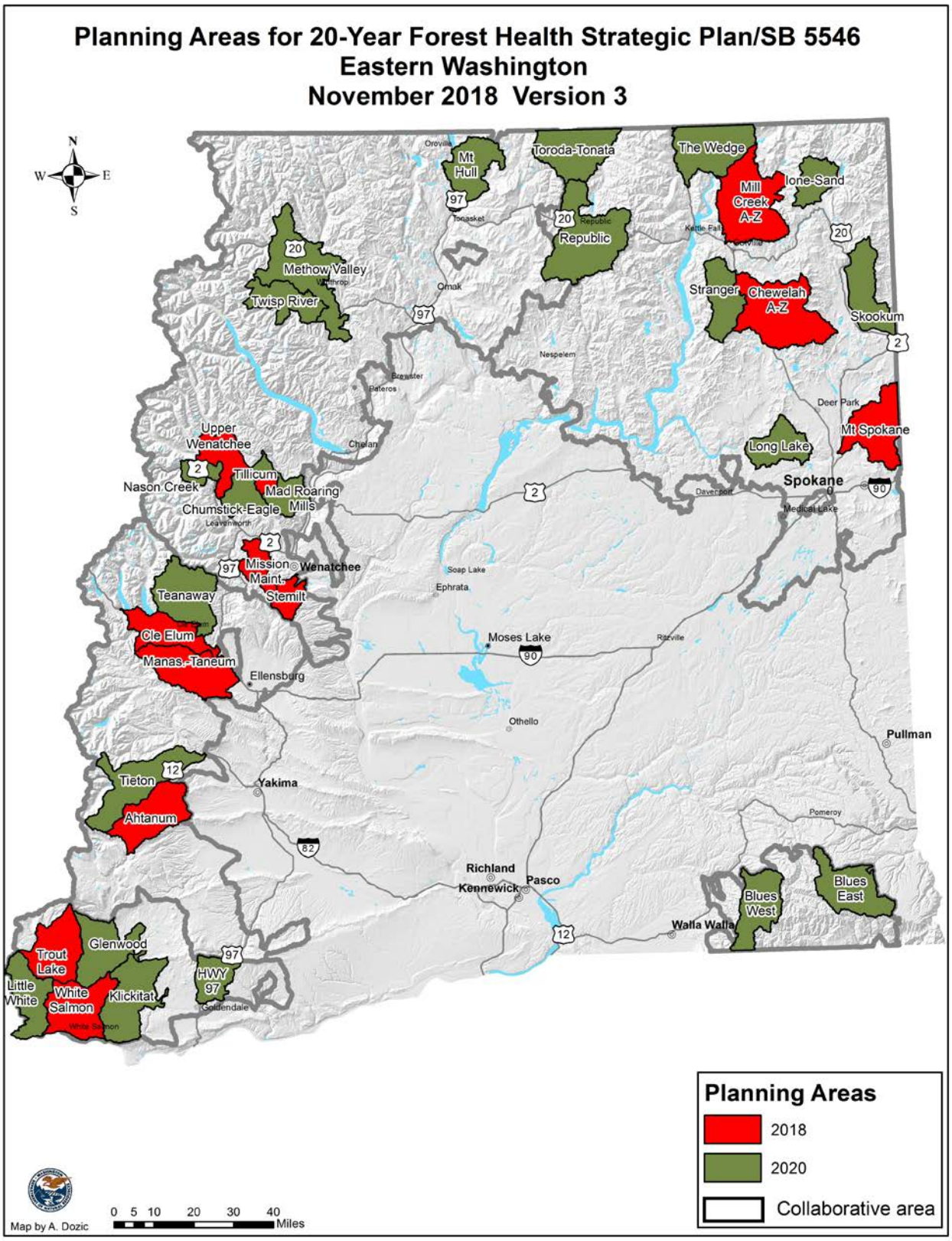
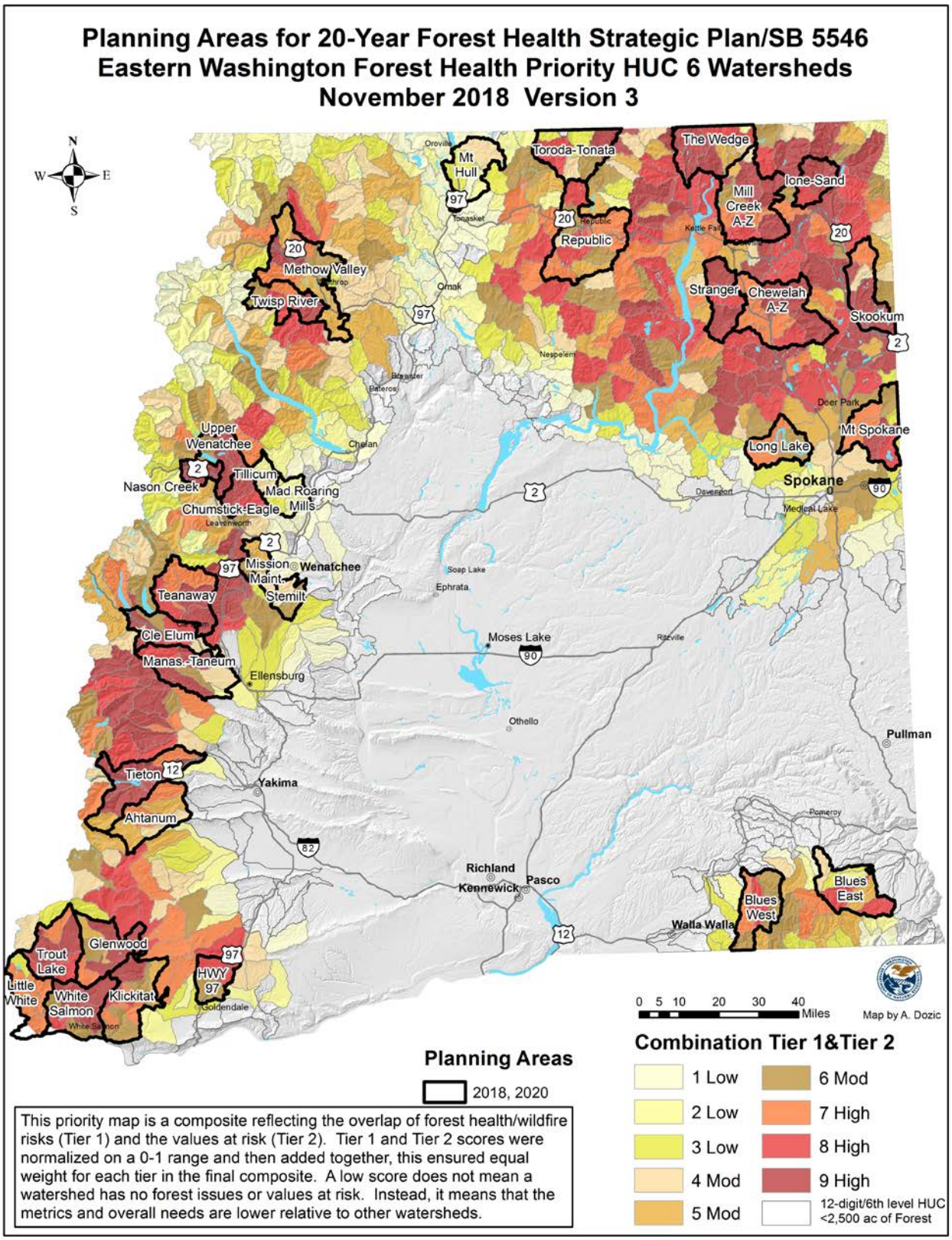


Figure 9: 2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan and SB 5546, and the Priority Rankings of their HUC 6 Watersheds



Landscape Evaluations and Prescriptions for 2018 Forest Health Planning Areas

What is a Landscape Evaluation and Prescription?

A landscape evaluation is a data driven approach to understanding the current condition of a landscape, its level of resilience[3] to disturbances and climatic change, and its ability to provide an array of ecosystem services over time (Hessburg et al. 2015). An evaluation includes detailed information about vegetation departure from historical conditions, fire risk, projected climate change impacts and associated drought stress, wildlife habitat, and other resources. Evaluations are first conducted ownership-blind (without knowledge of who owns the land), but management objectives of different public and private landowners are later incorporated into the evaluation process.

A primary output of the landscape evaluation is a summary of vegetation conditions (e.g. forest structure and composition) that are under- or over-represented relative to historical reference conditions, current fire and drought risk, and wildlife habitat needs. Landscape patterns are also analyzed to assess whether vegetation is overly fragmented or excessively aggregated into large, contiguous patches, which affects habitat suitability, and fire and insect behavior. In addition to terrestrial conditions, an aquatic evaluation is conducted to summarize the condition of the stream network and associated fish habitat, riparian vegetation, and road related impacts. However, DNR does not currently have the capacity to conduct aquatic evaluations. Instead, the agency is relying on collaborative partners to complete them, in some cases with grant support from DNR.

The information and data from a landscape evaluation is then synthesized into a landscape prescription that quantifies the shifts in vegetation conditions and patterns that are needed to create a landscape that is resilient to wildfire and drought-induced insect outbreaks (Hessburg et al. 2015). Overall treatment needs are estimated in the landscape prescription and then broken down by specific forest types (e.g. cold, moist, or dry), structure (tree size and density), and species composition. Maps are included that help managers identify potential opportunities where they can shift vegetation conditions in the desired direction. The aquatic component of the landscape prescription identifies and prioritizes opportunities for reduction of road related impacts, floodplain restoration, and in-stream habitat enhancements.

[3] Resilience is defined as the ability of a system to persist through and recover from disturbance while maintaining its basic structure and function without shifting to a qualitatively different state (Walker et al. 2004). However, we use an expanded definition that includes the ability of a landscape to change and reorganize in order to adapt to changing climate and disturbance regimes while maintaining the ecosystem services it provides, such as clean water and wildlife habitat (Schoennagel et al. 2017). In terms of wildfire, a resilient landscape is able to adapt to a warming, drying climate and increases in wildfire by shifting to more drought- and fire-tolerant tree species, fuel structures, and landscape patterns that are aligned with future climate and fire cycles. This will include shifts to non-forest vegetation in some places. A resilient landscape is resistant to large-scale, high severity fires and drought-induced tree mortality that can lead to rapid, destabilizing shifts in conditions that make adaptation much more challenging.

The landscape prescription estimates clear targets for the needed shifts in vegetation conditions to create a resilient landscape based on a data driven analysis. The scale of the needed shifts is generally high and may seem impossible given current treatment rates and management approaches, as well as the combined regulatory, social, and economic constraints. The goal of the 20-Year Forest Health Strategic Plan, however, is to achieve a resilient landscape by scaling up treatment capacity to meet these targets over 5-10 years or more in any given planning area. If targets cannot be met in a planning area, the barriers can be identified and addressed though adaptive management. These may include changes to management practices, agency programs, incentives, funding levels, policies and regulations, etc. To maintain social license for the 20 Year Plan, agreement among major stakeholders will be needed for any major policy or regulatory changes to move forward.

To achieve resilience goals, a combination of treatment tools will be needed. Commercial and non-commercial mechanical treatments are generally the most effective and predictable at reducing canopy density and fire risk as long as follow-up surface and ladder fuel reduction treatments are completed using prescribed fire and/or mechanical methods (Stephens et al. 2009, Fulé et al. 2012). Yet, it will not be possible in most planning areas to achieve the targets with mechanical treatments alone due to access and other limitations. Significantly increasing the use of prescribed fire will thus be critical. Managed wildfire is another cost effective tool that can be used to accomplish a lot of the needed work when used in the appropriate locations under the right circumstances. Finally, given current trends, the reality is that wildfires (managed or unmanaged) will burn a considerable number of acres over the coming decades and will thus shift vegetation conditions over thousands of acres in both positive and negative directions. Methods are currently being developed to quickly assess the effects of a wildfire and determine what post-fire treatments may be needed to move the landscape towards the desired range of conditions.

A landscape prescription does not mandate management actions or treatment targets for specific land ownerships. It provides recommendations for the planning area as a whole. Individual landowners conduct their own field assessments, planning, and decision making processes to determine the specific treatments they can carry out to achieve the collective goal of a resilient landscape, while also meeting their own management objectives and regulatory requirements. Furthermore, while acres of potential treatment types are summarized, individual landowners will determine what treatment types are most appropriate in specific locations given their objectives and operational and economic considerations (i.e. road access, logging systems, habitat issues, aquatic impacts, timber markets, etc.).

Terrestrial treatment needs in the landscape prescriptions are expressed as ranges of acres (e.g. shift 4,000 – 7,000 acres of medium-tree-sized, dense forest to large-tree, open forest). These ranges can be wide because there is no single condition that represents a resilient landscape. The historical landscapes that serve as the baseline

reference for resilient conditions were dynamic due to a combination of disturbances, and decadal oscillations in climatic conditions. The range of variation that existed was often quite wide. This reference range provides options for landowners to manage for and balance different objectives while still meeting the overall goal of a resilient landscape that can better adapt to a changing climate. For example, managing for the high end of treatment need will emphasize fire risk reduction, increased resistance to drought and related insect outbreaks, higher water yield potential, and more habitat for wildlife species that utilize open canopy forests. Conversely, managing for the lower end of treatment need will emphasize habitat for closed canopy dependent species, carbon storage, and reduction of road system impacts to aquatic systems.

DNR is employing the landscape evaluation and prescription process described above to assess the forest health treatment needs in the forest health planning areas as required by SB 5546. The process of collectively developing a landscape prescription provides a common scientific basis, set of data products, and a language for landowners to understand current conditions, risks to different resources, and future trends. This encourages cross-boundary coordination, builds consensus around treatment targets, and maintains social license for the long-term goals of the 20-Year Forest Health Strategic Plan. Evaluations and prescriptions are intended to accelerate the planning processes of individual landowners. They also provide a benchmark to track progress towards achieving conditions that are resilient to large-scale disturbances, such as wildfire and drought-induced insect outbreaks.

Finally, it is important to note that landscapes evaluations and prescriptions are living documents. Wildfires and other major natural disturbances will occur in planning areas at all stages of the planning and implementation process; indeed wildfires in 2018 affected several 2020 planning areas. Methods are currently being developed to quickly assess the effects of a wildfire and then update the landscape evaluation and prescription to include any post-fire treatments that are needed to move the landscape towards a resilient condition, as well as revised targets for the unburned portion of the planning area. In addition, updates will occur as treatments and growth change conditions on the ground, input datasets for current conditions are improved, and as methodologies are refined based on new science and monitoring results. As completing the recommended treatments in any one planning area will take five to 15 years, stakeholder and landowners should expect several updates to the landscape evaluation and prescription for a specific planning area. These updates may include changes to treatment targets.

Methodology

The methods used to conduct landscape evaluations and prescriptions are based on the best available science regarding landscape restoration (Hessburg et al. 2015, Spies et al. 2018), quantitative wildfire risk assessment (Scott et al. 2013), and climate change adaptation strategies (Littell et al. 2016, Halofsky et al. 2016). The approach utilizes the framework for landscape evaluations developed for the Okanagon-Wenatchee National Forest (OWNF) Restoration Strategy (Hessburg et al. 2013). In addition, input from local land managers and stakeholders is incorporated at various stages of the process for a specific planning area. A summary of the core components is provided below. A full description of methods is provided in Appendix D.

1. **Identify ownership types and management objectives:** The spatial distribution of different ownership types and corresponding management objectives provides important context for the types of treatments and long-term forest structure types that is possible in different parts of a planning area. The 2015 DNR statewide ownership layer was used and updated to capture recent changes.

2. **Map vegetation and forest types:** Consistent vegetation-type layers were used from the Integrated Landscape Assessment Project (ILAP) (Hemstrom et al. 2014). Modifications were made to ensure consistency with the Colville National Forest plan revision layer. To simplify results, vegetation types were grouped into cold, moist, and dry forests. Dry forests are ponderosa pine and Douglas-fir dominated forests that historically had low severity fires every 5-25 years. Moist forests historically had mixed severity fires. They include sites in draws, north facing aspects, and valley bottoms that had fire return intervals of 80-200 years or more and were typically dominated by fire intolerant conifers such as grand fir or western red cedar. They also include sites that historically had more frequent fire (about every 30-100 years) and were typically dominated by Douglas-fir, western larch, and ponderosa pine. Cold forests are mid- to upper-elevation forests that historically had high severity fires every 80-200 years or more and were dominated by subalpine fir, Engelmann spruce, lodgepole pine, as well as other conifers.

3. **Map current forest structure and species composition:** Current condition information for forest structure and composition was obtained in two ways based on the systems used in the national forest in that area. For planning areas in Northeast Washington and south of Mount Adams, 2015-2017 LiDAR and 2016 GNN data were used. Six structure classes were defined based two canopy cover classes (open <40% cover and dense >40% cover); and three tree size classes (Large: overstory diameter (OD) > 20”; Medium: OD 10-20”; Small: OD <10”). Data for planning areas along the Eastern Cascades was obtained through photo-interpretation of digitized, stereo imagery using the approach from the OWNF Restoration Strategy (USFS 2012). To ensure consistency in the

evaluation summaries, results for the seven structure classes used in this PI system were condensed into the same six classes used in the LiDAR based approach.

4. **Departure assessment:** Current forest conditions are compared to historical reference conditions to assess how healthy, or "out of whack," the planning area is. This does not mean that historical conditions (pre ~1900) are the end goal. Instead, they provide a general baseline for conditions DNR thinks are resistant and resilient to large-scale, high-severity disturbances while providing a range of other ecosystem services such as clean water, recreation, and wildlife habitat (Franklin and Johnson 2012).

   The primary outputs of a departure assessment are the number of acres of different structure and vegetation type classes that are too high, too low, or within range relative to the reference condition range. Departure of cover type and pattern are also assessed. Similar to forest structure, two different methodologies were used. For planning areas with LiDAR current condition data, historical reference conditions were derived from state and transition models (STM) that were developed for the ILAP project and the Colville National Forest plan revision. For areas with PI current condition data, historical reference conditions from early to mid-20th century aerial photographs are used (OWNF 2012).

5. **Wildfire risk assessment:** Data products from the 2017 Pacific Northwest Region Wildfire Risk Assessment (Gilbertson-Day et al. 2017) were used to quantify fire risk across each planning area. DNR staff calculated fire risk (expected net value change) by combining annual fire probability, expected fire intensity as measured by flame length, and the response of different resources to flame length (Scott et al. 2013). Risk to homes, infrastructure, and forest (overstory tree mortality) was calculated and then combined. Risk levels were binned into six categories based on relative values across all planning areas: extreme, very high, high, moderate, low, and beneficial. Maps of conditional net value change, which is the risk of loss or benefit without fire probability factored in, were also generated to examine expected loss or gain irrespective of fire probability in each planning area. Fire probability and intensity are derived from FS SIM model runs using contemporary ignition and suppression probabilities, as well as current climate (climate change is not incorporated). Also, this risk assessment did not include fire effects on wildlife habitat, watershed function, drinking water, or other resources. Fire risk in non-forested shrub-steppe areas was only calculated for homes and infrastructure.

6. **Climatic drought stress and biophysical alignment analysis:** This analysis assessed vulnerability to current and predicted future moisture stress, and is the primary way that climate change adaptation strategies were incorporated. Moisture stress, as measured by climatic water deficit (Deficit), is a good predictor of vegetation type in moisture-limited ecosystems and is a primary

driver of large insect outbreaks (Kolb et al. 2016). Deficit was calculated at 90m pixel resolution for the 1981-2010 and 2041-2070 time periods. Deficit levels were binned into four deficit zones – low, moderate, high and extreme – that were then associated with vegetation groups for each planning area.. Maps of current and future predicted zones were generated for each planning area in order to assess the magnitude of predicted effects of climate change. General areas within each planning area were identified where forest is unlikely to be supported in the future, where moist and cold vegetation types are likely to transition to dry vegetation types, and where moist and cold vegetation types are likely to be sustained in the future. Note that there is considerable uncertainty in climate models regarding the timing and mechanisms (e.g. fire, drought, regeneration failures) that will drive vegetation transitions, although the direction is clear. Thus, these maps should not be used as fine scale maps of predicted future vegetation.

7. **Habitat mapping of focal species:** Focal wildlife species were identified for each planning area through a process that involved wildlife biologists from multiple agencies and tribes. Habitat for these species was mapped and quantified based on current conditions data and habitat classifications. General effects to habitat from recommended treatment levels were then evaluated. This information will help managers identify key areas to protect as well as where treatments can create or improve habitat. Habitat needs for DNR's Habitat Conservation Plan (HCP) and Late Successional Reserve on USFS land were assessed.

8. **Aquatic evaluation:** These evaluations are conducted to better understand aquatic and riparian forest function in the planning area and determine restoration needs and priorities. This can include assessments of fish habitat, roads impacts (e.g. GRAIP), water yield, or fire risk to drinking water areas. Aquatic evaluations were not conducted by DNR for the 2018 planning areas. Instead, these are being conducted by collaborative partners. They have been completed for the Upper Wenatchee and Manastash-Taneum planning areas.

9. **Economic and operational analysis:** The analysis evaluates logging system type and hauls costs for locations of potential treatment opportunities. Combined with forest structure and volume information, potential neutral, positive, or negative treatments can be identified. This analysis has not been completed for the 2018 planning areas, but will be in the winter of 2018-2019.

10. **Estimating treatment targets:** Treatment needs for a planning area are first generated from the departure analysis. Dense structure-vegetation group classes (e.g. dry forest-large dense, moist forest medium dense) that are higher than the historical range of variation (HRV) are selected. These are the classes where departure can be shifted through treatments vs. departures that require time and growth (e.g. a shortage of large tree structure or too much open, small tree forest). For these departed, dense classes, the number of acres needed to

shift the class to the upper range of the HRV is calculated. This is the low end of the treatment range. The high end of the treatment range is the number of acres needed to shift the class to the mid-point of the HRV. In cases where small-dense classes are not currently departed but will be soon due to growth, treatment acres for small-dense classes are added. Targets for maintenance treatments in existing open, large and medium tree size classes on dry forest sites are added in based on knowledge of past treatments and projected re-growth of small trees, shrubs, and ground fuels. Targets for each class are rounded to the nearest 500 acres and then summed together to get the range of total treatment need. Treatment needs are broken out by anticipated treatment type based on tree size class alone. As discussed above, individual landowners will determine actual treatment types based on many factors.

Using information from the landscape evaluation components, the treatment range is then analyzed and potentially adjusted to ensure it is reasonable to address five functional aspects of a resilient landscape. The five aspects are: (1) reducing fire risk; (2) aligning structure and cover types with current and future moisture stress levels; (3) maintaining a sufficient amount and patch size of dense forest to meet habitat needs; (4) shifting tree species composition pattern issues such as excessively large patches of high-risk structure classes and/or fragmentation of habitat.

2018 Forest Health Planning Areas Landscape Evaluations and Prescriptions

DNR has completed landscape evaluations for the 2018 planning areas, which comprise about 1 million acres of forestland. Many agencies and organizations assisted in this process and provided input and feedback, including the Colville National Forest, Okanagon-Wenatchee National Forest, Washington State Department of Fish and Wildlife, the University of Washington, Washington State Parks, The Nature Conservancy, Conservation Northwest, American Forest Resource Council, the Confederated Tribes of the Colville Reservation, and the Confederated Tribes and Bands of the Yakama Nation. DNR will complete and report on the landscape evaluations for the 2020 planning areas, which comprise about 1.65 million acres of forestland, in the fall of 2020.

DNR conducted landscape evaluations for the following 2018 planning areas: Chewelah A-Z, Mill Creek A-Z, Mount Spokane, Cle Elum, Ahtanum, Trout Lake and White Salmon. Evaluations were also completed for Upper Wenatchee and Manastash-Taneum by updating prior evaluations that were completed by the OWNF, TNC, and other partners. Demonstrating the power of partnerships and the “all lands, all hands” ethic of the 20-Year Forest Health Strategic Plan, Chelan County funded a contractor to conduct a landscape evaluation for the Stemilt planning area to expand the capacity of DNR. DNR did not conduct a landscape evaluation for the Tillicum or Mission Maintenance planning areas as most of the land in these planning areas is managed by USFS, and there is already a signed NEPA decision in each of these planning areas that established significant forest health treatment targets.

DNR is employing the landscape evaluation and prescription process described above to assess the forest health treatment needs in the forest health planning areas as required by SB 5546. The purpose of the landscape evaluation and prescription is to set high-level forest health treatment targets for each planning area so that DNR, landowners, and other stakeholders understand the level of treatment needed to create forest conditions that are resilient to large-scale disturbances, such as wildfire and insect and disease outbreaks. It also helps landowners work together to implement landscape-scale treatments and provide a benchmark to track progress on achieving resilient landscape conditions.

A landscape prescription does not mandate management actions or treatment targets for specific landowners. It provides recommendations for the planning area as a whole. Individual landowners then conduct their own field assessments, planning, and decision-making processes to determine the specific treatments they can carry out to achieve the collective goal of a resilient landscape, while also meeting their own management objectives and regulatory requirements.

Based on the landscape evaluations and prescriptions for the twelve 2018 planning areas, DNR estimates that 286,220 to 430,120 acres of treatments are needed to move these landscapes into a resilient condition (Table 1). Across all of the 2018 planning areas, this equates to treating approximately 30-40% of the forested area. A combination of treatments will be needed to accomplish the identified forest health treatment needs, including commercial and non-commercial thinning, prescribed fire, regeneration harvests and managed wildfire. Based on tree size class, the majority of acres needing forest health treatment are commercially viable, although commercial viability ultimately depends on multiple factors. Individual landowners will determine what treatment types are most appropriate in specific locations given their objectives, regulatory requirements, and operational and economic considerations (i.e. road access, logging systems, habitat issues, log markets, etc.).

For more details about the size, ownership, priority score, and planning stage for each 2018 and 2020 planning area, please see Table 2. Priority scores are based on DNR's HUC 6 forest health watershed prioritization.

The implementation of the forest health treatment needs identified through the landscape evaluation process for each planning area will likely take several biennia to accomplish. The pace and scale of forest health treatment implementation will be driven by some common and unique factors for each planning area such as: ratio of commercial versus non-commercial treatments, forest product markets, access, capacity of land managers and contractors to plan and implement treatments, and funding levels for non-commercial treatments.

And finally, detailed landscape evaluation summaries, including forest type information, treatment goals, and maps showing projected drought conditions and wildfire risk, for each 2018 forest health planning area are included in Appendix D.

Please note that the landscape evaluations for each planning area will be updated over time to reflect changes in forest conditions due to management and natural disturbances and as DNR continues to assimilate data and refine the landscape evaluation methodology.

Table 1: Forest Health Treatment Needs for the 2018 Forest Health Planning Areas

Planning Area	Forest Structure Class (acres)		
	Small Dense[1]	Medium-Large Dense[2]	Large-Medium Open[3]
Chewelah A-Z	2,000 - 3,500	45,500 - 66,500	3,500 - 8,000
Mill Creek A-Z	1,000 - 2,000	54,000 - 72,000	2,000 - 6,000
Mt Spokane	500 - 1,000	21,000 - 29,000	4,000 - 8,500
Upper Wenatchee	-	15,000 - 25,000	500 - 2,000
Stemilt	-	6,200 - 7,900	3,000 - 5,700
Manastash-Taneum	3,500 - 6,500	11,000 - 19,000	2,000 - 4,000
Cle Elum	1,500 - 3,000	14,000 - 20,000	2,500 - 5,500
Ahtanum	2,000 - 2,500	13,000 - 18,500	4,000 - 8,000
Trout Lake	-	17,500 - 31,000	1,000 - 2,000
White Salmon	500 - 1,000	35,000 - 48,000	2,500 - 6,000
Total	11,000 - 19,500	232,200 - 336,900	25,000 - 55,700
Subtotal	**268,200 - 412,100 acres**		
Tillicum	7,614 acres		
Mission Maintenance	10,406 acres		
Grand Total	**286,220 - 430,120 acres**		
Anticipated Treatment Type	[1] Non-commerical thin + fuels treatment. May also be prescribed fire or managed wildfire in some areas.		
	[2] Commerical thin + fuels treatment where possible. May be non-commercial, prescribed fire, managed wildfire or regeneration harvest in some areas.		
	[3] Maintenance treatments: prescribed fire or mechanical fuels treatments.		

Table 2*:* 2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan and SB 5546

2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	FS Planning Stage	Request Year	DNR Planning Role	Funding Request	Priority Score (0-3)	Total Acres	Forested Acres	Federal	State	Private & Other
Northeast Washington										
Chewelah A-Z	Very early - next A-Z project	2018	Conduct landscape evaluation and landscape Rx	Treatments on private and State	2.8	195,408	151,500	54%	5%	41%
Mill Creek A-Z	Complete - implementation in progress	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.5	186,305	158,574	32%	11%	57%
Mt Spokane	None - no FS land	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.3	121,767	93,063	0%	21%	80%
Toroda-Tonata	Very early	2020	Conduct landscape evaluation and landscape Rx.	Treatments on private and State. Potentially NEPA on OWNF portion	1.8	129,879	93,403	69%	9%	22%
Long Lake	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.3	80,297	35,518	0%	16%	84%
Ione-Sand	Early	2020	Conduct landscape evaluation and landscape Rx	Treatments on private and State	2.8	59,571	54,671	73%	7%	21%
Stranger	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	3.0	89,904	70,419	1%	25%	74%
Skookum	Very early	2020	Conduct landscape evaluation and landscape Rx	Treatments on private and State	2.6	109,039	89,139	45%	8%	47%
Republic	Complete or not on schedule	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.2	208,002	163,920	66%	5%	29%
The Wedge	Complete - implementation in progress	2020	Conduct landscape evaluation and landscape Rx.	Treatments on private and State.	2.5	138,547	118,811	49%	13%	38%

Table 2 continued

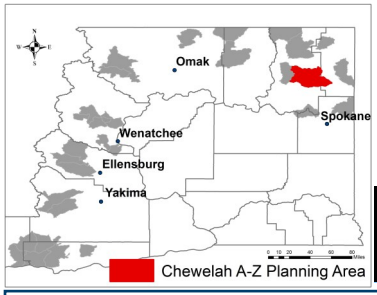
2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	FS Planning Stage	Request Year	DNR Planning Role	Funding Request	Priority Score (0-3)	Total Acres	Forested Acres	Federal	State	Private & Other
North - Central Washington										
Upper Wenatchee	Early - landscape evaluation complete	2018	Expand existing landscape evaluation and Rx to private. Assist USFS with NEPA process	Treatments on private	2.5	74,777	67,108	85%	1%	14%
Tillicum	Complete - implementation beginning	2018	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS and private	1.5	14,326	13,134	83%	2%	15%
Mission Maint.	Complete - implementation beginning	2018	Fund FS projects & nonFS	Treatments on USFS, private, and State	1.8	49,121	37,924	64%	3%	34%
Stemilt	None - very little FS land	2018	Assist Chelan County with landscape evaluation and plan.	Treatments on private and State	1.8	38,961	24,886	11%	40%	49%
Mt Hull	Mid - landscape evaluation complete	2020	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS, private, and State	0.9	105,431	34,308	54%	4%	42%
Twisp River	Early - landscape evaluation in progress	2020	Collaborate with USFS to develop landscape evaluation and Rx. Fund LiDAR	Treatments on private, State, and USFS. Potentially NEPA	2.6	84,711	70,375	93%	2%	5%
Methow Valley	Not on schedule	2020	Collaborate with USFS to develop landscape evaluation and Rx. Fund LiDAR	Treatments on private and State.	2.1	183,290	116,104	80%	7%	13%
Chumstick-Eagle	Not on schedule	2020	Collaborate with USFS to develop landscape evaluation and Rx.	Treatments on private and State.	3.0	50,310	46,430	61%	5%	34%
Mad Roaring Mills	Mid - landscape evaluation complete	2020	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS, private, and State	1.0	65,008	40,611	74%	9%	17%
Nason Creek	Not on schedule	2020	Collaborate with USFS to develop landscape evaluation and Rx.	Treatments on USFS and private	3.0	31,679	28,661	60%	2%	38%

Table 2 continued

2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	FS Planning Stage	Request Year	DNR Planning Role	Funding Request	Priority Score (0-3)	Total Acres	Forested Acres	Federal	State	Private & Other
Tapash-Central Washington										
Manas.-Taneum	Early - landscape evaluation complete	2018	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS and private	2.5	135,470	99,709	41%	45%	15%
Cle Elum	Very early	2018	Conduct landscape evaluaion and landscape Rx. Assist USFS with NEPA	Treatments on private and State	2.4	91,319	66,811	20%	9%	71%
Ahtanum	None - no FS land	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.1	120,477	104,856	1%	63%	36%
Tieton	Very early	2020	Collaborate with USFS to develop landscape evaluation and Rx. Fund LiDAR. Assist USFS with NEPA	Treatments on private, State, and USFS. Potentially NEPA	2.7	148,634	130,315	84%	12%	4%
Teanaway	Early - landscape evaluation in progress	2020	Collaborate with TNC and USFS to develop landscape evaluation and Rx. Focus on State lands	Treatments on private and State	2.7	132,120	120,634	52%	40%	8%
Klickitat/Skamania-South Gifford Pinchot										
Trout Lake	Complete - Implemention in progress	2018	Conduct landscape evaluaion and landscape Rx.	Treatments on private, State, and USFS.	2.8	117,153	106,971	62%	17%	21%
White Salmon	None - no FS land	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.7	126,688	109,636	5%	29%	67%
Little White	Very early - begin in 2020	2020	Conduct landscape evaluaion and landscape Rx.	Treatments on private, State, and USFS. Potentially USFS surveys or NEPA	2.2	95,750	71,695	77%	5%	18%
Klickitat	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.4	143,532	104,824	2%	19%	79%
HWY 97	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private	2.5	60,398	45,418	0%	0%	99%
Glenwood	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.4	116,772	101,311	2%	36%	62%

Table 2 continued

2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	FS Planning Stage	Request Year	DNR Planning Role	Funding Request	Priority Score (0-3)	Total Acres	Forested Acres	Federal	State	Private & Other
Blue Mountains										
Blues West	To be determined	2020	Conduct landscape evaluation and landscape Rx with USFS	Treatments on State, USFS, & some private	2.2	106,637	79,965	49%	1%	50%
Blues East	To be determined	2020	Conduct landscape evaluation and landscape Rx with USFS	Treatments on State, USFS, & some private	1.8	120,692	76,361	77%	4%	19%



Chewelah A-Z Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
195,480	151,500	51,000 - 78,000

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Chewelah planning area is dominated by mid-sized, dense forest and has major forest health treatment needs. Ownership of forestland is dominated by US Forest Service (53%), small private (23%), and private-industrial (17%), along with some DNR (5%), and US Fish and Wildlife (2%). **Fire risk is generally low to moderate, with higher risk in larger, dense forest patches**. Based on current conditions from 2015 and 2016, **shifting an estimated 47,500 - 70,000 acres from dense to open forest is recommended** to move the landscape into a resilient condition while maintaining 33-50% of the landscape in dense forest to provide for habitat, wood production, and carbon storage. Maintenance treatments on existing open forest are needed on 3,500-8,000 acres. In sum, treating 34-51% of the forested acres is recommended. The Colville National Forest is currently implementing the Power Lake project in which 1,800 acres have been treated and several thousand more are being implemented. A large A-Z project is being planned on USFS land.

20 Year Plan Landscape Goals

Overarching:

- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component.
- Reduce fire risk to communities and homes.
- Sustain wood production objectives on private and DNR land.
- Maintain large tree, dense forest in the least fire and drought prone areas to sustain dense forest dependent wildlife species.

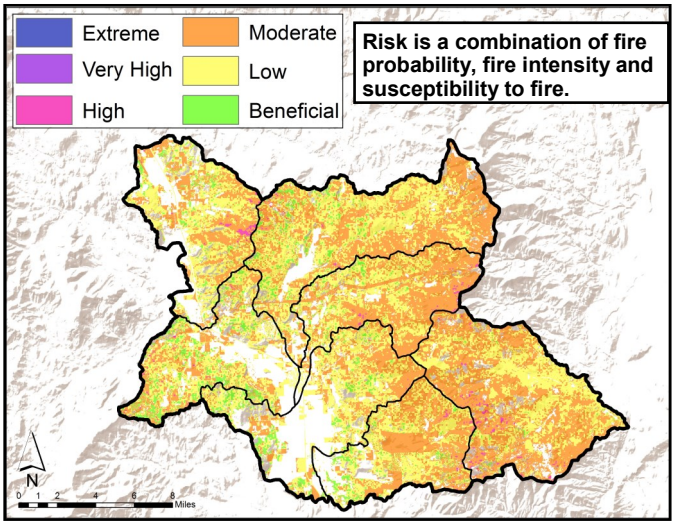


Figure 1. Wildfire risk to homes, infrastructure & forests.

Reduce wildfire risk:
Risk of tree mortality from fire is moderate to low in most of the planning area due to low current fire probability (0.5 - 1% per year) (Fig 1). When a large fire does occur, however, fire intensity is predicted to be moderate to high in most areas with dense forest. Thus treatments are needed near communities and on private parcels to protect homes and improve safety. Shifting a large portion of dense forest to open forest, along with treating fuels, will reduce the likelihood of a large crown fire that would impact private forest landowners, as well as public forests. Not all high risk areas need to be treated to reduce overall risk, especially in moist and cold forests. Some areas are predicted to burn as low-intensity fires, which will consume fuels and have habitat benefits.

Prepare for climate change:
Projected warming will increase moisture stress and probability of wildfire and insect outbreaks. By mid-century, 15% of the planning area is projected to have moisture stress levels currently associated with moist and cold forest vs 40% today (Fig. 2). Treatments to reduce density and favor drought-tolerant species on a large portion of current and future high deficit sites will help forests adapt.

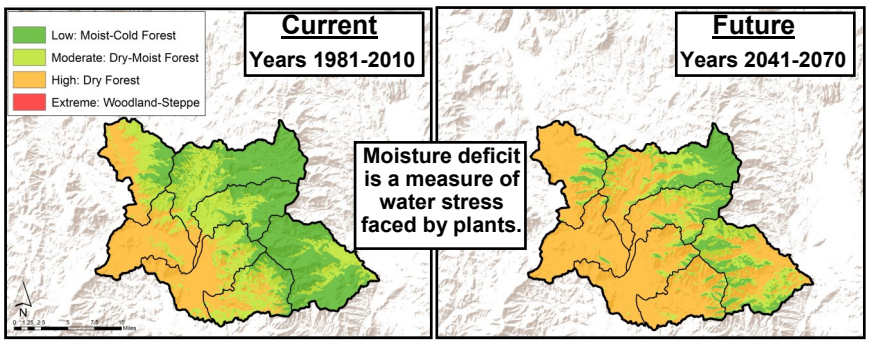


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:
Habitat for species such as the Northern Goshawk and American Marten that utilize medium to large, dense tree forest is currently abundant on USFS land. While treatments to lower fire risk will reduce this habitat, remaining untreated habitat will be less prone to large crown fires. Projected future moderate to low deficit sites are most likely to sustain this habitat over time. Habitat for dry-forest dependent species, such as the white headed woodpecker, is low and occurs mostly on private land. Treatments can increase this habitat if prescriptions incorporate key considerations. Fires that burn at characteristic severity in all forest types benefit habitat by creating snags and increasing understory plants.

Enhance rural economic development:
A large portion of the potential treatment areas have road access and are likely to be commercially viable. The proposed US Forest Service A-Z project has the potential to provide substantial work for operators and volume for wood processing facilities. Reducing fire risk will also help maintain recreation and tourism. Over time, the planning area will likely be able to support long term timber production on private land if proactive strategies to shift species composition and manage for lower density are gradually adopted.

Definitions (see Appendix for data sources and methods):
Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: Chewelah Planning Area

Dry forest:
Treating 39,000 - 55,000 acres of dense, dry forest acres (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by large patches of dense forest to open forest (Fig. 4). Treatments in large, medium and small diameter forest are needed. The highest priority treatments are on sites with high current and future drought stress, which are located mostly in the western half and overlap with dense forests near communities. Over time, treated medium size forest on public and some private land will grow into open canopy, large tree forest that is in short supply, which will increase fire resilience.

Moist and Cold forest:
Treating 8,500-15,000 acres of dense, moist forest is recommended to break up large patches to reduce risk of a large crown fire and help moist forests adapt to a warming climate. Shifting species composition towards fire and drought tolerant species is also needed. Post treatment, more than 2/3rds of moist and cold forest will remain dense, leaving sufficient buffer for when characteristic, mixed severity fires burn dense forest habitat. Area in large tree forest will increase over time on Federal land, while most private landowners and the DNR are likely to manage for small and medium size classes. No treatments in cold forest are needed.

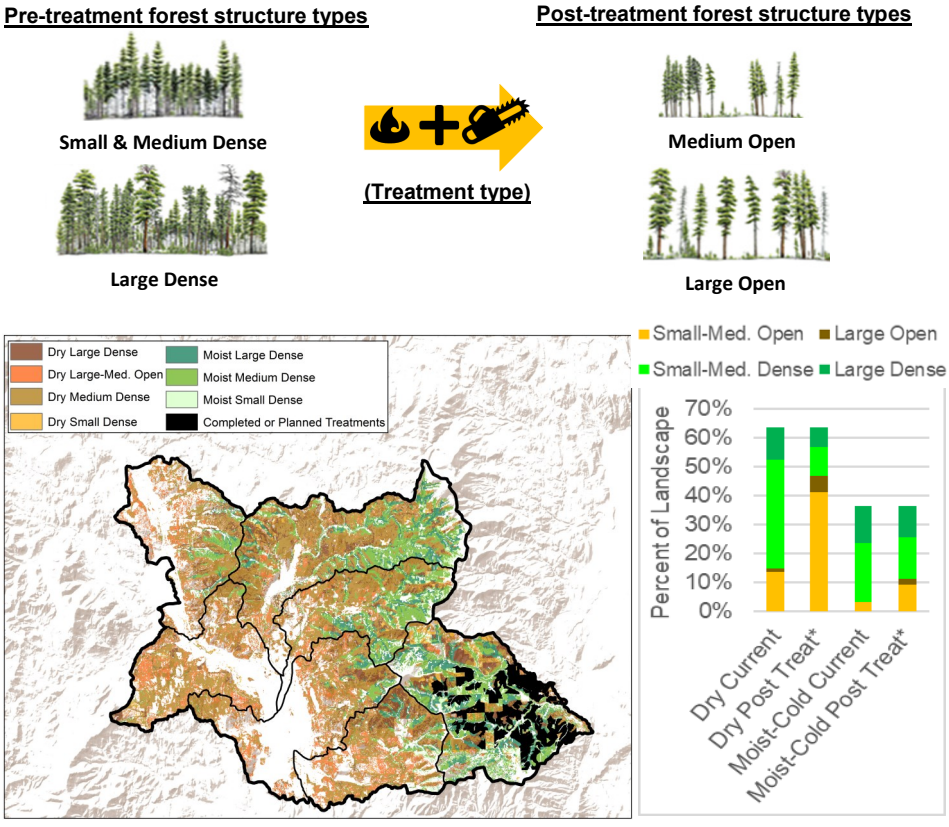


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated (Table 1).

Figure 4. Current & post treatment percent of forest types.
****mid-point of treatment range***

Maintenance treatments: A portion of existing open forests on dry sites need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. An estimated 3,500-8000 of treatments is currently recommended.

Open forest with small trees growing in

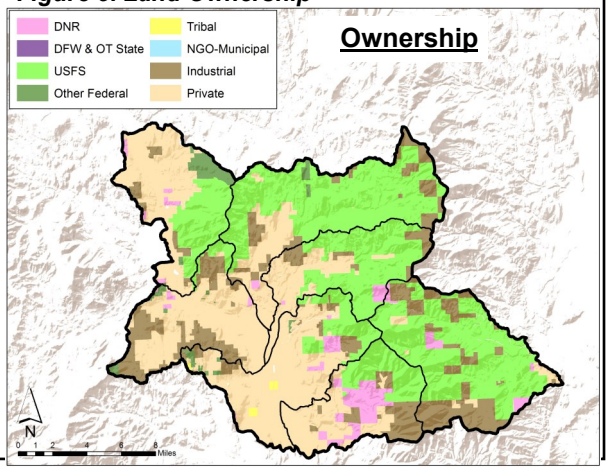
Open forest after maintenance treatment.

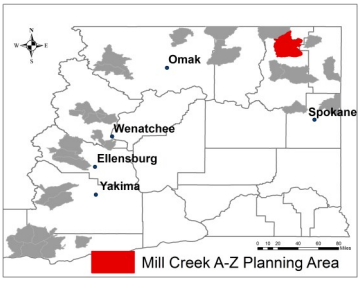
Overall treatment needs: Shifting an estimated 47,500 to 70,000 acres from dense to open forest is recommended (Table 1). A combination of treatments will be needed to accomplish this goal, and may include commercial and non-commercial thinning, prescribed fire, regeneration harvests, and mechanical fuel reduction. Based on tree size class, many of the acres are commercially viable. However, road access, logging systems, habitat requirements, aquatic impacts, timber markets, and other considerations will determine treatment type. Maintenance treatments on 3,500-8,000 acres are also recommended. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and decision making processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals while meeting their own management objectives and regulatory requirements. The Forest Service has already completed 1,800 acres of treatment with additional acres under contract.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment	Current Acres by Major Landower*			
Type	Size Class	Need Acres	USFS	Private	Industrial	DNR
Dry Dense	Small	1000-2000	1053	69	1181	40
	Medium	34000-44000	25631	16213	6966	2975
	Large	4000-9000	10539	1560	456	446
Moist Dense	Small	1000-1500	1053	69	1181	40
	Medium	6000-9000	14244	1382	3279	563
	Large	1500-4500	11772	297	677	239
Dry Open	Large-Medium	3500-8000	2603	7485	3942	1312
Total		51,000 - 78,000	*These are current acres, not targets			
Anticipated Treatment Type		Non-commerical thin + fuels treatment. Fire only as well				
		Commerical + fuels treatment where possible. May also be non-commercial or fire only.				
		Maintenance: fire or mechanical fuels treatment				

Figure 5. Land Ownership





Mill Creek A-Z Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
186,305	158,574	57,000 - 80,000

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Landscape Highlights

The Mill Creek planning area is dominated by mid-sized, dense forest and has significant treatment needs. Forestland ownership is dominated by small private (34%) and private-industrial (28%); while the US Forest Service (26%), the DNR (10%) and the BLM (2%) own the remainder. **Fire risk is generally low, with moderate risk in larger patches of dense forest**. Based on current conditions from 2015 and 2016, **treating an estimated 55,000 - 74,000 acres of dense forest is recommended** to move the landscape into a resilient condition while maintaining 33-45% of the landscape in dense forest to provide for habitat, wood production, and carbon storage. Maintenance treatments on existing open forest are needed on 2,000-6,000 acres. In sum, treating 36-50% of the forested acres is recommended. The Mill Creek A-Z project is currently being implemented in the southeastern corner on most of the USFS land in the planning area. Approximately 14,000 acres in total will be treated when the projectis completed in 2023.

20 Year Plan Landscape Goals

Overarching:

- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component.
- Sustain wood production objectives on private and DNR land.
- Reduce fire risk to communities and homes.
- Maintain large tree, dense forest in the least fire and drought prone areas to sustain dense forest dependent wildlife species.

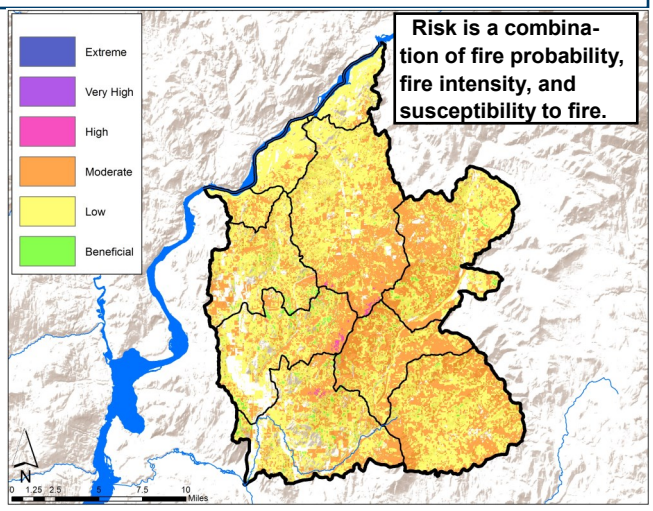


Figure 1. Wildfire risk to homes, infrastructure & forests.

Reduce wildfire risk:
Risk of tree mortality from fire is moderate to low in most of the planning area due to low current fire probability (0.3-0.6% per year) (Fig.1). When a large fire does occur, however, fire intensity is predicted to be high in the central and southeastern portion. Most of this area is moderate to higher elevation moist and cold forest, where it will be challenging to maintain lower fire risk due to rapid re-growth of fuels. Treating a portion of this area, along with most adjacent dense forest on dry sites, will reduce the likelihood of a large crown fire that would greatly impact private landowners, as well as public forests. Treatments in the southern portion will also create defensible space to protect the town of Colville, which lies just south of the planning area.

Prepare for climate change:
Projected warming will increase moisture stress and thus probability of wildfire and insect outbreaks. By mid-century, 20% of the area is projected to have moisture stress levels currently associated with moist and cold forest vs 55% today (Fig. 2). Treatments to reduce density and manage for drought-tolerant species on current and future high deficit sites will help forests adapt.

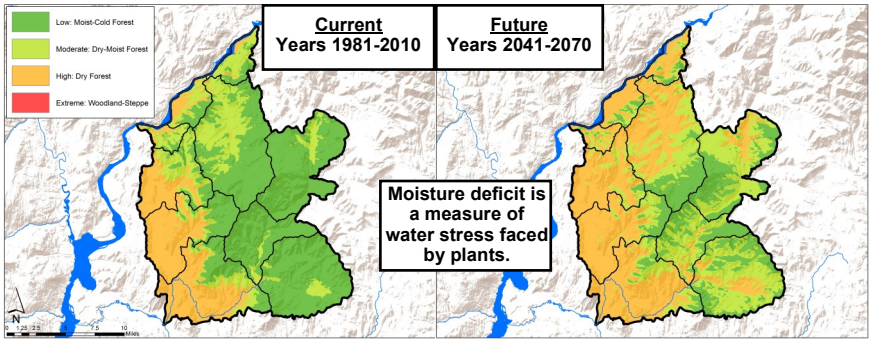


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:
Habitat for species such as the Northern Goshawk and American Marten that utilize medium to large tree forest with moderate to closed canopies is moderately abundant on USFS and DNR land. While treatments to lower fire risk will reduce this habitat, remaining untreated habitat will be less prone to a large crown fire. Projected future moderate to low deficit sites are most likely to sustain large patches of these habitat types over time. Habitat for open canopy, dry forest dependent species, such as the white headed woodpecker, is limited to a few larger patches on south facing Forest Service and DNR land in the western, lower elevation areas. Treatments can increase this habitat if prescriptions incorporate key considerations. Fires that burn at characteristic severity in all forest types can benefit habitat by creating snags and stimulating higher understory plant abundance and diversity.

Enhance rural economic development:
The Mill Creek A-Z project is expected to generate **120** million board feet and is providing substantial employment for operators and other forestry associated industries. This area will likely be able to support long term timber production on private and DNR land if proactive strategies to manage for drought tolerant species and lower density levels are adopted over time.

Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: Mill Creek A-Z Planning Area

Dry forest:
Treating 47,000 - 60,000 acres of dense, dry forest acres (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by large patches of medium sized, dense forest to open forest (Fig. 4). The highest priority treatments are on sites with high current and future drought stress, which are located mostly in the western half and overlap with dense forests near homes and the town of Colville. Over time, treated medium size forest on public and some private land will grow into open canopy, large tree forest that is in short supply (Fig. 4), which will increase fire resilience.

Moist and Cold forest:
Treating 8,000-14,000 acres of dense, moist forest is recommended to break up large patches to reduce risk of a large crown fire and to help moist forests adapt to a warming climate. Expanding and connecting existing patches of early seral habitat, or small open forest, will reduce existing fragmentation and provide opportunities to shift species composition towards fire and drought tolerant species. Post treatment, more than 60% of moist and cold forest will remain dense. Area in large tree forest will increase over time on Federal land, while most private landowners are likely to manage for small and medium size classes. No treatments in cold forest are needed.

Pre-treatment forest structure types

Small & Medium Dense

Large Dense

(Treatment type)

Post-treatment forest structure types

Medium Open

Large Open

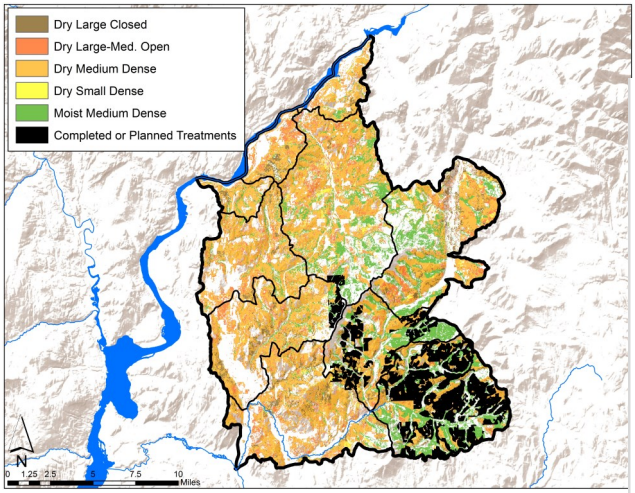


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated (See Table 1).

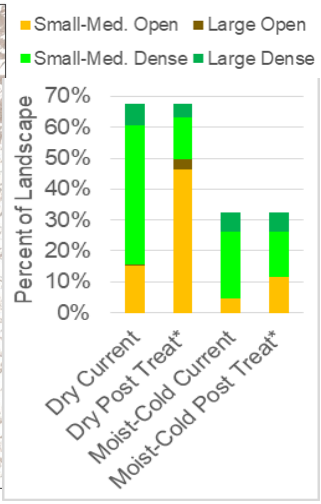


Figure 4. Current & post treatment percent of forest types. *mid-point of treatment range

Maintenance treatments: A portion of existing open forests on dry sites need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. Many of these sites have been recently treated and will need maintenance in the next 10-20 years.

Open forest with small trees growing in

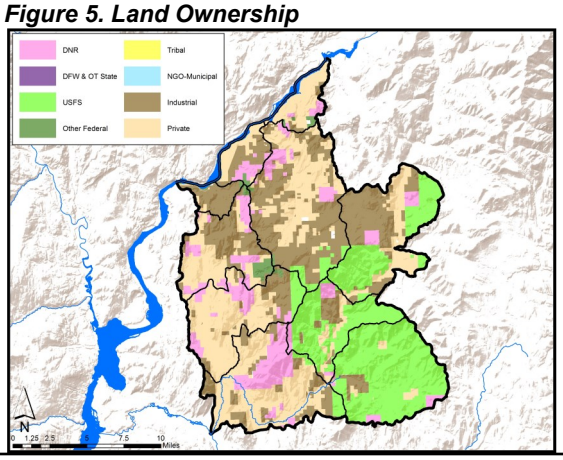
Open forest after maintenance treatment

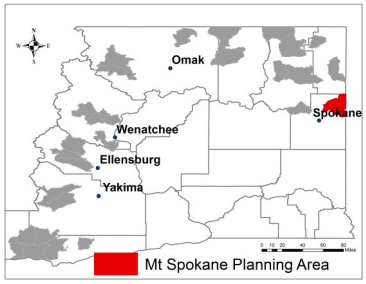
Overall treatment needs: Shifting an estimated 55,000 to 74,000 acres from dense forest to open forest is recommended (Table 1). A combination of treatments will be needed to accomplish this goal, and may include commercial and non-commercial thinning, prescribed fire, regeneration harvests and managed wildfire. Based on size class, many acres are commercially viable. However, road access, logging systems, aquatic impacts, habitat issues, timber markets and other factors will determine treatment type. Maintenance treatments on 2,000-6,000 are also recommended. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and decision making processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals while meeting their own management objectives and regulatory requirements. The USFS has completed 700 acres of the Mill Creek A-Z project with 13,300 acres in different phases of implementation.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment	Current Acres by Major			
Type	Size Class	Need Acres	Private	Industrial	USFS	DNR
Dry Dense	Small	1000-2000	114	727	331	86
	Medium	43000-53000	22002	18496	17105	9010
	Large	3000-5000	2249	932	3826	2208
Moist Dense	Medium	8000-14000	3084	5532	12496	1474
Dry Open	Large-Medium	2000-6000	6534	5707	1431	1579
Total	**57,000 - 80,000**		*These are current acres, not targets			
Anticipated Treatment Type	Non-commerical thin + fuels treatment					
	Commerical thin + fuels treatment. (Can be non-commercial,					
	Maintenance: prescribed fire or mechanical fuels treatment					

Figure 5. Land Ownership





Mount Spokane Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
121,767	93,403	25,500 - 38,500

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Mt. Spokane planning area consists of a mix of agricultural and forest land in the west, dense forests around Mt. Spokane, and private forestland in the north and south. Ownership of forestland is dominated by small private (60%) and private-industrial (24%), along with some Washington State Parks (10%), and DNR Trustlands (6%). **Fire risk is generally low to moderate, with higher risk in larger, dense forest patches** around Mt. Spokane and in the western portion of the planning area where homes are interspersed with forest and agricultural land. Based on current conditions data from 2016, **shifting an estimated 21,500 - 30,000 acres from dense to open forest is recommended** to move the landscape into a resilient condition while maintaining 36-46% of the landscape in dense forest to provide for wood production, habitat, and carbon storage. Maintenance treatments on existing open forest are needed on 4,000-8,000 acres. In sum, treating 27-41% of the forested acres is recommended.

20 Year Plan Landscape Goals

Overarching:

- Increase safety and fire protection for homes and communities.
- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component.
- Sustain wood production objectives on private and DNR land.
- Enhance habitat and recreational values in Mt Spokane State Park.

Reduce wildfire risk:

Risk to structures and forests is low to moderate to the planning area due to low current fire probability (0.3– 0.5% per year) (Fig 1). When a large fire does occur, however, tree mortality and impacts to homes, and infrastructure, are predicted to be high on private land with dense forest, and very high around Mt. Spokane. Thus treatments are needed on private parcels to protect homes and improve safety. Treatments within Mt Spokane State Park and adjacent dense forest will reduce the likelihood of a large crown fire that would impact forest and recreational values. Only a portion of dense forest needs to be treated to reduce overall risk, however.

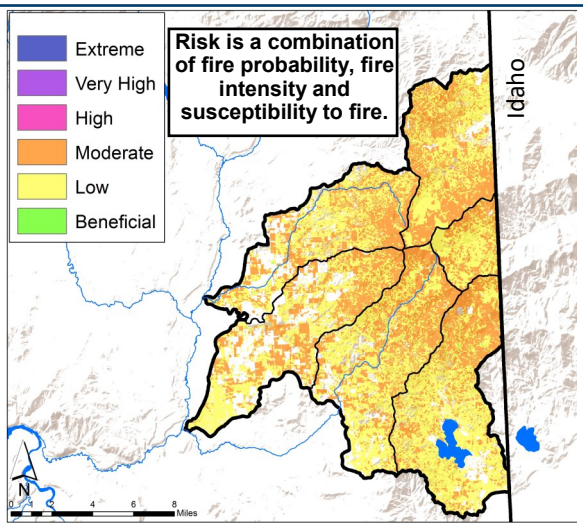


Figure 1. Wildfire risk to homes, infrastructure & forests.

Prepare for climate change:

Projected warming will increase moisture stress and thus probability of wildfire and insect outbreaks. By mid-century, 80% of the planning area is projected to have moisture stress levels currently associated with dry forest vs 40% today (Fig. 2). Treatments to reduce density and manage for drought-tolerant species on a large portion of current and future high deficit sites will help forests adapt to these changes.

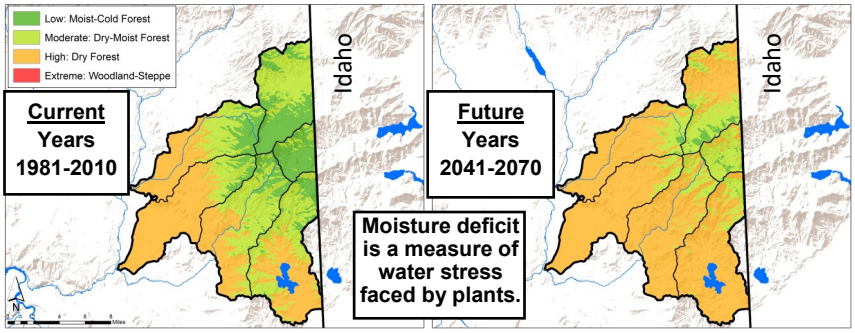


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:

Mt Spokane State Park, adjacent private, and DNR land provide a large patch (~15,000 acres) of habitat for species such as the Northern Goshawk and American Marten that utilize dense, medium to large tree forest. While treatments to lower fire risk will reduce this habitat, the remaining habitat will be less prone to a large crown fire. Projected future moderate to low deficit sites are most likely to sustain larger patches of these habitat types over time. Treatments on dry sites can build larger patches of currently under-represented habitat for open canopy dependent species, such as the white headed woodpecker, if prescriptions incorporate key considerations. Fires that burn at characteristic severity in all forest types benefit habitat by creating snags and enhancing understory plant diversity and abundance.

Enhance rural economic development:

Reducing fire risk will help maintain recreational activities and associated economic activity. Some treatments in Mt Spokane State Park are commercially viable, while many other areas lack road access and will need to be treated with non-commercial and/or fire only treatments. Over time, this area will likely be able to support long term timber production on private and DNR land if proactive strategies to shift species composition and manage for lower density are adopted over time.

Definitions (see Appendix for data sources and methods):

Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: Mount Spokane Planning Area

Dry forest:
Treating 16,000 - 20,000 acres of dense, forest on dry sites (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by large patches of dense forest to open forest (Fig. 4). Treatments in large, medium and small diameter forest are needed. The highest priority treatments are on private land with structures in the western portion of the planning area, as well as on south facing slopes around Mt Spokane. Over time, treated medium size forest on public and some private land will grow into open canopy, large tree forest that is in short supply (Fig. 4), which will increase fire resilience.

Moist and Cold forest:
Treating 5,500-10,000 acres of dense, moist and cold forest is recommended to break up the very large patch of dense forest around Mt Spokane in order to reduce risk of a large crown fire and help forests adapt to a warming climate. Shifting species composition towards fire and drought tolerant species is also needed. Post treatment, 55-65% of moist and cold forest area would remain dense, leaving sufficient buffer for when characteristic, mixed severity fires burn these areas. Sites with projected future low and moderate moisture deficit (Fig. 2) offer the most sustainable locations to maintain and grow large tree, dense forest.

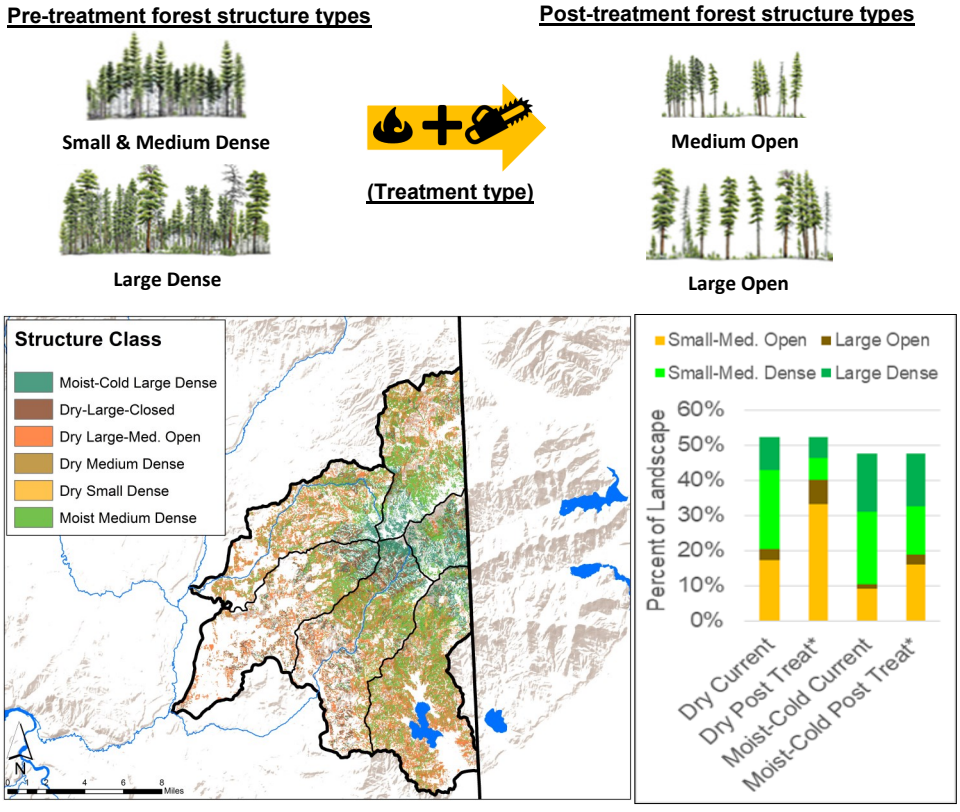


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated, see Table 1.

Figure 4. Current & post treatment percent of forest types.
****mid-point of treatment range***

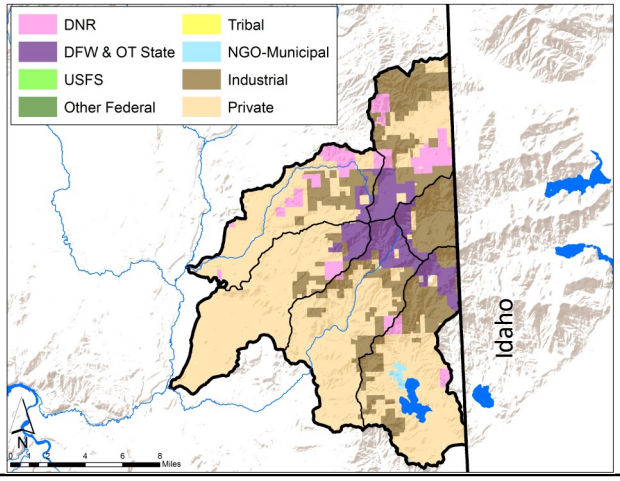
Maintenance treatments: A portion of existing open forests on dry sites need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. An estimated 4,000-8,500 of treatments is currently recommended.

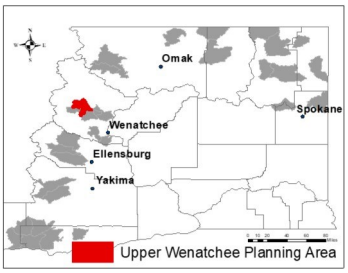
Overall treatment needs: Shifting an estimated **21,500 - 30,000** acres from dense to open forest is recommended (Table 1). A combination of treatments will be needed to accomplish this goal, including commercial and non-commercial thinning, prescribed fire, regeneration harvests, mechanical fuel reduction, and managed wildland fire use. Based on size class, many of the acres are commercially viable. However, road access, logging systems, aquatic impacts, habitat issues, timber markets, and other considerations will determine treatment type. Maintenance treatments on 4,000-8,500 acres are also recommended. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and decision making processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals while meeting their own management objectives and regulatory requirements.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment	Current Acres by Major Landower*			
Type	Size Class	Need Acres	Private	Industrial	St. Parks	DNR
Dry Dense	Small	500-1000	335	785	8	87
	Medium	13000-15000	11885	5326	388	1569
	Large	2500-4000	3428	1029	1231	429
Moist & Cold Dense	Medium	4000-7000	6196	5294	1041	1325
	Large	1500-3000	1526	2271	4288	413
Dry Open	Large-Medium	4000-8500	9066	2727	41	765
Total		**25,500 - 38,500**	*These are current acres, not targets			
Anticipated Treatment Type		Non-commerical thin + fuels treatment. May be fire only				
		Commerical + fuels treatment where possible. May also be non-commercial, fire only, or regeneration harvest				
		Maintenance: prescribed fire or mechanical fuels treatment				

Figure 5. Land Ownership





Upper Wenatchee Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
74,778	67,109	15,500 - 27,000

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Upper Wenatchee planning area is one of the highest fire risk areas in eastern Washington. Recent treatments on US Forest Service and private land have begun to reduce risk, yet more treatments are needed around homes and communities. Forest land is 85% USFS, 13% private, and 2% DNR and State Parks. Treating an estimated 15,000 - 25,000 acres of dense forest is recommended to move the landscape into a more resilient condition while also maintaining sufficient dense forest to help meet Late Successional Reserve objectives. Maintenance treatments on 500-2000 acres of currently open forest are also recommended. Treatment needs equate to **23-40%** of the forested area. Recommendations are based on WA DNR's update of a landscape evaluation conducted by the Forest Service using 2014 current conditions data. NEPA planning is underway for all Forest Service land in the project area.

20 Year Plan Landscape Goals

Overarching:

- Improve safety and fire protection for people and homes.
- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component
- Maintain large tree, dense forest for wildlife in the least fire and drought prone areas.

Reduce wildfire risk:

Extensive treatments on private parcels are needed to reduce the high level of risk to communities (Fig. 1), as well as on adjacent Forest Service land to create defensible space. In forest areas away from homes, risk of al large crown fire is high to extreme due to both high fire probability (3-4.5% per year) and high fuel loading. Treatments that increase the amount and patch size of fire resistant forest are recommended. Not all high risk forest needs to be treated to significantly reduce overall risk, however. Many recently treated areas are predicted to burn as low-intensity ground fires, which will have beneficial effects by consuming fuels.

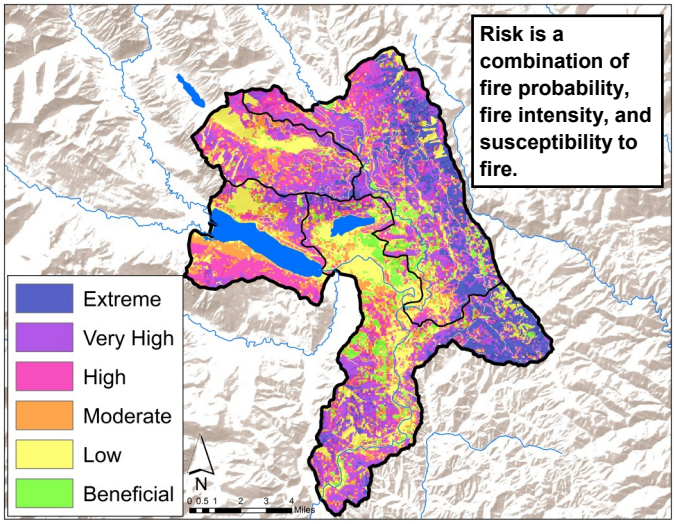


Figure 1. Wildfire risk to homes, infrastructure & forests.

Prepare for climate change:

Projected warming will increase moisture stress and probability of wildfire and insect outbreaks. By mid-century, only north slopes and higher elevations are projected to have moisture stress levels currently associated with moist and cold forest (Fig. 2), while levels associated with woodland and shrub-steppe are projected to increase from 0 to 20% of the planning area. Treatments to reduce density and favor fire and drought-tolerant species will help forests adapt.

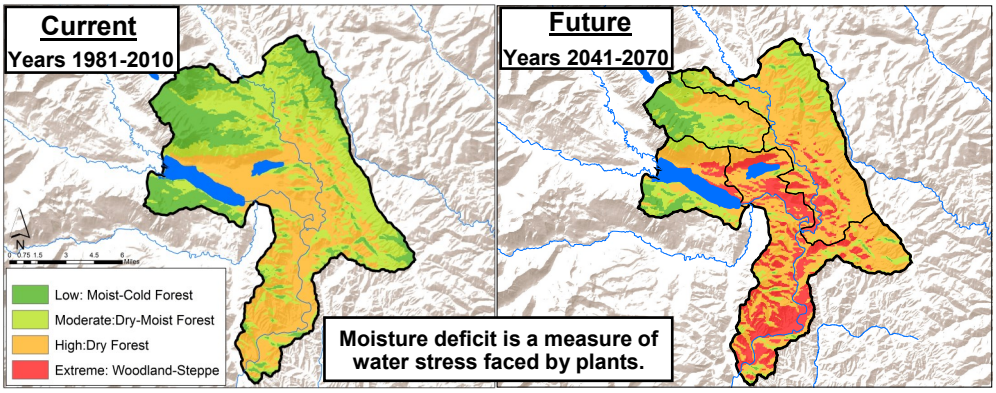


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:

Maintaining a substantial portion of the planning area in large tree, dense forest is necessary to provide northern spotted owl habitat and meet Late Successional Reserve (LSR) objectives on Forest Service land. Yet risk of habitat loss from fire is very high across most of the LSR. Thus treating a significant portion of the LSR is recommended to reduce risk. By creating a mosaic of large dense and open patches with large trees, treatments can reduce long term risk of habitat loss by slowing spread of crown fires and providing patches of replacement habitat.

Enhance rural economic development:

A large portion of the potential treatment areas have road access and are likely to be commercially viable. Treatments have the potential to provide meaningful volume for existing or new wood processing facilities. Reducing fire risk will help maintain recreational values and associated economic activity in the Wenatchee valley.

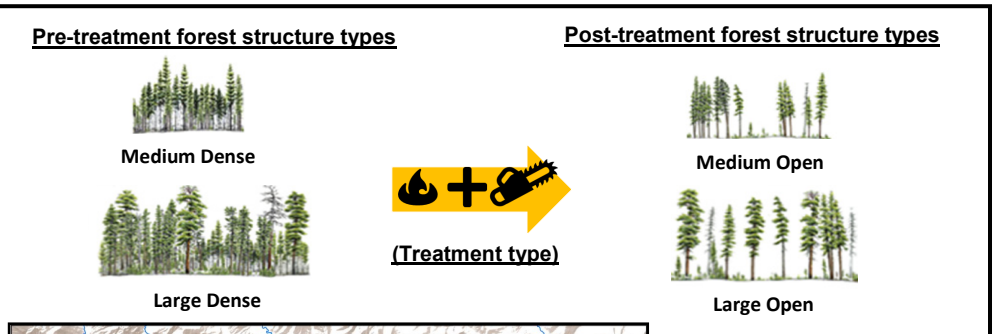
Definitions (see Appendix for data sources and methods):

Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: Upper Wenatchee Planning Area

Dry forest:
Treating 12,000 - 18,000 acres of dense, dry forest (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by large patches of dense forest to open forest with a large tree component. Treatments are needed in large, medium and small forest structure classes. Large tree structure exists in most places, and could be converted to more fire and drought resistant forest by removing smaller trees and treating fuels with prescribed fire or mechanical methods. The highest priority treatments are on private and USFS land near homes.

Moist and Cold forest:
Treating 3,000-7,000 acres of dense, moist forest is recommended to break up the some of the large patches of dense, high fire risk forest. Density reduction and shifting species composition will also help forests adapt to a warming climate. If a fire burns up existing large-tree, dense forest, treated areas can be left to develop into and replace this important habitat. Sites with low and moderate moisture deficit projected in the future offer the most sustainable locations to maintain and grow large tree, dense forest. Treatments in offsite ponderosa pine plantations are also recommended. No treatments in cold forest are needed.



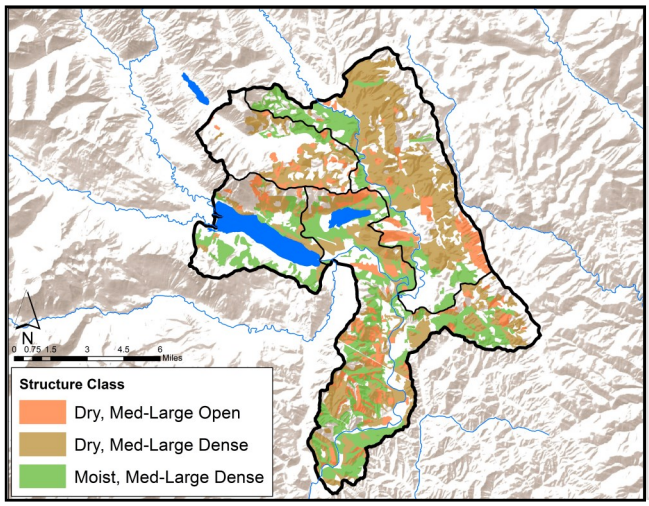


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated (See Table 1).

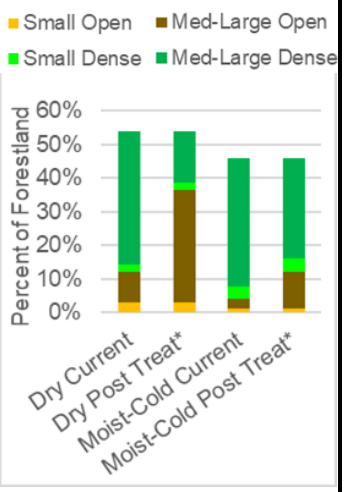


Figure 4. Current & post treatment percent of forest types.
**** mid-point of treatment range***

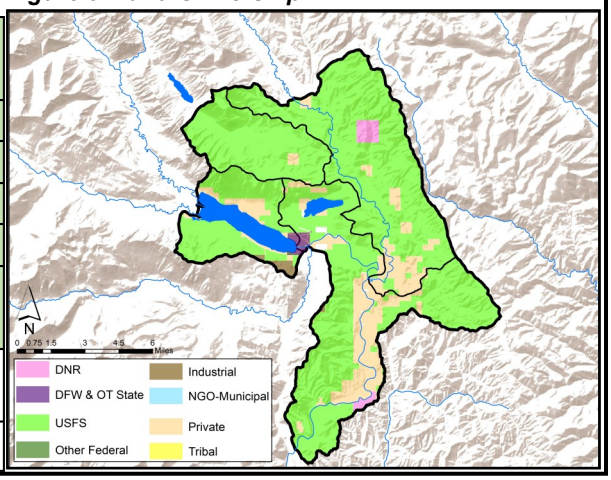
Maintenance treatments: A portion of existing open forests need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. The US Forest Service has already burned many of their recent treatments. An estimated 500-2,000 of additional treatments are recommended.

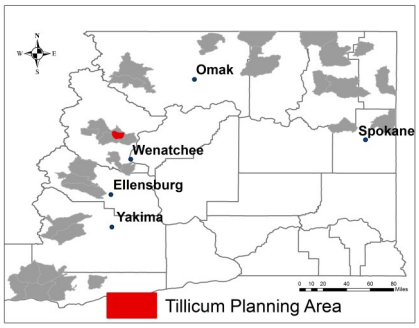
Overall treatment needs: Shifting an estimated 15,000 to 25,000 acres from dense to open forest is recommended (Table 1). A combination of treatments will be needed to accomplish this treatment goal, including commercial and non-commercial thinning, prescribed fire, regeneration harvests and managed wildfire. Based on tree size class, many acres are commercially viable. However, road access, logging systems, aquatic impacts, habitat issues, timber markets and other factors will determine treatment type. Maintenance treatments on 500-2,000 acres are also recommended. Individual landowners (Fig. 5), including the US Forest Service, will conduct their own planning and decision-making processes to determine acres and types of treatments they can implement to meet overall landscape goals while achieving their own legal mandates and management objectives.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment Need Acres	Current Acres by Major Landower*		
Type	Size Class		USFS	Private	State
Dry Dense	Med. -Large	12000-18000	21230	2386	830
Moist Dense	Med. -Large	3000-7000	13156	1686	240
Dry Open	Med. -Large	500-2000	5007	707	4
Total		**15,500-27,000**	*These are total current acres, not targets		
Anticipated Treatment Type		Commerical thin + fuels treatment where possible. May be non-commercial, fire only, or regeneration harvest			
		Maintenance: prescribed fire or mechanical fuels treat.			

Figure 5. Land Ownership.





Tillicum Planning Area
Landscape Evaluation Summary

Total Acres	Forested Acres
14,326	13,134

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Tillicum Planning Area is located northeast of Leavenworth and west of the town of Entiat. The area is mostly forested. Forest land is 83% USFS, 15% private and industrial, and 2% DNR. (Figure 1). A landscape evaluation for the Tillicum Planning Area has not been completed by the DNR, however the USFS conducted a landscape evaluation of US Forest Service lands as part of their Tillicum Watershed Restoration Project. The USFS has a signed NEPA decision for the Tillicum Watershed Restoration projects that includes 7,614 acres of planned forest health treatments. These USFS forest health treatments are all non-commercial treatments, a combination of thinning and prescribed fire. The USFS will also be implementing aquatic restoration activities as part of the project.

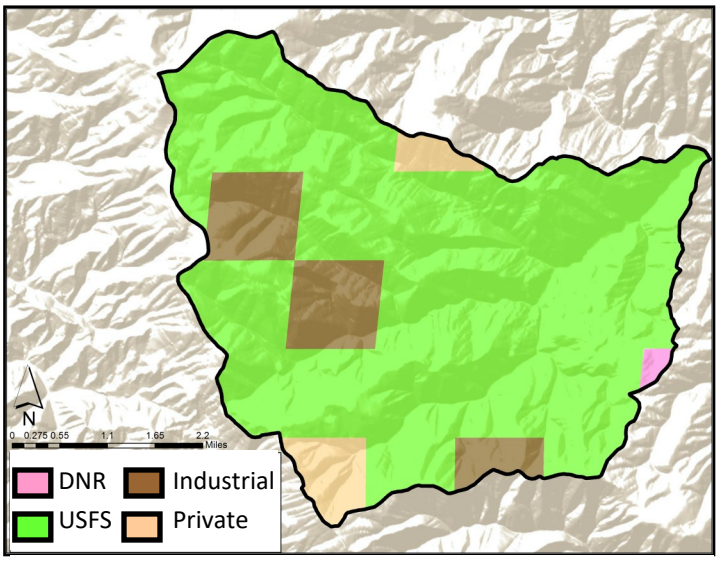


Figure 1. Forestland ownership in Tillicum Planning Area.

20-Year Plan Landscape Goals

- Reduce wildfire risk.
- Prepare for climate change (Figure 2).
- Sustain wildlife habitat.

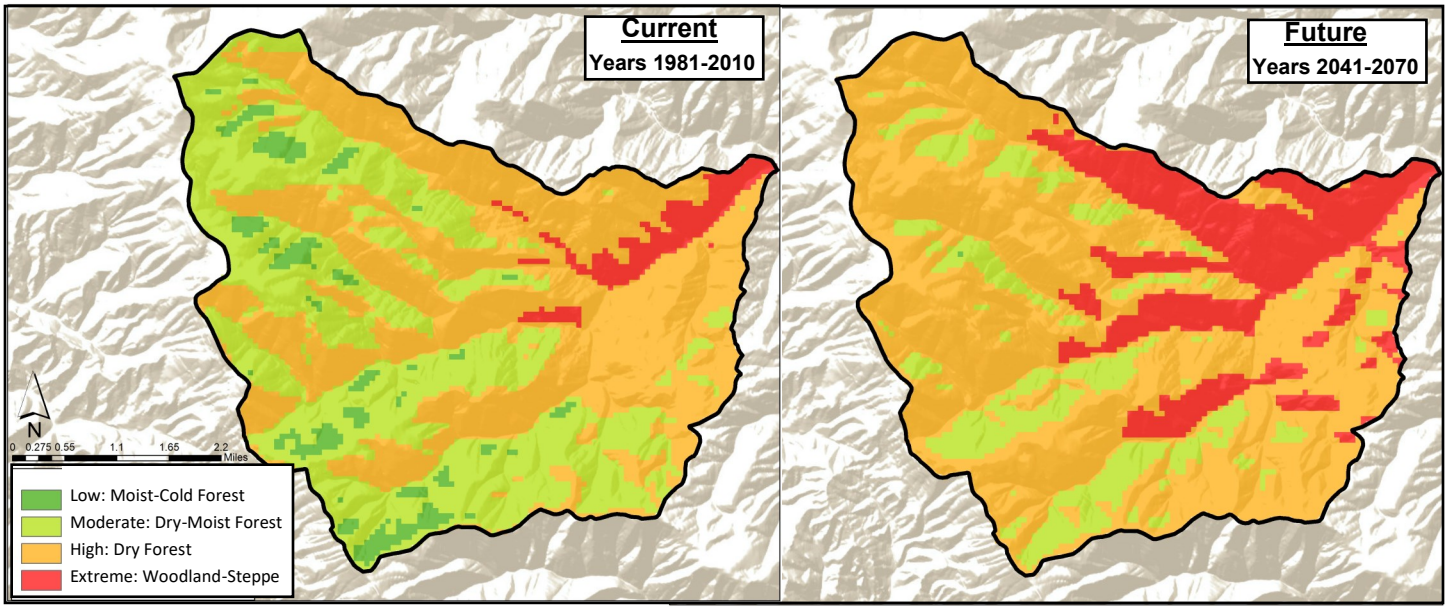


Figure 2. Current and future moisture deficit levels in the Tillicum Planning Area. Moisture deficit is a measure of water stress faced by plants. Projected warming trends will increase moisture stress and thus probability of wildfire and insect outbreaks. Treatments to reduce density and manage for drought-tolerant species on a large portion of current and future high deficit sites will help forests adapt to these changes.

Definitions (see Appendix for data sources and methods):
Dry: *Low to mid elevation ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-20 years.*
Moist: *Mid-elevation forests that historically had mixed severity fires and were dominated by Douglas-fir, western larch, and ponderosa pine, plus other fire-intolerant conifers.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.*

US Forest Service

Planned/Completed Treatments

The Okanogan Wenatchee National Forest (USFS) has begun planning and implementing treatments based on their landscape evaluation for the Tillicum Watershed Restoration Project. They are implementing a mix of treatments, including non-commercial forest thinning, tree pruning, vegetation pile burning, and underburning using prescribed fire. A total of 7,614 acres of treatments are planned.

In 2018, the USFS completed treatments on 415 acres (Table 1, Figure 3).

1,672 acres are under contract to have treatments implemented by 2022, this includes 208 acres that will be funded by DNR. 5,527 acres have treatments planned and are ready to be implemented when a funding source arises.

Table 1. US Forest Service forest health vegetation treatments, by acres, in the Tillicum Planning Area. Treatments under contract are expected to be completed by 2022.

Total Planned USFS Forest Health Treatments (Acres)	**7,614**
USFS Completed Treatments (Acres)	415
USFS Treatments under Contract (Acres)	1,672
USFS Planned Treatments Remaining (Acres), (dependent on obtaining funding)	5,527

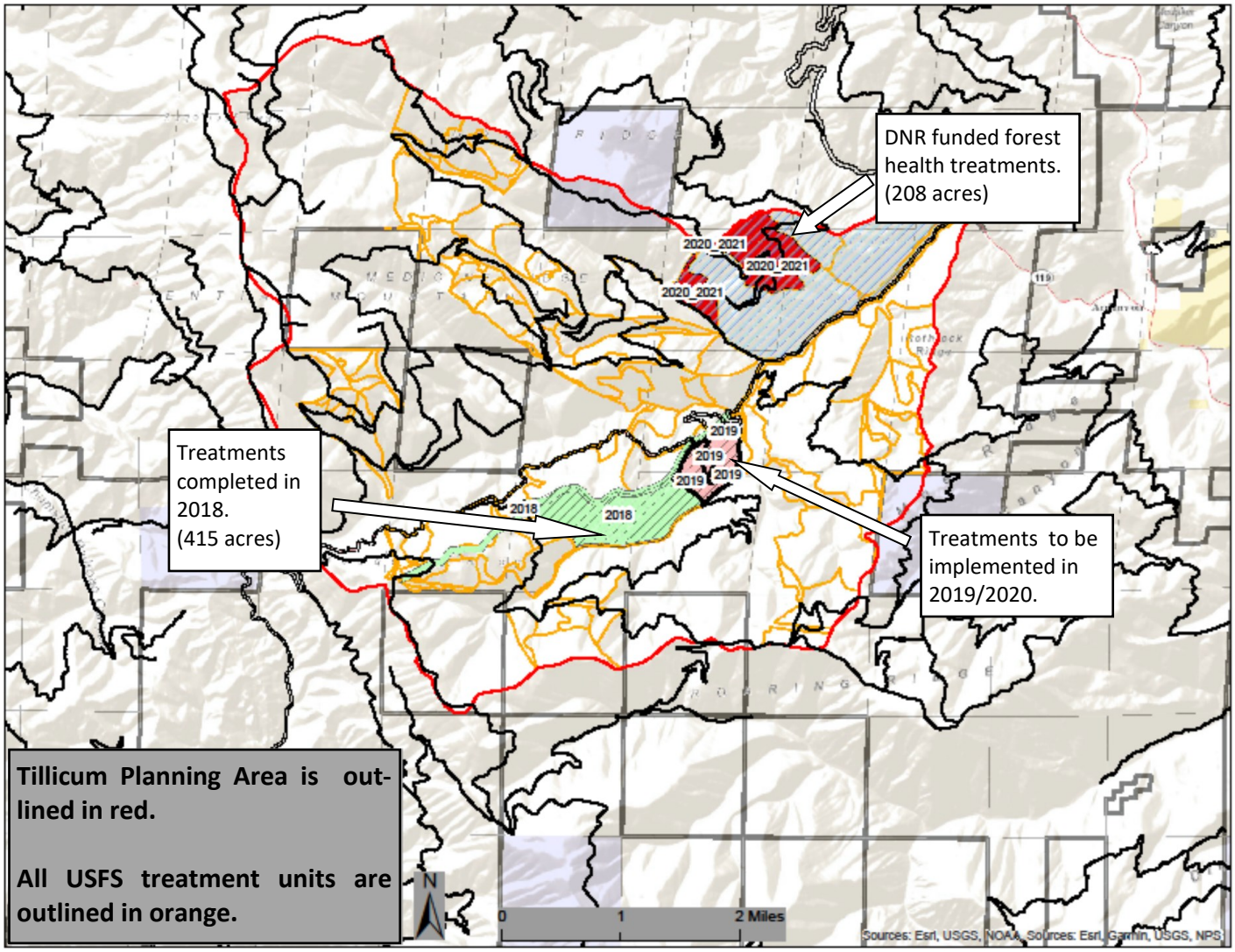
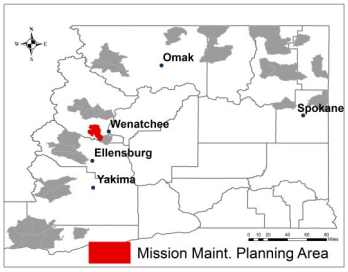


Figure 3. Map of Tillicum Planning Area (red outline) and Implemented and Planned US Forest Service Vegetation Treatments. *Adapted from a map by Aaron Rowe, USFS.*



Mission Maintenance Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres
49,121	37,924

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Mission Maintenance Planning Area is located near Mission Ridge, west and south of Wenatchee. The area is mostly forested, but there are also some grass and shrubland vegetation types in the lowland, northeastern areas closer to Wenatchee. Forestland is 64% US Forest Service, 34% private and industrial, and 3% DNR. (Figure 1). A landscape evaluation for the Mission Maintenance Planning Area has not been completed by the DNR, but the US Forest Service has planned 10,406 of fuel reduction treatments in the area as part of their Mission Maintenance Project.

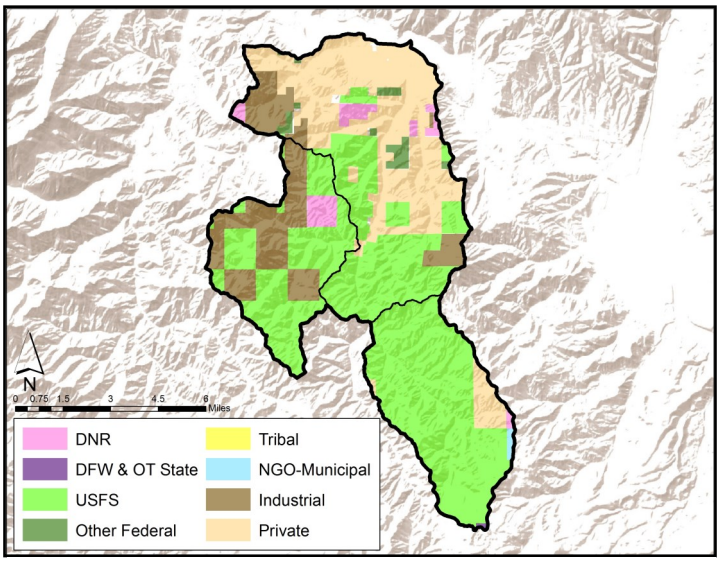


Figure 1. Forestland ownership in Mission Maintenance Planning Area.

20-Year Plan Landscape Goals:

- Reduce wildfire risk.
- Prepare for climate change (Figure 2).
- Sustain wildlife habitat.

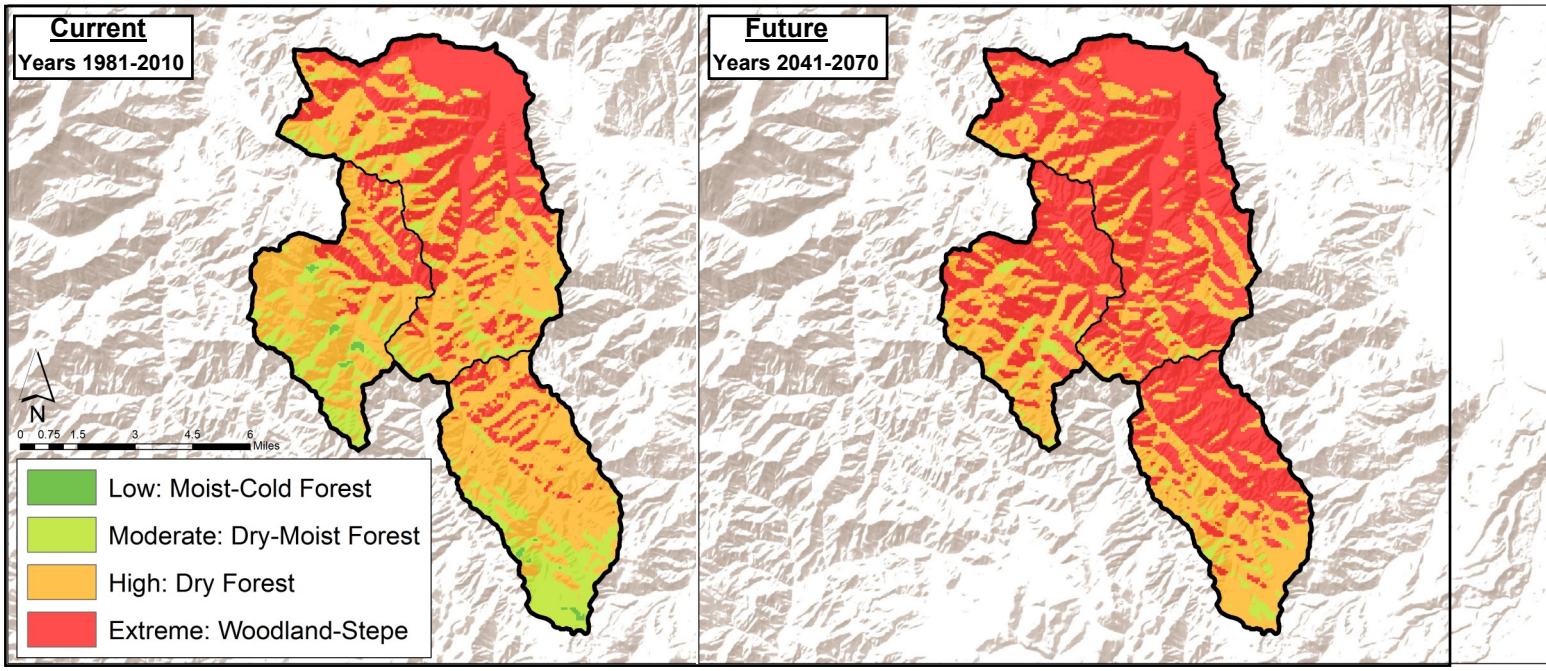


Figure 2. Current and future moisture deficit levels in Mission Maintenance Planning Area. Moisture deficit is a measure of water stress faced by plants. Projected warming trends will increase moisture stress and thus probability of wildfire and insect outbreaks. Treatments to reduce density and manage for drought-tolerant species on a large portion of current and future high deficit sites will help forests adapt to these changes.

Definitions (see Appendix for data sources and methods):
Dry: *Low to mid elevation ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-20 years.*
Moist: *Mid-elevation forests that historically had mixed severity fires and were dominated by Douglas-fir, western larch, and ponderosa pine, plus other fire-intolerant conifers.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.*

US Forest Service

Planned/Completed Treatments

The Okanogan Wenatchee National Forest (USFS) **planned 10,406 acres** of fuel reduction treatments on USFS land in the area as part of their Mission Maintenance Project.

The USFS planned a mix of treatments, including non-commercial forest thinning, tree pruning, vegetation pile burning and underburning using prescribed fire.

A total of 10,406 acres have forest health treatments planned on USFS managed lands in the area (Table 1). 1,978 acres of those are under contract and will be implemented in the near-term, while the remainder are ready to be implemented when a funding source arises.

Table 1. US Forest Service (USFS) forest health vegetation treatments, by acres, in the Mission Maintenance Planning Area. Treatments under contract are expected to be completed in the near-term.

Total Planned USFS Forest Health Treatments (Acres)	**10,406**
USFS Completed Treatments (Acres)	0
USFS Treatments under Contract (Acres)	1,978
USFS Planned Treatments Remaining (Acres) (dependent on obtaining funding)	8,428

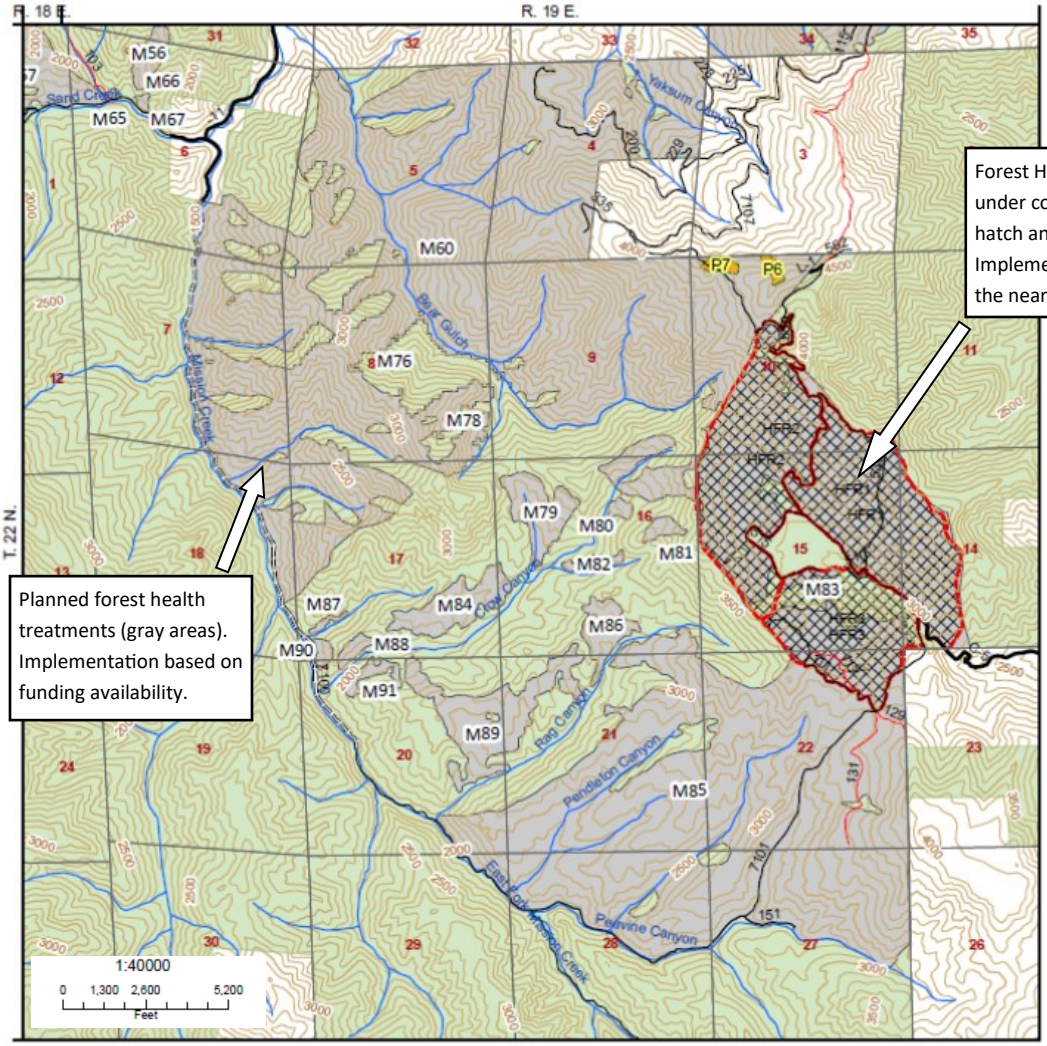
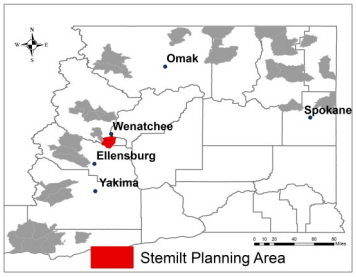


Figure 5. US Forest Service forest health vegetation treatment planning map. This map shows only a small subset of land base that the USFS has planned for forest health treatments in the Mission Maintenance planning area. Treatments under contract are expected to be completed in the near-term. Other treatment areas highlighted in grey are planned and ready for treatment when funding becomes available.



Stemilt/Squilchuck Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
38,960	24,886	9,200 - 13,600

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Stemilt/Squilchuck planning area **has high fire risk across much of the area**, although treatments that have been implemented over the last 20 years have lowered risk in a significant portion. Forest Service and Bureau of Land Management lands comprise 7%, WA Department of Natural Resources lands 14%, WA Department of Fish and Wildlife lands 12%, Chelan County lands 8%, and private land comprise 60% of the planning area. Considerable private lands with homes, agriculture, and other infrastructure exists. Based on 2017 current conditions, **treatments to shift forest structure on an estimated 9,200 – 13,600 acres would move the landscape into a resilient condition** and restore wildlife habitat. An additional 3,000 – 6,000 acres of maintenance treatments are also recommended. These treatments equate to about 26-32% of the forested acres.

20 Year Plan Landscape Goals

Overarching:

- Improve safety and fire protection for people and homes.
- Create and maintain open canopy forests with large early-seral trees that are resistant to drought, insects, diseases, and wildfire.
- Maintain the amount and restore the spatial pattern of dense, forest habitat for focal wildlife species and elk cover.
- Restore the abundance and spatial arrangement of large-old trees across the landscape.

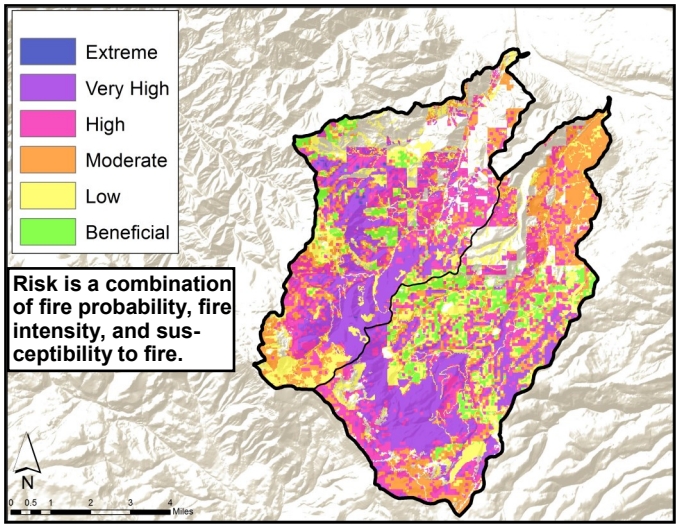


Figure 1. Wildfire risk to homes, infrastructure & forests.

Reduce wildfire risk:
Extensive treatments on public lands over the past 20 years have reduced wildfire risks. Many of these areas are predicted to burn low-intensity ground fires (Fig. 1), which will have beneficial effects by consuming fuels that have accumulated since treatment. However, risks are still high adjacent to private lands and in areas on private lands where homes are embedded in dense, dry forest with high fuels loads Treatments to create defensible space are important to reduce risks and create more sustainable forest conditions. On public lands, maintenance treatments in open-canopy areas are needed.

Prepare for climate change:
Projected warming will increase moisture stress and probability of wildfire and insect outbreaks. Moisture stress level currently associated with moist and cold forest types are projected to decrease considerably, while levels associated with dry forest are expected to increase (Fig. 2). Treatments that reduce tree density or maintain current open-canopy structure and restore early seral tree species will help forests adapt to these changes. Aggressively reducing density on future extreme deficit sites can help maintain forest cover on these sites for as long as possible.

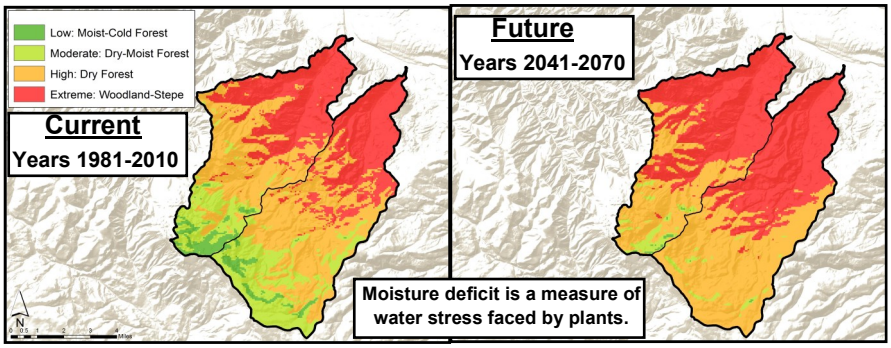


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:
Habitats for focal species could be enhanced throughout the planning area by treatments that restore large trees and enhance within-stand spatial variability. Habitats for species associated with open-canopy forests could be enhanced by creating larger and more contiguous patches. Habitat for wildlife species associated with closed-canopy forests could be enhanced by restoring and maintaining those habitats in future low and moderate deficit sites (e.g. north slopes and upper elevation areas).

Enhance rural economic development:
Reducing fire risk will help maintain recreational opportunities. A portion of the treatments are commercially viable and have good road access. Fuel reduction treatments around homes will require investments, but will provide significant work for local contractors. Long term timber production on DNR and private land is likely possible in the upper 1/3rd of the planning area if proactive strategies to shift species composition and manage for lower density are gradually adopted.

Definitions (see Appendix for data sources and methods):
Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

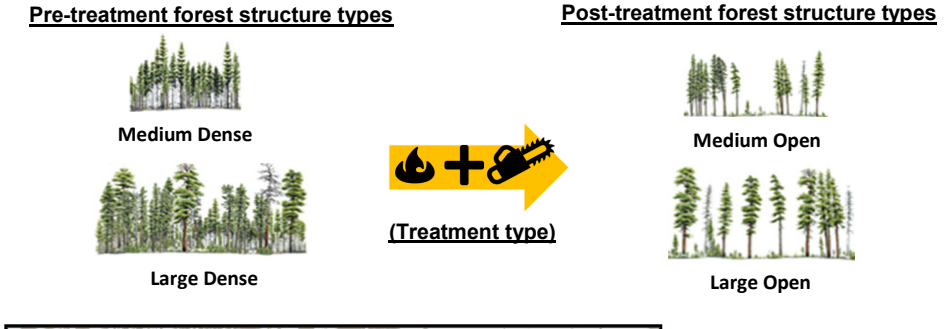
Treatment needs: Stemilt/Squilchuck Planning Area

Dry forest:

The Stemilt/Squilchuck planning area has received extensive treaments in the past 20 years that have created open, fire resistant conditions in a majority of the dry forest (Figs. 3 & 4). However, treating an additional 2,000 - 2,400 acres of dense, dry forest acres (Table 1) is recommended to further reduce fire risk and align forests with moisture stress levels. Increasing the amount of ponderosa pine cover type will also enhance drought and fire resistance. Large tree structure will develop over time. More aggressive density reduction is recommended in the lower portions of the planning area that will face increasing moisture stress over time.

Moist and Cold forest:

Treating 4,200-5,500 acres of cold forest is recommended to reduce the amount of dense, multistory forest. This will reduce risk of a large crown fire and help current cold forests adapt to a warming climate. Shifting species composition toward ponderosa pine is also recommended to increase fire, insect, and drought resistance. Moist forests are very limited in the planning area and do not need treatment.



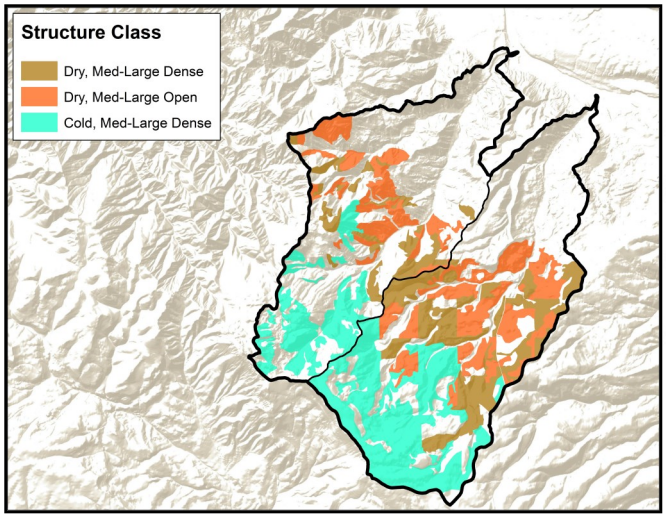


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated. (See Table 1).

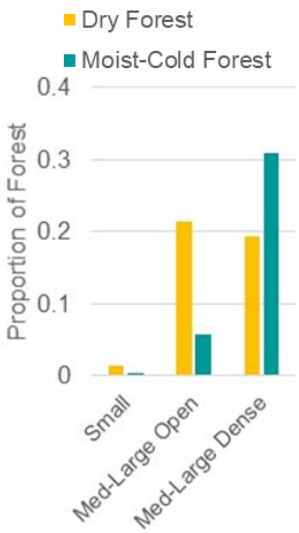
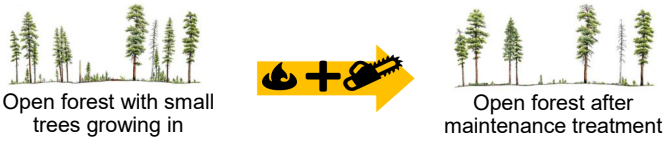


Figure 4. Proportion of forest and structure type.

Maintenance treatments: Approximately 3,000-5,700 acres of treatment (e.g., prescribed fire) in Dry Forest could occur in existing open forest habitats to maintain open forest conditions and promote the development of large tree structures.

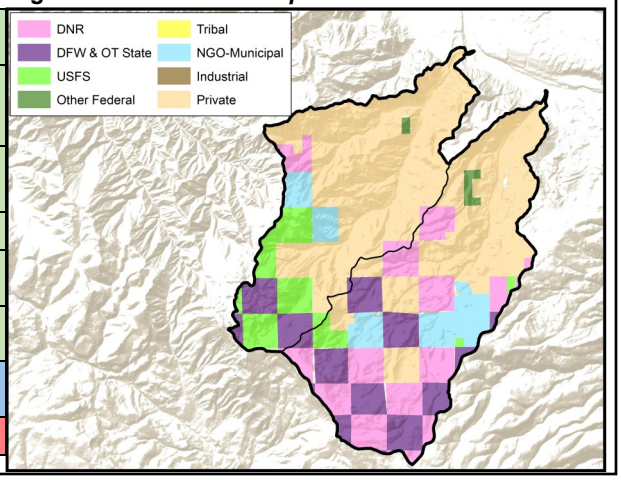


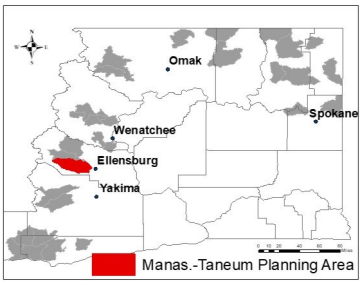
Overall treatment needs: There an estimated 9,200-13,600 acres of forest that could be treated to improve landscape resiliency, enhance forest health, restore wildlife habitats, and address forest fragmentation (Table 1). A combination of treatments will be needed to accomplish this goal, and may include commercial and non-commercial thinning, prescribed fire, regeneration harvests, and mechanical fuel reduction. Based on tree size class, many of the acres are commercially viable. However, road access, logging systems, habitat requirements, aquatic impacts, timber markets, and other considerations will determine treatment type. Maintenance treatments on 3,000-5,700 acres are also recommended. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and decision making processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals while meeting their own management objectives and regulatory requirements.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment Need Acres	Current Acres by Major Landowner*			
Forest Type	Structure Class		Private	State	County	USFS
Dry	Med-Large Dense	2,000 - 2,400	2,056	1,069	590	70
Dry	Med-Large Open	3,000 - 5,700	3,152	762	1,074	21
Moist-Cold	Med-Large Dense	4,200 - 5,500	1,565	1,575	219	1,289
Total Acres		9,200 - 13,600	*These are total current acres, not targets.			
Anticipated Treatment Type	Commerical thin + fuels treatment where possible. May be regeneration, non-commercial, or fire only.					
	Maintenance: prescribed fire or mechanical fuels treat.					

Figure 5. Land Ownership





Manastash-Taneum Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
98,277	68,140	16,500 - 29,500

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

This planning area encompasses the Manastash-Taneum Resilient Landscapes Project, which is a major focus of the Tapash collaborative. Forest land in the planning is owned by the WA Department of Fish and Wildlife (WDFW) (37%), Forest Service (38%), DNR (12%), Nature Conservancy (11%), and private (2%). Fire risk ranges from extreme in the western half to low in the eastern half. Treating an estimated 14,500-25,500 acres of dense forest is recommended to move the landscape into a resilient condition while also sustaining sufficient dense forest to help meet Late Successional Reserve objectives. Maintenance treatments on existing open forest is needed on 2,000-4,000 acres. In sum, treating 24-43% of the forested acres is recommended. These recommendations are based on WA DNR's update of a landscape evaluation completed by The Nature Conservancy and other project partners using 2012 current conditions data. The DFW and DNR have treated roughly 4,500 acres since 2016 and more treatments are planned. NEPA planning is underway for Forest Service land in the North Fork Taneum watershed with a decision expected in 2019. The planning area will be expanded in the 2020 planning cycle to include the South Fork Manastash Creek sub-watershed.

20 Year Plan Landscape Goals

Overarching:

- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component
- Maintain large tree, dense forest for wildlife in the least fire and drought prone areas.

Reduce wildfire risk:

Risk of a large crown fire is very high in the western half of the planning area (Fig. 1), due to both high fire probability (3 - 4% per year) and high fuel loading. Treatments on Forest Service land, as well as WDFW and DNR, are thus recommended. Not all high risk areas need to be treated, however, to significantly reduce overall risk. Farther east, much of the area is predicted to burn as low-intensity ground fires, which will have beneficial effects by consuming ground fuels. Some of this area has been recently treated. Significant risk to homes exists in the far eastern portion that is shrub steppe.

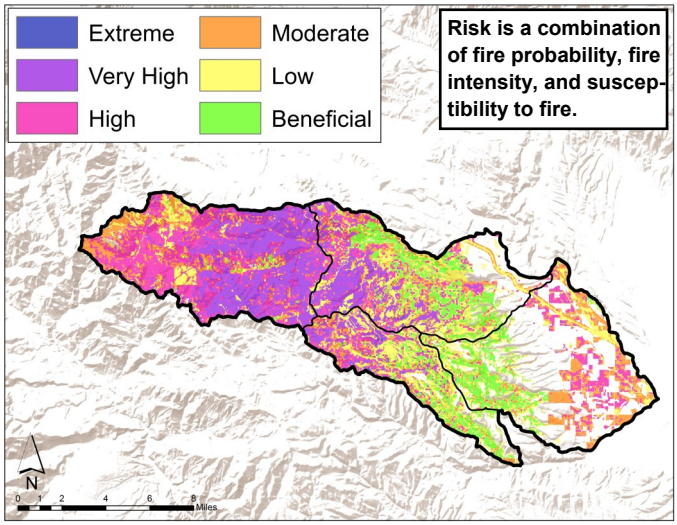


Figure 1. Wildfire risk to homes, infrastructure & forests.

Prepare for climate change:

Projected warming will increase moisture stress and probability of wildfire and insect outbreaks. By mid-century, 15% of the planning area is projected to have moisture stress levels currently associated with moist and cold forest vs. 35% today (Fig. 2). Treatments to reduce density and favor drought-tolerant species on current and projected future dry sites will help forests adapt.

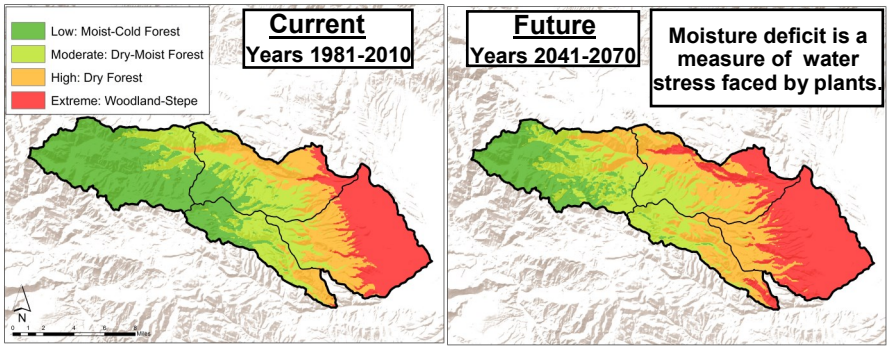


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:

Almost all of the Forest Service land is Late Successional Reserve (LSR), which is intended to sustain dense forest species, such as the Northern Spotted Owl. Yet risk of habitat loss from fire is very high. Thus treating a significant portion of the LSR is recommended to reduce risk. By creating a mosaic of large dense and open patches with large trees, treatments can reduce long term risk of habitat loss by slowing spread of crown fires and providing patches of replacement habitat. Dry-forest dependent species, such as the white headed woodpecker, can benefit from treatments on dry sites if habitat considerations are incorporated.

Enhance rural economic development:

Reducing fire risk will help maintain recreational values. Much of the potential treatment area is likely to be commercially viable and could produce meaningful volume for existing or new wood processing facilities. However, a significant portion of Forest Service and WDFW land lacks road access or is small diameter. Thus investments in non-commercial and fire only treatments will be needed.

Definitions (see Appendix for data sources and methods):

Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: Manastash-Taneum Planning Area

Dry forest:
Treating 7,000 - 13,000 acres of dense, dry forest acres (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by large patches of dense forest to open forest conditions (Fig. 4). The highest priority treatments are on sites with high fire risk and high current and future drought stress. These are located mostly in the eastern half of the project area. Treatments in medium and small diameter forest are needed.

Moist and Cold forest:
Treating 7,500-12,500 acres of dense, moist, and a small amount of cold, forest acres is recommended to break up the very large patch of dense forest in order to reduce the risk of a large crown fire. Density reduction and shifting species composition will also help forests adapt to a warming climate. Treatment location should focus on south facing slopes and areas projected to have low to moderate moisture stress in the future. If a fire burns up existing large-tree, dense forest, treated areas can be left to develop into and replace this important habitat. The recommended treatments include 2,000-3,500 acres of small diameter forest, mostly on TNC land in the far west.

Pre-treatment forest structure types

Medium Dense

(Treatment type)

Post-treatment forest structure types

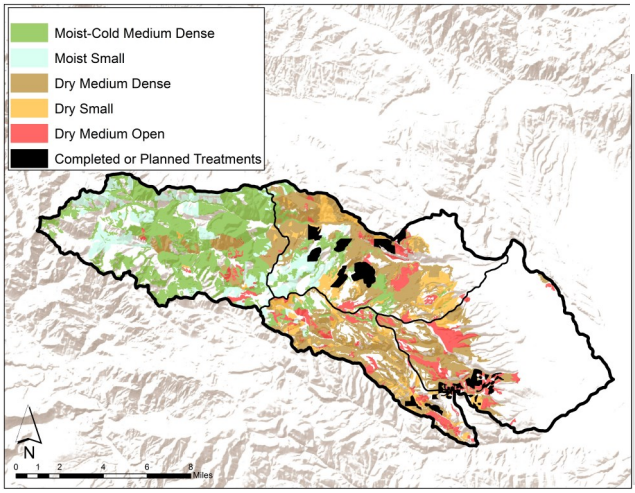


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated (See Table 1).

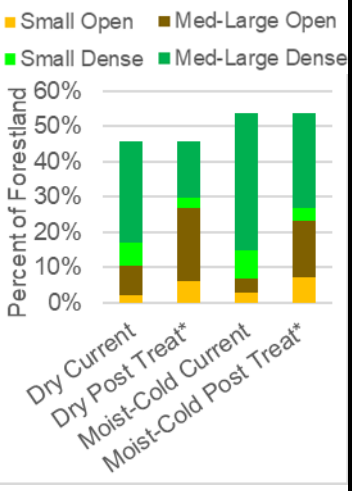
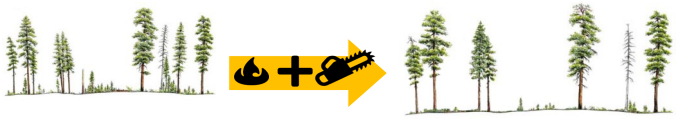


Figure 4. Current & post treatment percent of forest types.
****mid-point of treatment range***

Maintenance treatments: A portion of existing open forests need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. An estimated 2,000 - 4,000 of treatments are currently recommended.



Open forest with small trees growing in

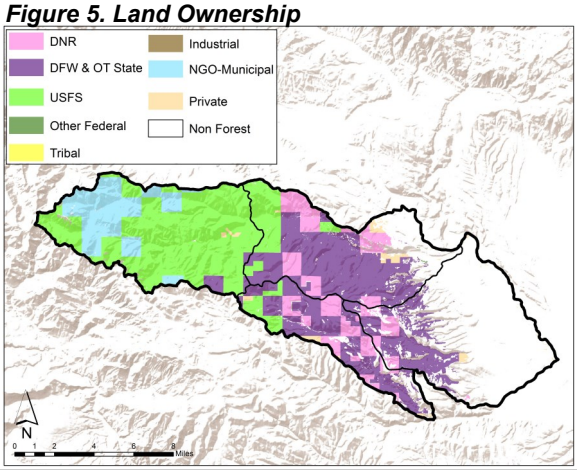
Open forest after maintenance treatment

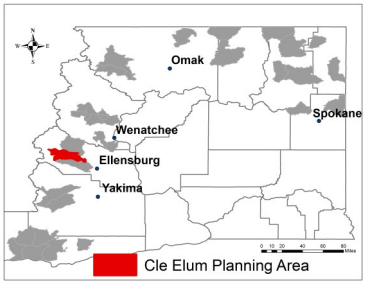
Overall treatment needs: Shifting an estimated 14,500 to 25,500 acres from dense to open forest is recommended (Table 1). A combination of treatments will be needed to accomplish this treatment goal, including commercial and non-commercial thinning, prescribed fire, regeneration harvests and managed wildfire. Based on tree size class, many acres are commercially viable. However, road access, logging systems, aquatic impacts, habitat issues, timber markets and other factors will determine treatment type. Maintenance treatments on 500-2,000 acres are also recommended. Individual landowners (Fig. 5), including the US Forest Service, will conduct their own planning and decision-making processes to determine acres and types of treatments they can implement to meet overall landscape goals while achieving their own legal mandates and management objectives. WDFW and DNR have completed roughly 4,500 acres of treatments and more are planned for 2019 – 2021.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment	Current Acres by Major Landower*			
Type	Size Class	Need Acres	USFS	DFW	DNR	TNC
Dry Dense	Small	1500-3000	399	3614	1150	0
	Medium	5500-10000	4205	9120	3455	8
Moist-Cold Dense	Small	2000-3500	1393	1183	340	2675
	Medium	5500-9000	12341	1929	295	1600
Dry Open	Medium-Large	2000-4000	586	3326	928	0
Total		**16,500 - 29,500**	*These are current acres, not targets			
Anticipated Treatment Type		Non-commerical thin + fuels treatment, may be fire only				
		Commerical thin + fuels treatment where possible. May be non-commercial, fire only, or regeneration harvest				
		Maintenance: prescribed fire or mechanical fuels treatment				

Figure 5. Land Ownership





Cle Elum Planning Area
Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
89,479	66,811	18,000 - 28,500

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Cle Elum planning area combines **high fire risk along the northern and southern ridges** with extensive development in the valley and foothills. Ownership of forestland is dominated by small private landowners (56%), along with Forest Service (19%), the Nature Conservancy (14%), and the DNR (8%). Based on current conditions data from 2017, **treating an estimated 15,500 - 23,000 acres of dense forest is recommended** to reduce fire risk to communities and move the move the landscape into a resilient condition. Community wildfire preparedness efforts are currently scaling up to address the large need to treat parcels with homes. Creating additional defensible space on Nature Conservancy, USFS, and undeveloped private land near communities is also a priority. Maintenance treatments on existing open forest are needed on 2,500-5,500 acres. **In sum, treating 27-43% of the forested acres is recommended.** This planning area will be expanded to include the Cle Elum Lake watershed in the 2020 planning cycle.

20 Year Plan Landscape Goals

Overarching:

- Improve safety and fire protection for people and homes.
- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component.
- Maintain large tree, dense forest in the least fire and drought prone areas to sustain dense forest dependent wildlife species.

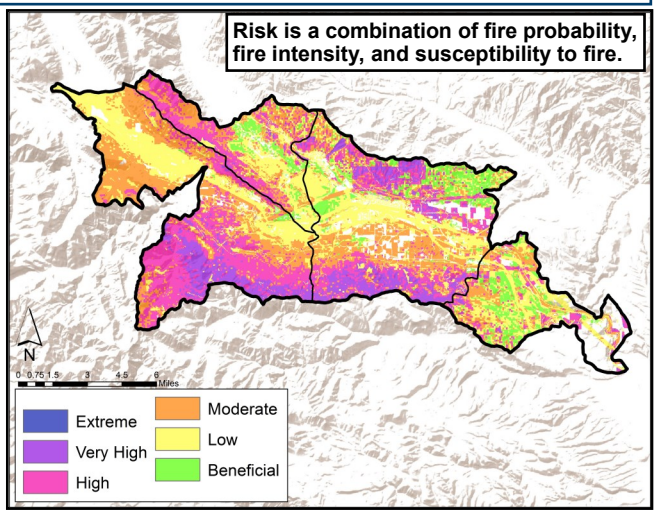


Figure 1. Wildfire risk to homes, infrastructure & forests.

Reduce wildfire risk:
Fire risk is high to very high along most of the northern and southern ridges that encompass the valley (Fig. 1). As fires are most likely to come from the north, the highest priority treatments are on the lower to upper slopes of Cle Elum ridge (northern ridge), and along the lower to mid slopes of the southern ridge. In the central part of the valley, the agricultural lands and extensive floodplain forests along the Yakima river provide a natural fire break. Treatments to reduce fire risk are low priority along the north facing, upper slopes of the southern ridge, where dense forest is sustainable. Some areas are predicted to burn as low-intensity ground fires, which will have beneficial effects by consuming fuels. Most of these areas are recently treated areas on DNR and private land.

Prepare for climate change:
Projected warming will increase moisture stress and thus probability of wildfire and insect outbreaks. By mid-century, 45% of the planning area is projected to have moisture stress levels currently associated with woodland and shrub-steppe (Fig. 2). Treatments to aggressively reduce density and shift to drought-tolerant species on currently high, and future extreme, deficit areas will help maintain forest cover on sites for as long as possible.

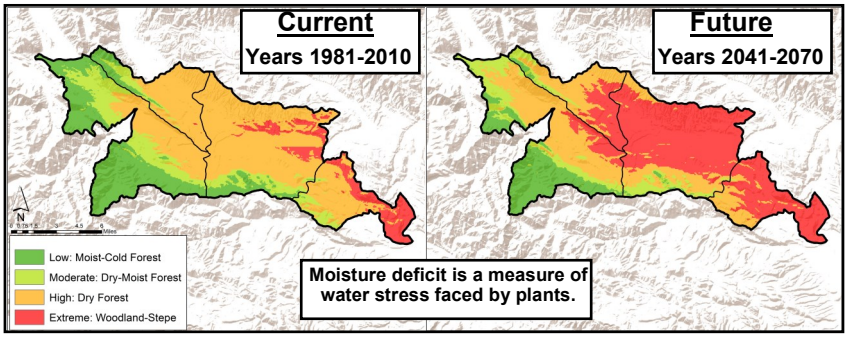


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:
Large patches of white headed wood pecker habitat exist on the south facing slopes of Cle Elum Ridge and in the far eastern portion the planning area. Treatments on dry sites will increase this habitat if prescriptions incorporate habitat considerations. Habitat for moderate to closed canopy dependent species exists on north facing slopes of the southern ridge and in the northwest corner. Treatments are not recommended in most of this area. Fires that burn at characteristic severity in all forest types can benefit habitat by creating snags and stimulating higher understory plant abundance and diversity.

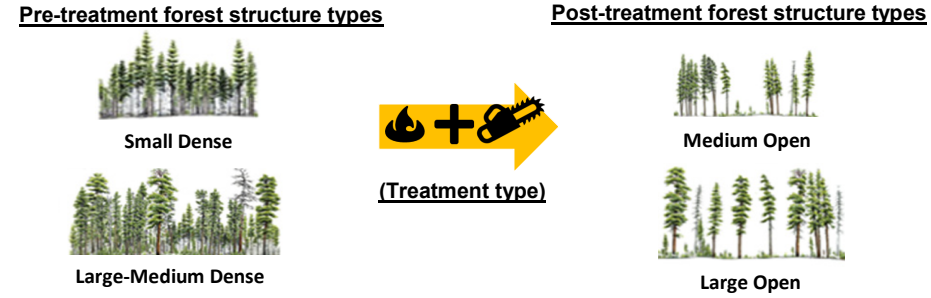
Enhance rural economic development:
Reducing fire risk will help maintain recreational opportunities and associated economic activity. Commercial treatments are possible on many of the recommended acres. However, the small size of many parcels, the high number of vacation homes, and limited road access on Forest Service land make commercial treatments difficult in many areas. Non-commercial treatments will require major investments and will provide a major source of work for local contractors. Warming trends will make it increasingly difficult to sustain long term timber production in the eastern and northern portions of the planning area.

Definitions (see Appendix for data sources and methods):
Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: Cle Elum Planning Area

Dry forest:
Treating 8,000 - 11,000 acres of dense, dry forest acres (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by dense conditions to open forest (Fig. 4. Extensive firewise treatments on parcels with homes are the highest priority. On public and private forestland without homes, creating larger patches of open canopy, fire resistant forest will reduce the current fragmentation of the dry forest area and facilitate fire protection for communities. The priority treatments are on the north and south slopes of the valley to create defensible space zones.

Moist and Cold forest:
Treating 7,500-12,000 acres of dense, moist and cold forest is recommended to break up large patches of dense, multistory forest. This will reduce risk of a large crown fire and help current moist forests adapt to a warming climate. Shifting species composition toward ponderosa pine and wester larch is also recommended to increase fire, insect, and drought resistance. Treatments in large, medium and small diameter forest are needed. Post treatment, more than 1/2 of moist and cold forest will still be in a dense condition, leaving sufficient buffer for when characteristic fires burn dense forest habitat.



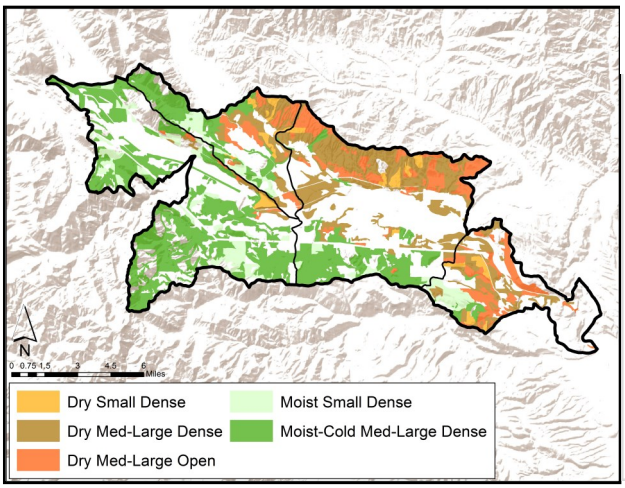


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated. See Table 1.

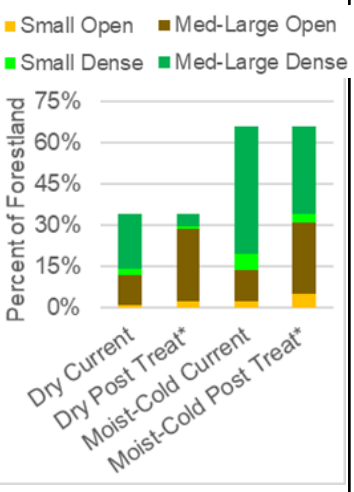


Figure 4. Current & post treatment percent of forest types.
**** mid-point of treatment range***

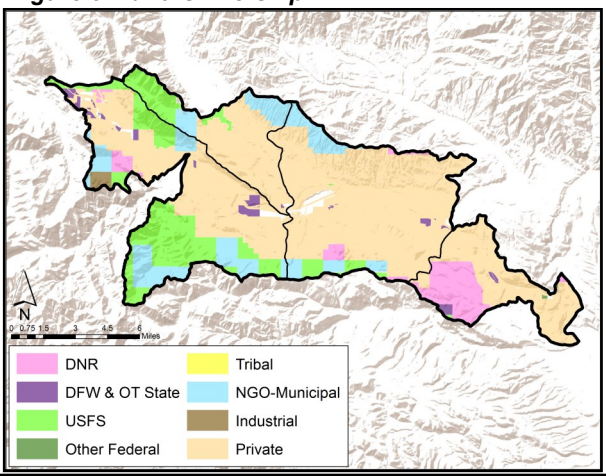
Maintenance treatments: A portion of existing open forests on dry sites need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. An estimated 2,500 - 5,500 acres of treatments is currently recommended. Many of these areas have been recently treated, but will fill in over the next 10-15 years.

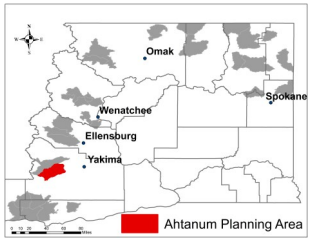
Overall treatment needs: Treating an estimated 15,500 to 23,000 acres of dense forest is recommended (Table 1). A combination of treatments will be needed to accomplish this goal, and may include commercial and non-commercial thinning, prescribed fire, regeneration harvests, and mechanical fuel reduction. Based on tree size class, many of the acres are commercially viable. However, road access, logging systems, habitat requirements, aquatic impacts, timber markets, and other considerations will determine treatment type. Maintenance treatments on 2,500-6,000 acres are also recommended. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and decision making processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals while meeting their own management objectives and regulatory requirements.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment	Current Acres by Major			
Type	Size Class	Need Acres	Private	USFS	TNC	DNR
Dry Dense	Small	500-1000	1224	5	172	229
	Medium-Large	7500-10000	10448	107	1499	729
Moist-Cold Dense	Small	1000-2000	1100	654	1973	776
	Medium-Large	6500-10000	9936	8786	3310	1322
Dry Open	Medium-Large	2500-5500	3637	80	1320	1099
Total		**18,000 - 28,500**	*These are current acres, not targets			
Anticipated Treatment Type	Non-commerical thin + fuels treatment, may be fire only					
	Commerical thin + fuels treatment where possible. May be non-commercial, fire only, or regeneration harvest					
	Maintenance: prescribed fire or mechanical fuels treatment					

Figure 5. Land Ownership





Ahtanum Planning Area
Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
120,497	104,855	19,000 – 29,000

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Ahtanum planning area has moderate to low risk of uncharacteristically large fires in most locations. DNR trustlands and Yakama Nation land occupy 86% of this planning area. Private land with homes covers a small portion of the area in several canyons in the eastern portion. Based on current conditions data from 2015, **shifting an estimated 13,000– 16,700 acres from dense to open forest is recommended** to the move the landscape into a resilient condition, while maintaining 28-40% of the overall landscape in dense forest to provide for habitat, wood production, and carbon storage. Maintenance treatments in existing open forest are needed on an estimated 4,000-8,000 acres. **In sum, treating 18-28% of the forested acres is recommended.**

20 Year Plan Landscape Goals

Overarching:

- Improve safety and fire protection for people and homes.
- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component
- Meet DNR habitat requirements for the northern spotted owl.
- Maintain wood production objectives on DNR and Yakama Nation.

Reduce wildfire risk:

Fire risk is very high on north facing slopes with dense conditions, as well as around homes in several eastern canyons. Predicted fire probability gradually increases from 0.2 % per year in the southwestern end to 2% per year in the northeastern corner. The highest priority treatments are on private parcels with homes in Cowiche Canyon and the north fork of Ahtanum Creek. In addition, treating a portion of dense forests and reducing ground fuels will increase fire resistance in the remainder of the planning area. Much of the eastern half is predicted to burn as low-intensity ground fires, which will have beneficial effects by consuming fuels. DNR has treated a large percentage of its land in the area.

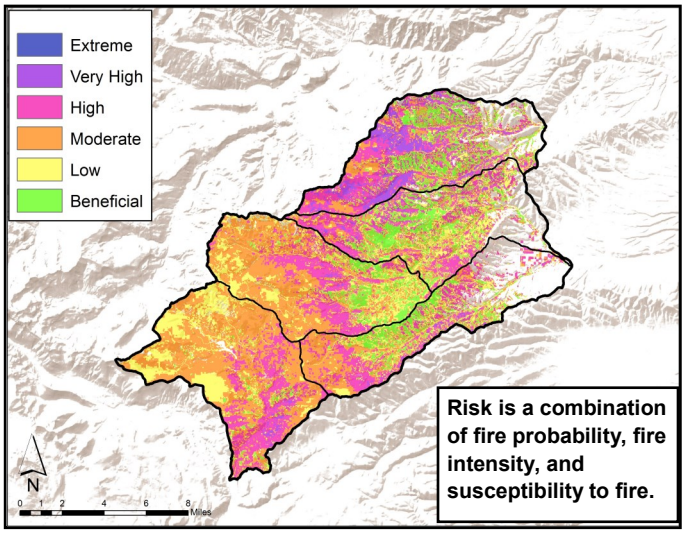


Figure 1. Wildfire risk to homes, infrastructure & forests.

Prepare for climate change:

Projected warming will increase moisture stress and probability of wildfire and insect outbreaks. By mid-century, most of the western half of Ahtanum is projected to have moisture stress levels currently associated with dry forest (Fig. 2), while levels associated with woodland and grassland will increase in the eastern half. Treatments to reduce density and manage for fire and drought-tolerant species will help forests adapt and maintain forest cover on drier sites for as long as possible.

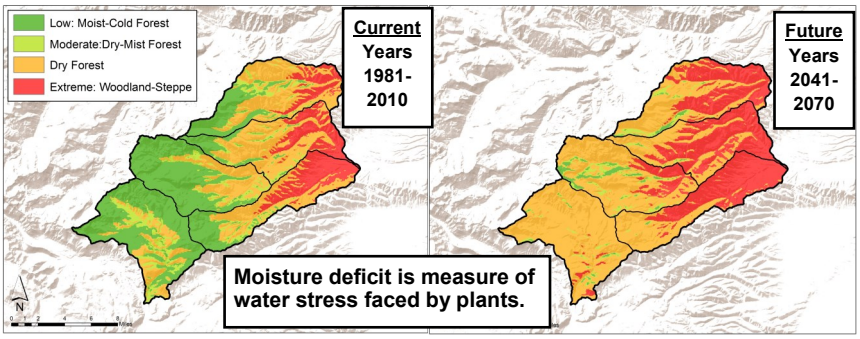


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:

Maintaining dispersal habitat for the Northern Spotted Owl on 50% of DNR land is needed to meet the DNR's Habitat Conservation Plan (HCP). Treatments that retain 40-60 trees per acre, consistent with the HCP, can maintain dispersal habitat functionality while also lowering risks from fire and drought. Treatments on dry sites can increase habitat and patch size for open canopy dependent species, such as the white headed woodpecker, if prescriptions incorporate habitat considerations. Fires that burn at characteristic severity in all forest types can benefit habitat by creating snags and stimulating higher understory plant abundance and diversity.

Enhance rural economic development:

Treatments that reduce fire risk will reduce potential losses to timber on DNR trustlands and Yakama Nation lands. Long term timber production will likely be possible in the western half of planning area if proactive strategies to shift species composition and manage for lower density are adopted over time.

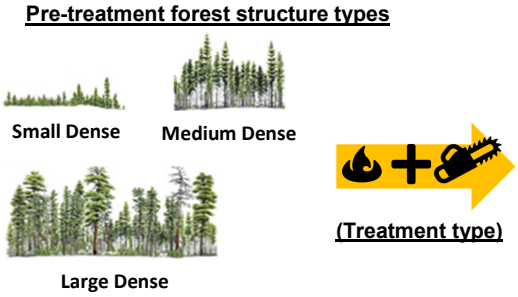
Definitions (see appendix for data sources and methods):

Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment needs: Ahtanum Planning Area

Dry forests:
Treating 13,000 - 16,600 acres of dense, forest on dry sites (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by dense forest to open forest (Fig. 4). This can be done while meeting DNR HCP habitat objectives for dispersal habitat. Treatments in small to large size classes are needed. Large-tree forests, which are under-represented on the landscape, can then develop over time and make the landscape more resilient to wildfires. More aggressive density reduction is recommended in the eastern portion of the planning area that will face increasing moisture stress over time.

Cold and moist forests:
Treating 2,000-4,400 acres of dense, moist and cold forest is recommended. Thinning treatments will accelerate the development of large-tree structure, which will increase resilience to fire and is underrepresented (Fig. 4). On south facing slopes and other drier sites, managing for some moderate and open large-tree forests with drought tolerant species will help prepare these forests for a warming climate. Regeneration harvests may be needed to convert to these species and to meet economic goals. Post treatment, approximately 45-50% of the moist and cold forest would remain dense.



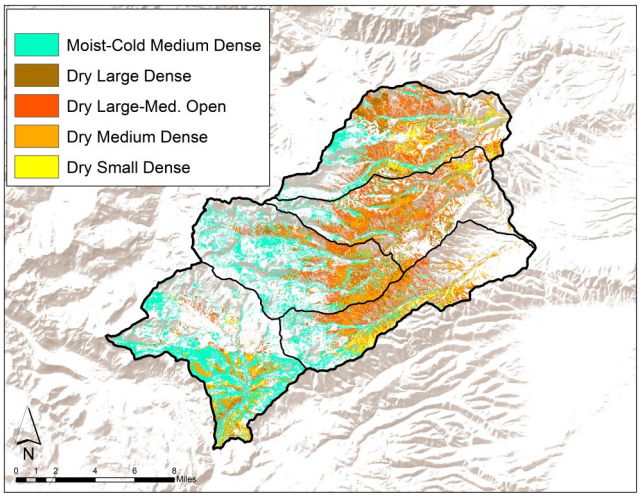


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated. (See Table 1).

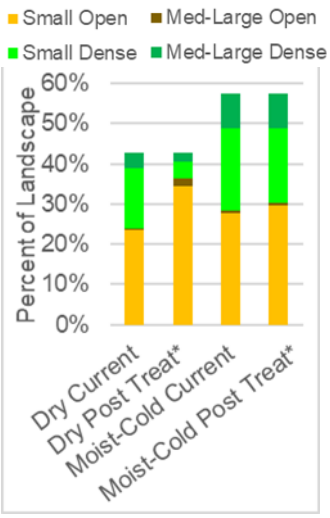
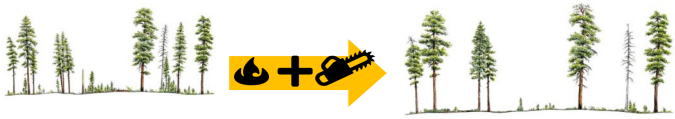


Figure 4. Current & post treatment percent of forest types.
**** mid-point of treatment range***

Maintenance treatments: An estimated 4,000-8,000 acres of existing open forests need prescribed fire or mechanical treatments to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. These areas can still be managed for wood production over time.



Open forest with small trees growing in

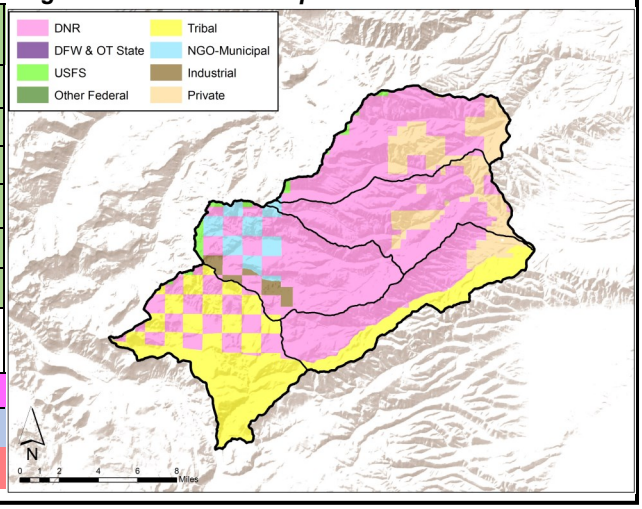
Open forest after maintenance treatment

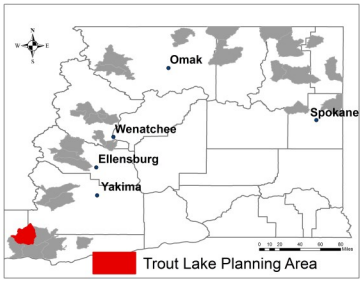
Overall treatment needs: Treating an estimated 15,000 to 21,000 is recommended, in addition to 4,000 to 8,000 acres of maintenance treatments. A combination of treatments will be needed to accomplish this goal, including commercial and non-commercial thinning, prescribed fire, regeneration harvests and managed wildfire. Based on tree size class, many of the acres are commercially viable. However, road access, logging systems, habitat requirements, aquatic impacts, timber markets, and other considerations will determine treatment type. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and decision making processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment Need Acres	Current Acres by Major Landowner*		
Forest Type	Structure Class		DNR	Tribal	Private
Dry	Small Dense	2,000-2,600	290	1,475	958
	Medium Dense	9,500-11,800	8,044	2,953	1,867
	Large Dense	1,500-2,200	3,102	433	238
Moist-Cold	Medium-Dense	2,000-4,400	8,482	6,511	478
Dry	Large-Med. Open	4,000-8,000	9,375	819	1,696
Total Acres		**19,000-29,000**	*These are total current acres, not targets		
Anticipated Treatment Type	Non-commercial thin + fuels treatment				
	Commercial thin + fuels treatment (may be regen harvest)				
	Maintenance: Rx fire or mechanical fuels treatment				

Figure 5. Land Ownership.





Trout Lake Planning Area
Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
117,153	106,971	18,500 - 33,000

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The Trout Lake planning area is dominated by large patches of dense forest in the central and southern portions that create high to moderate fire risk. Ownership of forestland is dominated by US Forest Service (61%), as well as DNR (16%), private industrial (14%), and small private (10%). Based on current conditions data from 2015 and 2016, **shifting an estimated 17,500 - 31,000 acres from dense to open forest is recommended** to move the landscape into a resilient condition while maintaining 52-64% of the landscape in dense forest to provide for habitat, wood production, and carbon storage. Maintenance treatments on existing open forest are needed on an estimated 1,000-2,000 acres. In sum, treating 17-31% of the forested acres is recommended. The US Forest Service has two signed NEPA decisions (Upper White and Coyote) that they are currently implementing. Upper White contains 7,071 acres of planned treatments. Coyote contains 4,763 acres of treatments, most of which are under contract and about 20% completed.

20-Year Plan Landscape Goals

Overarching:

- Increase safety and fire protection for homes and communities.
- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component.
- Maintain sufficient large tree, dense forest to meet DNR and Forest Service habitat needs for the Northern Spotted Owl.
- Maintain recreational values around Mt Adams and other areas.

Reduce wildfire risk:

Risk to structures and forests is moderate to high in most of the planning area (Fig 1). Predicted fire probability is low to moderate (0.5– 1.5% per year) in most areas, and low (0.1 - 0.5% per year) in western, upper elevation on the slopes of Mt Adams. When a large fire does occur, however, fire intensity is predicted to be high to extreme in most areas due to dense conditions and high fuel loading. Thus treatments are first recommended on public land near homes and private parcels to reduce risk and improve safety. In addition, treatments on DNR and Forest Service that shift some dense forest to open forest, along with treating fuels, will reduce the likelihood of a large crown fire that would impact habitat and recreational values. Not all dense forest needs to be treated to reduce overall risk, however.

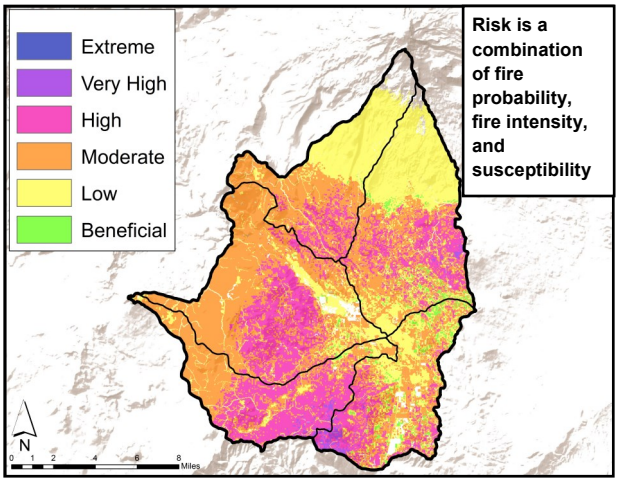


Figure 1. Wildfire risk to homes, infrastructure & forests.

Prepare for climate change:

Projected warming will increase moisture stress and probability of wildfire and insect outbreaks. By mid-century, 55% of the planning area is projected to have moisture stress levels currently associated with dry forest vs 15% today (Fig. 2). Treatments to reduce density and favor drought-tolerant species on a large portion of current and future high deficit sites will help forests adapt to these changes.

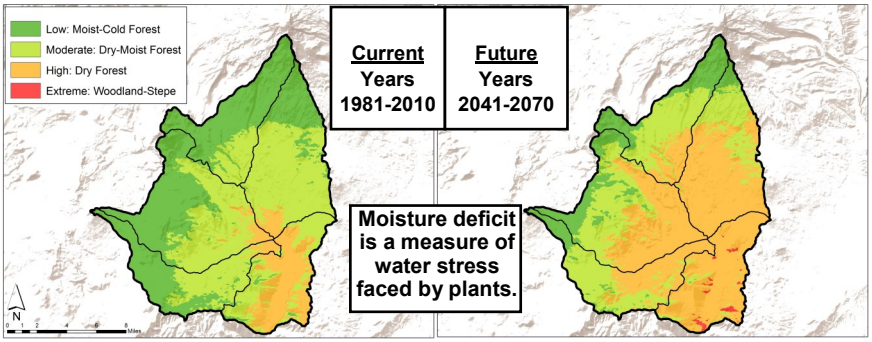


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:

Maintaining large tree, dense forest is necessary to meet the requirements of the DNR's Habitat Conservation Plan (HCP), as well as Late Successional Reserve objectives on Forest Service land. Treating the portion not required by the HCP to be sustained as habitat or identified to attain habitat, can reduce risk of high severity fire for the whole landscape. When consistent with the HCP, lighter, variable density thinning in mid-sized stands can accelerate habitat development while reducing fire and drought risk somewhat. Treatments on dry sites can increase habitat for open canopy dependent species if prescriptions incorporate habitat considerations. Fires in all forest types can benefit habitat by creating snags and higher understory plant abundance and diversity.

Enhance rural economic development:

Reducing fire risk will help maintain recreational opportunities and tourism. Many of the potential treatment areas have road access, are commercially viable, and have the potential to provide meaningful volume for wood processing mills. This area will likely be able to support long term timber production on private and DNR land if proactive strategies to shift species composition and manage for lower density are adopted over time.

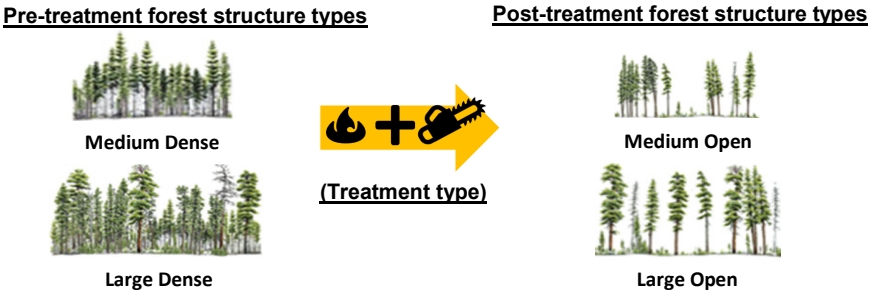
Definitions (see Appendix for data sources and methods):

Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: Trout Lake Planning Area

Dry forest:
Treating 9,000 - 11,500 acres of dense, forest on dry sites (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by dense forest to open forest when consistent with HCP habitat objectives (Fig. 4). Approximately 35% of the existing dry forest would remain dense to meet habitat objectives, however, and can be maintained in larger patches. The highest priority treatments are on DNR and private land in the southeastern portion of the planning area near homes. Large tree structure exists on much of the DNR land, and can be shifted to more fire and drought resistant forest by thinning smaller trees and treating ground fuels.

Moist and Cold forest:
Treating 8,500-19,500 acres of dense, moist and cold forest is recommended in the western half of the planning area to reduce risk of a large crown fire and help forests adapt to a warming climate. Shifting species composition towards fire and drought tolerant species is also needed when consistent with habitat objectives. Post treatment, approximately 2/3rds of moist and cold forest area would remain dense leaving sufficient buffer for when characteristic, mixed and high severity fires burn these areas. Areas with projected future low and moderate moisture deficit (Fig. 2) offer the most sustainable locations for large tree, dense forest.



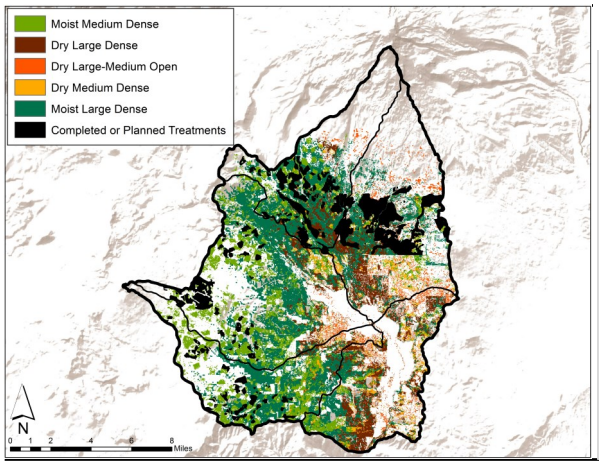


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated, see Table 1.

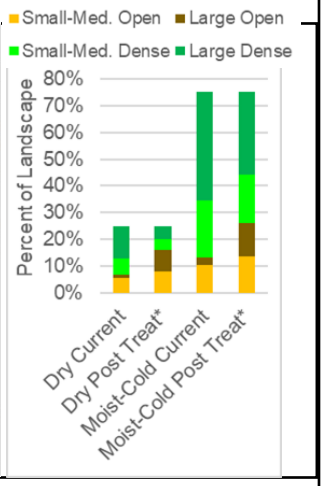
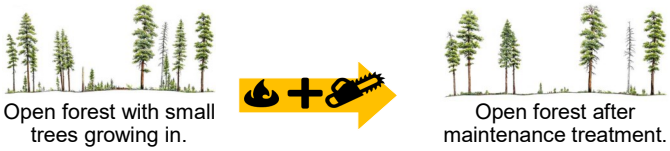


Figure 4. Current & post treatment percent of forest types. *mid-point of treatment range.

Maintenance treatments: A portion of existing open forests on dry sites need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. An estimated 1,000-2,000 of treatments is currently recommended.

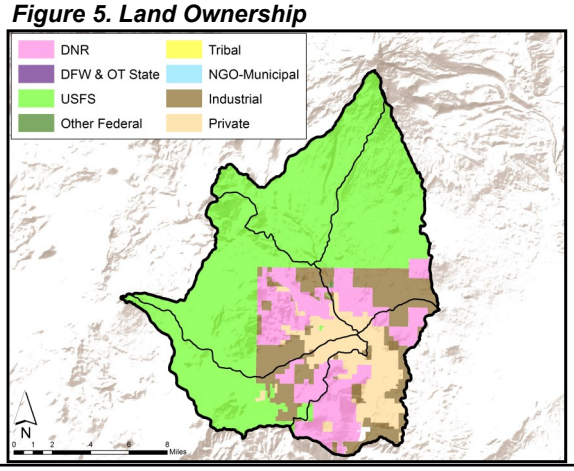


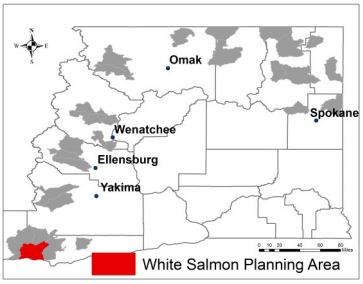
Overall treatment needs: Shifting an estimated **17,500 - 31,000** acres from dense to open forest is recommended (Table 1). A combination of treatments will be needed to accomplish this goal, and may include commercial and non-commercial thinning, prescribed fire, regeneration harvests, mechanical fuel reduction, and managed wildland fire use. Based on tree size class, many of the acres are commercially viable. However, road access, logging systems, habitat requirements, aquatic impacts, timber markets, and other considerations will determine treatment type. Maintenance treatments on 1,000-2,000 acres are also recommended. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and regulatory processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals while meeting their own management objectives and regulatory requirements. The US Forest Service has 11,834 of planned treatments that are part of Upper White and Coyote projects.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment	Current Acres by Major			
Type	Size Class	Need Acres	USFS	DNR	Industrial	Private
Dry Dense	Medium	2000-2500	545	580	1467	589
	Large	7000-9000	3742	4291	1307	1200
Moist Dense	Medium	1500-5500	11441	1965	2779	324
	Large	7000-14000	17329	6571	2369	647
Dry Open	Large-Medium	1000-2000	867	303	1211	949
Total		**18,500 - 33,000**	*These are current acres, not targets			
Anticipated Treatment Type		Commerical + fuels treatment where possible. May also be non-commercial, fire only, or regeneration harvest				
		Maintenance: prescribed fire or mechanical fuels treatment				

Figure 5. Land Ownership





White Salmon Planning Area Landscape Evaluation Summary

Total Acres	Forested Acres	Treatment Goal (Acres)
126,688	109,636	38,000 - 55,000

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Landscape Highlights

The White Salmon planning area is dominated by dense dry forest that is interspersed with recent harvests, agricultural lands, and non-forest patches. Fire risk ranges from low to extreme and is moderate to high near White Salmon and other areas with homes. Ownership is highly fragmented and is dominated by private industrial (36%), small private (33%), and DNR (24%), as well as a small amount of Columbia River Gorge Scenic Area that is managed by the Forest Service (6%). Based on current conditions data from 2015 and 2016, **shifting an estimated 35,500 - 49,000 acres from dense to open forest is recommended** to move the landscape into a resilient condition while maintaining 28-40% of the overall landscape in dense forest to provide for wood production, habitat, and carbon storage. Maintenance treatments on existing open forest are needed on an estimated 2,500-6,000 acres. In sum, treating 35-50% of the forested acres is recommended.

20 Year Plan Landscape Goals

Overarching:

- Increase safety and fire protection for homes and communities.
- Increase resilience to drought and wildfire by creating open canopy forest with resistant tree species and a large tree component
- Meet DNR habitat requirements for the northern spotted owl.
- Maintain wood production objectives on private and DNR land.

Reduce wildfire risk:

Fire risk to forests, homes, and infrastructure is high to extreme in the northwest and east-central portions of the planning area and moderate to low elsewhere (Fig 1). This is primarily due to differences in predicted fire probability, which ranges from 1-2% per year in higher risk areas and 0.1- 0.8% in moderate and low risk areas. When a large fire does occur, however, fire intensity is predicted to be high to extreme in many areas, including on most parcels with homes and to the east of White Salmon. The highest priority treatments are thus on private land near homes and communities. Away from communities, treatments are needed in dense forest to reduce the likelihood of a large crown fire. Some recently treated areas are predicted to burn as low-intensity ground fires, which will have beneficial effects by consuming fuels.

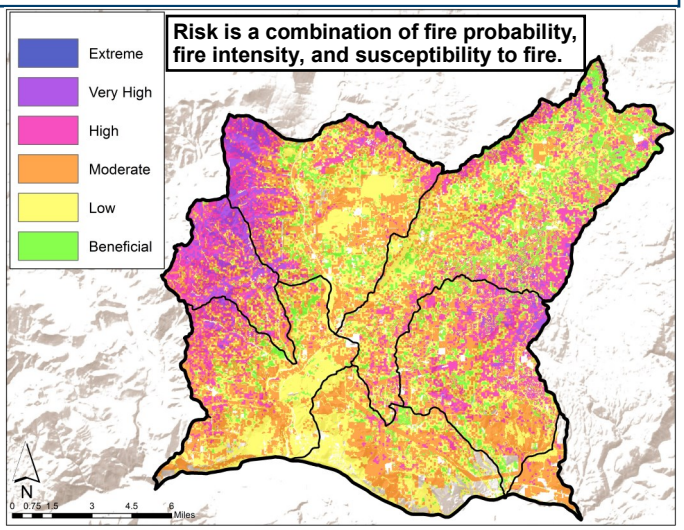


Figure 1. Wildfire risk to homes, infrastructure & forests.

Prepare for climate change:

Projected warming will increase moisture stress and probability of wildfire and insect outbreaks. By mid-century, 35% of the planning area is projected to have moisture stress levels currently associated with woodland and non-forest (Fig. 2). Treatments to reduce density and favor drought-tolerant species on a large portion the projected future high and extreme deficit sites will help forestland persist into the future.

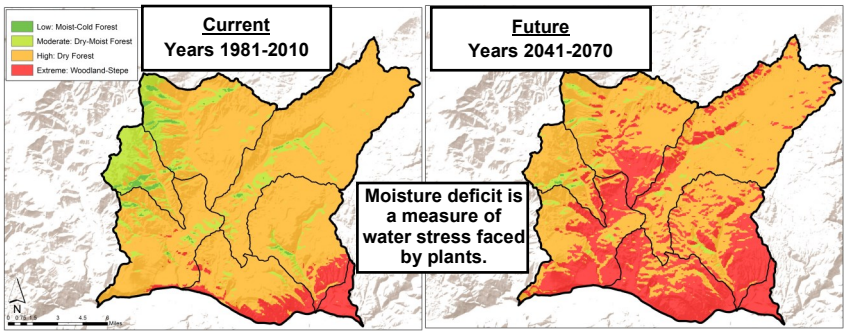


Figure 2. Current and future moisture deficit levels.

Sustain wildlife habitat:

Maintaining large tree, dense forest is necessary to meet the requirements of the DNR's Habitat Conservation Plan (HCP) for the northern spotted owl. Treating dense forest not required by the HCP to be sustained as habitat, or identified to attain habitat, can reduce risk of high severity fire for the whole landscape. When consistent with the HCP, lighter, variable density thinning in mid-sized stands can accelerate habitat development while reducing fire and drought risk somewhat. Treatments on dry sites can increase habitat for open canopy dependent species if prescriptions incorporate habitat considerations. Fires that burn at characteristic severity in all forest types can benefit habitat by creating snags and stimulating higher understory plant abundance and diversity.

Enhance rural economic development:

Warming trends will make it increasingly difficult to sustain timber production in the central and southeastern portions of the planning area. In the remainder, long term timber production will likely be possible on private and DNR land if proactive strategies to shift species composition and manage for lower density are adopted over time. Reducing fire risk will help maintain recreation and tourism.

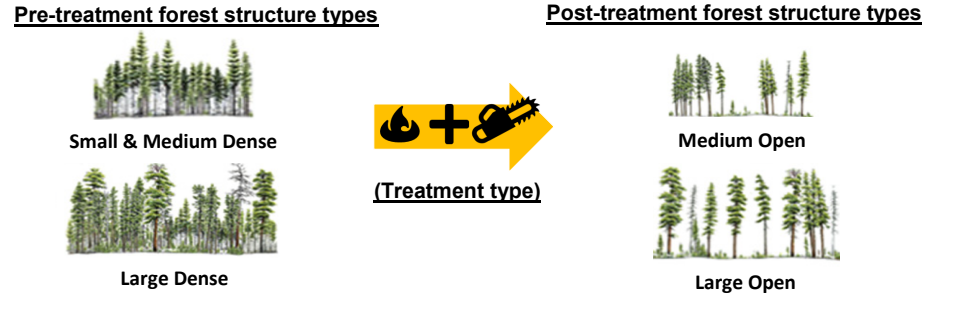
Definitions (see Appendix for data sources and methods):

Dry: *Ponderosa pine and Douglas-fir dominated forests that historically supported ground fires every 5-25 years.* ***Moist:*** *forests that historically had mixed severity fires and were dominated by fire resistant species on sites with more frequent fire (~30-80 years) and fire intolerant species such as grand fir on sites with less fire.* ***Cold:*** *Upper elevation mixed conifer forests with high severity fires every 80-200+ years.* ***Woodland/Steppe:*** *Grass and shrublands that may have oak woodlands or up to 10% cover of conifer trees.* ***Size classes:*** *Large: overstory diameter (OD) > 20"; Medium: OD 10-20"; Small: OD <10".* ***Canopy cover classes:*** *Open: <40%; Dense: >40%.* ***Fuels:*** *shrubs, grasses, small trees, duff, & dead woody material.*

Treatment Needs: White Salmon Planning Area

Dry forest:
Treating 32,000 - 43,000 acres of dense, forest on dry sites (Table 1, Fig. 3) is recommended to flip the dry portion of the landscape from being dominated by large patches of dense forest to open forest, when consistent with DNR HCP habitat objectives (Fig. 4). Treatments in small to large size classes are needed. Approximately 25% of the dry forest would remain dense to meet habitat objectives, however. Large tree structure exists on much of the DNR land, as well as some private, and can be converted to more fire and drought resistant forest by removing smaller trees and treating fuels with prescribed fire or mechanical methods. Shifting composition toward ponderosa pine and reducing Douglas-fir on the drier sites is recommended.

Moist forest:
Treating 3,500-6,000 acres of dense, moist forest is recommended to reduce risk of a large crown fire and help forests adapt to a warming climate, when consistent with DNR HCP habitat objectives. Increasing the relative composition of ponderosa pine and western larch is also needed. Post treatment, approximately 1/2 of the moist forest area would remain dense. North facing slopes and higher elevation sites are projected to have moderate and low moisture deficit (Fig. 2), and thus offer the most sustainable locations to maintain and grow large tree, dense forest.



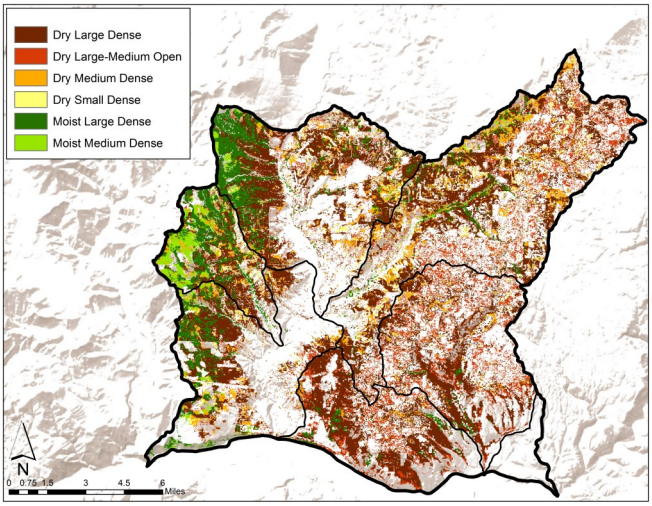


Figure 3. Potential Treatment Areas. Total area of target structure classes is shown. Only a portion needs to be treated, see Table 1.

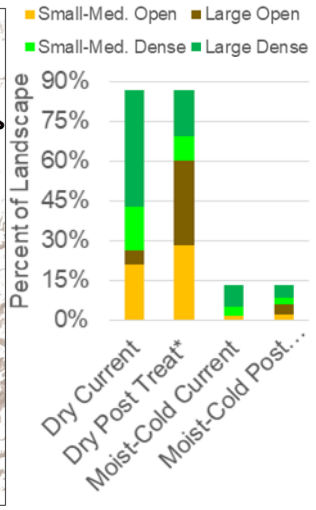
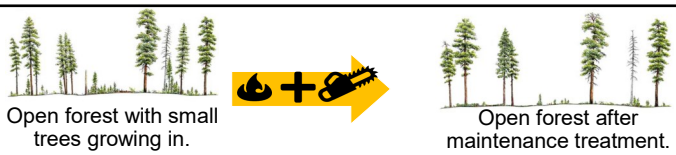


Figure 4. Current & post treatment percent of forest types.
****mid-point of treatment range***

Maintenance treatments: A portion of existing open forests on dry sites need prescribed fire or mechanical methods to maintain open conditions by reducing ground fuels and excessive small trees that have grown in. An estimated 2,500-6,000 of treatments is currently recommended.

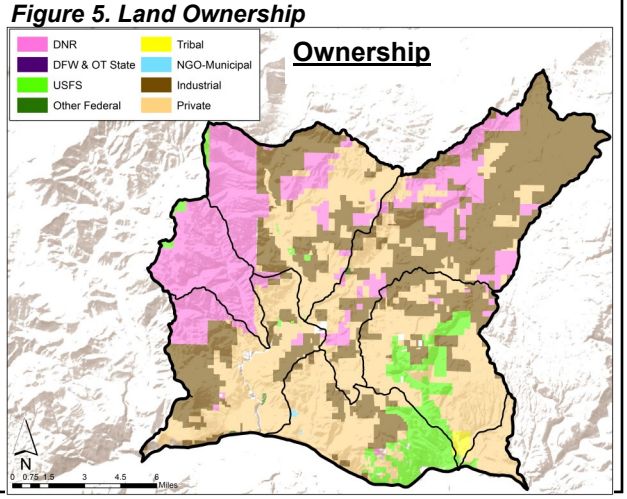


Overall treatment needs: Shifting an estimated **35,500 - 49,000** acres from dense to open forest is recommended (Table 1). A combination of treatments will be needed to accomplish this goal, and may include commercial and non-commercial thinning, prescribed fire, regeneration harvests, and mechanical fuel reduction. Based on tree size class, many of the acres are commercially viable. However, road access, logging systems, habitat requirements, aquatic impacts, timber markets, and other considerations will determine treatment type. Maintenance treatments on 2,500-6,000 acres are also recommended. Individual landowners (Fig. 5) will conduct their own field assessments, planning, and decision making processes to determine acres and types of treatments they can carry out to achieve the overall landscape goals while meeting their own management objectives and regulatory requirements.

Table 1. Forest Health Treatment Need

Forest Conditions to Treat		Treatment	Current Acres by Major Landower*			
Type	Size Class	Need Acres	Industrial	Private	DNR	USFS
Dry Dense	Small	500-1000	1040	329	367	6
	Medium	6500-9000	4298	4220	3218	203
	Large	25000-33000	11271	11891	10929	2914
Moist Dense	Medium	500-1000	387	191	1796	168
	Large	3000-5000	1156	947	5877	484
Dry Open	Large-Medium	2500-6000	5787	5373	830	650
Total		**38,000 - 55,000**	*These are current acres, not targets			
Anticipated Treatment Type		Non-commerical thin + fuels treatment. May be fire only				
		Commerical + fuels treatment where possible. May also be non-commercial, fire only, or regeneration harvest				
		Maintenance: prescribed fire or mechanical fuels treatment				

Figure 5. Land Ownership



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Appendix A

20-Year Forest Health Strategic Plan
Eastern Washington

Planning Area Prioritization

Methodology and Documentation

January 2018

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Introduction

Washington's 20 Year Strategic Plan sets a goal of treating 1,250,000 acres over the next 20 years to improve the resilience of forests in eastern Washington. To accomplish this ambitious target, the Washington Department of Natural Resources (DNR) will work with landowners and stakeholders to select and treat 125,000 acres each biennium. The plan lays out a process for the DNR to strategically identify planning areas where state funding for forest health and restoration projects will be focused[1]. Planning areas will generally be a HUC 6 watershed (5000 ~ 25,000 acres), but may be several watersheds in some cases.

The selection process for planning areas has a number of steps. First, the DNR has assessed fire risk, restoration need, aquatic function, economic potential, wildlife habitat, and other resources across all forested HUC 6 watersheds in eastern Washington. Based on this assessment of multiple resources, a data driven ranking of watersheds has been completed. DNR staff and local stakeholders (land management agencies, forest collaboratives, tribes, private landowners, etc) will combine this information with local priorities and ongoing planning efforts to select candidate planning areas for each collaborative area. These candidate areas will then be submitted to the Forest Health Advisory Committee and then to the Commissioner of Public Lands for final selection. A new set of planning areas will be selected each biennium.

The purpose of this document is to describe in detail the methodology used to assess and rank HUC 6 watersheds across Eastern Washington. This methodology is very similar to the methods used to prioritize HUC 5 watersheds for the 20 Year Plan, but has some important differences and updated datasets. The focus of the HUC 5 prioritization in the 20 Year Plan was to analyze, rank and display risks and treatment need across Eastern Washington. The focus of the HUC 6 assessment described in this document is to select smaller scale planning areas. We combine documentation from the 20 Year Plan[2] where relevant with new information where different information sources or methods were used.

Collaborative Zones in Eastern Washington

The active engagement of Forest Collaboratives in the implementation of the 20 Year Plan is critical to its success. The DNR cannot achieve the goals of the plan without local stakeholders who are directly involved in the selection, implementation, and monitoring of projects. In addition, the HUC 5 prioritization done for the 20 Year Plan shows that high priority watersheds occur across all of Eastern Washington. The selection of candidate planning areas will thus be conducted within each collaborative area or zone. Based on the geographic coverage of each collaborative, five zones were created for Eastern Washington and are shown in figure 1. The boundaries of 5 zones were created by placing each HUC 5 watershed, and all the HUC 6 watersheds within them, into one of the zones. This map will be used to help organize the evaluation and selection of planning areas

[1] For a full description of this process, see Appendix 1-II of the 20 Year Forest Health Strategic Plan. https://www.dnr.wa.gov/ForestHealthPlan

[2] See appendix 1.I of the the 20 Year Forest Health Strategic Plan.

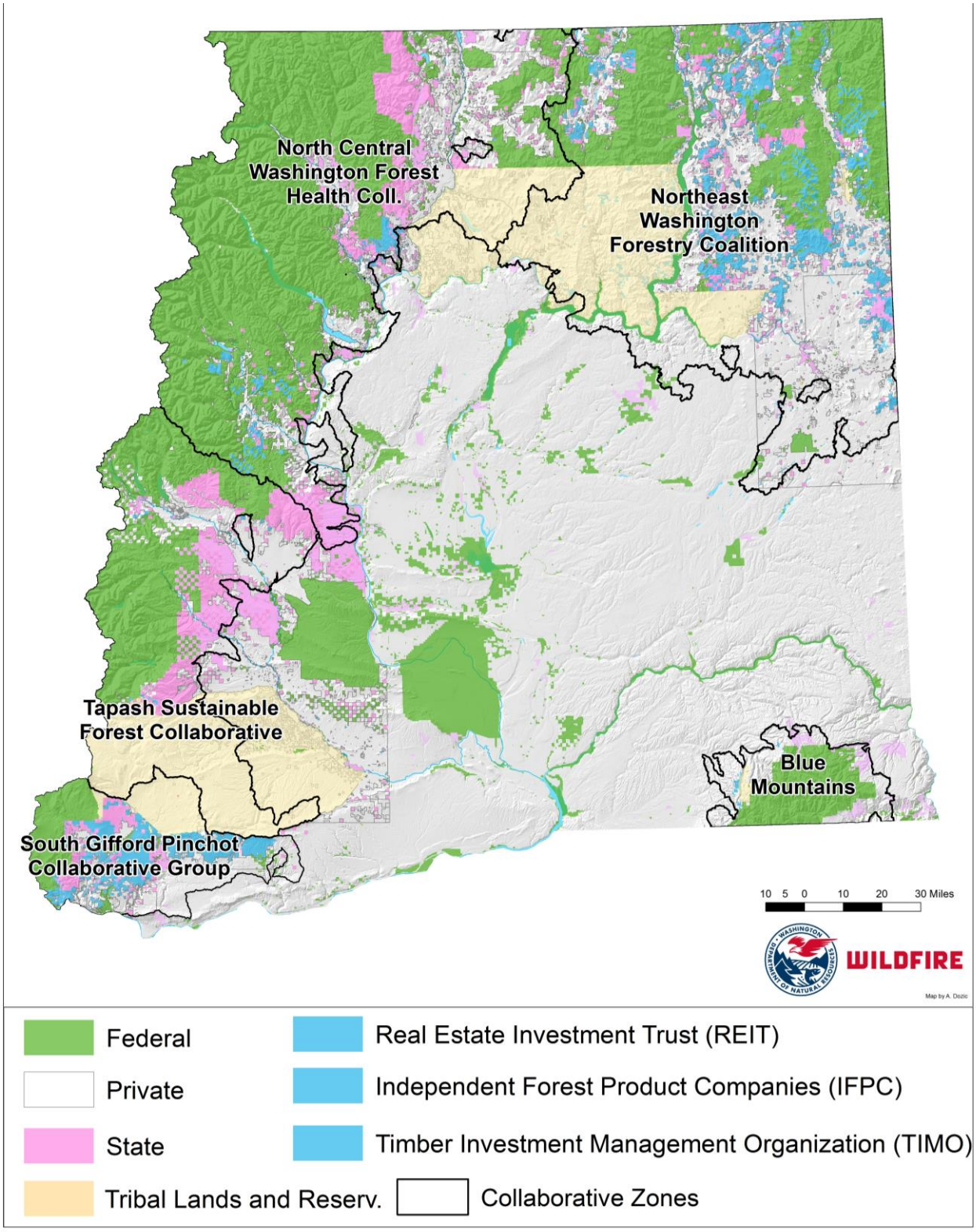

***Figure 1**:* Map of 5 collaborative zones in Eastern Washington. Note that some boundaries are approximate as there is potential overlap between zones in a few places.

Selection Process for Forest Health Projects

Once the final planning areas are selected for the 2017-2018 biennium, landscape evaluations will be conducted in each planning area to assess forest health conditions and determine treatment needs. A landscape evaluation is a data driven approach to understanding the current conditions of a landscape and its level of resilience to future disturbances and climatic change. In watersheds where similar types of evaluations have recently been completed by other landowners (e.g. US Forest Service NEPA planning), the DNR will seek to complement the existing evaluations where needed. The information and data from the evaluations will then by synthesized into a landscape prescription that lays out treatment targets and identifies potential treatment locations. The final steps will be to field verify and refine treatment locations and types as needed and then develop a final list of recommended treatments for the planning area. These will be submitted to the Forest Health Advisory Committee and then packaged into an appropriations request to the state legislature.

The DNR will rely on partnerships with local land management agencies, forest collaboratives, tribes, and other stakeholders to select planning areas and forest health projects. The timeline for selecting the 2018 projects is short. A number of meetings and check-in points with local partners will be needed in the next 8 months. A timeline of the process and meeting dates is shown below (Figure 2)

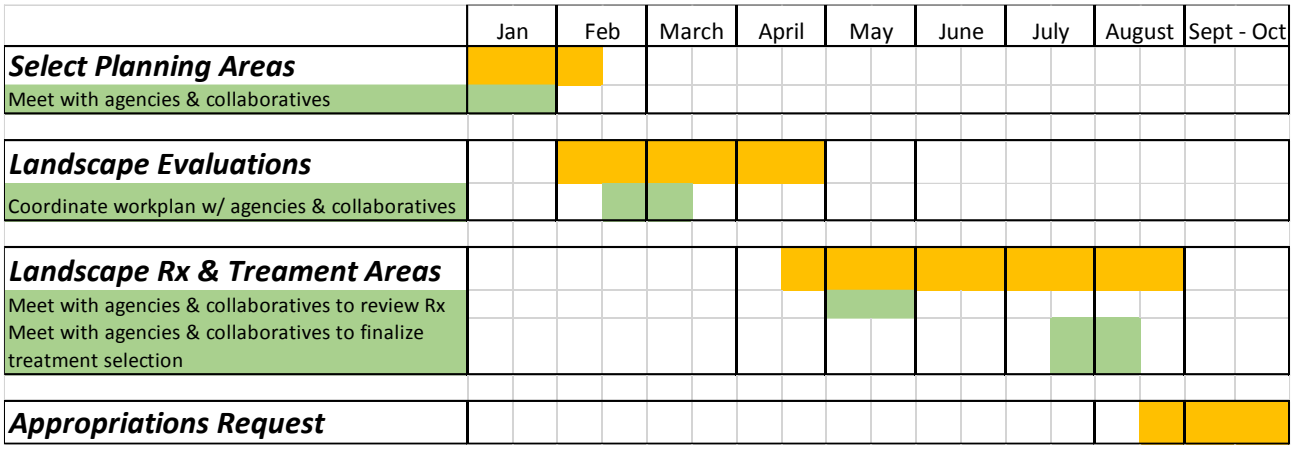

Figure 2: Timeline for selecting planning areas and forest health treatment projects

Methodology to Combine Metrics and Rank HUC 6 Watersheds

Tiered Organization

This assessment uses the same two tier structure to organize and rank different resources that was used in the 20 Year Plan to prioritize HUC 5 watersheds. Tier 1 includes metrics that represent forest health conditions such as probability of major fire or insect and disease disturbances as well as departure from historical conditions. Tier 2 metrics represent natural and human values at risk from major, uncharacteristic disturbances or declines in forest health.

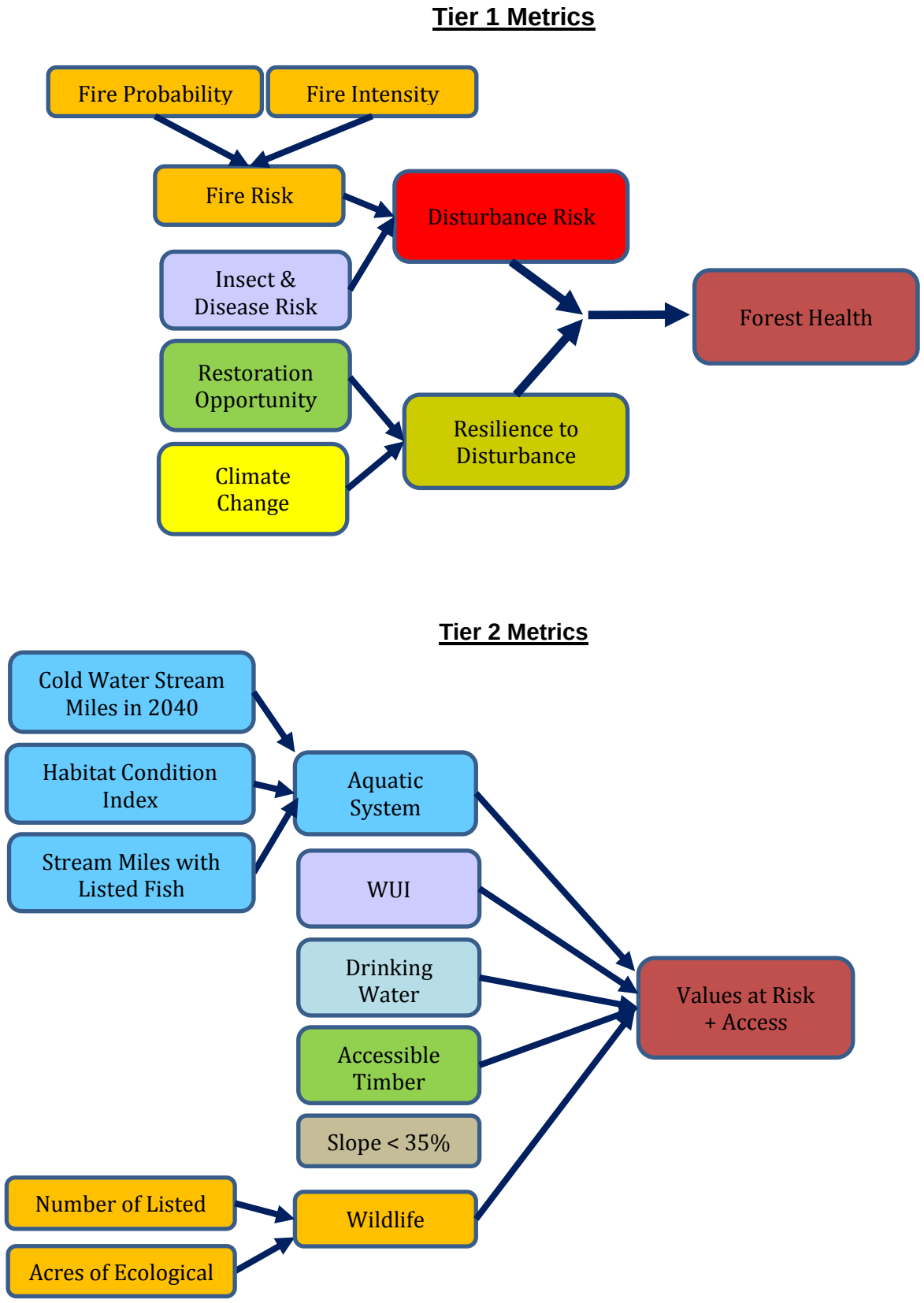

Figure 3: Metrics for two tiers used in assessment of HUC 6 watersheds.

The two tiers were used to allow for separate evaluations of each tier and to ensure equal weighting between the two sets of metrics. Scores for each metric were derived from one or more datasets that represent the best available science that is publically available. A number of updated datasets were available for this assessment compared to what was used for the HUC 5 prioritization in May of 2017. Road access considerations were added to Tier 2 to factor in the feasibility of treating specific watersheds, based on feedback from a number of advisory committee members. All metrics were summarized at the HUC 6 level in order to combine them into Tier 1 and Tier 2 scores. Figure 3 displays the metrics and how they are organized into the two Tiers.

Screens

In addition to the Tier 1 and Tier 2 metrics, HUC 6 watersheds were screened based on acres. HUC 6 watersheds with less than 2500 acres of forest were removed from consideration as they do not contain sufficient acres to be a planning area. Watersheds with less than 2500 acres outside of wilderness and roadless areas, as well as recent moderate and high severity fire (2012-2015), were also flagged. These flagged watersheds were included in the assessment as they may have significant forest health issues. However, many of the data layers used in the assessment do not reflect the 2012-2015 fires. Thus these watersheds can be evaluated by the planning teams to determine if including them in part of planning area is appropriate.

Combining metrics into composite ranks

In order to rank and prioritize HUC 6 watersheds for treatment need, the datasets making up Tier 1 and Tier 2 were combined together using the process described below. Note that all scores are relative. A low score does not mean that a watershed has no forest health issues or need for treatment. Instead, it means that metrics and overall needs are lower relative to other watersheds. In combing metrics into composite scores, we used the simplest, most transparent approaches possible unless a clear need and advantage for a more complicated approach existed. We did not apply any weights to the metrics and the metrics were equal within each Tier.

1. *Derive HUC 6 scores:* For each dataset (see figure 2), the value of pixels or smaller polygons across each HUC 6 were aggregated to derive a single score for each HUC 6. This was done in three different ways for different datasets. For the fire, climate change, and habitat condition index metrics, the values of pixels or catchments were averaged across the HUC 6. For restoration opportunity, insect and disease, WUI, accessible timber, ESOC, listed fish miles, and cold water miles in 2040, the total number of acres or stream miles was summed. Drinking water and listed wildlife species were obtained at the HUC 6 level. For all relevant metrics, a non-forest mask was first applied to remove all pixels that are non-forested. Wildlife, aquatics, and fire had multiple datasets that were combined to create a single score for each HUC 6. To do this, the scores were first standardized and then averaged.

2. *Rank watersheds for each metric:* A simple ranking approach was used to convert the HUC 6 scores derived for each dataset onto a standardized 0-1 scale. For each dataset or metric, values for the HUC 6 watersheds were first ranked with ties allowed. The ranks were then standardized by dividing by the highest rank for each dataset. The watershed with the highest value for a dataset has a score of 1 and the lowest value a score of 0. Maps showing the ranks

for each metric across all watersheds are provided in Appendix 2. This relative approach resulted in similar contributions of each metric to the composite scores.

Before calculating the ranking, raw scores for all metrics were first rounded to a specified numeral for each metric, based on the distribution of that metric. For example, increase in deficit was rounded to the nearest 0. (e.g. 121, 118, 115). Fire probability was rounded to the nearest thousandth (e.g. 0.001, 0,021), and all acre metrics to the nearest 100 (e.g. 800, 2100, 5500). Rounding created tied rankings for watersheds that had close scores. This removed artificial differentiation from small differences in scores.

3. *Calculate composite rankings:* Rankings for all Tier 1 metrics were averaged together and standardized (dividing by the maximum value to get a 0-1 score) to generate a rank for Tier 1. The same process was used for Tier 2. The last step was to add Tier 1 and Tier 2 together to obtain a final, composite ranking. We explored more complex approaches to combining the two tiers, but determined that this simpler approach worked as well as any of the others. In particular, no watersheds with low Tier 1 score received a high priority composite ranking. All high priority watersheds had either a high Tier 1 and medium Tier 2, or a medium Tier 1 and high Tier 2.

   These final scores, as well as the tier 1 and tier 2 scores, were then placed into low, medium, and high priority categories based on percentiles. For example, watersheds with the top 33% scores were given a high priority rank. Each category was broken into 2 or 3 sub-categories on maps to allow for more in depth visualization of relative rankings. The Tier 1, Tier 2, and final composite prioritization of all HUC 6 watersheds are shown in figures 4-6. The composite prioritization maps each collaborative zone are provided in Appendix 1.

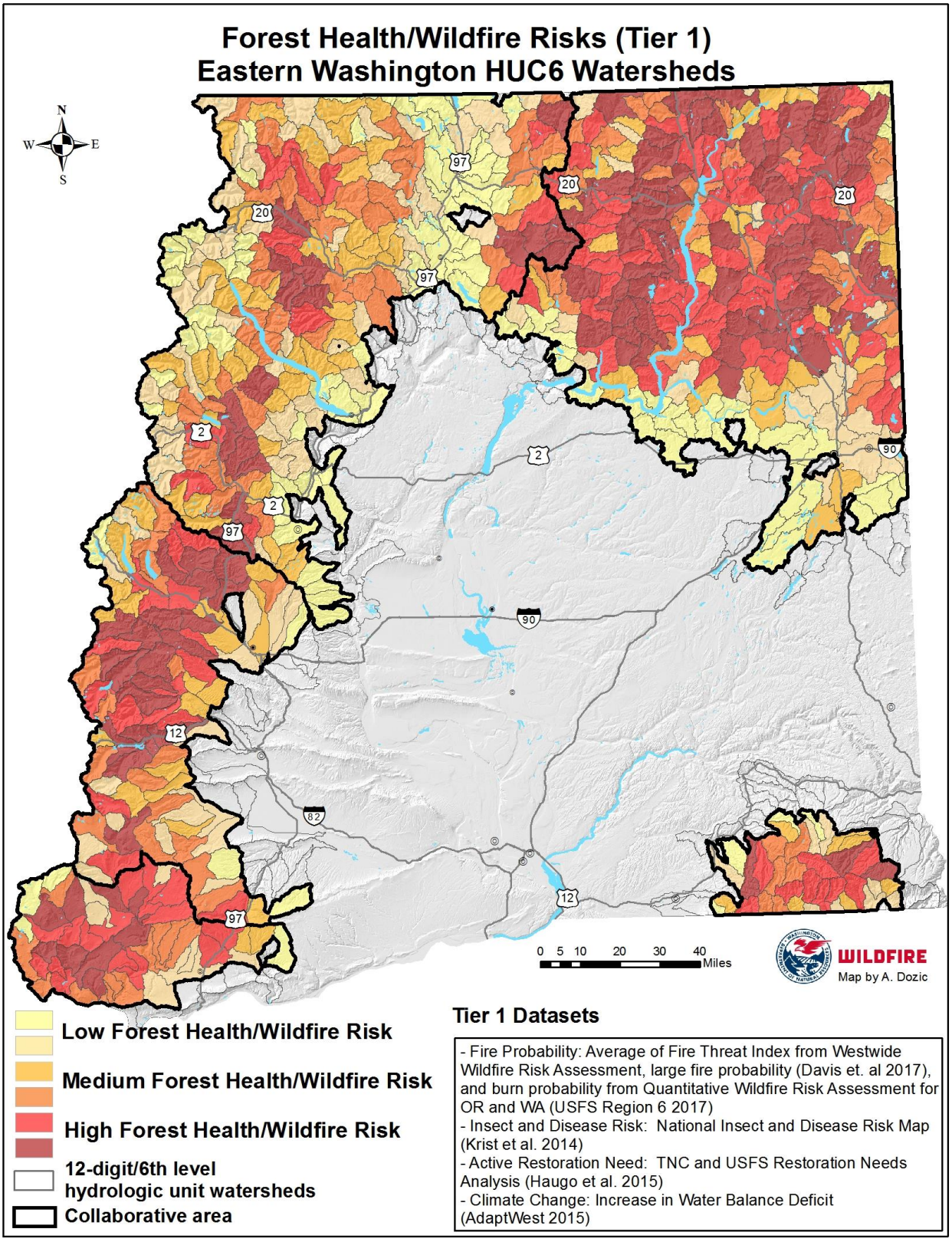

Figure 4: Tier 1 prioritization for HUC 6 forested watersheds in eastern Washington

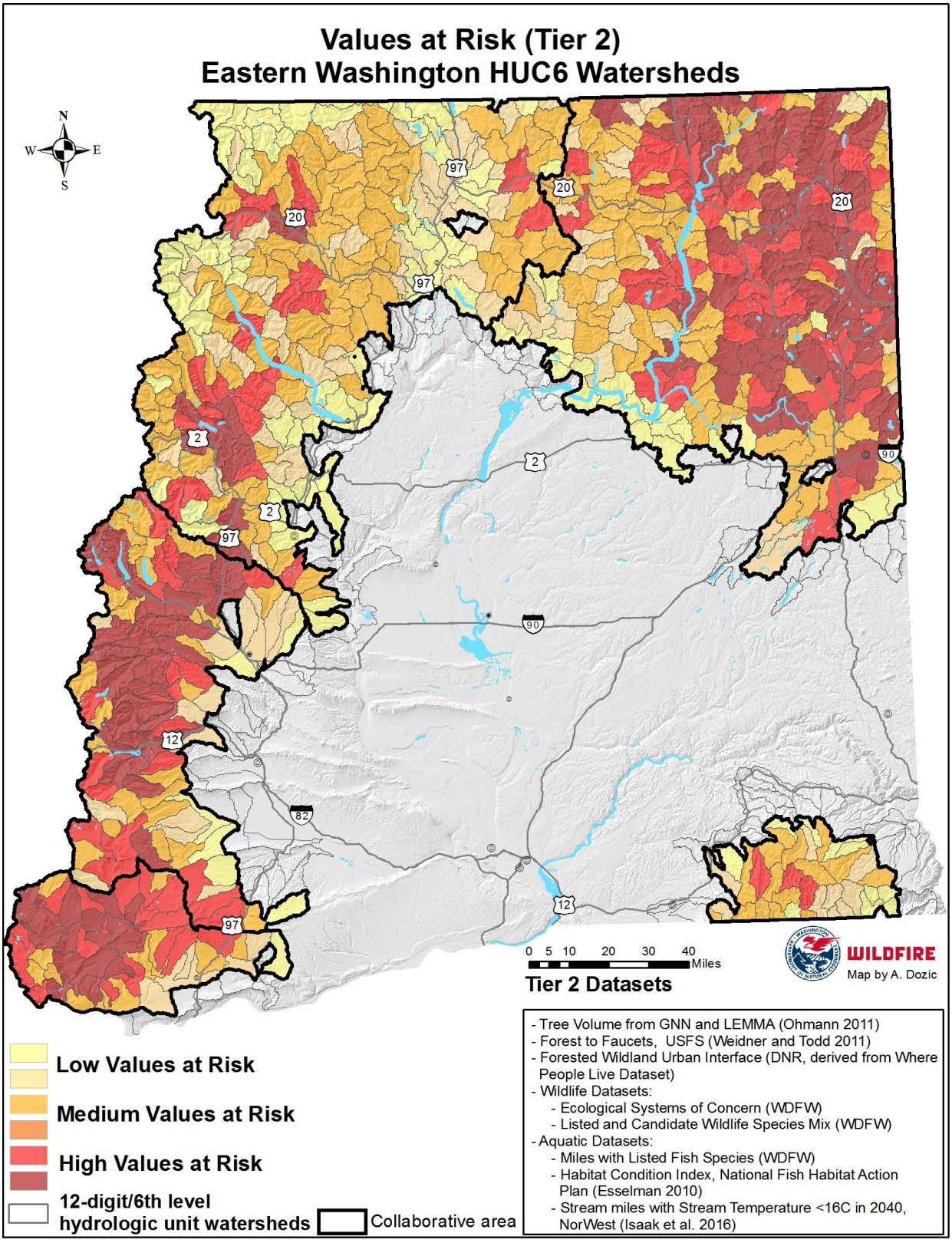

Figure 5: Tier 2 prioritization for HUC 6 forested watersheds in eastern Washington.

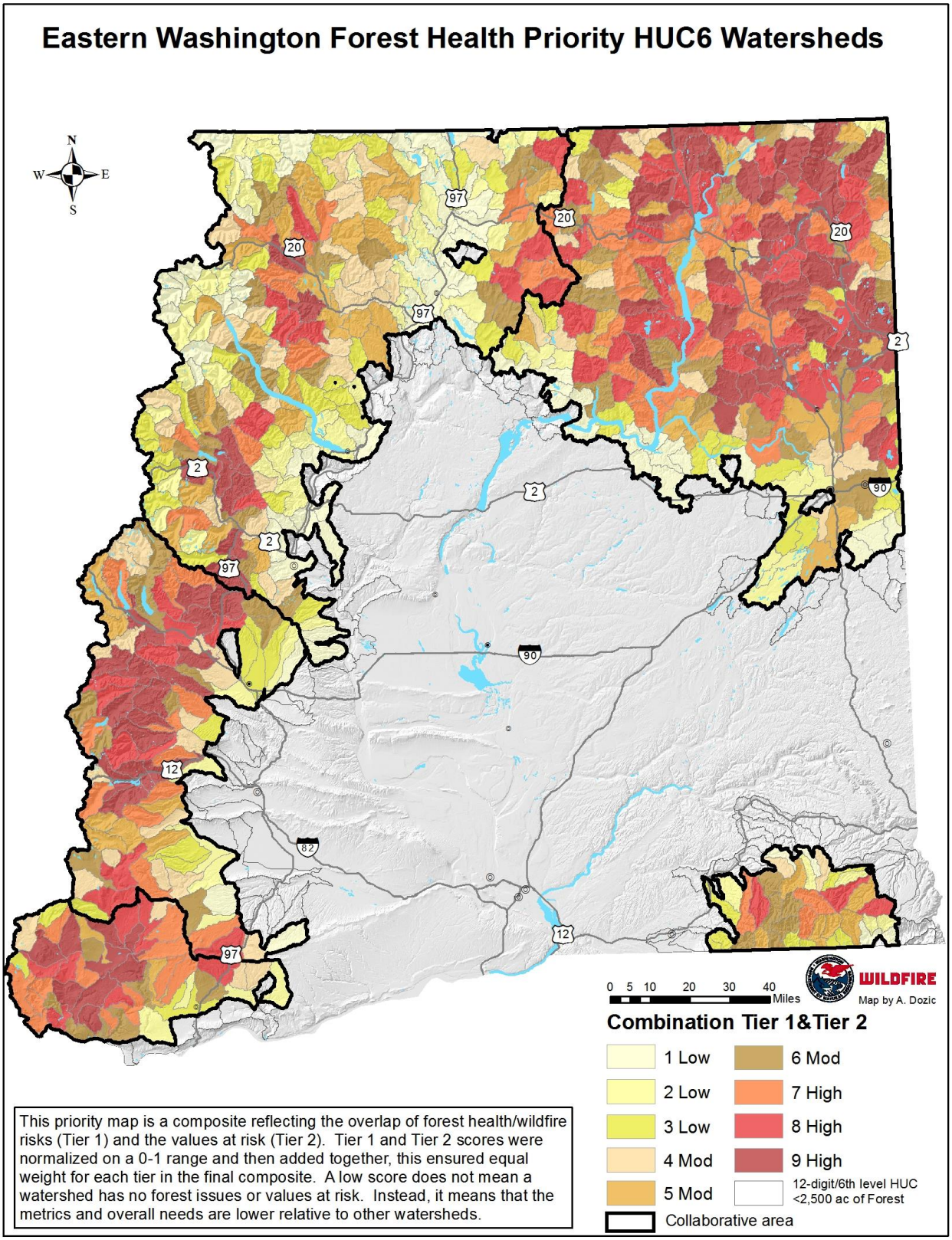

Figure 6: Combined prioritization for HUC 6 forested watersheds in eastern Washington.

Data Sources

All of the data sources used are publically available, although the most recent versions for a few metrics were obtained directly from the producers of the data. Maps for each data layer are provided in Appendix 3.

Tier 1: Forest Health

1. *Fire Risk:* This metric combines two datasets for fire probability with two datasets for fire intensity. Probability is the annual probability that a pixel will burn, while intensity is measured by the flame length of fires that burn each pixel. Flame length is a good measure of how severe a fire is. As higher intensity and severity fires threaten homes and other resources, combining these two aspects of fire provides a better estimate of fire risk that probability alone. Three of the datasets come from quantitative wildfire risk assessment recently produced for Oregon and Washington by Rick Stratton of the USFS (Stratton In Prep) using the FSim fire modeling system (Finney et al. 2011). These include burn probability, probability of flame lengths greater than 8 feet, and average flame length for 120m pixels. The forth dataset dataset predicts large fire probability for 140 acre pixels based on a statistical model (MaxEnt model) developed from past fire events (up to the year 2015), fuel conditions, climate, and topography for current and future time periods using downscaled climate projections (Davis et al. 2017). To capture areas most at risk from increasing fire probability due to climate change, we used the change in fire probability from the current period 1981 – 2010 to the future 2041- 2070 period. The final step was to create a single fire risk score for each HUC 6. To do this, the mean value for each of the four fire datasets was calculated for each HUC 6. These four scores were then each standardized. The final step was to average all four standardized datasets together to create a single fire risk score for each HUC 6.

2. *Insect and Disease Risk.* The National Insect and Disease Risk Map was used (Krist et al. 2014). This dataset quantifies the hazard or probability of tree mortality from different insects and diseases based on current forest conditions, climate, proximity to known insect and disease disturbances, soils, topography, and other factors. The combined risk of all insect and disease agents was used. Risk values are based on vegetation conditions in 2012. A threshold mortality risk of 25% or greater was used based on recommendations from the creators of the model. To calculate a risk value for each HUC 6, the percentage of 30m pixels with 25% or greater risk of mortality in the watershed was derived.

3. *Restoration Opportunity:* This data comes from an update to Haugo et al. (2015), which was the data source used to estimate restoration need in the 20 Year Plan. The updated departure assessment used for this round (DeMeo et al. In Press), compares estimated historical ranges of five structure classes with current conditions to quantify how departed or "out of whack" a watershed is. The analysis is done for different biophysical settings (BPS), which are similar to potential vegetation groups (e.g. dry mixed conifer, etc). Based on these departures, the percent of acres in a HUC 5 that need mechanical and/or prescribed fire treatments to align with historical conditions was derived. However, departure information and percent of acres needing treatment is not available at the HUC 6 level. Thus we created a different metric using the following steps: (1) We determined which structure classes x BPS were departed for each HUC 5 watershed and by how many acres; (2) We summed the total number of acres in each departed structure class x BPS for every HUC 6; (3) If this number was higher than the number of departed acres in the respective HUC 5 for that structure class x BPS, the HUC 5 number of departure acres was used for that structure class x BPS in that HUC 6 instead of the value from

step 2; (4) The final step was to sum up all the acres from steps 2 and 3 for each HUC 6. This total is the number of acres in a HUC 6 that could be treated to move the larger HUC 5 towards alignment with historical conditions. It is not the number of acres that need to be treated to restore that HUC 6, but potential acres to restore conditions at the HUC 5 level. The purpose of this metric is to identify the greatest relative opportunities among HUC 6 watersheds to restore departed conditions.

4. *Climate Change:* The projected increase in water balance deficit was included to capture the projected changes in climate that will exacerbate forest health issues. Water balance deficit, or deficit, is a measure of moisture stress that plants face and thus constrains were different plant species can grow (Stephenson 1998). Increases in deficit elevate fire behavior and make forests more susceptible to insect and disease outbreaks (Littell et al. 2010). Downscaled climate projections from the AdaptWest Project (AdaptWest 2015) were used, which is based on climate data from Climate North America (Wang et al. 2016). Future projections are based on an Ensemble of 15 Global Circulation Models under the R8.5 emissions scenario. The difference between for the 1981–2010 and 2041–2070 time periods was calculated for 1km pixels and then averaged across each watershed to get a single score for each HUC 6. Absolute change in deficit was used instead of proportional change. The Hargreave's method of calculating water balance deficit was used as it is readily available on the AdaptWest site.

Tier 2: Values at Risk

1. *Aquatic System Health:* Three different datasets were used to rate both riparian conditions and fish habitat. HUC 6s with higher scores have higher functioning aquatic systems that could be degraded by uncharacteristic high severity fires, thus potentially warranting forest restoration treatments in portions of the watershed. Within a HUC 6, areas more suitable for no-management, treatment as well as aquatic related restoration activities will be identified during landscape evaluations. The first dataset is the number of stream miles in each HUC 6 with listed fish species and was provided by WDFW. The second dataset is the Habitat Condition Index (HCI) from the National Fish Habitat Assessment which quantifies the overall level of human disturbance (e.g. road density, stream crossings, percent in agriculture, percent in developed areas, etc) by catchment (smaller than HUC 6) (Esselman et al. 2010). The third dataset is projected stream temperature in 2040 from the NorWest Stream Temperature Modeling project to capture future cold water fish habitat (Isaak et al. 2016). The total miles of stream with projected maximum temperatures less than 16 C was used as the metric for each HUC 6. Scores from the three datasets were standardized and then averaged together to create a single score for each HUC 6.

2. *Wildland Urban Interface*: This dataset was created by DNR staff by buffering all values of the Where People Live dataset used in the West Wide Wildfire Risk Assessment by 0.5 miles and then intersecting the buffered Where People Live dataset with forestland (Oregon Dept. of Forestry 2013). This dataset is a good approximation of where there are forests and structures to represent the forested WUI. The Where People Live dataset estimates the number of housing units per acre and was developed using advanced modeling techniques based on the LandScan population count data available from the Department of Homeland Security, HSIP Freedom Dataset.

3. *Drinking Water:* The Forest to Faucets dataset was used to identify forest areas most important to surface drinking water (Weidner and Todd 2011). Scores are based on the number of people that derive water from a watershed and the amount of water supply. High scores mean that more people rely on the watershed for drinking water and the overall amount of water supplied is higher.

4. *Accessible Timber:* To estimate both timber value at risk and potential for commercial treatments that can generate revenue, the number of acres with greater than 12,000 board feet within 1500' of a road was calculated. For volume, the regional 2014 GNN forest inventory dataset from LEMMA (Ohmann and Gregory 2002, Ohmann et al. 2011) was used. The DNR road layer for Washington was used, but first cross referenced with current road layers for the Okanogan NF and Colville NF.

5. *Percent of Watershed with Slope Less than 35%:* This metric was generated to factor in topographic complexity and the corresponding feasibility and economic cost of both mechanical and prescribed fire treatments. Treatments on slopes over 35% are certainly possible. However, they are more expensive and challenging to implement due to greater complexity with temporary road building, elevated fire behavior, need to cable yard, greater potential for negative aquatic impacts, and fewer number of available contractors to conduct the work.

6. *Wildlife*: Two datasets were averaged together to identify overall wildlife habitat importance for each HUC 6. The first was the number of listed and candidate wildlife species. The second was the number of acres in "ecological systems of concern", which are habitats that are at risk and support a high number of species. Scores were obtained at the HUC 6 level from WDFW. The two datasets were standardized and averaged together to create a single wildlife score. No attempt was made to distinguish between species that require dense, closed canopy forest vs. more open forest. This will be done during landscape evaluations, where a finer scale approach can be used to identify portions of watersheds best suited to sustain dense forest habitats vs. more open forest habitat.

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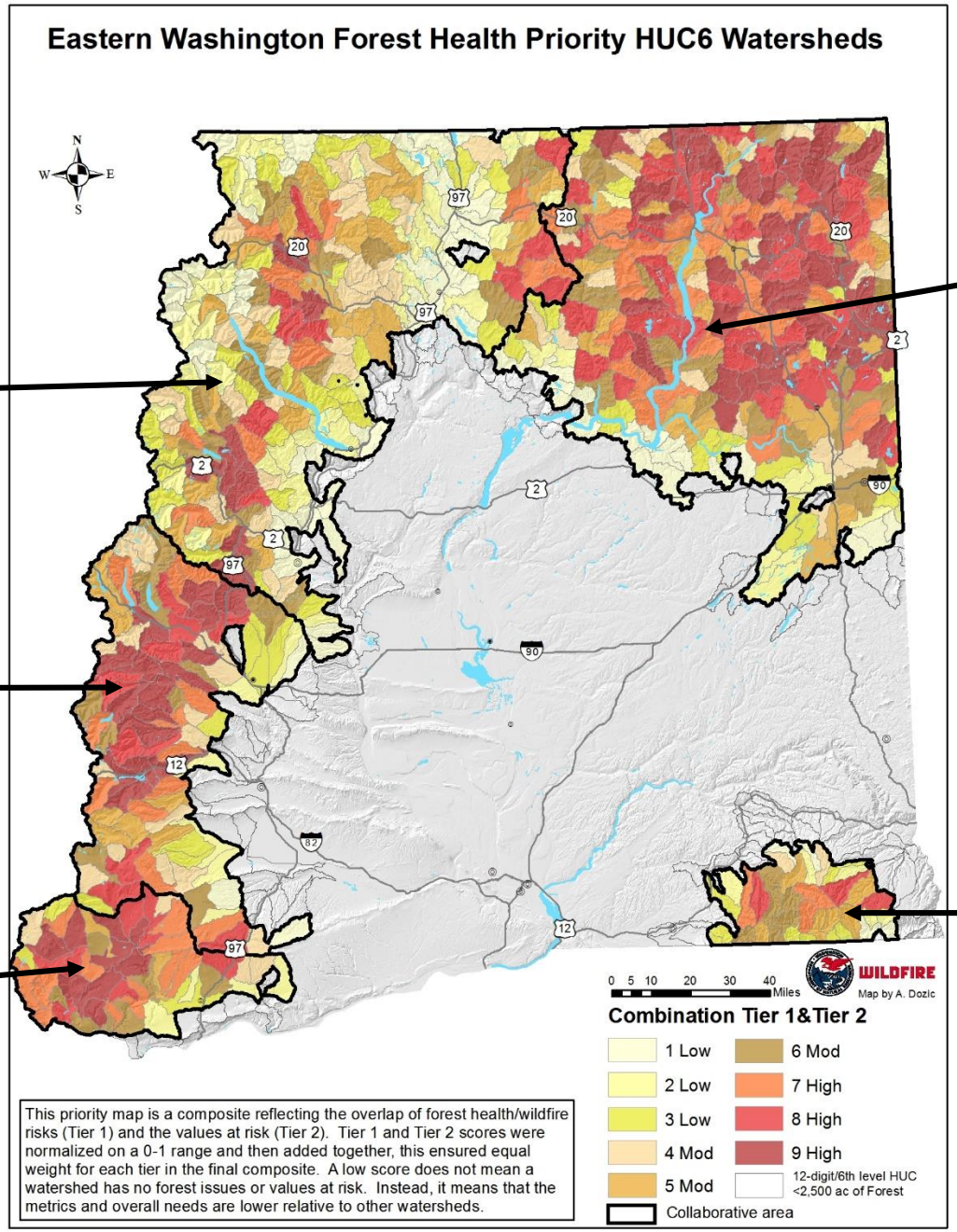
Appendix B

Prioritization Maps by Collaborative Zone

B2

Collaborative Zones



NEWFC

N. Central FHC

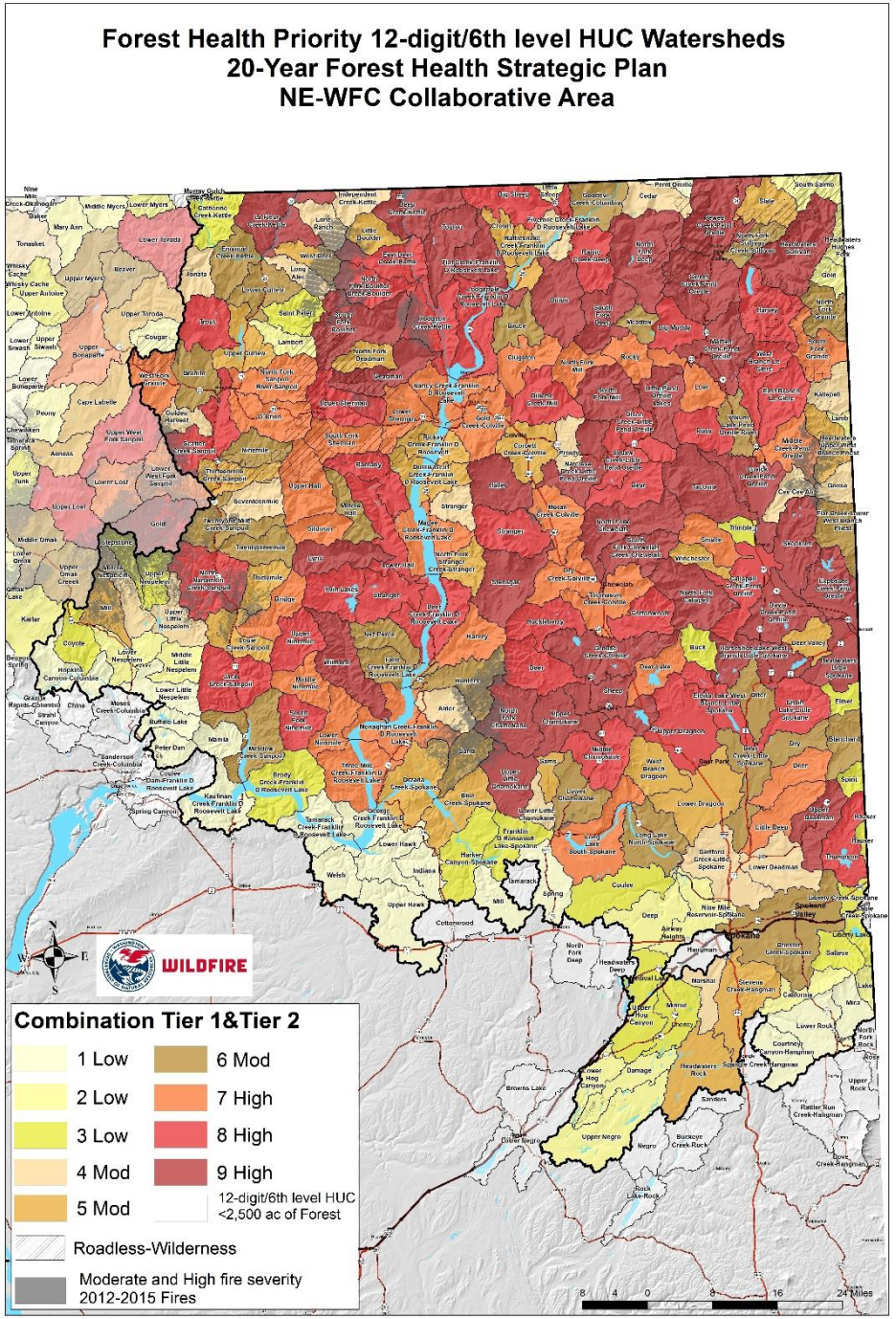
Tapash

Blue Mountains

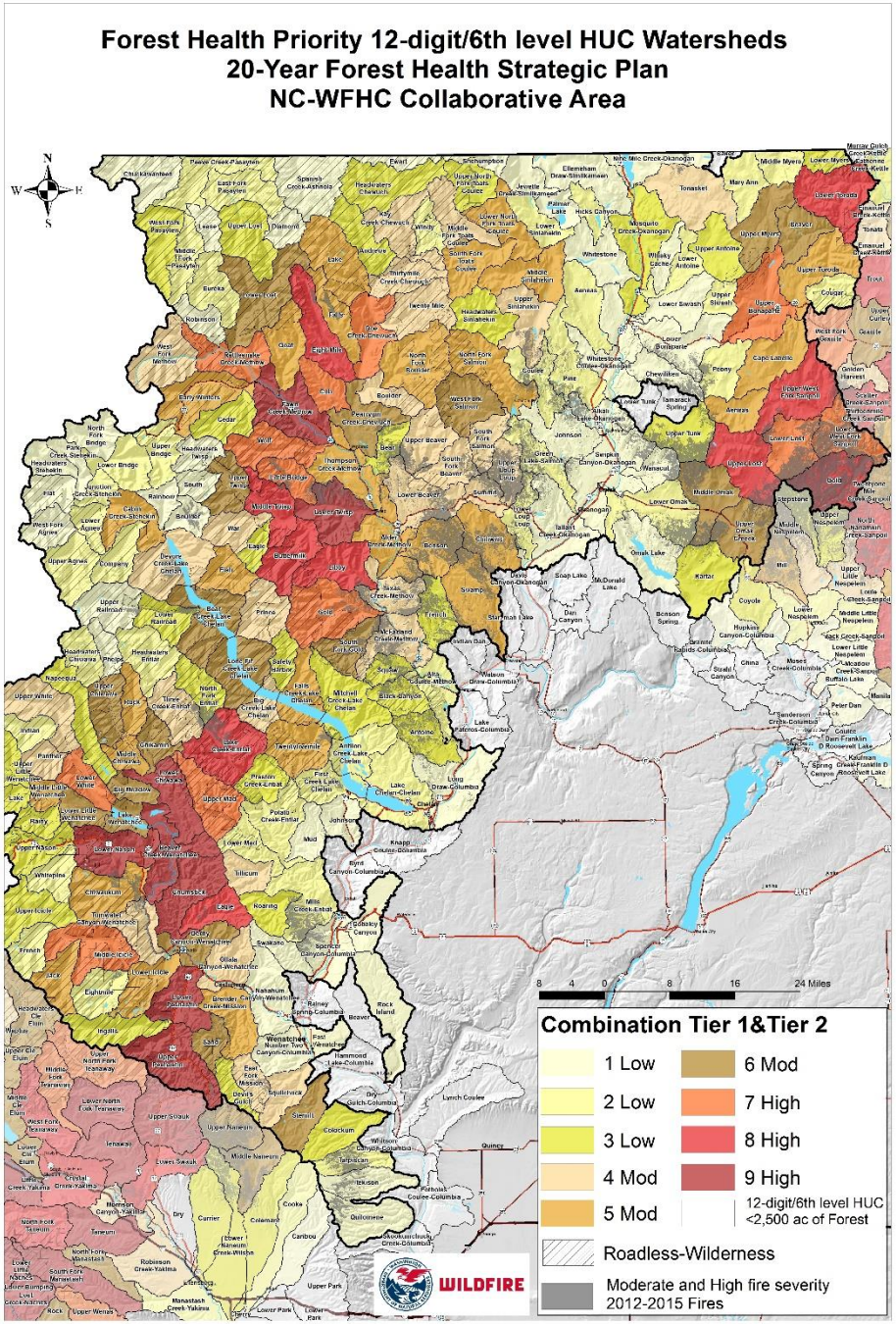
South GP

B3

NE Washington Forest Collaborative

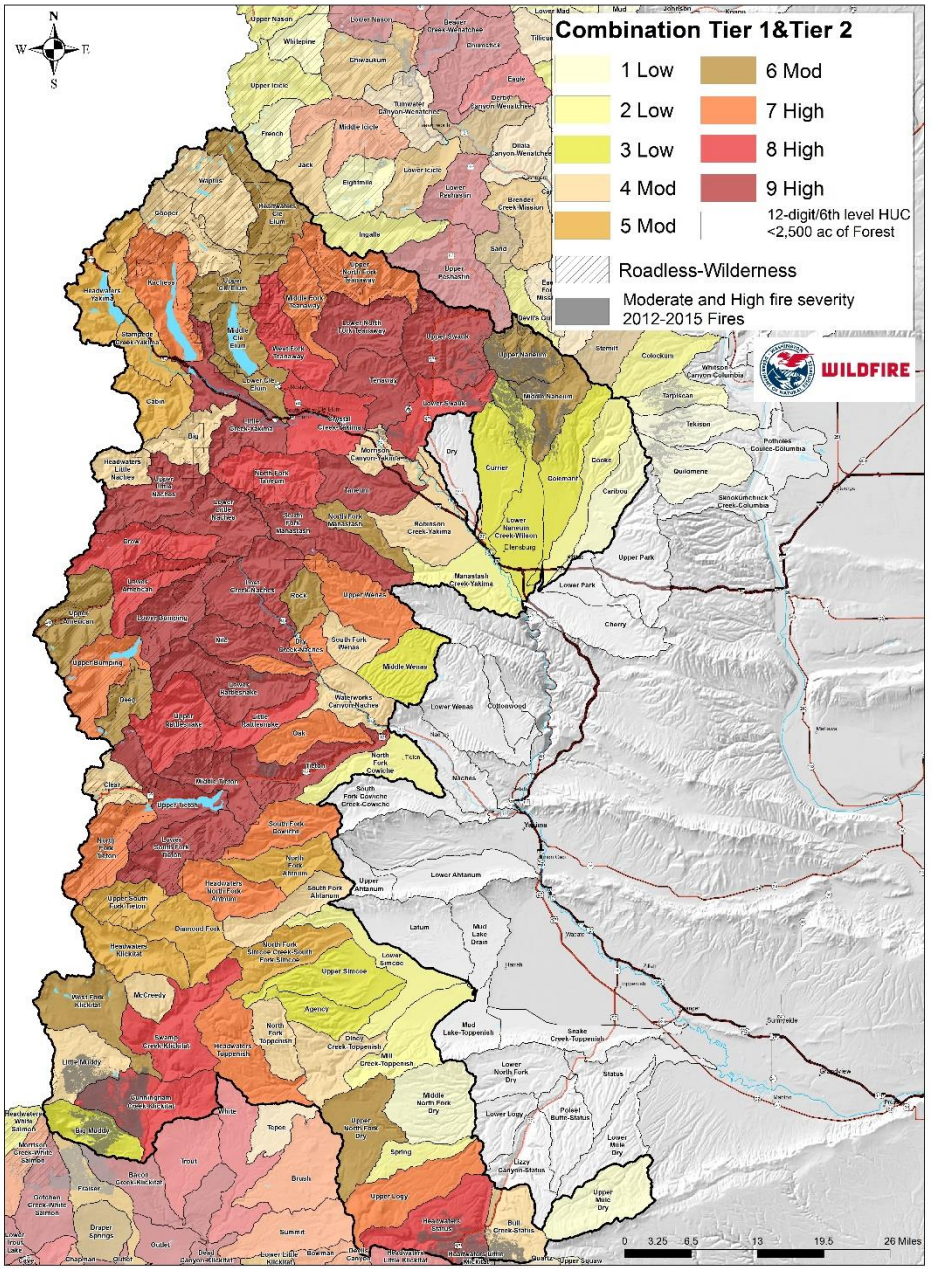


North Central Forest Health Collaborative



Tapash

Forest Health Priority 12-digit/6th level HUC Watersheds
20-Year Forest Health Strategic Plan
Tapash Collaborative Area

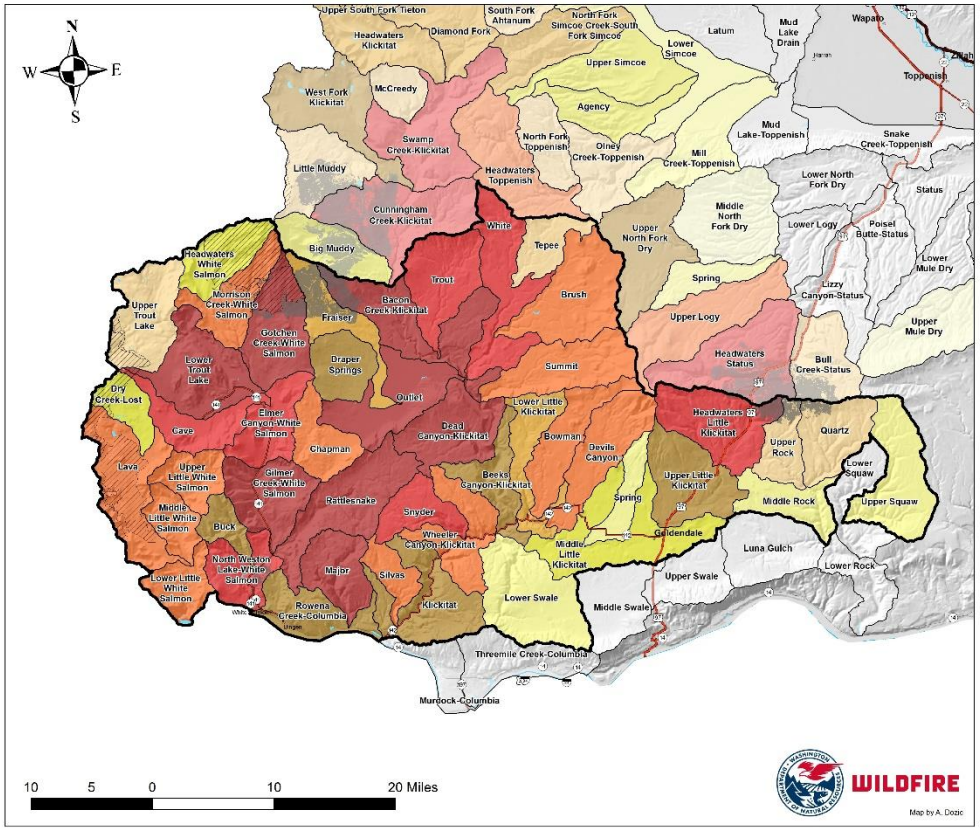


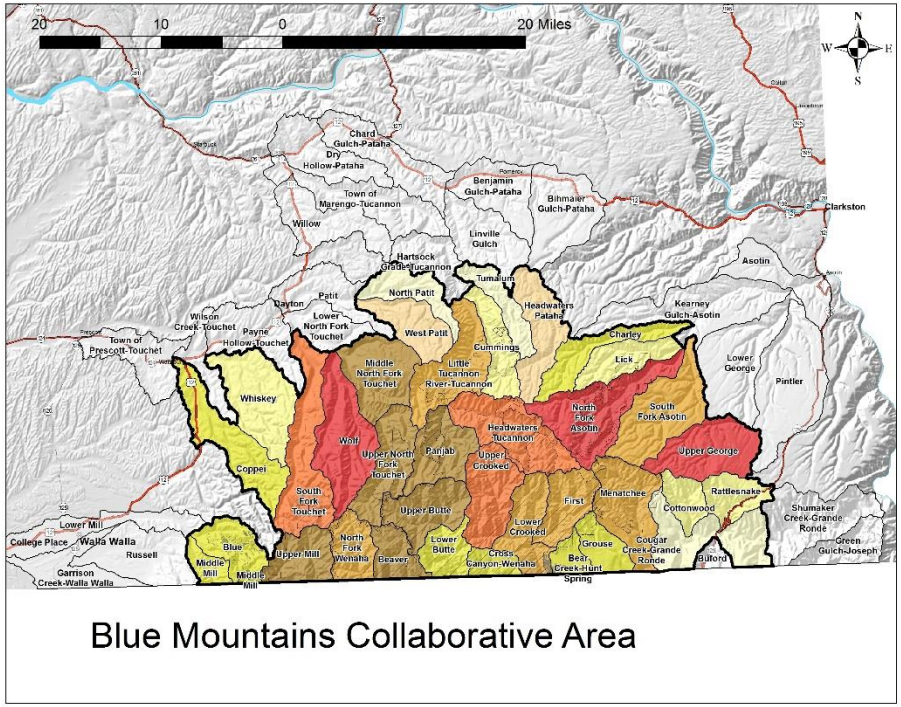
B6

South Gifford Pinchot & Blues

Forest Health Priority 12-digit/6th level HUC Watersheds
20-Year Forest Health Strategic Plan
South GP, and Blue Mountains Collaborative Areas

South GP Collaborative Area





Blue Mountains Collaborative Area

Combination Tier 1&Tier 2

1 Low	6 Mod
2 Low	7 High
3 Low	8 High
4 Mod	9 High
5 Mod	12-digit/6th level HUC <2,500 ac of Forest

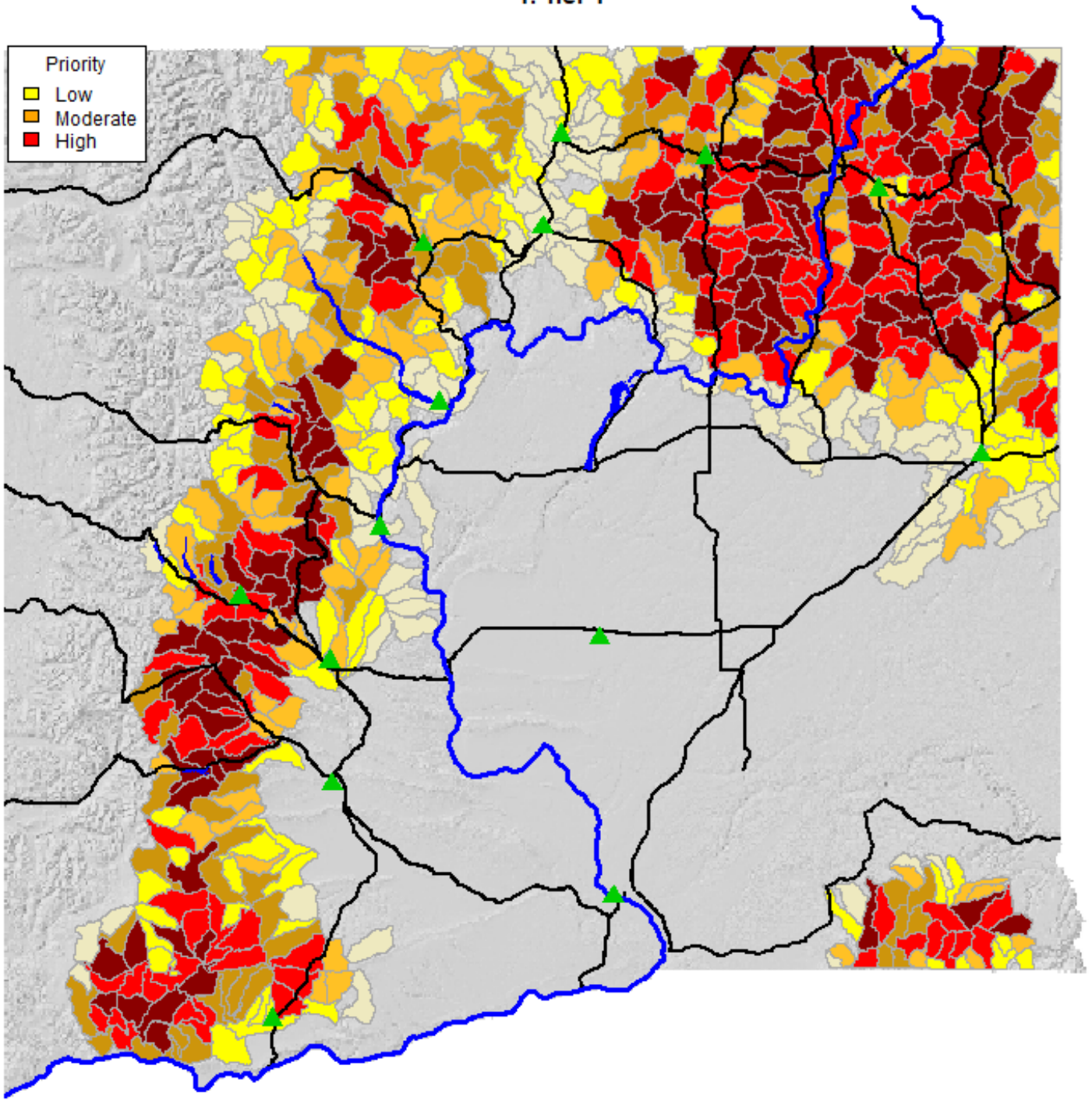
Roadless-Wilderness

Moderate and High fire severity 2012-2015 Fires

HUC 6 Ranking for all Metrics

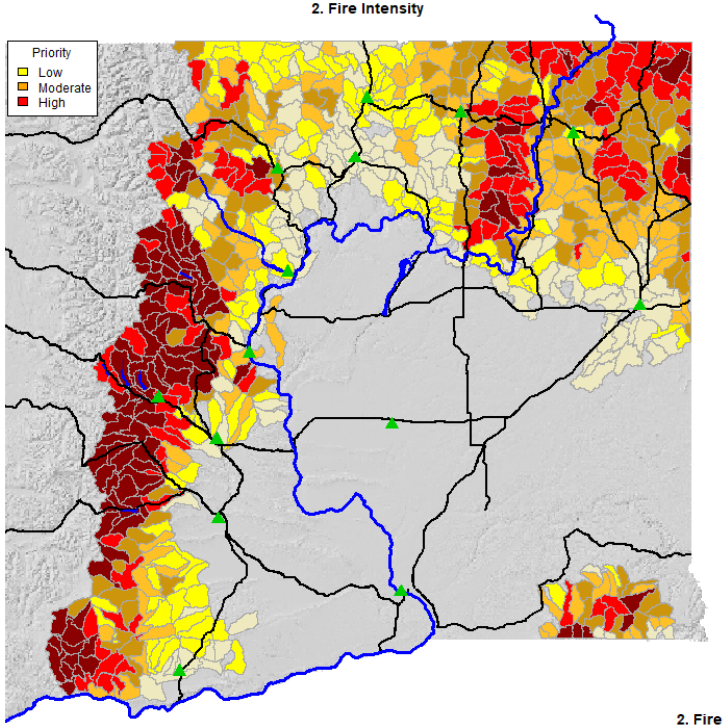
B8

1. Tier 1

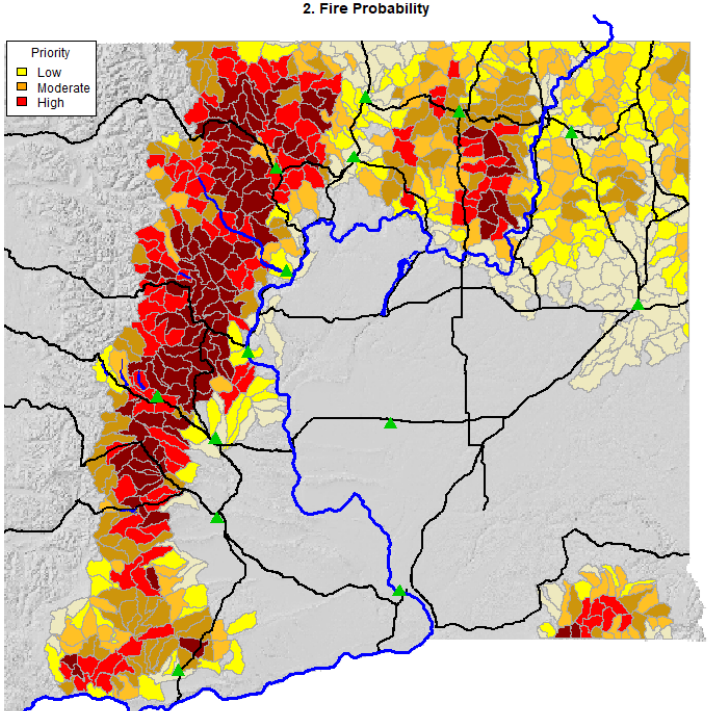


B9

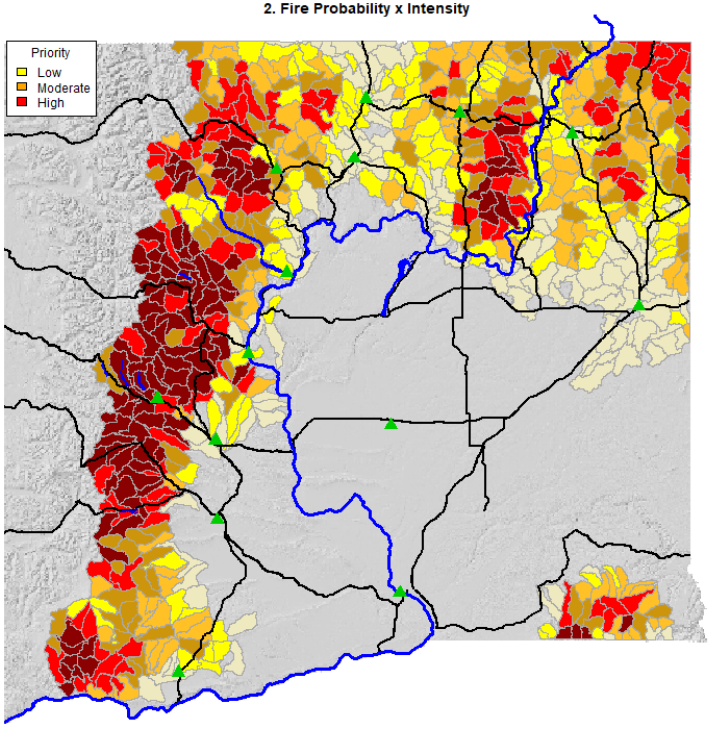
2. Fire Intensity



2. Fire Probability

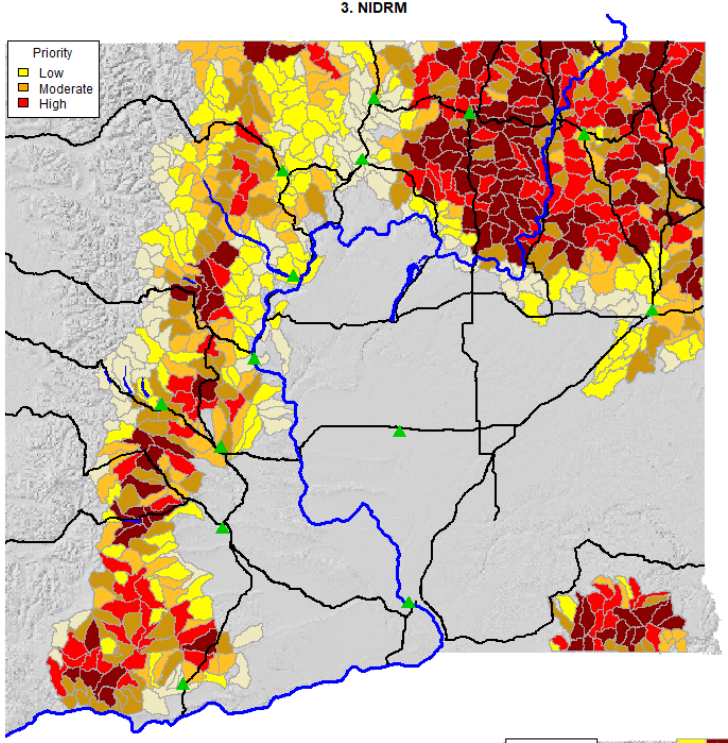


2. Fire Probability x Intensity

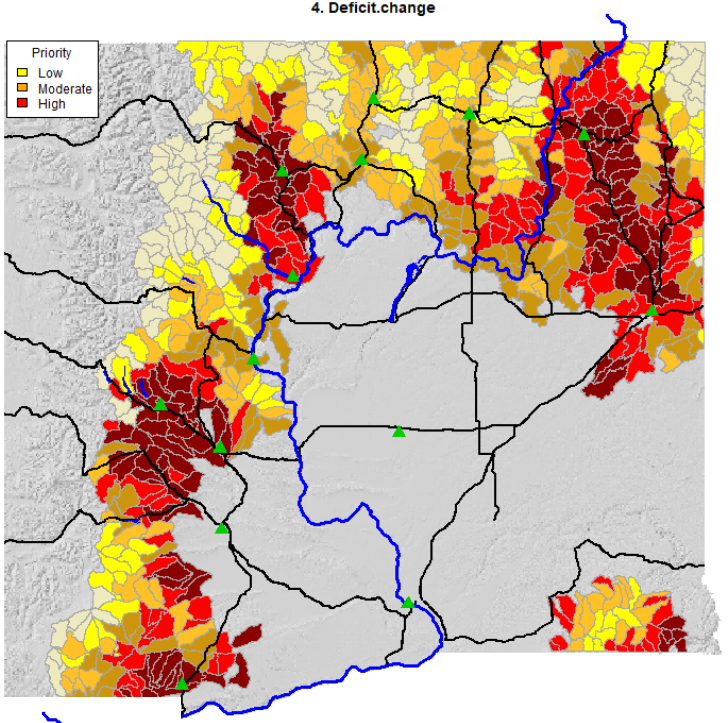


B10

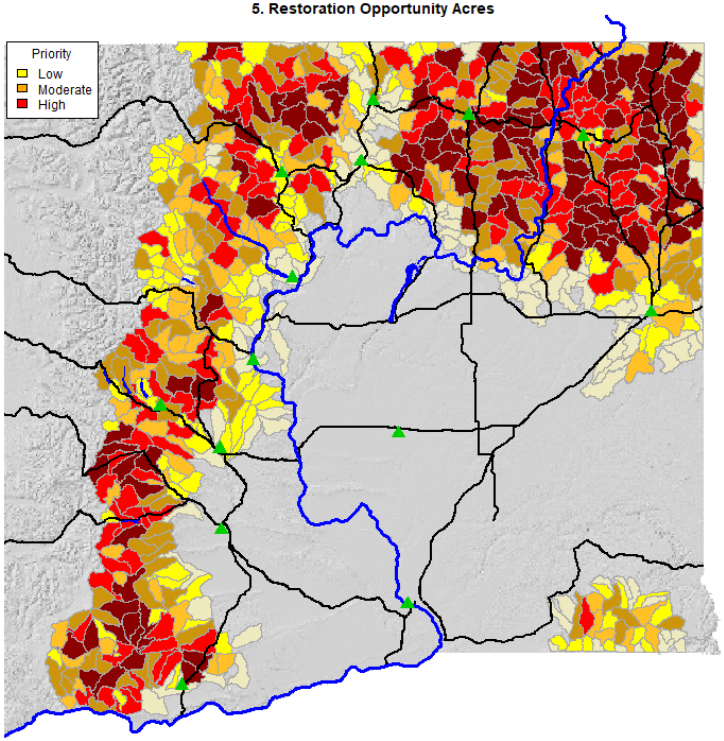
3. NIDRM



4. Deficit.change

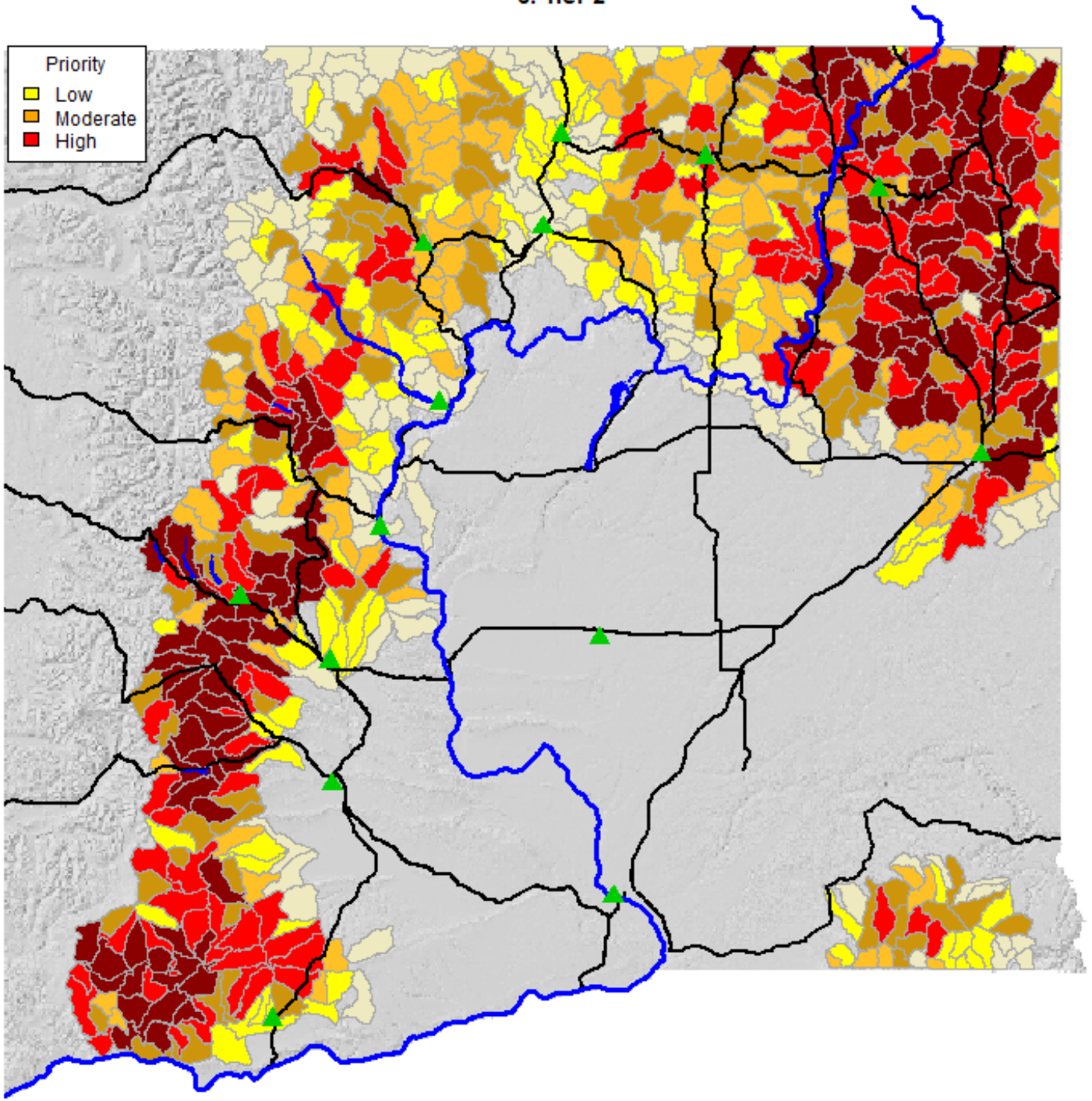


5. Restoration Opportunity Acres

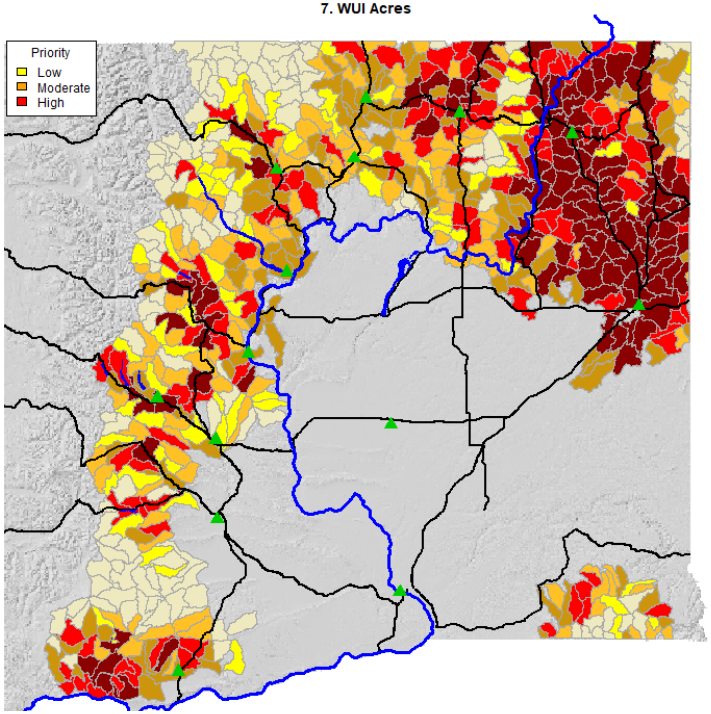


B11

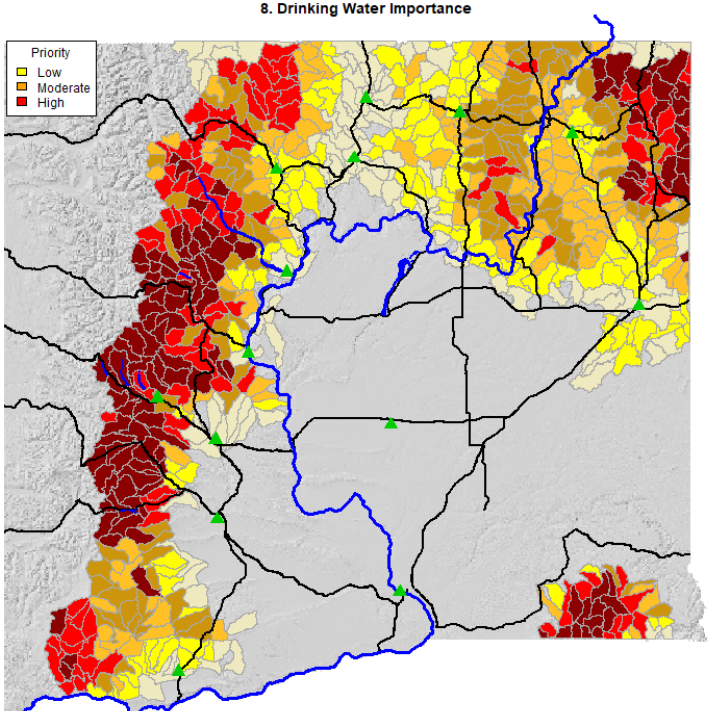
6. Tier 2



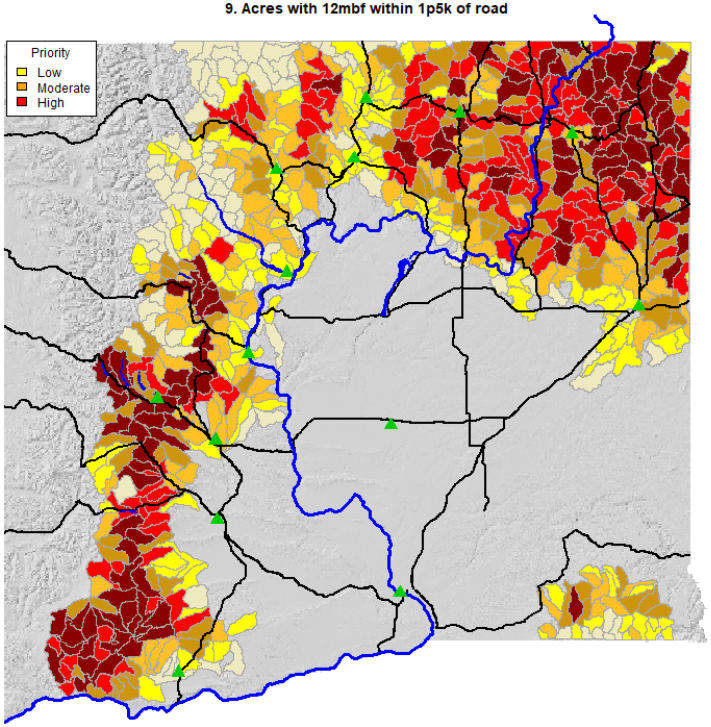
7. WUI Acres



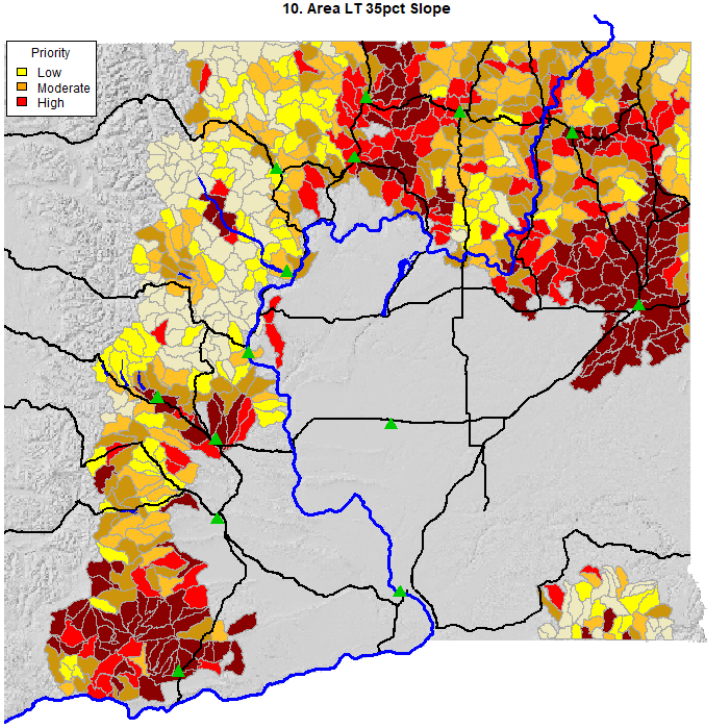
8. Drinking Water Importance



9. Acres with 12mbf within 1p5k of road

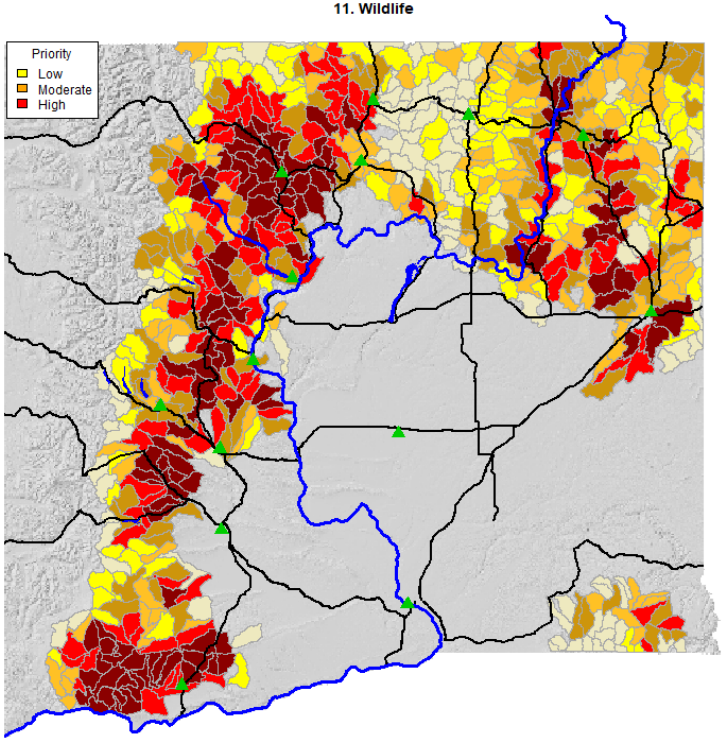


10. Area LT 35pct Slope

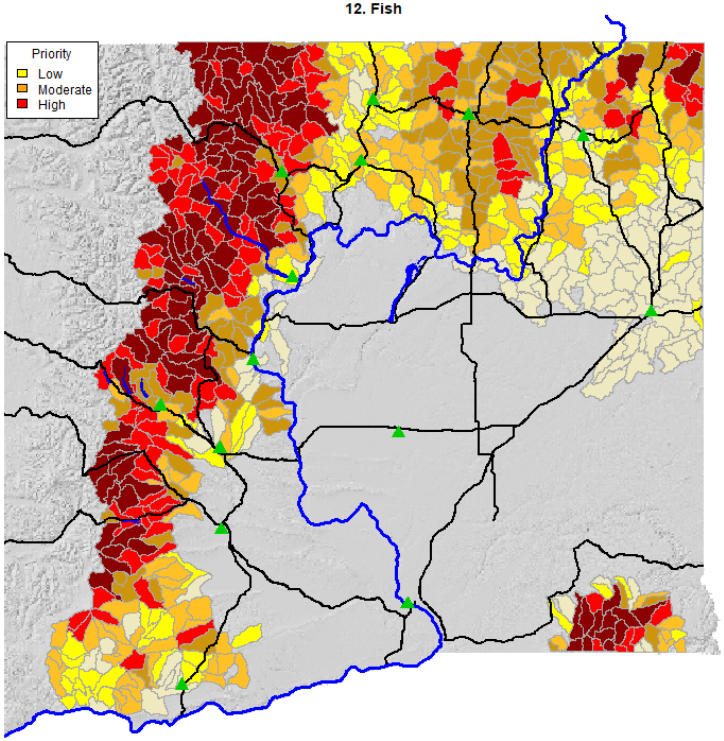


B13

11. Wildlife



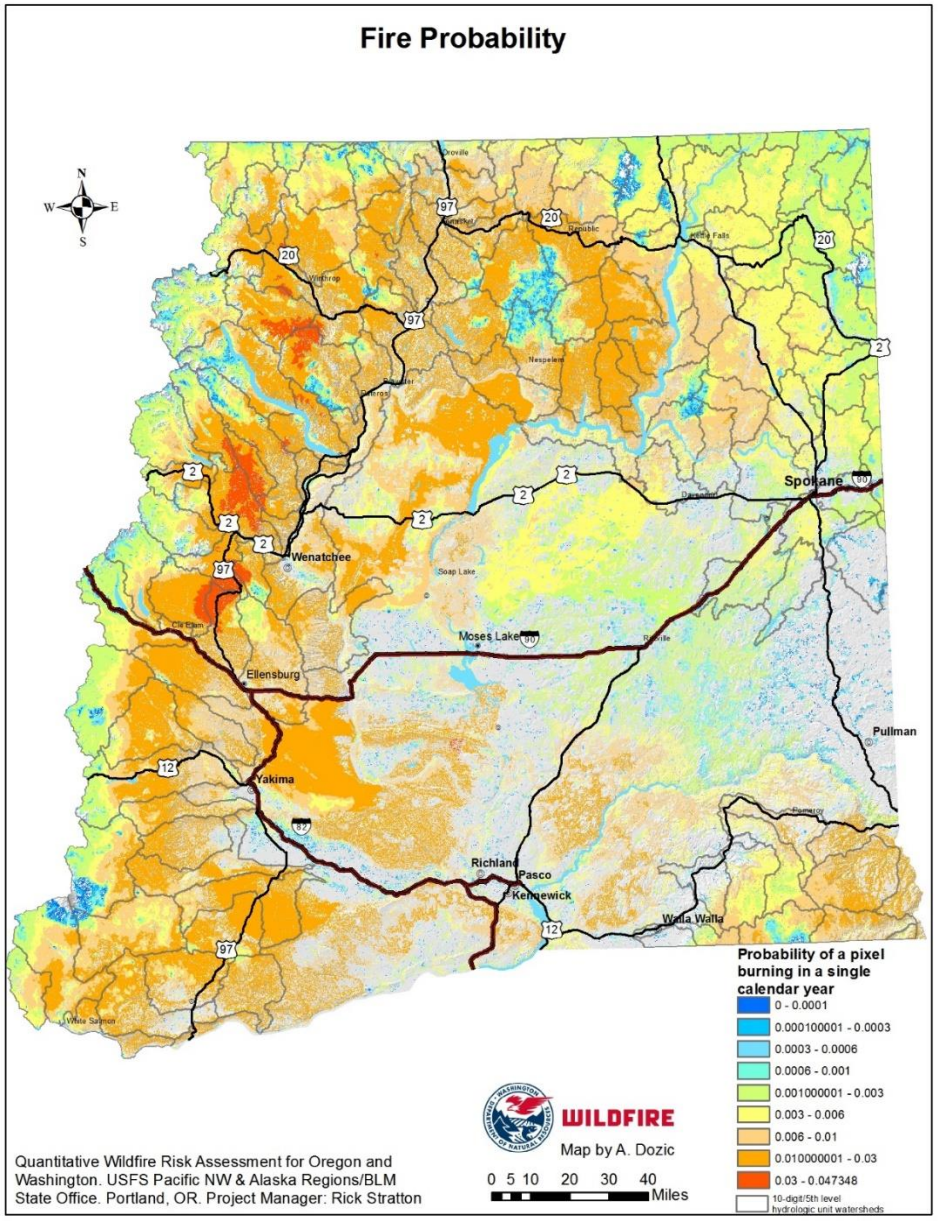
12. Fish

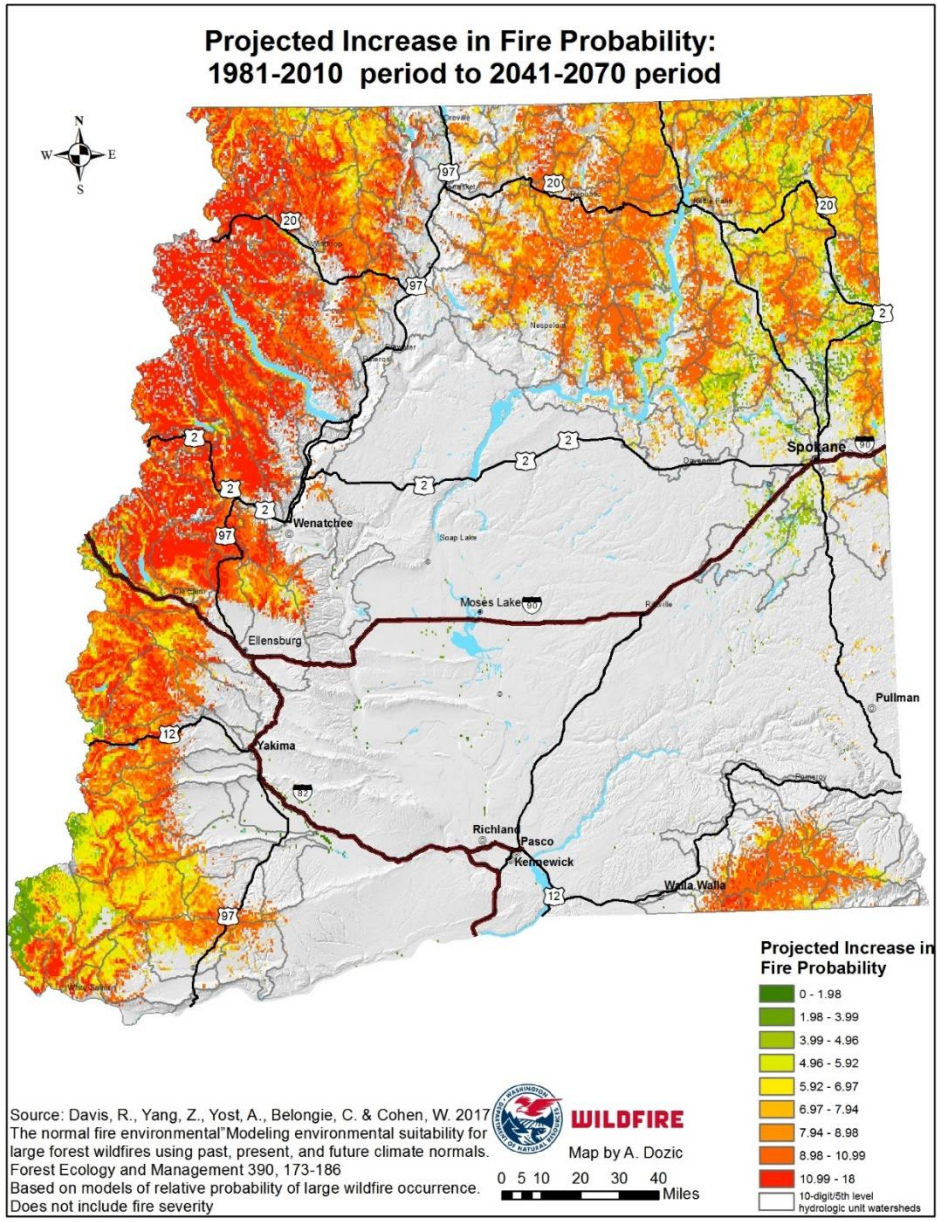


Data Layer
Maps

B15

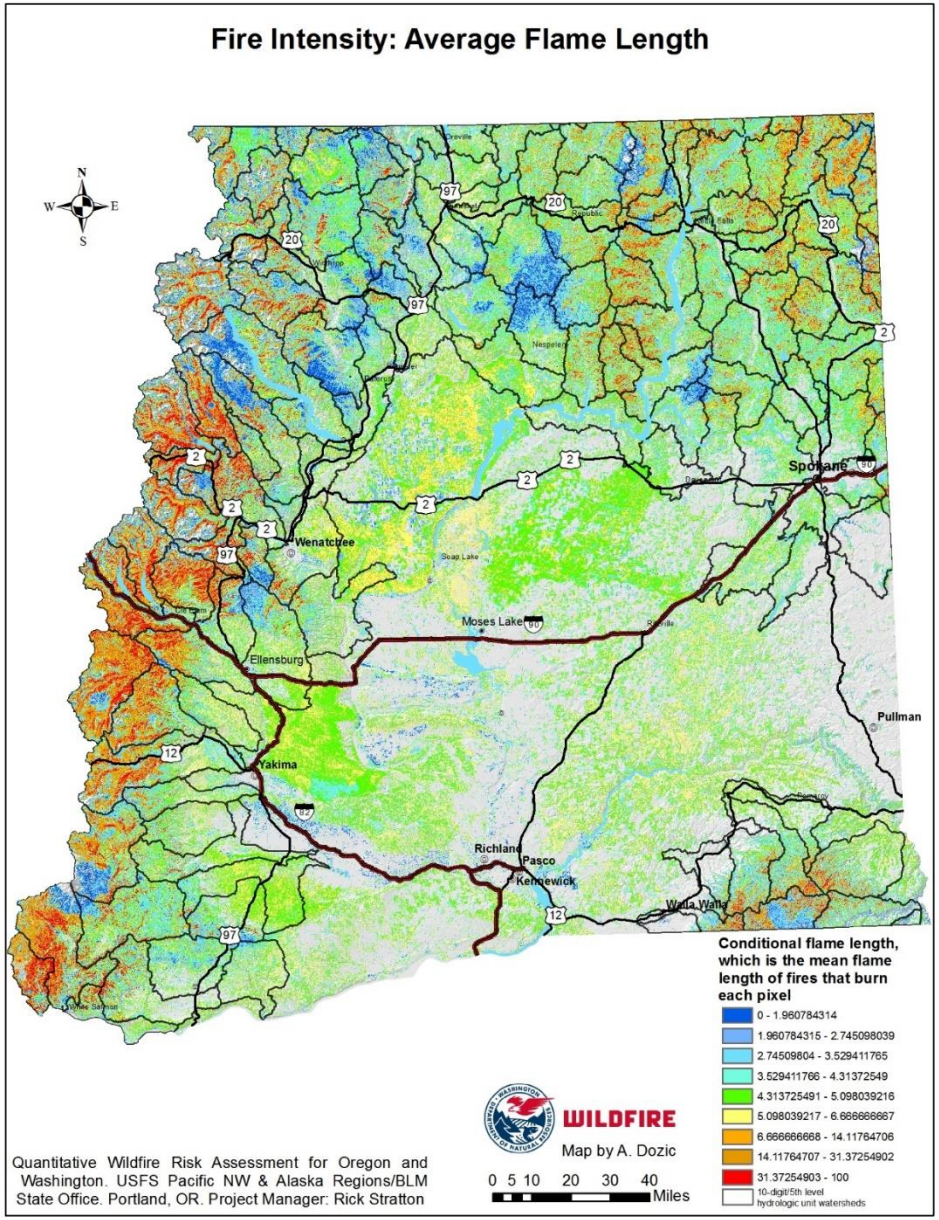
Tier 1: Fire Probability

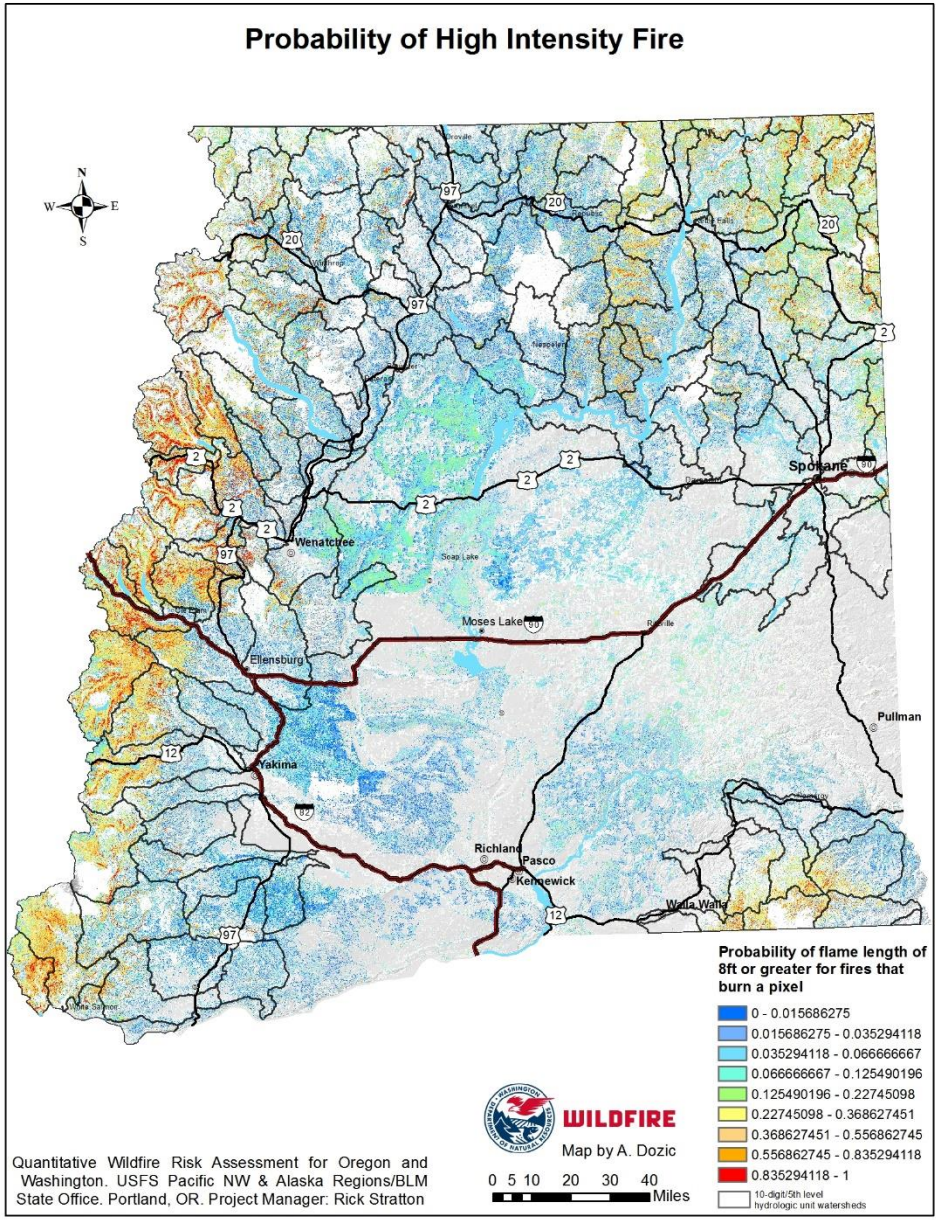




B16

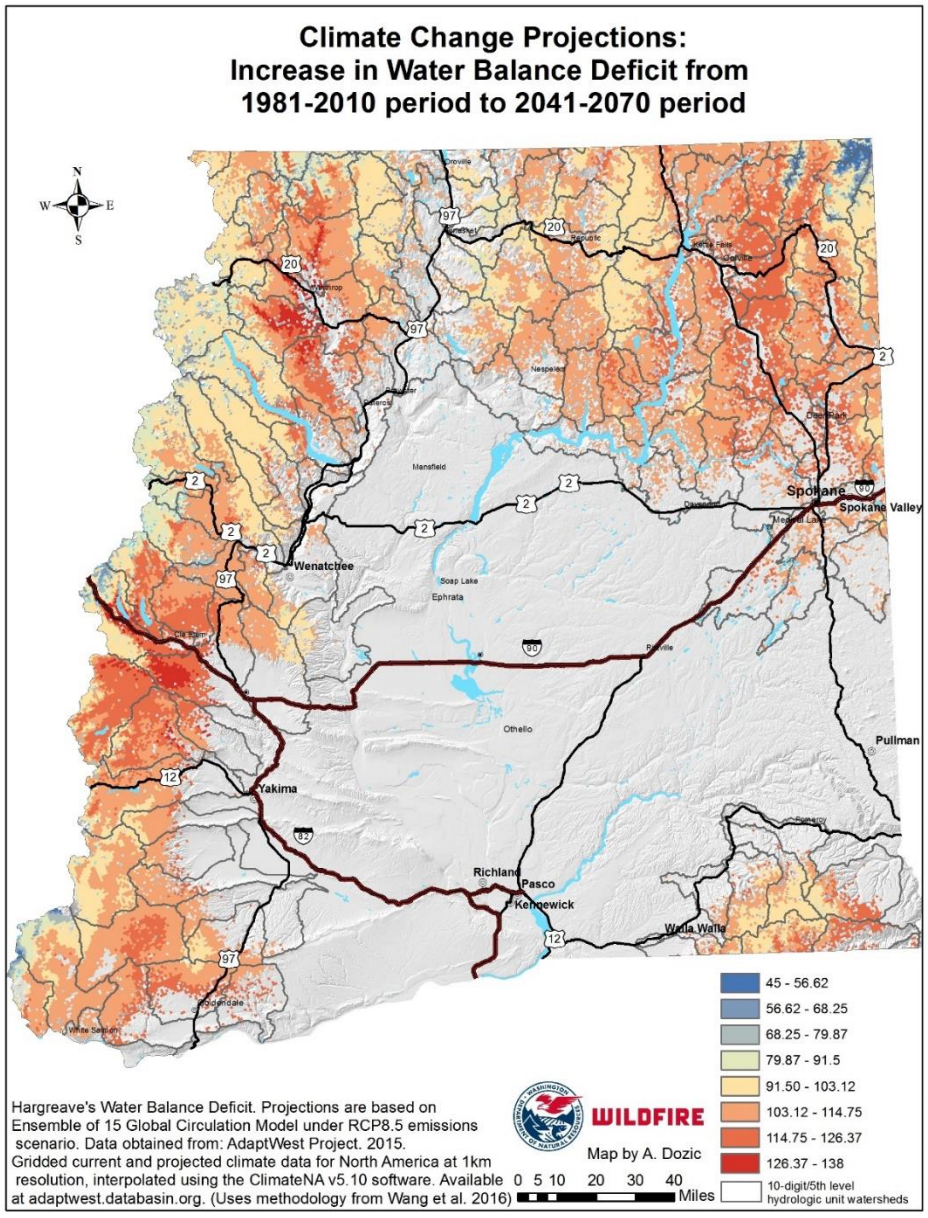
Tier 1: Fire Intensity

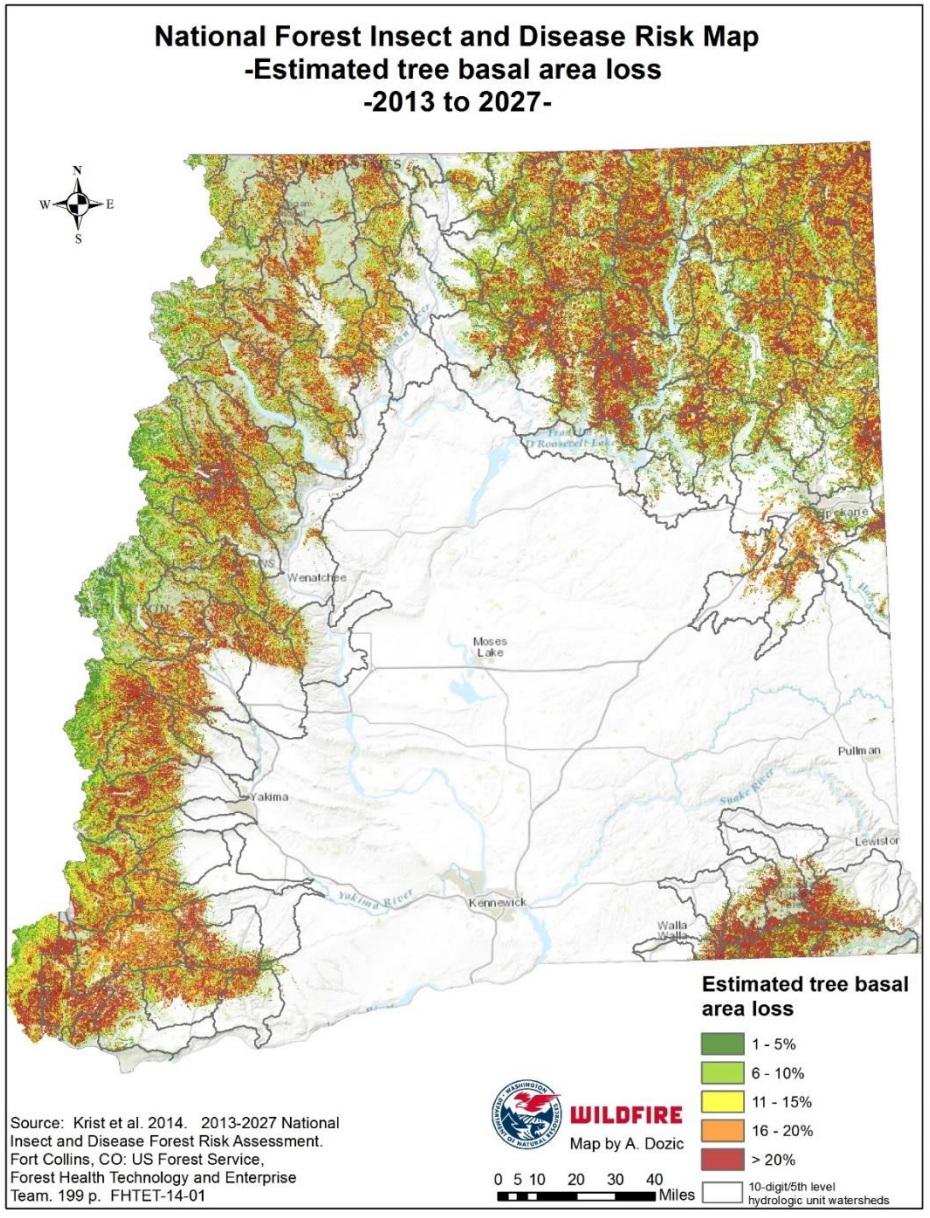




B17

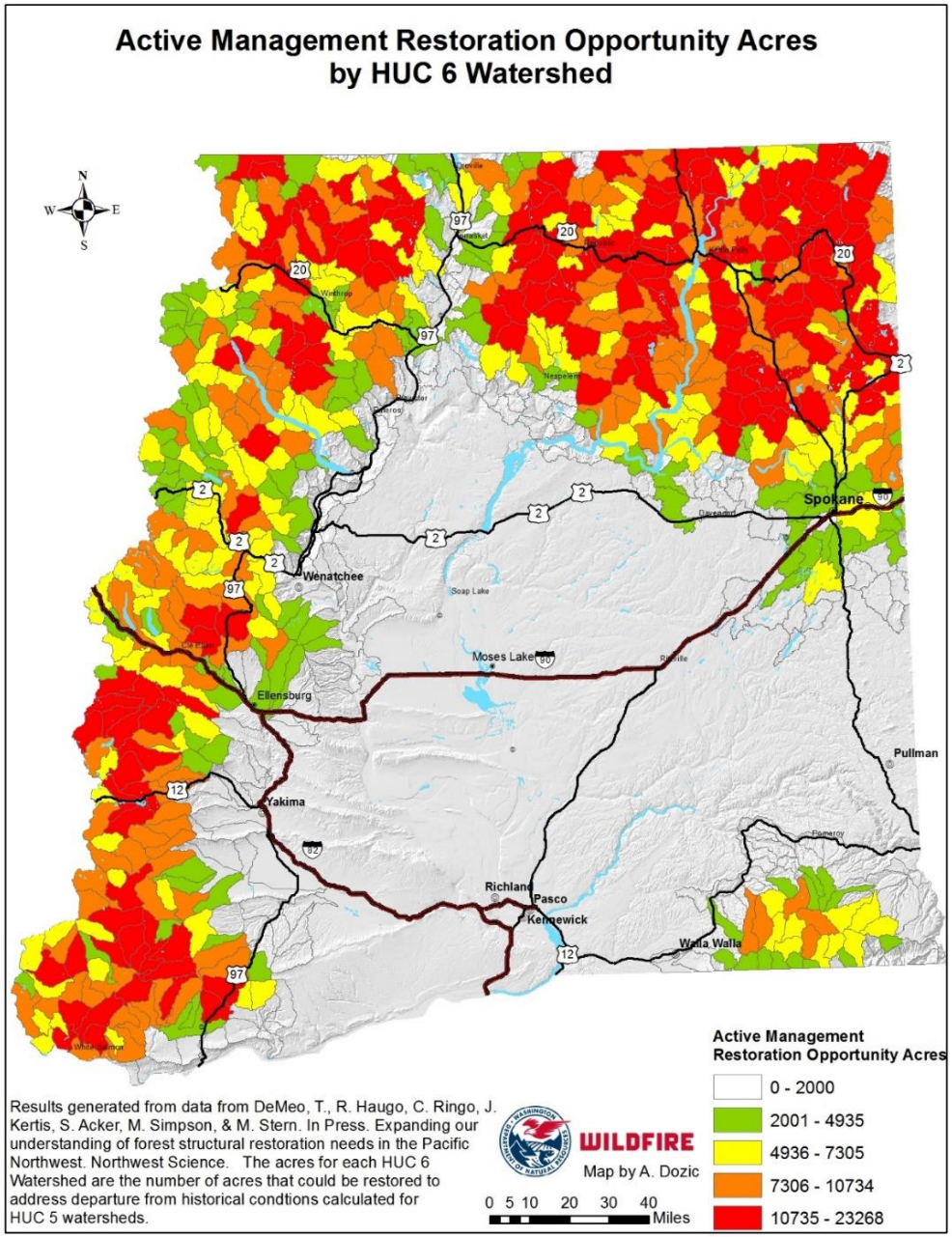
Tier 1: Climate Change – Insect & Disease



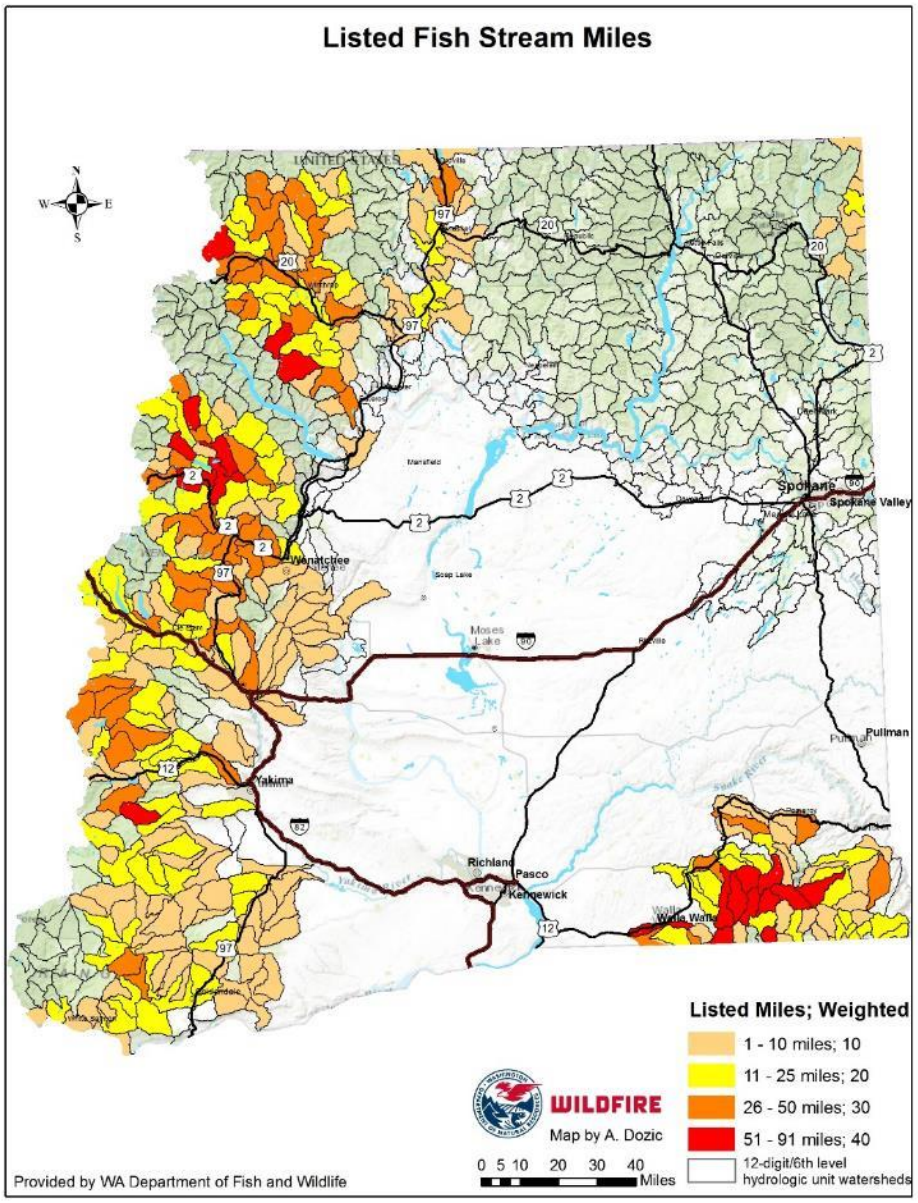


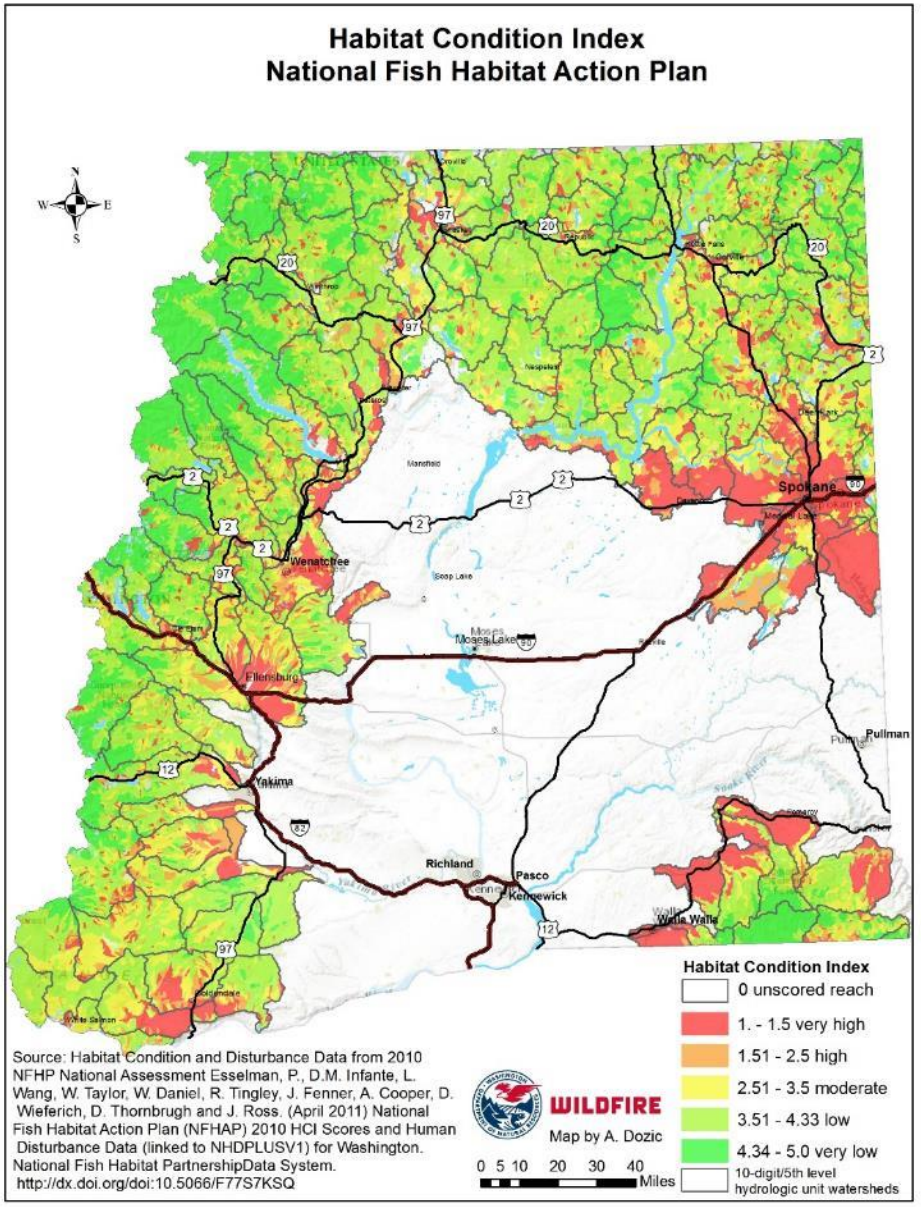
B18

Tier 1: Departure & Restoration Opportunity

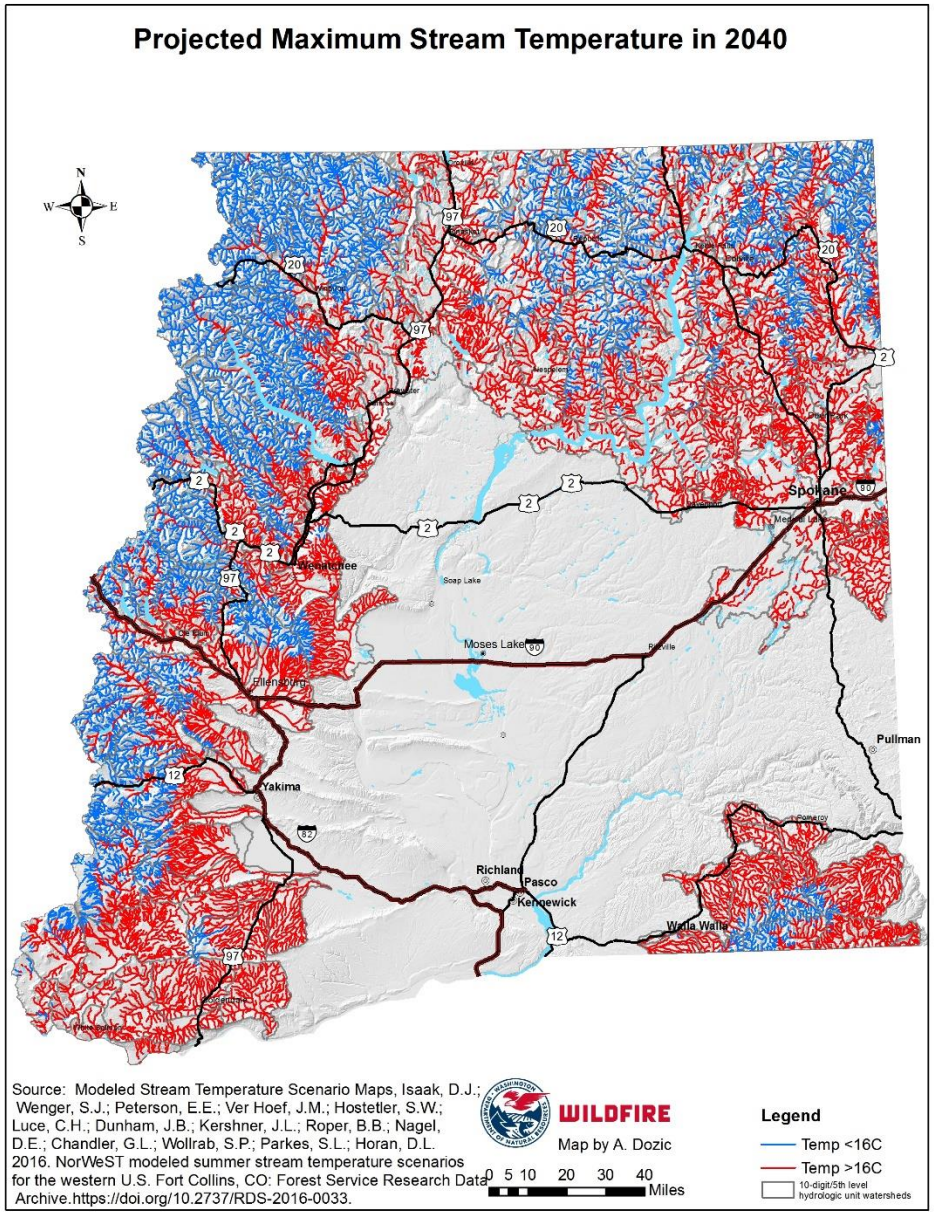


Tier 2: Aquatic Systems





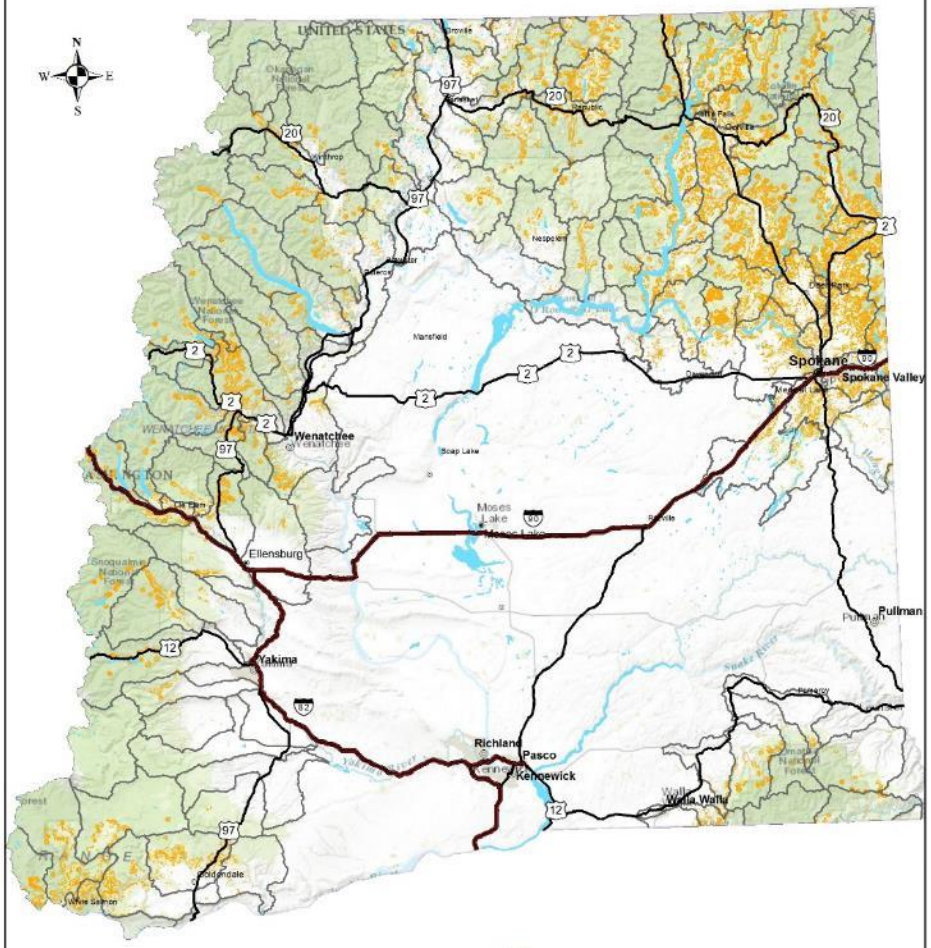
Tier 2: Aquatic Systems



B21

Tier 2: WUI & Drinking Water

Forested Wildland Urban Interface (WUI)



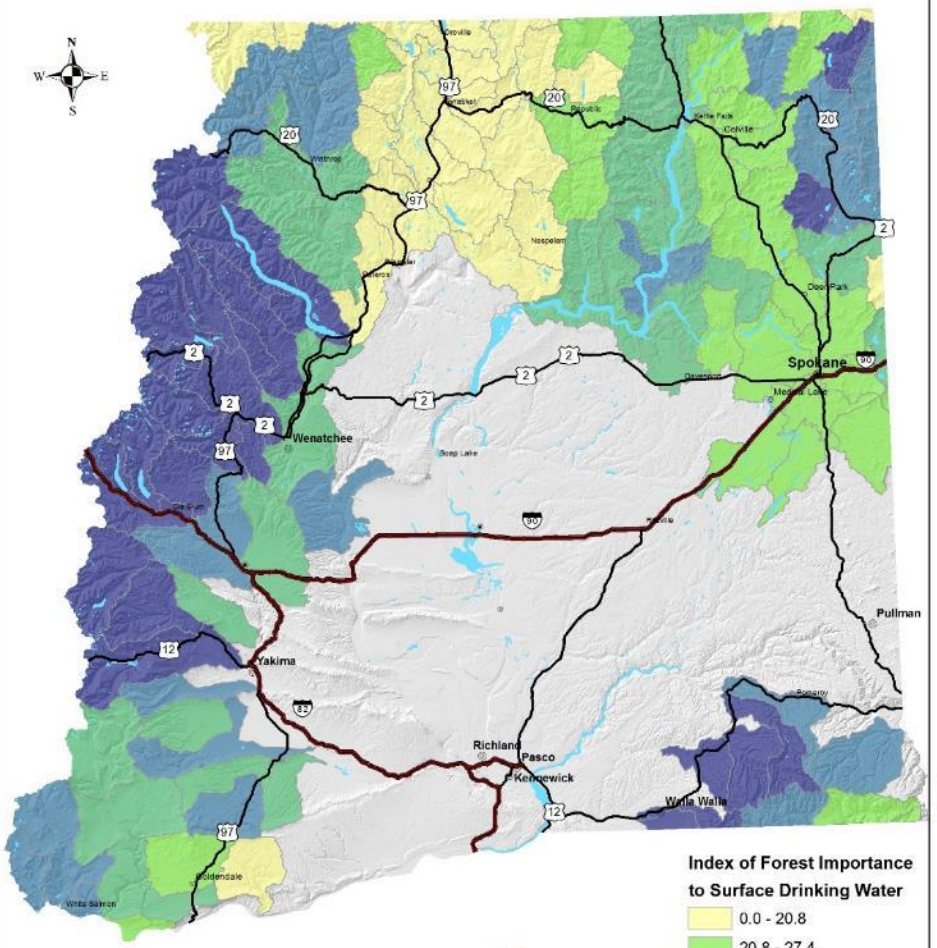
Source: This dataset was created by buffering all values of the Where People Live dataset used in the Westwide Wildfire Risk Assessment by 0.5 miles and then intersecting the buffered Where People Live dataset with forest land. This forested WUI layer was created to develop an estimate of forestland within the wildland urban interface

WILDFIRE
Map by A. Dozic

0 5 10 20 30 40 Miles

Forested Wildland Urban Interface (WUI)
Forested WUI
10-digit/5th level hydrologic unit watersheds

Forests to Faucets
Index of Forest Importance to Surface Drinking Water



Source:
USDA
https://www.fs.fed.us/ecosystemservices/FS_Efforts/forests2faucets.shtml

WILDFIRE
Map by A. Dozic

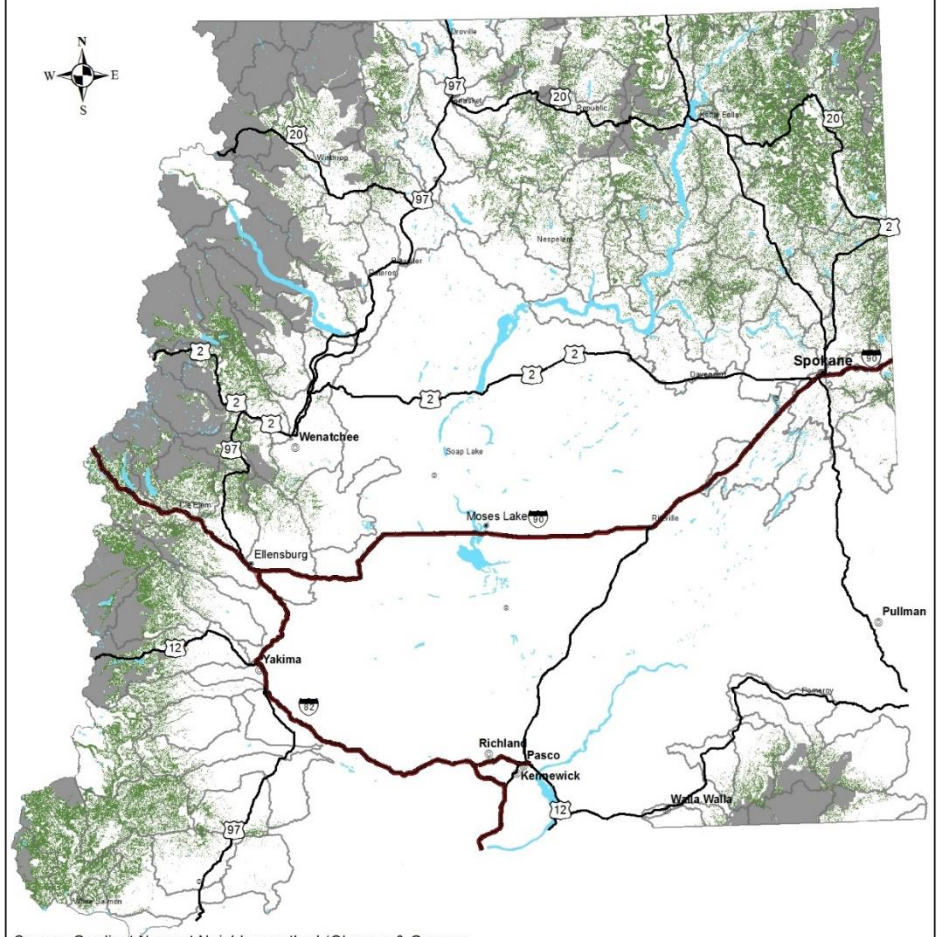
0 5 10 20 30 40 Miles

Index of Forest Importance to Surface Drinking Water
0.0 - 20.8
20.8 - 27.4
27.4 - 37.0
37.0 - 52.8
52.8 - 83.87
10-digit/5th level hydrologic unit watersheds

B22

Tier 2: Timber Volume and Access

Potential Commercial Treatment Acres within 1500' of Existing Roads



Source: Gradient Nearest Neighbor method (Ohmann & Gregory 2002, CJFR) for assigning forest inventory plot identities to unsampled (and sampled) spatial locations. Conversion from m3/ha to bf/acre done by refering to Measuring Timber Products Harvested from Your Woodland (P. Oester and S. Bowers) page 7 Table 4. Commercial volume is based on volume greather than 12 mbf/ac within 1,500 ft of a road. DNR road layers can be found: http://data-wadnr.opendata.arcgis.com/datasets?group_ids=878cfb11b9b04c35b0c966474efeeace

WILDFIRE

Map by A. Dozic

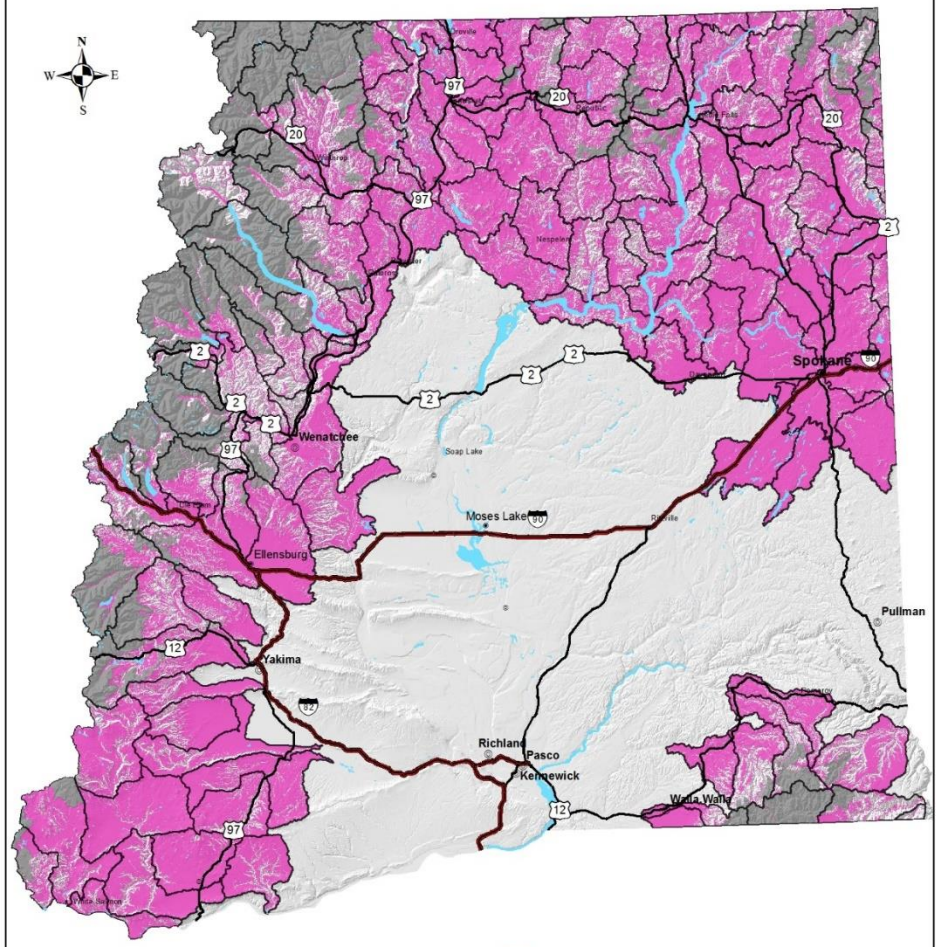
0 5 10 20 30 40 Miles

volume greather than 12mbf/ac within 1,500 ft of a road

Wilderness-Roadless

10-digit/5th level hydrologic unit watersheds

Area with Slope less than 35%



90m DEM of Washington USGS

WILDFIRE

Map by A. Dozic

0 5 10 20 30 40 Miles

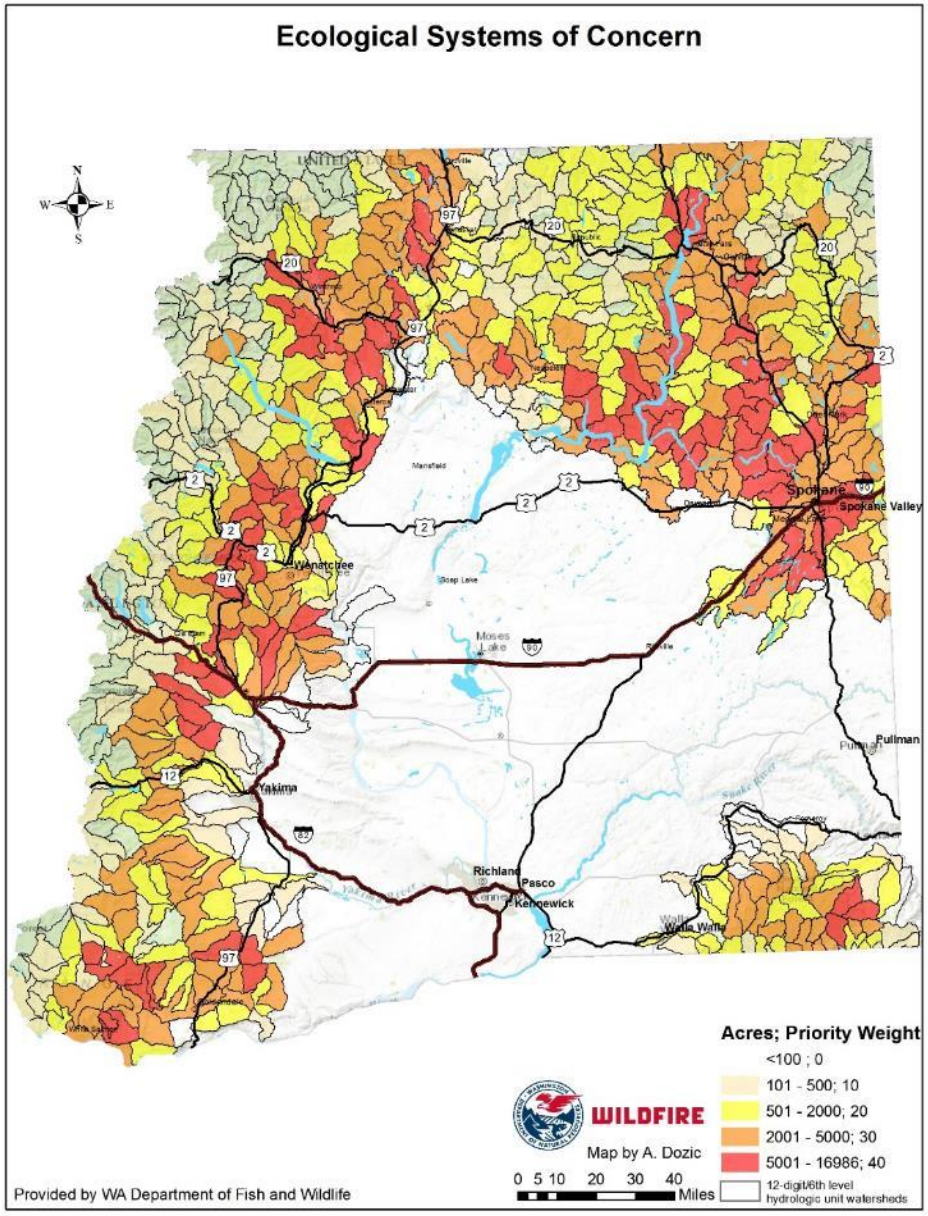
Wilderness-roadless

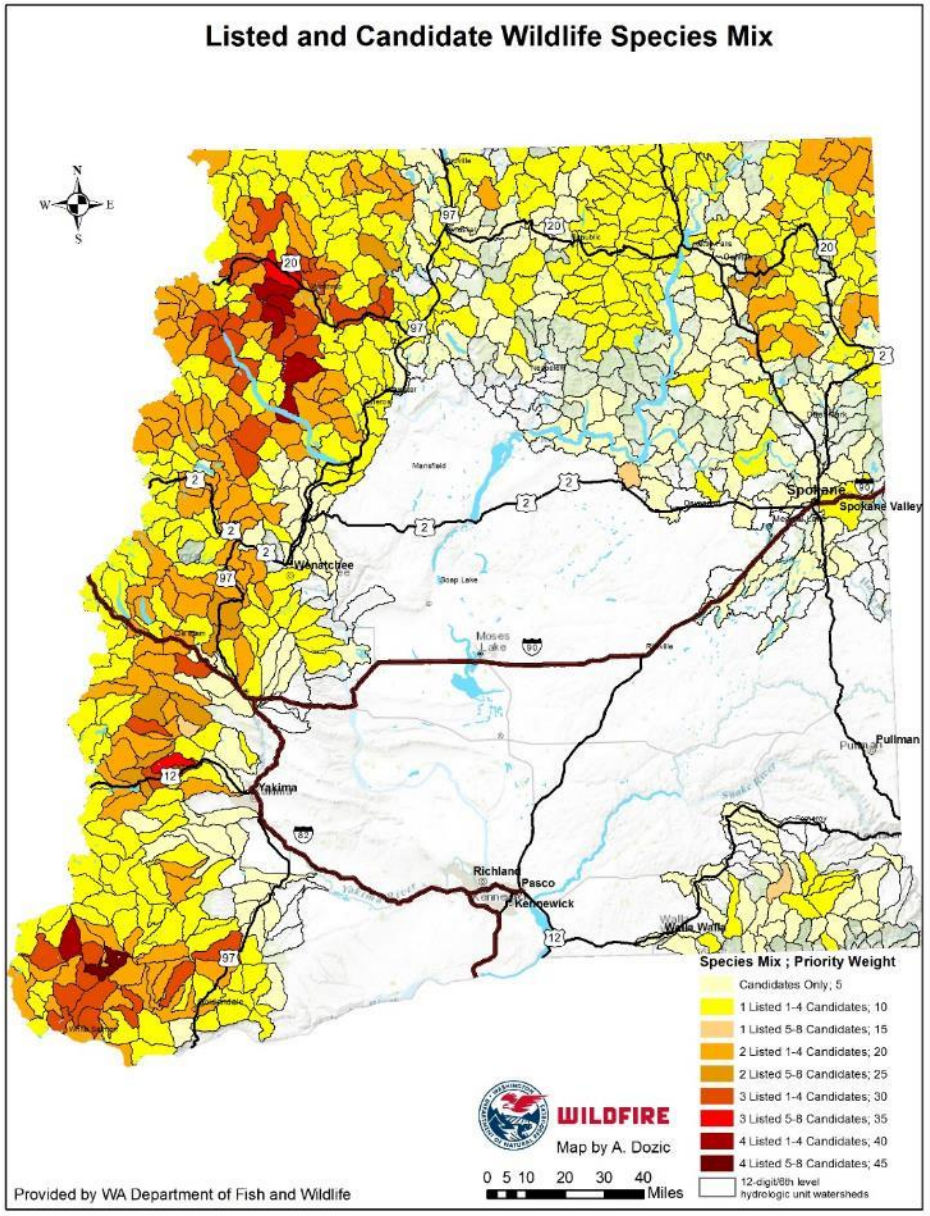
Slope less than 35%

10-digit/5th level hydrologic unit watersheds

B23

Tier 2: Wildlife





Appendix C

20-Year Forest Health Strategic Plan
Eastern Washington

2018 and 2020 Planning Areas and SB 5546 Forest Health Assessment and Treatment Workplan

Version 3 - November 2018

WASHINGTON STATE DEPT OF NATURAL RESOURCES

Introduction

Washington's 20-Year Forest Health Strategic Plan sets a goal of treating 1,250,000 acres over the next 20 years to improve the resilience of forests in eastern Washington. To accomplish this ambitious target, the Washington Department of Natural Resources (DNR) will work with landowners and stakeholders to select and treat 125,000 acres each biennium. The plan lays out a process for the DNR to strategically identify planning areas where state funding for forest health and restoration projects will be focused[1]. Planning areas will consist of 1-7 HUC 6 watersheds, which equates to approximately 15,000-200,000 acres. The SB 5546-Forest Health Assessment and Treatment Framework requires DNR to assess a minimum of 200,000 acres of fire prone lands and communities each biennium to identify forest health treatment needs and develop a prioritized list of treatments to include in an appropriations request.

The purpose of this document is to describe the process DNR undertook to identify planning areas for the 2018 and 2020 planning cycles as well as describe the work plan for implementing SB 5546 Forest Health Assessment and Treatment Framework.

SB 5546 Forest Health Assessment and Treatment Framework Workplan

Identifying forest health treatment needs and locations to accomplish the goals of the 20-Year Forest Health Strategic Plan will follow the general steps shown in figure 1 below. For more details on these steps please see pages 22-23 and Appendix 1 of the strategic plan.

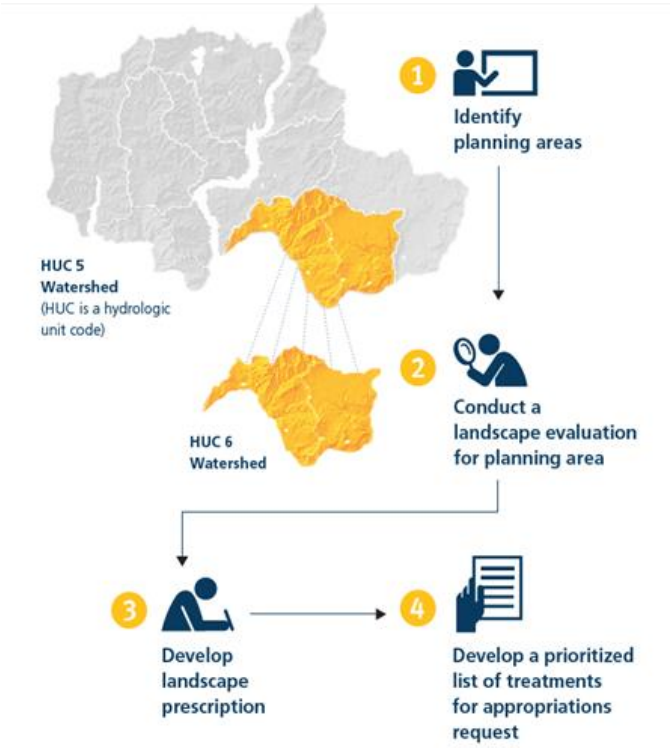


Figure 1: Steps to accomplish treatment goals of 20 Year Plan.

[1] For a full description of this process, see Appendix 1-II of the 20 Year Forest Health Strategic Plan. https://www.dnr.wa.gov/ForestHealthPlan

In March 2018, DNR finished the process of identifying planning areas to evaluate for forest health treatment needs for the 2018 and 2020 planning cycles (Step 1 in Figure 1). To guide this process, the DNR first completed a data driven prioritization of HUC 6 watersheds in December of 2017. This prioritization assessed fire risk, restoration need, aquatic function, economic potential, wildlife habitat, and other resources across all forested HUC 6 watersheds in eastern Washington. DNR staff then met with US Forest Service staff, DNR regional staff, and other local stakeholders in Wenatchee, Colville, Moses Coulee and Trout Lake in January 2018 to present the HUC 6 watershed prioritization and gather feedback on which watersheds would be good candidates for planning areas.

In February 2018, DNR shared draft proposed planning areas with the Forest Health Advisory Committee, forest collaboratives, US Forest Service, Tribes, WA Department of Fish and Wildlife, DNR staff, and many other partners. The proposed planning areas were based on the HUC 6 prioritization and feedback received from the meetings and conversations with local stakeholders. DNR then solicited and received extensive feedback on the proposed planning areas from these same partners. In October 2018, DNR met with the Umatilla National Forest and selected two planning areas to add to the 2020 planning cycle in the Blue Mountains. The DNR incorporated this feedback to produce the final list of planning areas for the 2018 planning cycle, as well as areas for 2020 (Figures 3 and 4 and Table 1).

Now that the final planning areas are selected for the 2018 cycle, landscape evaluations will be conducted in each planning area to assess forest health conditions and determine treatment needs (Step 2 in Figure 1). A landscape evaluation is a data driven approach to understanding the current conditions of a landscape and its level of resilience to future disturbances and climatic change. In watersheds where similar types of evaluations have recently been completed by other landowners (e.g. US Forest Service Landscape Evaluations or Environmental Assessments), the DNR will seek to complement the existing evaluations where needed.

The information from the evaluations will then by synthesized into a landscape prescription that lays out treatment targets and identifies potential treatment locations (Step 3 in Figure 1). The DNR will then work closely with local managers and stakeholders to recommend and prioritize specific treatments for each planning area. These recommendations will be submitted to the Forest Health Advisory Committee and then packaged into an appropriations request to the state legislature (Step 4 in Figure 1). The timeline for evaluating treatment needs for 2018 planning areas is short. A number of meetings and check-in points with local partners will be needed in the over the remainder of 2018. A timeline of the process and meeting dates is shown below (Figure 2).

Each even-numbered year, DNR must submit a forest health treatment appropriations request to the Legislature to fund treatments in the following biennium. The DNR's first forest health appropriations request using the SB 5546 Forest Health Assessment and Treatment Framework will be in the fall of 2018 for the 2019-2021 biennium. Thus for 2018 planning areas, the DNR will be analyzing and prioritizing treatments during 2018 for an appropriations request in the Fall 2018 for funding in the 2019- 2021 biennium. Funds for treatments will be available beginning in July of 2019. For 2020 planning areas, DNR will be analyzing and prioritizing treatments in 2019 and 2020 for an appropriations request in 2020 for funding in the 2021-2023 biennium. Funds for treatments will be available beginning in July of 2021.

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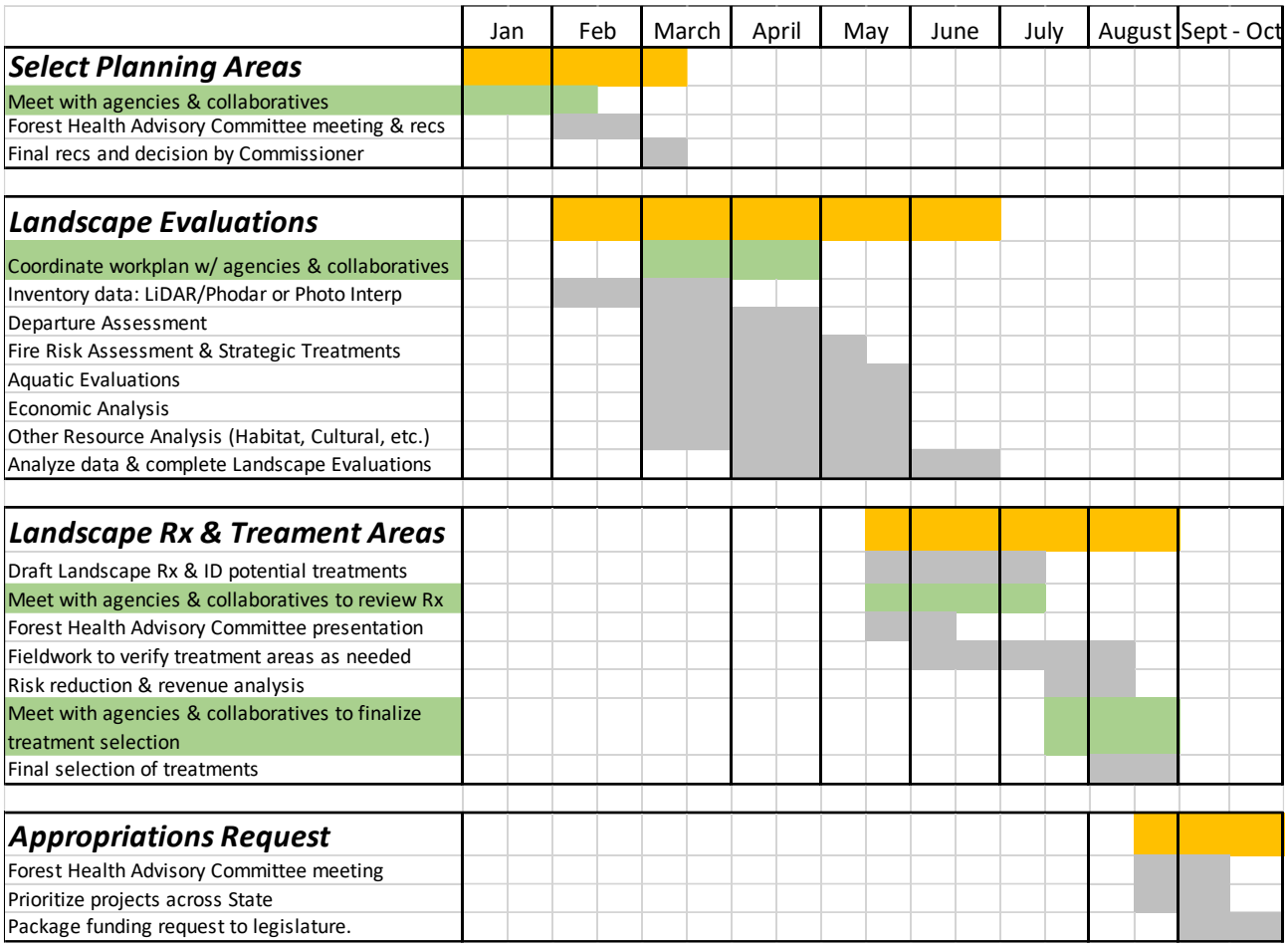

Figure 2: Timeline for SB 5546 Forest Health Assessment and Treatment Framework Implementation in 2018

2018 and 2020 Planning Areas

Below are maps (Figures 3 and 4) depicting the final planning areas for the 2018 funding cycle under SB 5546 Forest Health Assessment and Treatment Framework, as well as areas for 2020. As described in the preceding section, these planning areas are based on extensive local stakeholder feedback and the HUC 6 prioritization conducted by DNR. There are 33 planning areas for the 2018 and 2020 funding cycles. For the 2018 funding cycle, the planning areas contain approximately 1 million acres of forestland. Almost all of these planning areas consist of multiple HUC 6 watersheds.

As is evidenced by Figure 4, the vast majority of the HUC 6 watersheds contained in these planning areas are high priority watersheds based on DNR's HUC 6 prioritization. Table 1 describes some attributes of these planning areas including the acres of forestland and land ownership. Table 1 also describes the stage of NEPA planning on US Forest Service lands in the planning area, DNR's planning role, and what DNR would likely be requesting in the appropriations request. DNR's planning role and potential appropriations request will vary depending on the stage of NEPA planning on US Forest Service Lands:

1. New Planning Area or Very Early US Forest Service NEPA

- DNR Role: Conduct all lands landscape evaluation to identify forest health treatment need across all lands. The landscape evaluation will provide baseline analysis of landscape conditions and treatment needs that could be used by the US Forest Service in their pre-NEPA planning process and potentially move the NEPA planning timeline forward for the planning area. In cases where a National Forest has conducted or will conduct a landscape evaluation, the DNR will collaborate with USFS staff to expand the evaluation and prescription to private and state lands.

- Potential appropriations request: DNR would request funding for private and state forest health treatment needs in the planning area. DNR could potentially request funding to fund full NEPA planning on US Forest Service lands in the planning area if it is likely that the result of the NEPA planning will achieve the 20-Year Forest Health Strategic Plan's mission of landscape-scale forest resilience. DNR could also potentially request funding for surveys and data needs (such as LiDAR) necessary for full NEPA planning in the planning area.

2. Mid-Course NEPA Planning

- DNR Role: In areas where the US Forest Service is already in the process of NEPA planning, DNR's primary role would to evaluate forest health treatment needs on non-US Forest Service lands and coordinate treatment planning among landowners. DNR would also evaluate all lands to ensure achievement of risk reduction goals in the planning area.

- Potential appropriations request: DNR would request funding for private and state forest health treatment needs in the planning area.

3. NEPA Planning Completed (Signed Decision)

- DNR Role: In areas where the US Forest Service has completed NEPA and there is a signed decision, DNR's primary role would be to evaluate forest health treatment needs on non-US Forest Service lands and coordinate treatment planning among landowners. DNR would also evaluate all lands to ensure achievement of risk reduction goals in the planning area.

- Potential appropriations request: DNR would request funding for private and state forest health treatment needs in the planning area. DNR could also request funding for US Forest Service forest treatments needs in the planning area. DNR will only request funding for US Forest Service treatments when there is a signed decision.

The exact boundaries of the 2018 planning areas (Figures 3 & 4) may be modified in some cases during the landscape evaluation process due to data availability, resource conditions, capacity, and other factors. In addition, the 2020 planning areas are subject to change as planning and implementation of the 20 Year Plan further develops.

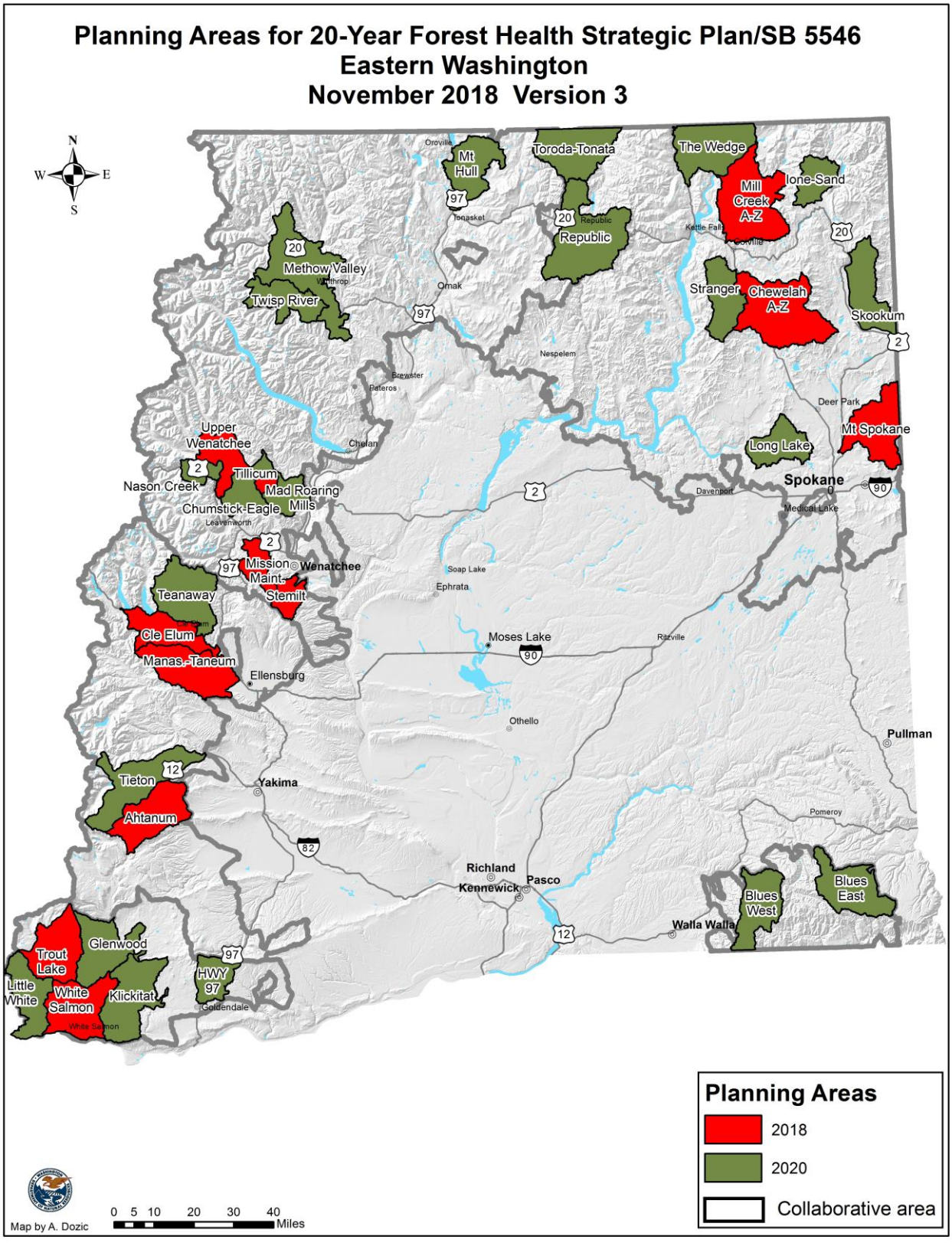

Figure 3: 2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546

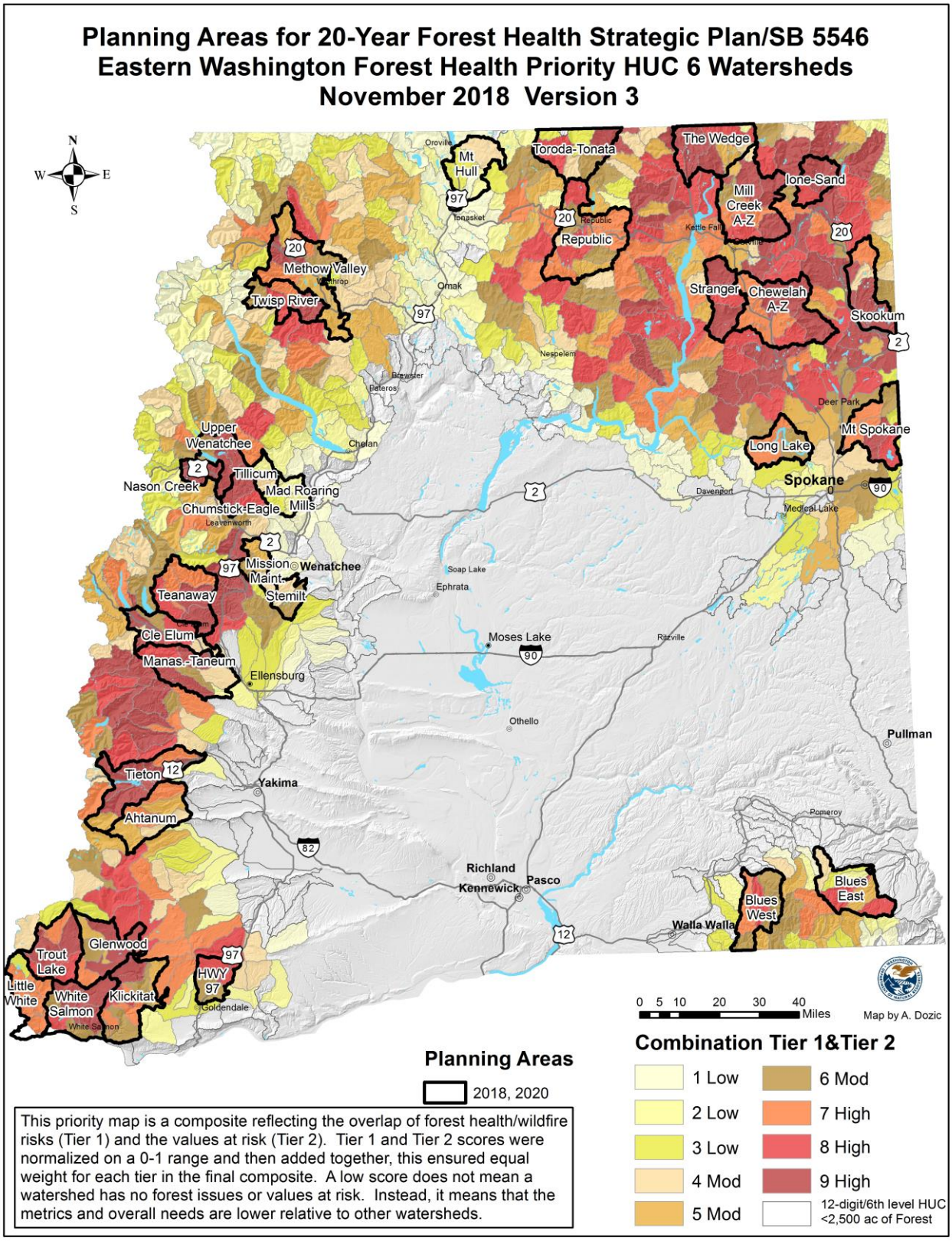

Figure 4: 2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 and priority ranking of HUC 6 Watersheds based on multiple resources.

Table 1: 2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546

2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	**FS Planning Stage**	**Request Year**	**DNR Planning Role**	**Funding Request**	**Priority Score (0-3)**	**Total Acres**	**Forested Acres**	**Federal**	**State**	**Private & Other**
Northeast Washington										
Chewelah A-Z	Very early - next A-Z project	2018	Conduct landscape evaluation and landscape Rx	Treatments on private and State	2.8	195,408	151,500	54%	5%	41%
Mill Creek A-Z	Complete - implementation in progress	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.5	186,305	158,574	32%	11%	57%
Mt Spokane	None - no FS land	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.3	121,767	93,063	0%	21%	80%
Toroda-Tonata	Very early	2020	Conduct landscape evaluation and landscape Rx.	Treatments on private and State. Potentially NEPA on OWNF portion	1.8	129,879	93,403	69%	9%	22%
Long Lake	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.3	80,297	35,518	0%	16%	84%
Ione-Sand	Early	2020	Conduct landscape evaluation and landscape Rx	Treatments on private and State	2.8	59,571	54,671	73%	7%	21%
Stranger	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	3.0	89,904	70,419	1%	25%	74%
Skookum	Very early	2020	Conduct landscape evaluation and landscape Rx	Treatments on private and State	2.6	109,039	89,139	45%	8%	47%
Republic	Complete or not on schedule	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.2	208,002	163,920	66%	5%	29%
The Wedge	Complete - implementation in progress	2020	Conduct landscape evaluation and landscape Rx.	Treatments on private and State.	2.5	138,547	118,811	49%	13%	38%

Table 1 continued:

2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	**FS Planning Stage**	**Request Year**	**DNR Planning Role**	**Funding Request**	**Priority Score (0-3)**	**Total Acres**	**Forested Acres**	**Federal**	**State**	**Private & Other**
North - Central Washington										
Upper Wenatchee	Early - landscape evaluation complete	2018	Expand existing landscape evaluation and Rx to private. Assist USFS with NEPA process	Treatments on private	2.5	74,777	67,108	85%	1%	14%
Tillicum	Complete - implementation beginning	2018	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS and private	1.5	14,326	13,134	83%	2%	15%
Mission Maint.	Complete - implementation beginning	2018	Fund FS projects & nonFS	Treatments on USFS, private, and State	1.8	49,121	37,924	64%	3%	34%
Stemilt	None - very little FS land	2018	Assist Chelan County with landscape evaluation and plan.	Treatments on private and State	1.8	38,961	24,886	11%	40%	49%
Mt Hull	Mid - landscape evaluation complete	2020	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS, private, and State	0.9	105,431	34,308	54%	4%	42%
Twisp River	Early - landscape evaluation in progress	2020	Collaborate with USFS to develop landscape evaluation and Rx. Fund LiDAR	Treatments on private, State, and USFS. Potentially NEPA	2.6	84,711	70,375	93%	2%	5%
Methow Valley	Not on schedule	2020	Collaborate with USFS to develop landscape evaluation and Rx. Fund LiDAR	Treatments on private and State.	2.1	183,290	116,104	80%	7%	13%
Chumstick-Eagle	Not on schedule	2020	Collaborate with USFS to develop landscape evaluation and Rx.	Treatments on private and State.	3.0	50,310	46,430	61%	5%	34%
Mad Roaring Mills	Mid - landscape evaluation complete	2020	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS, private, and State	1.0	65,008	40,611	74%	9%	17%
Nason Creek	Not on schedule	2020	Collaborate with USFS to develop landscape evaluation and Rx.	Treatments on USFS and private	3.0	31,679	28,661	60%	2%	38%

Table 1 continued:

2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	**FS Planning Stage**	**Request Year**	**DNR Planning Role**	**Funding Request**	**Priority Score (0-3)**	**Total Acres**	**Forested Acres**	**Federal**	**State**	**Private & Other**
Tapash-Central Washington										
Manas.-Taneum	Early - landscape evaluation complete	2018	Expand existing landscape evaluation and Rx to private and State	Treatments on USFS and private	2.5	135,470	99,709	41%	45%	15%
Cle Elum	Very early	2018	Conduct landscape evaluaion and landscape Rx. Assist USFS with NEPA	Treatments on private and State	2.4	91,319	66,811	20%	9%	71%
Ahtanum	None - no FS land	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.1	120,477	104,856	1%	63%	36%
Tieton	Very early	2020	Collaborate with USFS to develop landscape evaluation and Rx. Fund LiDAR. Assist USFS with NEPA	Treatments on private, State, and USFS. Potentially NEPA	2.7	148,634	130,315	84%	12%	4%
Teanaway	Early - landscape evaluation in progress	2020	Collaborate with TNC and USFS to develop landscape evaluation and Rx. Focus on State lands	Treatments on private and State	2.7	132,120	120,634	52%	40%	8%
Klickitat/Skamania-South Gifford Pinchot										
Trout Lake	Complete - Implemention in progress	2018	Conduct landscape evaluaion and landscape Rx.	Treatments on private, State, and USFS.	2.8	117,153	106,971	62%	17%	21%
White Salmon	None - no FS land	2018	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.7	126,688	109,636	5%	29%	67%
Little White	Very early - begin in 2020	2020	Conduct landscape evaluaion and landscape Rx.	Treatments on private, State, and USFS. Potentially USFS surveys or NEPA	2.2	95,750	71,695	77%	5%	18%
Klickitat	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.4	143,532	104,824	2%	19%	79%
HWY 97	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private	2.5	60,398	45,418	0%	0%	99%
Glenwood	None - no FS land	2020	Conduct landscape evaluation and landscape Rx focused on private and state lands	Treatments on private and State	2.4	116,772	101,311	2%	36%	62%

Table 1 continued:

2018 and 2020 Planning Areas for the 20-Year Forest Health Strategic Plan/SB 5546 (As of November 30, 2018)										
Planning Area	**FS Planning Stage**	**Request Year**	**DNR Planning Role**	**Funding Request**	**Priority Score (0-3)**	**Total Acres**	**Forested Acres**	**Federal**	**State**	**Private & Other**
Blue Mountains										
Blues West	To be determined	2020	Conduct landscape evaluation and landscape Rx with USFS	Treatments on State, USFS, & some private	2.2	106,637	79,965	49%	1%	50%
Blues East	To be determined	2020	Conduct landscape evaluation and landscape Rx with USFS	Treatments on State, USFS, & some private	1.8	120,692	76,361	77%	4%	19%

Appendix D

Landscape Evaluation and Prescription Methodology

The methods used to conduct landscape evaluations and prescriptions are based on the best available science regarding resilience in fire dependent landscapes (Stine et al. 2014, Spies et al. 2018), quantitative wildfire risk assessment (Scott et al. 2013), climate change impacts and adaptation strategies (Clark et al. 2016, Schoennagel et al. 2017), treatment prioritization (Vogler et al. 2015), and landscape restoration (Hessburg et al. 2015). The overall approach utilizes the framework for landscape evaluations established in the Okanagon-Wenatchee National Forest (OWNF) Restoration Strategy (USFS 2012, Hessburg et al. 2013) and described in the 20-Year Forest Health Plan's Appendix 2. In addition, input and professional judgement from local land managers and stakeholder was incorporated at various stages of developing the evaluations and prescriptions in each planning area.

Evaluations and prescriptions consist of the components listed below. All data used and generated for landscape evaluation is available for public download[1] or upon request. Note that the methodologies used for landscape evaluations are still evolving and will change over time as new science and approaches emerge. Also, the operational and economic analysis toolset is still being developed and has not yet been run for the 2018 planning areas. This appendix document will be updated periodically as methods change and will be posted at the link shown below[1] .

1. Identify Ownership Types and Management Objectives

Recognizing the diverse objectives of different landowners is a critical first step in a landscape evaluation. Knowing the spatial distribution of different ownership classes provides important context for the types of treatments and long-term forest structure that is likely in different parts of the planning area. Ownership information was derived from a DNR ownership layer developed by Atterbury Consultants in 2015 from county tax parcel data. Updates were made based on U.S. Forest Service (USFS), Washington State Department of Natural Resources (DNR), and Washington Department of Fish & Wildlife (WDFW) corporate ownership layers to capture recent land transactions.

2. Map Vegetation Types

The first step in assessing vegetation for the planning areas was to develop a consistent vegetation type layer across all ownerships. Geospatial layers for the East Washington

[1] Download data from: https://deptofnaturalresources.box.com/s/ejg0hx8l9n6uj5bfeocwd9km0qwme4eg

Cascades and Northeast Washington from the Integrated Landscape Assessment Project were used (ILAP) (Hemstrom et al. 2014) that were developed by the USFS Region 6 ecology program. Modifications were made to these vegetation type layers to ensure they were consistent with the version being used by the Colville National Forest for their plan revision and to add some small areas along the Columbia River that were missing. To simplify reporting of results, vegetation types were grouped into three potential vegetation groups: cold forest, moist forest, and dry forest (Table 1). Dry forests are ponderosa pine and Douglas-fir dominated forests that historically had low severity fires every 5-25 years. Moist forests historically had mixed severity fires. They include sites in draws, north facing aspects, and valley bottoms that had fire return intervals of 80-200+ years and were typically dominated by fire intolerant conifers such as grand fir or western red cedar. They also include sites that historically had more frequent fire (~30-100 years) and were typically dominated by Douglas-fir, western larch, and ponderosa pine. Cold forests are mid to upper elevation forests that historically had high severity fires every 80-200+ years and were dominated by subalpine fir, Engelmann spruce, lodgepole pine, as well as other conifers.

Table 1: Vegetation Types and Groups used in Landscape Evaluations

Vegetation Type	Region[1]	Potential Vegetation Group
Oak-pine	WEC	Dry Forest
Ponderosa pine	WEC	Dry Forest
Dry mixed-conifer	WEC	Dry Forest
Moist mixed-conifer	WEC	Moist Forest
Pacific silver fir	WEC	Cold Forest
Mountain hemlock	WEC	Cold Forest
Subalpine parkland	WEC	Cold Forest
Ponderosa pine dry	WNE	Dry Forest
Douglas-fir dry	WNE	Dry Forest
Northern Rocky Mountain Mixed Conifer (Grand fir - Cool/moist)*	WNE	Moist Forest
Western red cedar/ Western hemlock	WNE	Moist Forest
Subalpine fir-Lodgepole Pine (Subalpine fir-Cold Dry)*	WNE	Cold Forest
Spruce-Subalpine fir (Subalpine fir)*	WNE	Cold Forest
Subalpine parkland	WNE	Cold Forest
[1]WEC: Washington East Cascades WNE: Washington Northeast		

*ILAP names are in parentheses where they differ from names used in the Colville National Forest plan revision.

3. Map Current Forest Structure and Species Composition

Current condition information for forest structure and composition was obtained for each planning area in two ways (Table 2) based on the systems used in the National Forest in that

area. In six of planning areas, recent LiDAR (2015 – 2017 acquisitions), forest structure and inventory geospatial layers were generated by analysts at the University of Washington using direct LiDAR metrics (e.g. canopy cover and 95th percentile height) and modeled metrics (e.g. average diameter, basal area, volume). Modeled metrics were derived from DNR and Forest Service plot networks and LiDAR metrics (i.e. Fusion outputs) using standard LiDAR inventory modeling methods. Eight basic structure classes were defined based on total canopy cover and the average diameter of the overstory (Table 3). These classes provided the basic framework for quantifying current conditions in the planning area. Classes were condensed into six classes for the landscape evaluation summaries to facilitate communication of results (Table 3). A 30m pixel structure class layer was developed for each planning area with LiDAR. For portions of planning areas that lacked LiDAR coverage, GNN data from 2016 was used to derive structure class (Table 2). These areas without LiDAR were generally dominated by agriculture or shrub-steppe vegetation. In addition, 2015 DNR inventory layers (RS-FRIS) were used to generate structure classes for the Ahtanum planning area as the LiDAR for this area is from 2006. DNR inventory layers are derived from phoDAR, which is a LiDAR product derived from 2015 NAIP stereo imagery. Finally, 2016 GNN data was used to derive species composition or cover type.

Table 2: Current Condition Data Source for Forest Structure and Departure Assessment Method

Planning Area	Source and Year of Current Condition Data (Percent of plan area for that data source)	Departure Assessment Method
Chewelah A-Z	LiDAR 2015 & 2016 (90%) + GNN 2016 (10%)	State and Transition Model
Mill Creek A-Z	LiDAR 2015 & 2016 (95%) + GNN 2016 (5%)	State and Transition Model
Mt Spokane	LiDAR 2016 (60%) + GNN 2016 (40%)	State and Transition Model
Ahtanum	DNR RS-FRIS[2] 2015 (90%) + GNN 2016 (10%)	State and Transition Model
Trout Lake	LiDAR 2015 & 2016	State and Transition Model
White Salmon	LiDAR 2015 (75%) + GNN 2016 (25%)	State and Transition Model
Upper Wenatchee	PI[1] 2014 Forest Service Imagery	Historical Imagery
Stemilt	PI[2] 2017 DNR Imagery	Historical Imagery
Manastash.-Taneum	PI 2012 Forest Service Imagery	Historical Imagery
Cle Elum	PI 2017 DNR Imagery	Historical Imagery

[1] Photo interpretation of digitized, stereo imagery.
[2] DNR RS FRIS canopy cover and tree diameter layers were used. This data is developed using phoDAR, which is a LiDAR product derived from 2015 NAIP stereo imagery.

Current condition data for the remaining planning areas was obtained through photo-interpretation (PI) of digitized, stereo imagery (Table 2). The PI protocol, as well as quality control procedures, used the by OWNF for its Restoration Strategy (USFS 2012) was followed. The first step in the PI process is to delineate stands, or polygons, that have similar structure and composition across the whole planning area Canopy cover, size class, species composition, canopy layering, and other attributes are then collected for each polygon. Structure class, cover type (species groups) and other derived attributes such as habitat classifications are then generated for each polygon using classification criteria. To ensure consistency in the

reporting of evaluation summaries, results for the seven classes used in this PI system were condensed into the same six classes used in the LiDAR based approach (Table 3). A crosswalk was developed for each planning area based on the dominant canopy cover and size classes ranges for each structure class. The actual departure data was not converted to the six simple structure classes, just the treatment need ranges.

Table 3: Structure Classes used for Planning Areas

Class	Condensed Class	Definition	Corresponding Structure Classes from Photo-Interpretation System
Small Open	Small Open	Canopy[1] Cover <10% or Trees[2] < 10" dbh & canopy cover 10 - 39.9%	Stand Initiation
Small Closed	Small Dense	Trees less than 10" dbh canopy cover ≥ 40%	Stand Initiation; Stem exclusion closed canopy
Medium Open	Medium Open	Trees 10-20" dbh, canopy cover ≥ 10% and < 40%	Stem exclusion open canopy
Medium Moderate	Medium Dense	Trees 10-20" dbh, canopy cover ≥40% - <60%	Young forest multistory; understory re-initiation.
Medium Closed	Medium Dense	Trees 10-20" dbh, canopy cover ≥ 60%	
Large Open	Large Open	Trees ≥ 20" dbh, canopy cover ≥ 10% and < 40%	Old forest single story
Large Moderate	Large Dense	Trees ≥ 20" dbh, canopy cover ≥40% - <60%	Old forest multistory, young forest multistory
Large Closed	Large Dense	Trees ≥ 20" dbh, canopy cover ≥ 60%	

[1] Canopy cover was derived from LiDAR using the percent of returns above 6.6 feet.
[2] Tree diameter was derived from modeling relationships between LiDAR tree height layers and tree diameter from field plots. Tree diameter used to define structure class is based on the mean diameter of the dominant and co-dominant trees in a field plot. It is calculated by deriving the quadratic mean diameter of trees whose diameters are in the top 25% of trees that are greater than 5" in diameter.

4. Departure Assessment

Current forest conditions are compared to historical reference conditions to assess how healthy, or out of whack, the planning area is. Historical conditions are those that existed under an active fire regime and before fire exclusion and suppression, grazing, and extensive harvesting caused widespread changes to fire dependent ecosystems (Hessburg and Agee 2003). We use historical conditions as baseline reference for resilient landscape as they persisted through centuries of frequent fire, insect and other disturbances, as well as climatic fluctuations, while sustaining biodiversity, aquatic, and other functions (Stephens et al. 2010, Franklin and Johnson 2012). Fire kept biomass levels well below carrying capacity in historical landscapes and maintained a patchwork of forest conditions; both of which provided substantial resistance to large scale, high severity fires and drought related insect outbreaks (Fule 2008, Hessburg et al. 2015). Utilizing historical reference conditions does not mean that we should or can try to fully restore these conditions. Instead, they provide a general baseline for conditions that we think

will be resistant and resilient to large scale, high severity disturbances while providing a range of other ecosystem services that we want from our forests.

The primary outputs of a departure assessment are the number of acres of different structure classes that are too high, too low, or within range relative to the reference condition range. These outputs provide general targets for the classes of forest structure that are in excess and need to be shifted to classes that are below reference conditions. Shifting classes can be accomplished through mechanical and fire based treatments, as well as growth over time. Historical ranges and departure are broken out by the three broad vegetation groups discussed above (dry, moist, and cold forests) in order to reflect different ecological conditions and disturbance regimes in each types. Finally, outputs from the departure assessment ideally includes an evaluation of cover type, and pattern.

Two different methodologies were used for departure assessments in different parts of Central and Eastern Washington based on systems used by the National Forests in each area (Table 2). The first method is the approach used on the Okanagon-Wenatchee National Forest for their Restoration Strategy (USFS 2012). This method was used for the Upper Wenatchee and Manastash-Taneum planning areas, where current condition data and departure assessments had already been completed by Forest Service staff and partners. The method was also used for the Cle Elum planning area. Photo interpretation of aerial photography from the early- to-mid 20th century was used to derive a large dataset of historical reference conditions for forest structure, composition, and pattern from a sample of HUC 12 watersheds across Interior Columbia Basin (Hessburg et al. 1999). To assess departure of current conditions in a HUC 12 watershed, the same attributes are derived from current aerial photography. These current conditions are then compared with historical conditions from a subset of watersheds with similar environmental conditions to derive departure from the historical range of variation (HRV) (Hessburg et al. 2013).. In addition, comparison with a subset of historical watersheds with warmer and drier conditions is conducted to derive departure from the “future range of variation” (FRV).

The second method follows the approach used in the Colville National Forest Plan Revision. Historical reference conditions were derived from state and transition models (STM) that were developed for the ILAP project and the Colville National Forest plan revision, and then revised by DNR staff and Miles Hemstrom for this planning effort. STM models were developed for each vegetation type (Table 1). Departure of different structure classes is derived by comparing current structure class information from LiDAR and GNN with the historical range from the STM models.

5. Wildfire Risk Assessment

Data products and methods from the 2017 Pacific Northwest Region Wildfire Risk Assessment (PNRWRA) (Gilbertson-Day et al. 2017) were used to quantify fire risk across each planning area. This assessment was conducted for USFS Region 6 using the FS Sim fire model quantitative risk assessment methods from Scott et al. (2013). DNR staff calculated fire risk

(expected net value change) by combining annual fire probability, expected fire intensity as measured by flame length, and the response of different resources to the expected flame length. Risk to three different resources was calculated and then combined into a single raster layer with higher priority resources overlaid on top. Risk levels were binned into six categories based on relative values across all planning areas: extreme, very high, high, moderate, low, and beneficial. Maps of conditional net value change, which is the risk of loss or benefit without fire probability factored in, were also generated to examine expected loss or gain irrespective of fire probability in each planning area.

The three resources in order of priority were: (1) private or public parcels with structures derived from county tax parcel layers, (2) infrastructure from GIS layers used in the PNRWRA report, and (3) general forest based on structure classes and vegetation types as described in previous sections. Response functions of how each resource responds to different flame length levels were taken from the PNRWRA report. General forest used the timber resource functions that quantify expected mortality of overstory trees. In this risk assessment approach, low intensity fires (low flame lengths) have beneficial effects on medium and larger diameter forests in dry and moist forests as they consume ground fuels and smaller, understory trees (ladder fuels).

Fire probability and intensity are derived from FS SIM model runs using contemporary ignition and suppression probabilities, as well as current climate (climate change is not incorporated). Also, this risk assessment did not include fire effects on wildlife habitat, watershed function, drinking water, or other resources. Fire risk in non-forested shrub-steppe areas was only calculated for homes and infrastructure.

6. Climatic Drought Stress and Biophysical Alignment Analysis

This analysis assessed vulnerability to current and predicted future moisture stress, and is the primary way that climate change predictions and corresponding adaptation strategies were incorporated into the landscape evaluations. Moisture stress, as measured by climatic water deficit (Deficit), is a good predictor of vegetation type in moisture-limited ecosystems and is a primary driver of large insect outbreaks.

Deficit was calculated for all forested watersheds in eastern Washington at a 90m pixel resolution. Deficit was calculated as the difference between potential evapotranspiration (PET) and actual evapotranspiration (AET). PET is closely related to the amount of photosynthesis that could occur in a given location if an infinite amount of water were available, while AET is related to the amount that can actually occur given water inputs and soil conditions. Deficit, then, represents the amount of evaporative demand that cannot be met because soil water has been depleted during the summer dry period.

PET was calculated using the Priestley-Taylor equation (Priestley and Taylor 1972). Along with elevation and latitude, the Priestley-Taylor equation uses albedo, solar radiation, relative humidity, and minimum and maximum temperatures to estimate PET for a given day of the year. PET was calculated for the 15th day of each month. Albedo was set to 0.23 (a generic value for vegetated land cover) when there was no snow pack and 0.8 (a generic value for snowy land

cover) when there was a snow pack (Dobrowski et al. 2013). Solar radiation was estimated by calculating the amount of net downward shortwave radiation (Mitchell et al. 2004), modeling the shading effect of topographic relief (Hofierka and Suri 2002), and then adding in net downward longwave radiation, i.e., greenhouse-effect warming (Dobrowski et al. 2013). Relative humidity and temperature were calculated by Wang et al. (2016).

To calculate AET, the amount of water present in the soil was estimated for the 15th day of each month. For months where the amount of soil water was greater than the estimated PET, AET was set equal to PET. Otherwise, AET was set equal to the amount of available water. Soil water was calculated for each month based on water input, water use (i.e., PET), and soil water holding capacity. To determine water input, precipitation was divided into rain and snow based on temperature (Wang et al. 2016) and snow pack, melt, and sublimation was tracked month to month (Dobrowski et al. 2013). Water holding capacity data were taken from the Natural Resources Conservation Service Soil Survey Geographic Database (NRCS 2014, 2018). Water inputs in excess of the water holding capacity were treated as surface runoff.

Monthly Deficit was calculated by subtracting AET from PET for each month. The final annual Deficit values were then calculated as the sum of monthly Deficit over the course of a year. Deficit layers were generated for the 1981-2010 time period, and then for the 2041-2070 period based on predicted future climate data from the average (ensemble) of 15 Global Circulation Models under the RCP 8.5 emissions scenario (Wang et al. 2016).

Four deficit zones were then created and associated with vegetation groups to facilitate ecological interpretation of current and predicted future Deficit levels. A database of over 4000 vegetation plots from the Forest Service, DNR, and other sources, was used to divide Deficit into 4 zones in each planning area that correspond with vegetation groups. The plot data was summarized by calculating the percent basal area or canopy cover of each tree species for each plot. The distributions of Deficit associated with each species in the planning areas was analyzed to identify thresholds where transitions in vegetation groups occurred. Species like subalpine fir, Engelmann spruce, noble fir, and western hemlock were indicators for a moist and cold vegetation group in the low deficit zone. Ponderosa pine and some Douglas-fir were the main indicators for a dry vegetation group in the high deficit zone. The moderate deficit zone corresponded with a transitional vegetation group between the dry and moist types, indicated by a mix of Douglas-fir, western larch, lodgepole pine, or grand fir with small amounts of other species. A woodland/shrub steppe group in the extreme deficit zone was indicated by white oak, a low density of Ponderosa pine, or a lack of forest cover. This group identified the lower elevation transition between forest and non-forest vegetation.

Maps of current and future predicted zones were generated for each planning area in order to assess the magnitude of predicted effects of climate change. Note that these maps should not be used as fine scale maps of current or future vegetation types. General areas within each planning area were identified where forest is unlikely to be supported in the future, where moist and cold vegetation types are likely to transition to dry vegetation types, and where moist and cold vegetation types are likely to be sustained in the future. Finally, current structure layers were combined with the current and future Deficit predictions to locate areas with vegetation out

of alignment with soils, topography, and current and projected future climate (e.g. high density forest located on high or extreme deficit sites).

7. Habitat Mapping of Focal Species

Focal wildlife species were identified for each planning area by Bill Gaines from the Washington Conservation Science Institute through a process that involved wildlife biologists from multiple agencies and tribes (Table 4). Habitat for these species was mapped and quantified based on current conditions data from both LiDAR and PI data and habitat classifications. A full report on the focal species selection and habitat selection is available upon request. General effects to habitat from recommended treatment levels were then evaluated. This information will help managers identify key areas to protect as well as where treatments can create or improve habitat. Habitat needs for the DNR's Habitat Conservation Plan (HCP) and Late Successional Reserve on USFS land were assessed.

Table 4: Focal species selected for 20 Year Plan planning areas.

Common Name	Group	Family
American (Pacific) marten	Medium/large trees	Cool/moist forest
Black-backed woodpecker	Postfire habitat	Open forest
Canada lynx	Boreal forest	Alpine/boreal
Fox sparrow	Early successional	Open forest
Northern goshawk	All forest communities	Forest mosaic
Northern spotted owl	Medium/large trees	Cool/moist forest
Pileated woodpecker	Medium/large trees	Cool/moist forest
White-headed woodpecker	Medium/large trees	Dry forest
Woodland caribou	Medium/large trees	Cool/moist forest
Western Gray Squirrel	Medium/large trees	Dry forest

8. Aquatic Evaluation

These evaluations are conducted to better understand aquatic and riparian forest function in the planning area and determine restoration needs and priorities. This can include a fish habitat assessment, road impacts analysis (e.g. GRAIP), water yield analysis, and assessment of fire risk to drinking water areas. Aquatic evaluations were not conducted by the DNR for the 2018 planning areas. Instead, these are being conducted by collaborative partners. Aquatic evaluation have been completed for the Upper Wenatchee and Manastash-Taneum planning areas.

9. Economic and Operational Analysis

The analysis evaluates spatial locations of treatment opportunities and derives logging system and hauls costs. Combined with forest structure and volume information, potential neutral, positive, or negative treatments can be identified. These methods and analysis have not been developed for the 2018 planning areas. They will be added in the winter of 2018-2019.

10. Estimating Treatment Targets

Treatment needs for a planning area are first generated from the departure analysis. Dense structure-vegetation group classes (e.g. dry forest-large dense, moist forest medium dense) that are higher than the historical range of variation (HRV) are selected. These are the classes where departure can be shifted through treatments vs. departures that require time and growth (e.g. a shortage of large tree structure or too much open, small tree forest). For these departed, dense classes, the number of acres needed to shift the class to the upper range of the HRV is calculated. This is the low end of the treatment range. The high end of the treatment range is the number of acres needed to shift the class to the mid-point of the HRV. In cases where small-dense classes are not currently departed but will be soon due to growth, treatment acres for small-dense classes are added. Targets for maintenance treatments in existing open, large and medium tree size classes on dry forest sites are added in based on knowledge of past treatments and projected re-growth of small trees, shrubs, and ground fuels. Targets for each class are rounded to the nearest 500 acres and then summed together to get the range of total treatment need. Treatment needs are broken out by anticipated treatment type based on tree size class alone. As discussed above, individual landowners will determine actual treatment types based on many factors.

Using information from the landscape evaluation components, the treatment range is then analyzed and potentially adjusted to ensure it is reasonable to address five functional aspects of a resilient landscape. The five aspects are: (1) reducing fire risk; (2) aligning structure and cover types with current and future moisture stress levels; (3) maintaining a sufficient amount and patch size of dense forest to meet habitat needs; (4) shifting tree species composition; and (5) pattern issues such as excessively large patches of high-risk structure classes and/or fragmentation of habitat. A detailed description of the methods used for this process is available upon request.

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