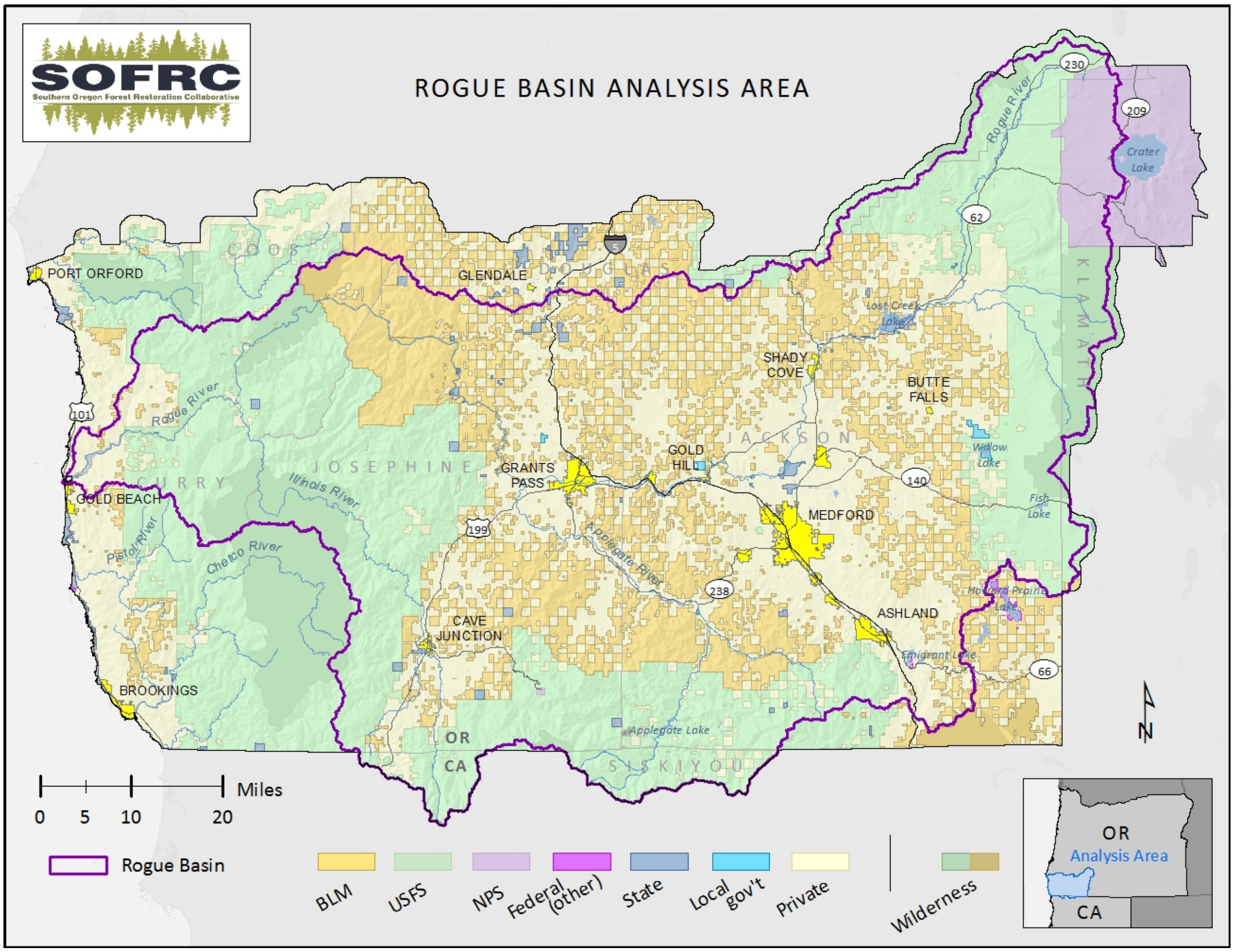
Rogue Basin Cohesive Forest Restoration Strategy: A Collaborative Vision for Resilient Landscapes and Fire Adapted Communities v.1

1 August 2015



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Executive Summary

The Southern Oregon Forest Restoration Collaborative (SOFRC) and stakeholders developed a Rogue Basin Cohesive Forest Restoration Strategy (Strategy) that integrates wildfire risk mitigation with multiple lines of ecological need for opening up uncharacteristically dense forests. This Strategy manifests the goals and components of the National Cohesive Wildland Fire Management Strategy. We aggregated, refined, and developed data to describe vegetation, fuels, high value resources and assets (HVRA), access and yarding capabilities, and identified no-treatment zones across 4.6 million acres. We used the large fire simulator FSim to model fire probability and likely intensity across the Basin. Through a series of workshops we collaboratively identified HVRA's, mapped them, and described their likely response to wildfire. The wildfire risk assessment (RA) describes the HVRA's and landscapes most at risk to wildfire and provides data to evaluate the sources of problematic wildfire. These data were used to strategically design treatments and as a baseline to evaluate different management scenarios.

Treatment placement was optimized with Landscape Treatment Designer (LTD), balancing five objectives 1) mitigating local fire community risk, 2) mitigating large wildfire community risk, 3) addressing landscape resilience measured as the proportion of seral states relative to the natural range of variability, 4) protecting existing and promoting future Northern Spotted Owl (NSO) habitat, and 5) promoting fire resistance in climate resilient settings. The analysis excluded congressionally withdrawn lands from any potential projects. Treatment placement excluded existing nesting, roosting and foraging (NRF) NSO habitat in high relative habitat suitability settings, in NSO historical ½ mile cores, or in the interim riparian reserves of the Northwest Forest Plan. These collaboratively derived sideboards ensured a conservative approach. Strategy implementation will need to be refined with site-level analysis.

The Strategy predicts restoration and fuels work needed, along with the restoration commercial byproduct generated, by applying four treatment themes: ecological resilience, fuel management, long-range complex habitat, and near-range complex habitat. Each theme sets target densities and stand structures specified by forest type and seral state. On average the treatments for each of the treatment themes would reduce canopy cover to 42%, 48%, 44%, and 54 % respectively, while reducing ladder and activity fuels with mechanical treatments and prescribed fire. Higher canopy cover would be maintained by excluding treatment in NSO habitat and Riparian Reserves.

The basin-wide assessment suggests that 2.1 million vegetated acres (47% of the landscape), is available and accessible to accomplish treatment objectives, operating within ½ mile of the existing road system. Approximately 17% of the landscape is inaccessible and 53% of the landscape is some combination of inaccessible and/or unavailable. Application of the treatment themes to the available and accessible federal lands (USFS and BLM) would treat 1.1 million acres and generate an estimated 2.1 billion board feet of restoration byproduct. Of that total acreage 883,000 acres would require subsidy but generate 1.2 billion board feet of restoration byproduct. A final 206,000 acres would be economically viable and generate ~0.9 billion board feet. The remaining 1.0 million acres will require subsidy to maintain resilient conditions and to treat vegetation <10 inches diameter at breast height to achieve the Strategy objectives of landscape resilience, enduring habitats, and fire adapted communities. This will require increased agency capacity for mechanical treatments in addition to increased social and agency support for prescribed burning on a large scale and the careful management of naturally ignited wildfire for resource benefits.

We provide draft results of the LTD runs to identify 15 potential treatment areas, rank them, and evaluate objectives among projects. The interim results reflect an even weighting of the five objective functions for projects in both a Federal Lands strategy (Forest Service and BLM lands) and an All-lands strategy including both public and private lands. These interim results are being vetted with stakeholders for feedback and suggested refinements. In the final LTD optimization, objective function weightings will be refined and we will generate 120 project areas ranging in size from 8,000-12,000 treated acres, covering the entire available landscape, parsed by relevant federal administrative units.

Introduction

Forests of western North America face significant stressors stemming from fire regime disruption, extensive even-aged management and other land-use (Sensenig et al. 2013, Stephens et al. 2013, Hessburg et al. 2015). A key regional assessment completed by the US Forest Service Region 6 and The Nature Conservancy suggests that thinning through mechanical treatments and fire is needed on 40% of Oregon and Washington's conifer forests to increase the proportion of open habitats and promote resilient landscapes (Haugo et al. 2015). Reflecting this, the Federal government has supported and currently supports restorative forest work under various programs, e.g. the National Fire Plan of 2000, ongoing fuels management programs, the Collaborative Forest Landscape Restoration Program initiated in 2008, and the Joint Chiefs' Landscape Restoration Partnership Program.

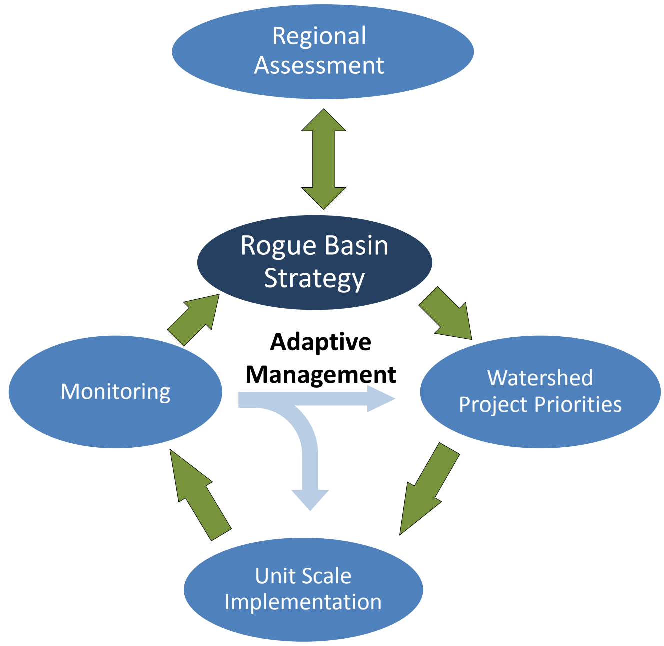

Figure 1: Increasing efficiency by integrating regional assessment with project planning, unit scale implementation, and monitoring.

The Southern Oregon Forest Restoration Collaborative (SOFRC) formed to address these issues locally, and has participated in pilot and demonstration restoration projects and ongoing dialogue and collaboration with the federal land management agencies and stakeholders. The SOFRC has developed this cohesive Rogue Basin Forest Restoration Strategy (Strategy) to accelerate forest restoration planning, implementation, and monitoring tiered to regional assessments to match the scale of need (Figure 1). For context, thinning through mechanical treatments and fire is needed on 2.1 million acres of dry forest across southern Oregon to increase the proportion of open forests and promote resilient landscapes (Haugo et al. 2015). We delimited a 4.6 million acre analysis area centered on the Rogue River Basin and subsuming the full extent of federal lands managed by the Rogue River-Siskiyou National Forest (RRSNF), the Medford District Bureau of Land Management (MBLM), and the National Park Service, along with the coastal watersheds south of the Rogue River (Figure 2). The assessment area encompasses 4.2 million acres of forested lands, and federal ownership covers 2.7 million acres, of which 2.6 million are managed by the RRSNF and the MBLM (Table 1).

Table 1: Analysis area characteristics, from forested to non-forested with significant developed areas not exposed to wildland fire and other non-burnable substrates. Bureau of Land Management (BLM) and US Forest Service (FS) lands are predominately Medford District BLM or Rogue River Siskiyou National Forest but include 117,000 acres of neighboring agency lands, largely the Crater Lake National Park.

Characteristics	BLM	USFS	Other	Total
Forest	883,804	1,768,273	1,506,637	**4,158,714**
Non-Forest, Burnable	10,652	13,480	68,381	**92,512**
Developed, Non-burnable	22,907	37,735	260,641	**321,282**
Total	**917,363**	**1,819,488**	**1,835,658**	**4,572,508**

The Strategy has at its core locally developed wildfire risk and restoration need assessments which support the National Cohesive Wildland Fire Management Strategy (Jewell and Vilsack 2014), key recovery actions identified in the Recovery Plan for the Northern Spotted Owl (U.S. Fish & Wildlife Service 2011), and collaboratively developed forest restoration principles (sidebar).

Forest Restoration Principles

i. *Inform management with historical fire return intervals and site productivity*
ii. *Take a fine grained approach for a fine grained landscape*
iii. *Utilize fire and mechanical harvest to promote and maintain desired ecological and economic outcomes*
iv. *Support fire adapted communities*
v. *Ensure enduring viability of critical habitats and species*

The Strategy considers the magnitude of restorative treatment need in forests as the basis to frame a comprehensive 20 year plan of work. This ecological perspective is balanced with a wildfire risk assessment which quantifies the urgency to abate threats and avoiding unnecessary uncharacteristic losses, with potential to increase wildfire management capacity (Figure 3). The Strategy also elevates a nested 5-year action plan which would integrate ongoing federal efforts with the highest priorities for treatment. The SOFRC Strategy identifies and prioritizes project areas that are roughly 40,000 acres in size, containing 12,000 acres of treatments, effectively dividing the work load into 120 projects, or 6 per year.

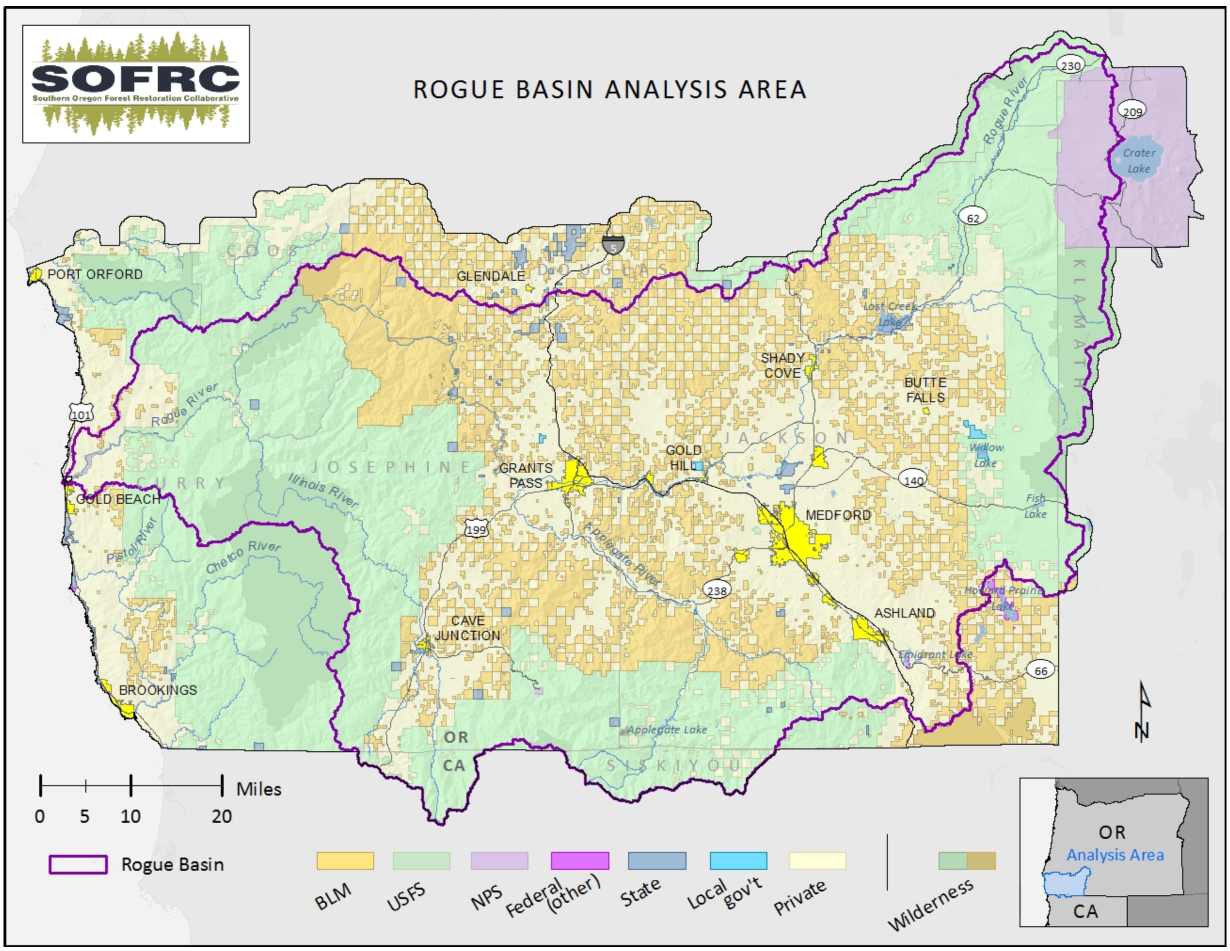

Figure 2: The Rogue Basin Cohesive Forest Restoration Strategy analysis area is 4.6 million acres across many ownerships and land allocations.

The Strategy is designed to inform and support the federal land management agencies, the State of Oregon, and private landowners in planning integrative and cohesive active management to promote resilient landscapes, diverse habitats, fire-adapted human communities, and a predictable flow of ecosystem services and economic benefits. The Strategy will also be integral to updating the Jackson and Josephine County Fire Plans and regional Community Wildfire Protection Plans with risk assessment and potential priorities for treatment.

Figure 3: This analysis integrates a strategic wildfire risk mitigation using the outputs of a quantitative Wildfire Risk Assessment with Analyses of Restoration need that evaluate critical complex forest habitat, the proportion of seral states, and forest density and structure.

A quantitative wildfire risk assessment (RA) was convened by SOFRC but supported broadly following the methods of Scott et al. (2013). In a series of local workshops starting in January 2015, participants refined fuels data for predicting fire behavior, identified high value resources and assets (HVRA), agreed on their relative importance, and established the likely wildfire responses for each. The RA guides effective treatment placement and project prioritization and provides a metric for how management scenarios perform.

The Strategy uses the optimization software, Landscape Treatment Designer, to define priority project areas and optimal treatment extents based on five critical objectives: 1) mitigating risk of local fires to communities, 2) mitigating risk of large wildfire to communities, 3) promoting landscape resilience by reducing ecological departure, 4) protecting existing and promoting near- and long-range future habitat for the Northern Spotted Owl and other complex forest habitat dependent species, and 5) promoting landscapes resilient to climate change. Priorities among project areas were based on their relative performance on the above objectives, and project areas were refined to spread acres of economically viable restoration byproduct evenly across projects in order to help achieve a predictable, even flow of economic activity.

Within project areas, the SOFRC collaboratively developed forest restoration principles to guide the prescriptive actions along treatment themes that include: 1) *fuel management* to ameliorate fire intensity and improve fire management potential to protect the Community at Risk, 2) *complex habitat management* protecting and promoting complex habitats for Northern Spotted Owl (NSO) and other species, and 3) *ecological resilience* to re-balance the landscape of open and closed forest to restore resilience to future wildfire in a changing climate. Collaboration, community engagement and generation of products, employment, and economic activity are important to the resilience of the local communities and critical for the success of all of the treatment themes.

Scope

The 4.6 million acre project area (Figure 2) is centered on the Rogue River Basin of southwest Oregon and overlaps with several of the driest forest regions in the range of the Northern Spotted Owl as identified in the Northwest Forest Plan (NWFP) including parts of the West Cascades, East Cascades, and the Klamath Mountains. The streams of the Klamath, Siskiyou and Cascade Mountain ranges support salmonid and other species and populations of considerable conservation significance. Diverse floras from several western US floristic provinces intermingle and thrive in the complex environmental and geomorphological gradients that characterize the landscape and which allowed it to function as a climate refuge in the past. In dry forests and woodlands of the northern Klamath Mountains and southern slopes of the Cascades, steep topographic gradients and a particularly strong Mediterranean climate historically drove frequent fire regimes with mixed severity effects (Taylor and Skinner 1998, 2003, Halofsky et al. 2011, Perry et al. 2011). Dry forest types in the analysis area are largely dominated by Douglas-fir but include white fir, Jeffery pine, ponderosa pine, and tanoak dominated forests. Oak woodlands, comprised largely of tanoak with California black oak increasing in the mountains away from the coast and Oregon white oak in the inland valleys are abundant.

Residential development prevails in the lowland prairie, woodland and forested systems and timber resource management increases with elevation and productivity except where there are access limitations or where, federally protected wilderness, a national park and national monuments have been established. The analysis areas includes numerous important conservation opportunity areas identified at the ecoregional scale for representation of species and systems and or ecologically intact and less developed areas by several entities including The Nature Conservancy and the Oregon Department of Fish and Wildlife, among others.

Globally, Mediterranean forests and woodlands are of high conservation importance due to habitat conversion and lack of protection (Hoekstra et al. 2005). Fire regimes have been significantly disrupted for the last 100 years across the Mediterranean forests and woodlands of the Rogue Basin (McNeil and Zobel 1980, Agee 1991, Colombaroli and Gavin 2010, Sensenig et al. 2013), including lowland and mixed conifer riparian forests (Messier et al. 2012). Fire regime disruption, combined with extensive even-aged management and other land-uses, has resulted in forests at extensive risk to wildfire, insects, and disease, issues exacerbated by climate change (Sensenig et al. 2013, Stephens et al. 2013, Hessburg et al. 2015). These risks threaten complex forests habitats, the oldest most structurally important trees, and even the development of younger stands.

Heavily fragmented ownerships (Figure 2 and Table 1) complicate land management decisions. This region is known for past land management conflicts over timber and conservation. Integrating collaboration with project development has emerged with the growing awareness of fire risks to forest values and communities in southwestern Oregon, as elsewhere, and is critically important for building shared understanding and community support for restoration to promote forest health and resilience. The SOFRC has actively supported collaboratively designed projects in the region, including the Medford District Secretarial Pilot, Friese Camp Forest Management Project, Ashland Forest Resiliency Stewardship Project, Biomass Utilization, and South Fork Little Butte Creek. This wildfire risk assessment, Cohesive Forest Restoration Strategy, and other ongoing work are advances to continue to improve public dialogue and understanding and broaden support for collaboratively developed, ecologically-based restorative land management.

The SOFRC Strategy promotes and conserves critical closed canopy, old, complex forest habitats in appropriate landscape positions, restores open fire and drought resilient stands by recoupling vegetation and geomorphological characteristics in intervening areas, and encourages a fire adapted landscape and communities by promoting strategic fuels reduction in the public-private interface. We take a conservative approach to determining where active management might be permitted. The Strategy models no treatment within the Northwest Forest Plan interim riparian reserves. Management of NSO habitat is grounded in the US Fish and Wildlife Service Revised Recovery Plan (U.S. Fish & Wildlife Service 2011) and designated critical habitat for the Northern Spotted Owl (U.S. Fish & Wildlife Service 2012), retaining existing nesting, roosting, and foraging habitat (NRF) in appropriate landscape positions and in historical ½ mile core areas, reducing risk of delivering severe wildfire to existing NRF, developing future habitat in appropriate landscape positions , and focusing on ecological restoration as the overriding management theme throughout the landscape. Congressionally withdrawn lands are also identified as no-treatment for this assessment, which is focused on integrating mechanical treatments and prescribed fire. Site specific review will be required to design the appropriate mix of treated and untreated forest on a project level basis. Operating within these robust protections built-in for species dependent on complex habitats, active management generates ecosystem benefits, forest products and associated economic outputs, as well as attendant social benefits.

As stated in the National Cohesive Wildland Fire Management Strategy, landscape scale resilience and fire adapted communities can only be accomplished by working across all-lands with an all-hands approach (Jewell and Vilsack 2014). Accordingly, three management scenarios are evaluated by SOFRC, in addition to the existing landscape condition. These scenarios integrate wildfire risk mitigation with various approaches to meeting restoration need (Figure 3) to articulate the costs and benefits of different treatment footprints and scheduling over a 20 year period.

Alternatives to evaluate

To evaluate the trade-offs inherent in changing the pace and scale of treatment on Federal lands, as well as the relative contribution of an all-lands approach we compared three management scenarios:

<u>Scenarios</u>

1. **Business-as-usual over 20 years** – treatment of the Federal Land at the 10-year historical pace. Treatment placement in most optimal watersheds. Assuming 9,000 acres/year the likely footprint is 180,000 acres after 20 years.
2. **Federal Land** – treatment pace and scale increased to treat all forests on USFS and BLM in need of treatment within the existing road infrastructure over 20 years. Total treatable forested footprint is about 2.655 million acres. Total forested footprint that is treatable within the existing road network, assuming the potential of a ½ mile helicopter haul is 1.2 million acres.
3. **All-lands** – USFS and BLM lands treated as in #2 above, with the same proportion of acres treated on private lands as on Federal lands to provide rationale and guidance for landowners and public funding opportunities that support the Strategy objectives. Optimally all-lands treatments will build on Federal forest restoration projects.

The alternatives are compared on how well they maximize return on investment relative to performance indicators identified in the 'Comparing Strategy Scenarios' section below.

Inference of the Strategy

The scope and scale at which the data are interpreted is a critical consideration for applying the Strategy to on-the-ground action.

<u>Vegetation and Related Fire-Potential Data</u>

The LANDFIRE and GNN data used in this assessment infer existing vegetation and fuel data remotely. The relationships are inherently correlations by nature and thus somewhat imprecise. We used extensive field reviews and a local fuels calibration workshop to refine the best available data. However, all such data should be evaluated, refined, and augmented at the project scale with local field data as appropriate. A known limitation of the s-class mapping appears to be over prediction of late-seral stands nearer to the coast and under prediction of late-seral stands further inland.

<u>Wildfire Modeling Limitations</u>

Wildfire is a complex and highly stochastic process, thus difficult to model. State-of-the-art wildfire modeling was employed for the quantitative risk assessment. This modeling relies on the quality of the underlying fuel data (see above), 20 years of historical fire occurrences, and many informed decisions made by the fire modeling specialist from the Forest Service Enterprise TEAMS unit. Fire modeling results must therefore be taken as models to evaluate relative wildfire effects between and among scenarios/landscape within this assessment and not as absolute prediction of future fire behavior.

Limitations of Inference

The outputs of Landscape Treatment Designer are quite fine in resolution, but many of the input data sources are most appropriately interpreted at a scale larger than a HUC 6 (>10,000 acres). As such, the data generated here are excellent for identifying project areas, clarifying the objectives behind those projects, and ranking among projects. However, site specific data and analysis for individual project planning is required.

Quantitative Wildfire Risk Assessment

The Southern Oregon Forest Restoration Collaborative conducted the Rogue Basin Wildfire Hazard and Risk Assessment (RA) in 2015, a quantitative risk assessment (Scott et al. 2013). The RA incorporated fire behavior modeling using the large wildfire simulator, FSim, to characterize large wildfire likelihood and intensity as well as a stakeholder/expert driven process to identify high value resources and assets (HVRAs) and their wildfire susceptibility. This RA was unique in the level of collaborative development and ownership. Three workshops were held to ensure rigorous and broad-based input, understanding, and support for the RA; the participants of those workshops are listed in Appendix 1a and 1b.

Fire Behavior Modeling

Anticipated wildfire behavior and likely changes to anticipated fire behavior with proposed treatments were modeled by the Southern Oregon Forest Restoration Collaborative, Rogue-River Siskiyou National Forest, Medford District Bureau of Land Management and other partners, in conjunction with the Forest Service TEAMS Enterprise Unit. Large wildfire fire behavior (fires >35 acres) was modeled for a 10 million acre project area that buffered the Rogue River Basin and adjacent federal lands by ~15 miles. Modeled fire incorporates topography, weather, and vegetation or fuels. Vegetation fuel data from the national LANDFIRE (LANDFIRE 2010) were obtained and reviewed on extensive field tours. A deficiency was noted in how LANDFIRE mapped oak habitats in Map Zones 3 and 7. Vegetation data from the Integrated Landscape Mapping Project (GNN; Landscape Ecology Modeling Mapping and Analysis (LEMMA) 2014) were used to modify the initial LANDFIRE data on 252,720 acres, <3% of the landscape but characterized by high population density.

Collaborators hosted a workshop to review and further calibrate the mapping of fuels (21-24 January 2015) derived from the vegetation data. The local fuel calibration workshop relied on 13 technical team contributors from the Forest Service Region 6 office, RRSNF, MBLM, Oregon Department of Forestry (ODF), TNC, US Geological Survey, and National LANDFIRE (Appendix 1a and 1b). The team of professionals applied direct knowledge of the landscape, its vegetation, and how fire interacts with the vegetation with the objective of refining a product useful to the fire managers of the RRSNF, the MBLM, ODF and local fire districts. Key outcomes of the workshop were:

1. Addressed known concerns about homogeneous surface fuel models representing the majority of the analysis area forests
2. Developed more nuanced models of vegetation types, including oaks
3. Assembled up-to-date spatial data on the extents of mechanical and fire disturbances
4. Defined rules for how mechanical and fire disturbances impact fuels

A 20 year fire occurrence database was assembled for the 10 million acre analysis area and used to build probability distributions of ignition locations and weather conditions under which the fires burned. The landscape was split into two fire occurrence areas (FOA) of relatively uniform large fire conditions: a coastal fire modeling zone and an interior fire modeling zone. We used Remote Automatic Weather Station (RAWS) weather data for the previous 20 years from the National Weather Service gathered at Bald 2 RAWS for the coastal FOA and Onion 2 RAWS for the inland FOA.

We determined the characteristic size of contemporary wildfires using the “balanced fires-acres percentiles” and Lorenz curve methods (Scott 2014) to determine that 98 percent of the area burned by wildfires was burned by fires >35 acres in the Coastal FOA and >36 acres in the inland FOA; settling on 35 acres as the large fire size threshold for the analysis.

The large fire simulation system, FSim, was then used to run 10,000 iterations, with each iteration representing a “fire year” with ignition points distributed and burn weather determined by historically informed probability distributions. This produced an annual burn probability (Figure 4) for each 18 acre pixel as well as a probability of burning at each of six fire intensity levels (Figure 5). Modeled fire occurrence, size and frequency were evaluated against the past 20 years of regional fire to refine model inputs. The final FSim run reflected the 20 year historical average fire years, with greater standard deviation as one could expect from 10,000 iterations compared to 20 annual observations (Table 2). Wildfire burn probabilities varied markedly across the 10 million acre project area, consistent with the recent historical observations, with the highest probabilities in the southwest corner and the lowest probabilities in the Cascade Mountains (Figure 4). Annual burn probabilities at the scale of 18 acre patches are of course low, but when summed to a larger, more meaningful size such as a watershed they are significantly larger. The probability of fire intensity levels did not necessarily correlate with burn probability and notably there was a tradeoff between probability of low and higher severity fire (Figure 5). These probabilities are best interpreted as relative values and not as a prediction of annual fire frequency.

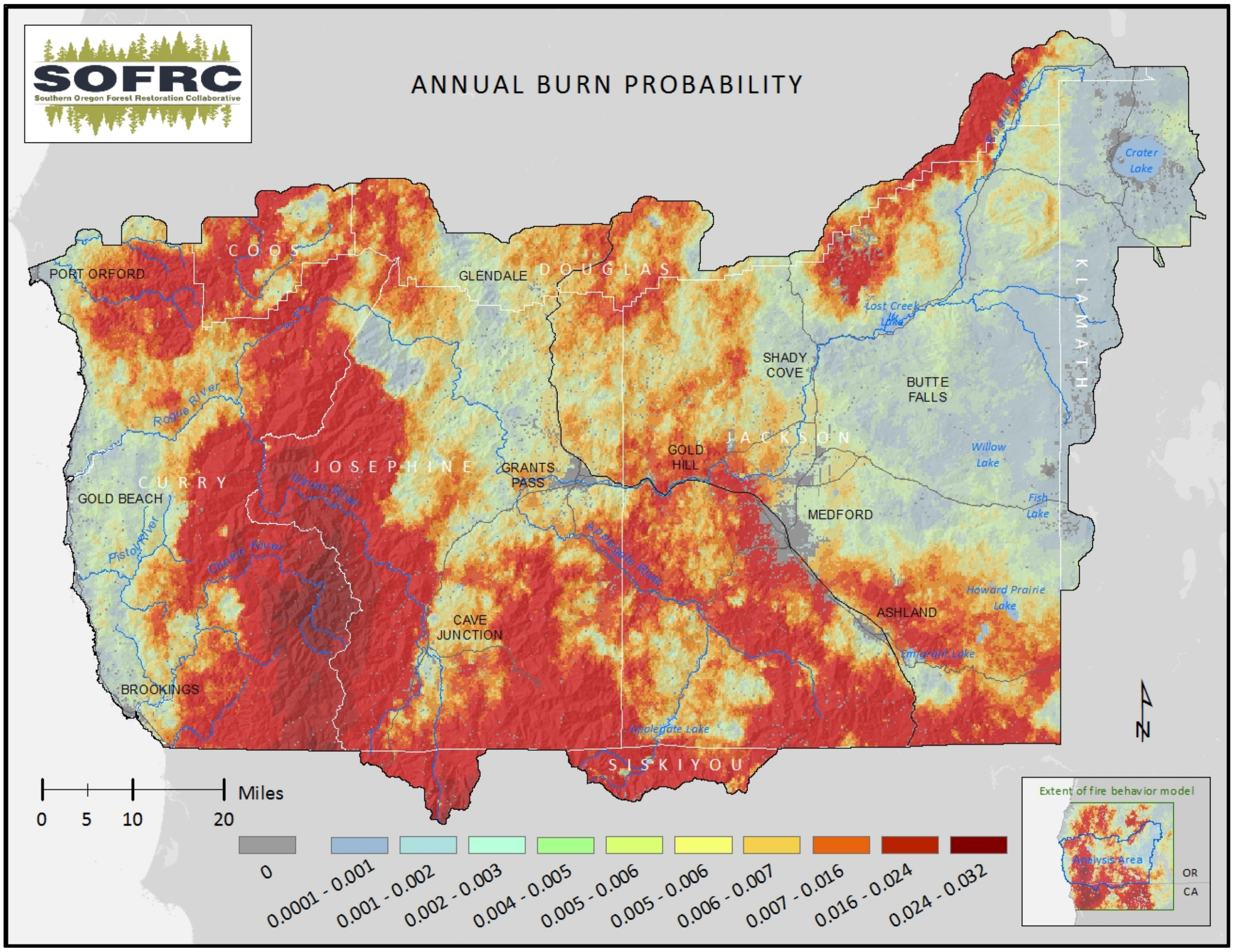

Figure 4: FSim generated annual probability of a 0.22 acre pixel burning in a fire >35 acres in a given year for the 10 million acre fire behavior modeling area (see inset) centered on the 4.6 million acre Rogue Basin Project area.

Table 2: Fire year parameters for the 10 million acre fire modeling analysis area for the years 1982-2012 and for 10,000 modeled fire year iterations.

Source	Parameters	Mean	Median	Standard Deviation
20 year record	Acres Burned	26,352	9,282	42,576
	Fire Size	1,415	959	1,493
	Fire Number	15	11	9
Modeled fires	Acres Burned	69,092	14,777	165,601
	Fire Size	2,645	826	4,943
	Fire Number	19	18	11

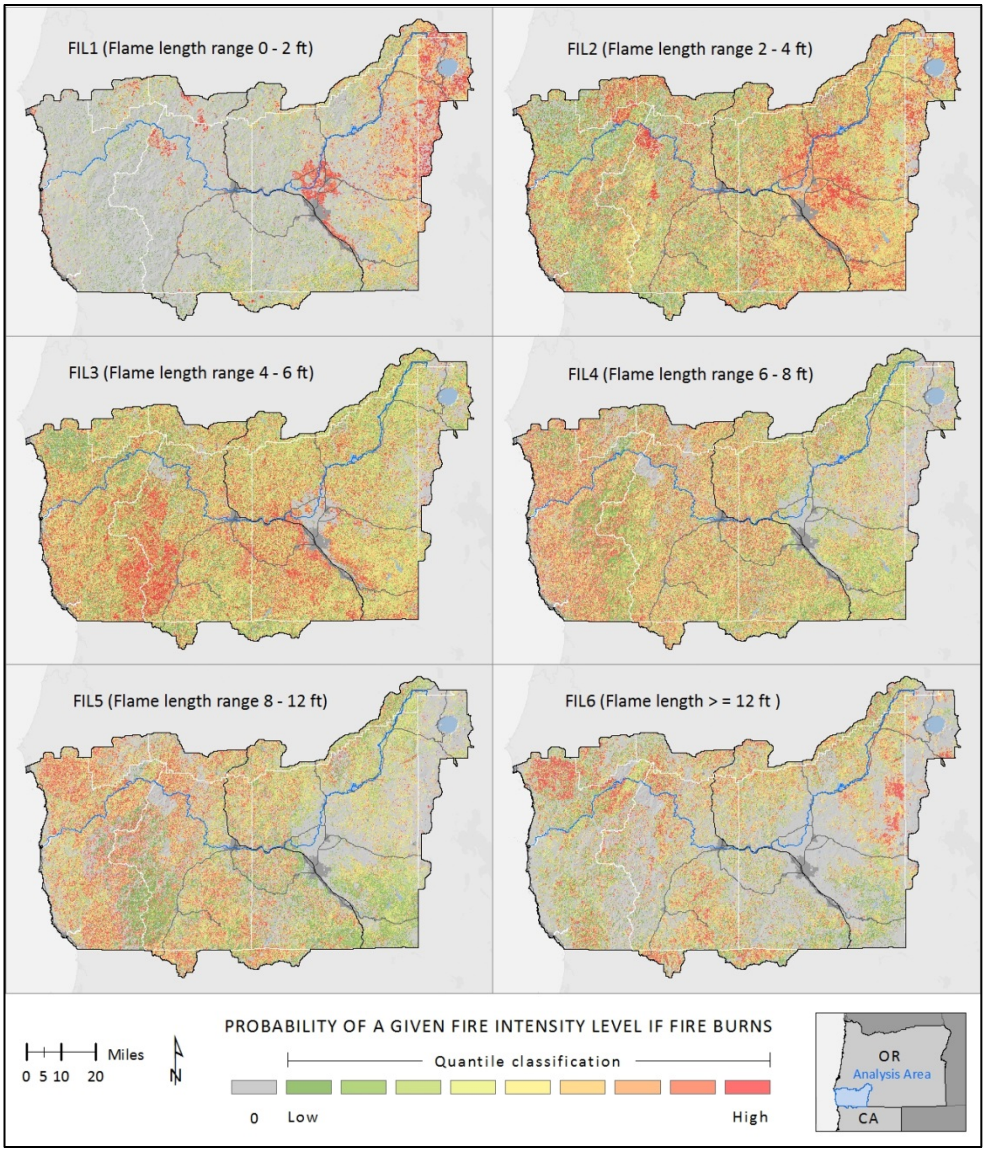

Figure 5: FSim generated probability of fire > 35 acres burning at six fire intensity levels (FIL) with one being the least and six the most intense when fire was predicted to occur across the 10 million acre fire behavior modeling area centered on the Rogue Basin.

High Value Resources and Assets

Local stakeholders identified high value resources and assets (HVRA's) at two workshops convened by the SOFRC and facilitated by Joe Scott of Pyrologix LLC, held 10-11 February 2015. These workshops were attended by 51 participants representing a wide range of local, state, and federal agencies as well as non-governmental organizations (Appendices 1a and 1b). Participants assembled an initial list of 59 values for subsequent mapping. After refining the list SOFRC mapped 12 HVRA's (Figure 6), split into 32 sub-HVRA's: 12 assets and 20 resources (Tables 3, 4, and 5). An asset is a human-built structure, such as a home, or cell tower, etc. Resources are natural features such as a forested wildlife habitat or a unique species for which the distribution can be mapped.

A second workshop series April 8-9 used a carefully structured and deliberative method to integrate science and value-based information to describe likely sub-HVRA wildfire responses (Tables, 3, 4, and 5) and weight their relative importance. This workshop was facilitated by Joe Scott (Pyrologix LLC) and Matt Thompson (Rocky Mountain Research Station). Agreement on relative importance varied across a range of interest groups, but the entire group quickly agreed to a rough averaging as fairly representative, and the result across HVRA's was fairly even (Figure 6a). After accounting for spatial extent of each HVRA, the technical team reached agreement on calibrating adjustments of relative importance of each HVRA while also roughly reflecting the rank order of importance from the workshop (Figure 6b).

Figure 6: The relative importance of collaboratively identified high value resources and assets (a) as identified in the workshop and (b) after accounting for their relative extent and replacement value.

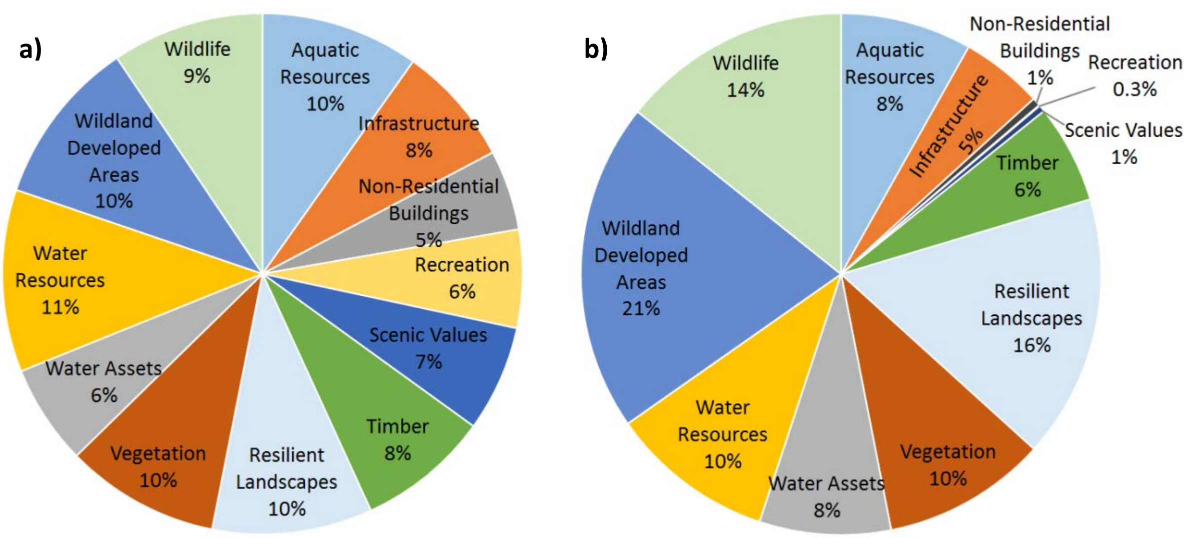

Table 3: Five classes of assets (HVRA) were identified and mapped as 18 individual sub-HVRA's. Their likely wildfire response was classed on a scale ranging +/- 100, with -100 representing a complete removal of the asset and +100 being a 100% increase in the asset value.

		Fire Intensity Level*					
HVRA	**Sub-HVRA**	**1**	**2**	**3**	**4**	**5**	**6**
Infrastructure	Comm Sites/Cell Towers	0	0	-10	-20	-30	-30
	Electric Trans-Line/Sub	0	0	-20	-20	-20	-20
Non-residential	Fire Lookouts	0	-10	-30	-60	-100	-100
	National Park Structures	-10	-20	-40	-80	-100	-100
	Ski Area Buildings	-10	-20	-40	-80	-100	-100
	USFS Cabins/Structures	-10	-20	-40	-80	-100	-100
Recreation	Recreation Sites	-10	-20	-40	-80	-100	-100
	Ski Area (Mt. Ashland)	0	0	0	-10	-20	-40
	Pacific Crest Trail	0	0	-10	-10	-20	-20
Water Assets	Canals-Irrigation	0	0	0	-10	-10	-10
	Reservoirs - Drinking	0	0	0	-10	-20	-40
Where People Live	Residences <1 / 40 ac	-10	-20	-40	-80	-100	-100
	Residences 1/10 - 1/5	-10	-20	-40	-80	-100	-100
	Residences 1/2 to 3/ac	-10	-40	-80	-100	-100	-100
	Residences 1/20 - 1/10	-10	-20	-40	-80	-100	-100
	Residences 1/40 - 1/20	-10	-20	-40	-80	-100	-100
	Residences 1/5 - 1/2	-10	-40	-60	-100	-100	-100
	Residences 3+/ac	-20	-60	-80	-100	-100	-100

*Fire Intensity Level: 1 = 0-2 foot flame lengths, 2 = 2-4 foot flame lengths, 3 = 4-6 foot flame lengths, 4 = 6-8 foot flame lengths, 5 = 8-12 foot flame lengths, 6 = >12 foot flame lengths

Table 4: Four of the seven classes of resources (HVRA) identified and mapped as 26 covaried sub-HVRA's (of 47 total). Their likely wildfire response was classed on a scale ranging +/- 100, with -100 representing a complete removal of the resource and +100 being a 100% increase in the resource value.

			Fire Intensity Level*					
HVRA	**Sub-HVRA**	**Covariate**	**1**	**2**	**3**	**4**	**5**	**6**
Aquatic Resources	Chinook Distribution		10	10	10	0	-10	-20
	Coho Distribution		20	10	10	0	-30	-40
	Lamprey Distribution		10	10	10	0	-10	-20
	Resident Fish Species		10	-5	-30	-40	-60	-80
	Steelhead	Intermittent	20	10	0	0	-10	-20
	Steelhead	Perennial	20	10	0	-10	-20	-30
Resilient Landscapes**	Biophysical Settings	Seral States	Many					
Scenic Values	Scenic Byways		10	0	-20	-50	-70	-90
	Wild and Scenic rivers		10	0	-20	-50	-70	-90
Timber***	Federal Timber	Restricted (A)	10	10	-100	-100	-100	-100
	Federal Timber	Restricted (B)	10	50	-10	-100	-100	-100
	Federal Timber	Restricted (C)	20	50	-10	-100	-100	-100
	Federal Timber	Restricted (D)	30	50	30	-100	-100	-100
	Federal Timber	Restricted (E)	30	50	30	-50	-100	-100
	Federal Timber	Unrestricted (A)	10	-20	-100	-100	-100	-100
	Federal Timber	Unrestricted (B)	10	50	10	-90	-90	-90
	Federal Timber	Unrestricted (C)	20	50	10	-90	-90	-90
	Federal Timber	Unrestricted (D)	30	50	30	-60	-70	-70
	Federal Timber	Unrestricted (E)	30	50	30	-50	-60	-60
	Private Industrial		10	20	10	-90	-90	-90
	Private Non-industrial	(A)	10	-20	-100	-100	-100	-100
	Private Non-industrial	(B)	10	50	10	-35	-40	-40
	Private Non-industrial	(C)	20	50	10	-35	-40	-40
	Private Non-industrial	(D)	30	50	30	-30	-35	-35
	Private Non-industrial	(E)	30	50	30	-30	-35	-35
	State Timber		10	20	10	-90	-90	-90

*Fire Intensity Level: 1 = 0-2 foot flame lengths, 2 = 2-4 foot flame lengths, 3 = 4-6 foot flame lengths, 4 = 6-8 foot flame lengths, 5 = 8-12 foot flame lengths, 6 = >12 foot flame lengths
**Proportions of seral-structural states relative to the natural range of variation
***Federal and private non-industrial timber lands were mapped by successional class where A=early, B=mid-closed, C=mid-open, D=late-open and E=late-closed.

Table 5: Three of seven classes of resources (HVRA) identified and mapped as 21 covaried sub-HVRA's (of 47 total). Their likely wildfire response was classed on a scale ranging +/- 100, with -100 representing a complete removal of the resource and +100 being a 100% increase in the resource value.

			Fire Intensity Level*					
HVRA	**Sub-HVRA**	**Covariate**	**1**	**2**	**3**	**4**	**5**	**6**
Vegetation	Aspen		20	50	100	100	50	0
	Late-seral Forest	Dry, (D)	80	90	10	-10	-90	-100
	Late-seral Forest	Dry, (E)	70	30	-10	-50	-90	-100
	Late-seral Forest	Wet, (D)	80	90	10	-10	-90	-100
	Late-seral Forest	Wet, (E)	40	10	-30	-60	-100	-100
	Oak Woodlands		100	100	30	-40	-80	-100
	Tan Oak		100	100	100	80	10	-20
	Unique/Endemic	Fire dependent	30	50	100	100	60	30
	Unique/Endemic	Fire resilient	60	70	60	60	-10	-40
	Unique/Endemic	Fire sensitive	0	-20	-40	-60	-80	-100
Water Resources	Municipal Watersheds	Ground water	10	20	30	0	-10	-20
	Municipal Watersheds	Spring source	10	20	0	-10	-30	-50
	Municipal Watersheds	Surface	10	20	-10	-40	-60	-90
	Riparian Zones		20	10	-5	-40	-80	-100
Wildlife	Deer and Elk Winter Range		10	50	50	30	10	-40
	Dispersal NSO **		20	0	-30	-60	-80	-100
	NRF NSO ***		10	-10	-40	-80	-100	-100
	Marbled Murrelet		20	10	-10	-80	-100	-100
	Mardon Skipper		-50	-100	-100	-100	-100	-100
	Oregon Spotted Frog		10	-10	-30	-40	-60	-80
	Siskiyou Mountain Salamander		20	10	0	-40	-70	-90

*Fire Intensity Level: 1 = 0-2 foot flame lengths, 2 = 2-4 foot flame lengths, 3 = 4-6 foot flame lengths, 4 = 6-8 foot flame lengths, 5 = 8-12 foot flame lengths, 6 = >12 foot flame lengths
**NSO=Northern Spotted Owl
***NRF NSO=Nesting, Roosting, and Foraging Northern Spotted Owl Habitat

Wildfire Response

Relative importance, relative extent, and likely response to wildfire were combined with modeled fire behavior to generate wildfire risk across the project area. This allows identification of locales with the greatest likely consequence of wildfire when it burns (conditional net value change, cNVC), as well as the likely risk due to wildfire across the landscape (expected net value change, eNVC; Scott et al. 2013). Conditional net value change (cNVC) highlights the likely effects of a fire *when* it burns, e.g. the range of potential likely negative and positive effects in the Cascades (Figure 7a). These conditional responses are simply multiplied by the burn probability (Figure 4) to generate eNVC, and the Cascades illustrate lesser likely wildfire effects in line with lower fire probability (Figure 7b).

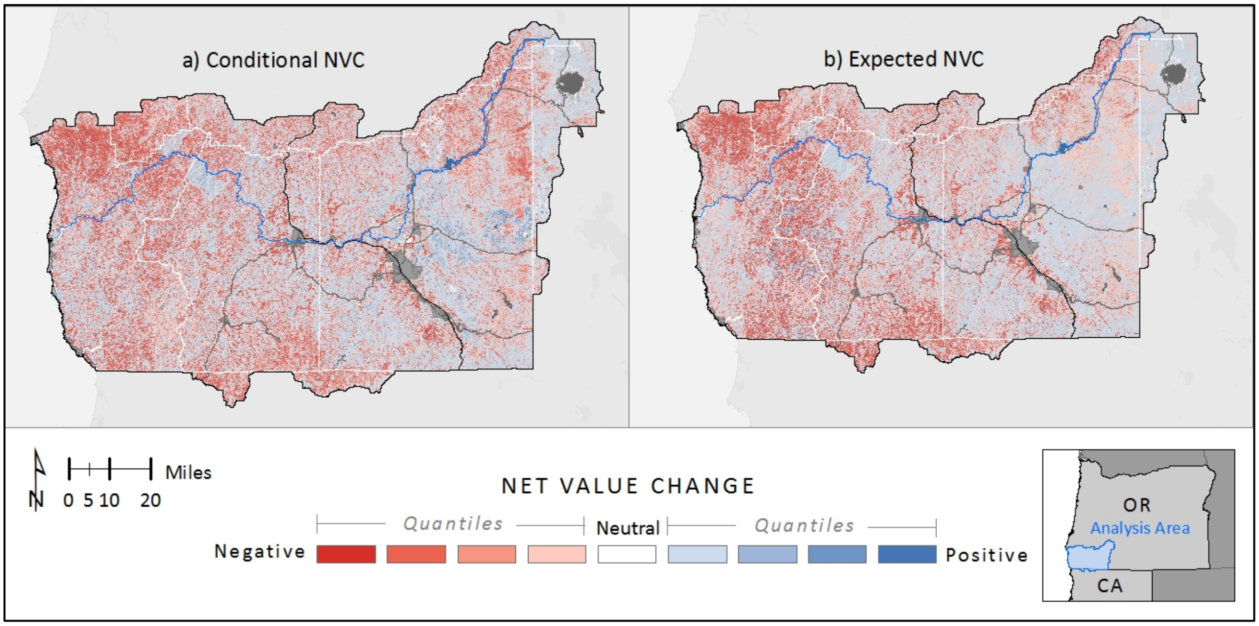

Figure 7: a) Conditional (cNVC) net value change and b) Expected net value change (eNVC) to all mapped high value resources and assets for the Rogue Basin analysis.

Probabilistic cNVC and eNVC can be used in a variety of ways to identify aggregations of potential wildfire impact, as well as the source of the fires that affected HVRA's. Similarly, the impact to HVRA's can be summed (Figure 7 or Figure 8c) or used for individual HVRA's (Figure 8 a, b, d). These risk data were used to prioritize risk-abatement treatments at the landscape scale, to evaluate the effectiveness of different strategies to reduce overall wildfire risk, and to inform safe effective wildfire response.

The patterns of likely wildfire responses vary widely across different resources and assets, and varied stakeholders' perceptions of risk can dramatically diverge depending on their interest and focus. On average, expected large fires effects on landscape resilience ranges from positive to negative (Figure 8a), contrasting sharply with largely negative predicted fire effects on timber resources, community assets, and NSO habitat (Figure 8b, c, and d). The balance of forest successional classes relative to the natural range of variability is an important metric of landscape resilience (Haugo et al. 2015) for which we modeled likely wildfire effect as the impact on transitions among successional classes by biophysical setting, and the relative benefit or detriment of the transition to the proportion of seral states at a landscape scale (Scott et al. 2014). For many forest settings where fire functions as a thinning agent, facilitating favorable transitions from both mid- and late-seral closed to open states, or transitions that fill deficits of complex early-seral, it alleviates departure and thus builds landscape resilience, though it might also threaten people and homes, degrade standing timber, or reduce extent of NRF for the NSO. Note that the relative value of change to HVRA's covaries; for example, timber value varies among ownerships, land allocation, and successional classes (Table 4).

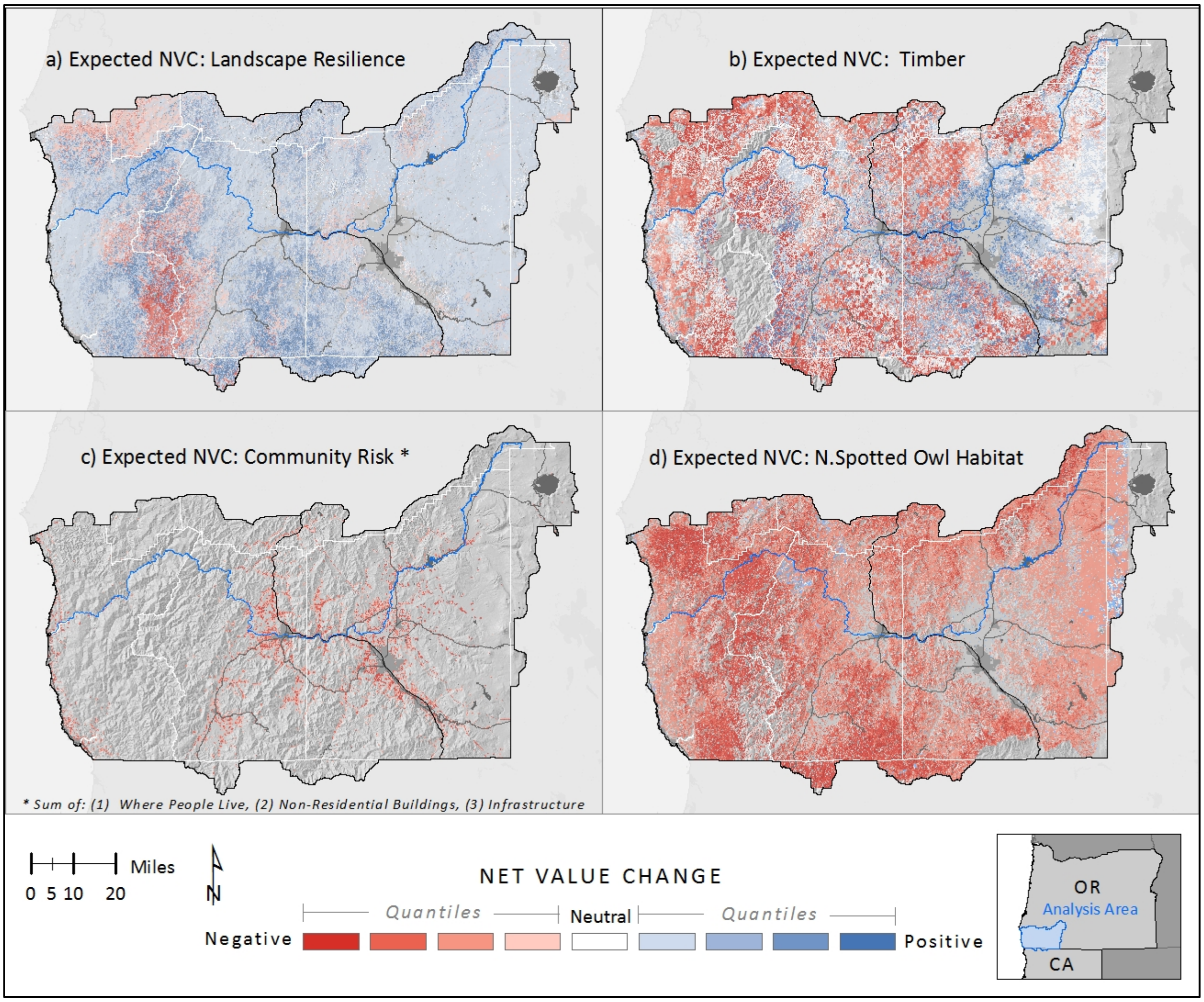

Figure 8: Expected net value change (eNVC) for a) landscape scale ecological resilience as reflected in the proportion of seral states, b) timber value varied by ownership and land allocation (as in Table 4), c) the cumulative eNVC on assets mapped that impact community values, and d) Northern Spotted Owl dispersal, nesting, roosting, and foraging habitat.

As a rule, assets are negatively impacted by wildfire, though susceptibility and replacement cost, as well as likely fire behavior, drive variable wildfire risk (Table 3). Many assets were mapped, but only a subset directly impact fire adapted communities. A strength of the qualitative risk assessment is the ability to sum the response of multiple values to wildfire. For example, in Figure 8c the eNVC for three classes of assets are summed: where people live (Oregon Department of Forestry et al. 2013), non-residential structures, and infrastructure. This represents the risk to community assets, scaled to likelihood of large wildfire.

Optimization

The SOFRC Strategy integrates wildfire risk and ecological restoration objectives (Figure 3). As in the National Cohesive Wildland Fire Management Strategy (Jewell and Vilsack 2014) resilient landscapes and fire adapted communities are key overarching objectives (Table 6). Along with incorporation of goals from the National Cohesive Strategy, the SOFRC Strategy is acting on key components of the National Cohesive Strategy that have been identified to facilitate implementation: strategic alignment, collaborative engagement, and programmatic alignment (Jewell and Vilsack 2014). This has been accomplished with broad-based collaborative meetings driving the assessment (participant lists in Appendix 1a and 1b), frequent collaborative engagement at SOFRC meetings, and periodic updates and reports to the agencies. Programmatic alignment ultimately will require incorporation of SOFRC Strategy components into agency resource management plans but ongoing collaboratively-based restoration projects are already demonstrating convergence on shared goals and approaches.

Each project area developed by the Cohesive Forest Restoration Strategy optimizes performance on five objective functions (Table 6) that tier directly to the National Action Plan for the National Cohesive Strategy (Suh and Bonnie 2014). The spatial overlap of the objective functions (Figure 9) was evaluated in Landscape Treatment Designer (LTD; Ager et al. 2012) and aggregated to form optimized treatment areas. Performance indicators were identified for each of the objective functions for optimization.

Table 6: The Rogue Basin Cohesive Forest Restoration Strategy designs proposed planning areas that optimize performance on five objective functions, all of which tier to key elements of the National Cohesive Wildland Fire Management Strategy National Action Plan (Suh and Bonnie 2014).

Objective Function	Description	National Cohesive Strategy Goals
1. Local fire community risk	Risk of fires originating within the Community at Risk	*Fire-adapted communities; Wildfire response*
2. Large wildfire community risk	Risk of fires to community assets from fires >35 acres	*Fire-adapted communities; Wildfire response*
3. Landscape resilience	Balancing the proportions of open and closed forest habitats	*Restore and maintain resilient landscapes*
4. Protecting and promoting Northern Spotted Owl habitat	Maintaining existing habitat and reducing adjacent wildfire risk while promoting complex forest in appropriate landscape settings	*Restore and maintain resilient landscapes*
5. Climate resilient landscapes	Prioritization of limited resources to landscapes most climate resilient	*Restore and maintain resilient landscapes*

Local Fire Community Risk

"Community At Risk" (CAR) focuses on a geographic area within and surrounding permanent dwellings (at least 1 home per 40 acres) with basic infrastructure and services, under a common fire protection jurisdiction, government, or tribal trust or allotment, for which there is a significant threat due to wildfire (Healthy Forests Restoration Act (HFRA) 2003). We defined our CAR beginning with the results of a statewide task force which established a uniform CAR framework for the state of Oregon (Oregon Department of Forestry 2006). This base CAR was augmented with the data on where people live generated by the Westwide Wildfire Risk Assessment using LandScan data from 2009 and people per housing unit from 2010 census data, integrated with a rigorous methodology (Oregon Department of Forestry et al. 2013).

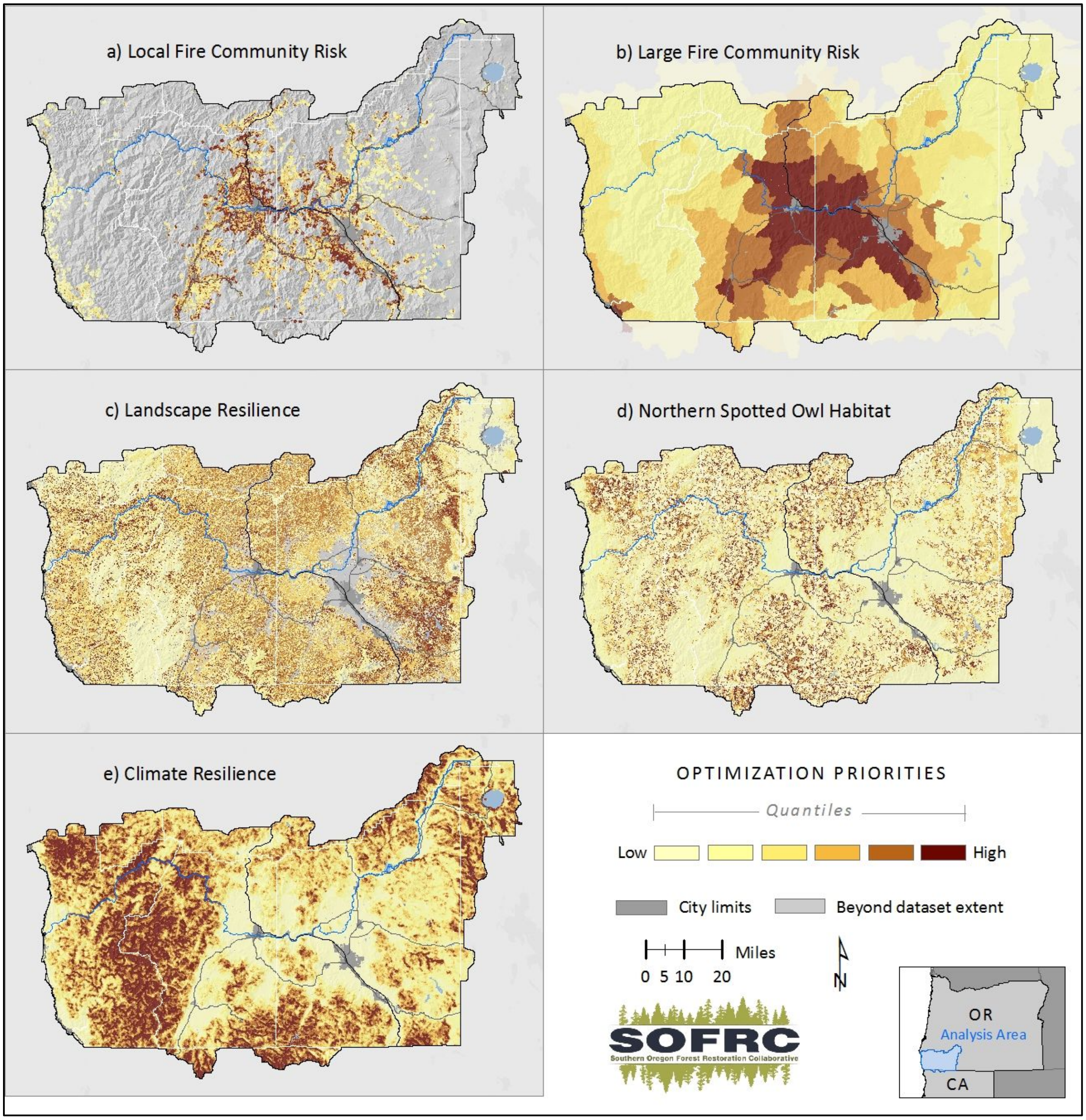

Figure 9: Forest restoration thinning and fuel reduction treatments were prioritized across the Rogue Basin project area based on five priorities a) fuel reduction to reduce local fire community risk b) fuel reduction to reduce large wildfire community risk c) thinning to promote landscape resilience d) thinning to promote and protect complex forest habitats e) thinning in settings likely to be resilient to climate change.

Analysis of the potential consequence of fires smaller than 35 acres was not a component of the SOFRC's quantitative large wildfire risk assessment. Suppression capabilities within the CAR generally keep fires small, although fires smaller than 35 acres have potential to impact community values due to highly aggregated assets. The Westwide Wildfire Risk Assessment (WWRA; Oregon Department of Forestry et al. 2013) utilized an ignition density grid of all fires, including the very small fires that can have high consequence for communities. Correspondingly, we supplemented our large fire risk assessment by creating a layer for Local Fire Community Risk using the Fire Risk Index from the WWRA within a 0.25 mile buffer of the SOFRC Communities at Risk (Figure 9a).

Large Wildfire Community Risk

The quantitative wildfire risk assessment developed for the Rogue Basin modeled likely large wildfire intensity for fires >35 acres and produced a quantified large wildfire risk metric for every pixel for a number of collaboratively derived resources and assets. Community assets evaluated for large wildfire community risk were: where people live (Oregon Department of Forestry et al. 2013), non-residential structures, infrastructure, and the only surface-water municipal watershed (Ashland, OR) in the analysis area. We aggregated the conditional net value change for each of these assets for every simulated wildfire, and then attributed the ignition source for those modeled fires with the likely consequence of that fire for our community assets. We then averaged the cumulative conditional net value change to community assets risk to the 12-digit/6th level hydrologic unit code (HUC) to quantify the likely consequence to communities of fires >35 acres igniting in a given spot on the landscape (Figure 9b). The intent was to guide fuel reduction treatments, in part, toward locations most prone to producing wildland fires that damage the community.

Landscape Resilience

Treatments were prioritized to restore resilient landscapes by addressing ecological departure as in Haugo et al. (2015), utilizing data from appendices to the published paper. The data describe the potential vegetation type (PVT) and the successional class (s-class) for each 30-meter pixel, as well as the status of that s-class attributed as similar, deficit, or excess relative to the natural range of variability (NRV) at the appropriate landscape analytical extent for the vegetation type. Landscape analytical spatial extent is a key context needed to understand the status of a particular s-class relative to the natural range of variability. Landscape resilience was evaluated at the landscape scale appropriate for the fire regimes associated with vegetation types. For Fire Regime I this was the 10-digit/5th level hydrologic unit code (HUC), which averaged 84,993 acres across our project area. For Fire Regime Group III the 8 digit/4th level HUC was used, averaging 633,169 acres across our project area. To identify appropriate places to apply restoration treatments we identified strata: biophysical settings associated with Fire Regime I and III (excluding subalpine woodland), in a closed s-class, evaluated at their appropriate landscape scale (Appendix A Haugo et al. 2015).

In addition to strata, vegetation types that historically experienced more frequent fire analyzed at their appropriate landscape scale, topographic position and solar insolation are important facets that influence vegetation composition and structure (Lydersen and North 2012). We attempt to recouple vegetation patterns with topographic facets (sensu Hessburg et al. 2015) by prioritizing thinning treatments on appropriate landscape positions. The vegetation data were intersected with solar insolation and topographic position creating two facets: bottoms and cool midslopes as appropriate locations to maintain more closed forests and ridges and warm midslopes as locations to more actively promote open forest. Thus, strata facets were the intersection of biophysical setting, s-class, topographic position, solar insolation, and landscape scale analytical unit.

Thinning relatively small, shade tolerant trees to reduce canopy cover, protect and promote larger trees was prioritized in excess late-closed forest if it was in appropriate landscape positions -- ridges or warm mid-slopes. The greater weight given to thinning excess late-seral forest in these settings was to represent the significant greater ecological investment in growing large old trees. Thinning was also prioritized in mid-seral closed stands on ridges and warm mid-slopes, landscape settings which are most appropriate for more open conditions (Table 7). Priority for treatment to open the forest from closed s-classes to open s-classes was calculated using Equation 1, giving an alternating ridge/bottom pattern of priority across the entire project area (Figure 9c). Across the 4.6 million acre project area, 4 million acres were vegetated, with 2.7 million acres in strata where thinning could be appropriate (s-class B or E, fire regime I or III). Across these strata there were 2.1 million acres of excess closed forest, suggesting a need for active treatments to promote more open forest conditions on about 51% of the forested landscape (Figure 9c).

$$\text{Equation 1: } \boldsymbol{Ecological\ Departure\ Priority} = \boldsymbol{M_{ED}} * \left(\frac{\boldsymbol{E}}{\boldsymbol{C}}\right)$$

Where:

M_{ED} = Priority Multiplier from Table 7
E = Excess acres of that strata facet
C = Current acres of that strata facet

Table 7: Priority for thinning forests to promote landscape resilience was limited to closed seral classes (s-classes) and favored in appropriate topographic positions (facets).

S-class (Code)	Facet	Priority Multiplier
(E) Late-closed	Ridges and warm mid-slopes	**2**
(B) Mid-closed	Ridges and warm mid-slopes	**0.5**
(B) Mid-closed	Bottoms and cool mid-slopes	**0.3**
(E) Late-closed	Bottoms and cool mid-slopes	**0.2**
(C) Mid-open	All	**0**
(E) Late-open	All	**0**
(A) Early	All	**0**

Northern Spotted Owl Habitat

Development and maintenance of complex forest associated with Northern Spotted Owl habitat in accordance with NSO habitat recovery plans RA 10 and RA 32 (U.S. Fish & Wildlife Service 2011, 2013) and NSO critical habitat designation (U.S. Fish & Wildlife Service 2012) is an essential feature of the analysis. Key actions are thinning in young forests to accelerate their development into old growth, thinning smaller trees to reduce wildfire hazard adjacent to existing NRF in appropriate landscape settings, and light thinning in simplistic second-growth stands to promote complex canopy layering. Extensive analysis utilizing remotely sensed data were used to generate likely treatment areas to inform treatment unit prioritization and estimates of likely work needed and restoration byproduct. As on-the-ground projects are developed, **site-specific analysis will be needed for every project** to appropriately balance short-term impacts and long-term benefits for NSO conservation and other objectives**.**

Treatment areas were prioritized based on existing NSO habitat and two classes of relative habitat suitability (RHS; U.S. Fish & Wildlife Service 2013). Exiting NSO habitat was modeled using the GNN data (Landscape Ecology Modeling Mapping and Analysis (LEMMA) 2014) and locally derived vegetation thresholds (U.S. Fish & Wildlife Service 2013) to identify NRF and dispersal habitat. The RHS layer utilized the same GNN data but also incorporated abiotic and biotic variables (e.g. slope position, aspect, and core use area size) that are associated with successful NSO habitat use patterns (U.S. Fish &

Wildlife Service 2011). For this analysis, areas classified as high RHS ranged from 35-127 and low RHS was classified <35. These classifications were identified by Rogue Basin FWS, BLM, and USFS wildlife specialists and informed by the NSO recovery plan (U.S. Fish & Wildlife Service 2013). Combinations of existing NSO habitat and RHS were used to identify treatment priorities and objectives (Table 8).

Meaningful aggregations of habitat were emphasized by running a majority filter on modeled existing habitat. The majority filter was based on the classification of the neighboring eight cells, and we then ran a boundary clean function. To ensure treatment placement would optimally benefit existing NRF in high RHS, an adjacency function was used where pixels closer to existing NRF high were prioritized for treatment. Wildfire risk was also considered by including the expected net value change to NRF and dispersal habitat for that pixel. These factors were combined as in Equation 2 to rank forests for thinning to promote and protect complex forest habitats (Figure 9d).

Equation 2: $$\textit{Northern Spotted Owl Priority} = M_{NSO} * 1/D_{NRFH} * R_{Habitat}$$

Where:

M_{NSO} = *Priority Multiplier from Table 8*

D_{NRFH} = *Distance to High RHS NRF scaled to max*

$R_{Habitat}$ = *Wildfire risk to NSO NRF or dispersal habitat for that pixel scaled to the max*

Table 8: Northern Spotted Owl (NSO) existing habitat and relative habitat suitability (RHS) classes used to prioritize active management. Priority of 0 indicates no proposed treatment. Priorities are further weighted by adjacency to existing Nesting Roosting and Foraging (NRF) habitat in high RHS settings. *Site specific review is critical for every project.*

Abbreviation	Definition	Objectives	Priority Multiplier
NRF high anywhere and NRF low within ½ mile known core	Existing NRF in high RHS or within any historic core	No treatment	**0**
Dispersal high (Near Range NRF)	Dispersal habitat in high RHS setting	Promote development to NRF with thinning single canopied dense stands	**1.5**
Capable high (Long Range NRF)	Capable habitat in high RHS setting	Promote development to dispersal with thinning in young stands	**1.4**
NRF low	Existing NRF in low RHS **Outside of ½ mile core**	Reduce wildfire risk to adjacent NRF and encourage ecological resistance by maintaining large trees and more open forest in ecologically appropriate settings.	**1.3**
Dispersal low	Dispersal habitat in low RHS settings	Thinning to promote ecological resilience while maintaining NSO dispersal capability at the landscape scale	**1**
Capable low	Capable habitat in low RHS settings	Thinning to promote ecological resilience while maintaining NSO dispersal capability at the landscape scale	**1**

Climate Resilient Landscapes

Areas of high geophysical diversity and landscape permeability to migration are expected to be the most resilient to climate change (Anderson and Ferree 2010, Buttrick et al. 2015). Climate change is predicted to increase the likelihood of fire (Westerling et al. 2006, Whitlock et al. 2008, Littell et al. 2009), fire severity (Brown et al. 2004, Van Mantgem et al. 2013), and suppression difficulty (Fried et al. 2004) across western North America. In the Mediterranean forests and woodlands of the Rogue Basin, this is expected to increase the amount of fire and shift the conversation from *if* fires will burn to *how* they will burn. A key climate change adaptation strategy is to reduce forest loss and thereby avoid rapid state changes (McKinley et al. 2011, Peterson et al. 2011, Stephens et al. 2013). Climate change will impact forests of the Rogue Basin in a numbers of ways, but uncharacteristically severe fire is a key change agent likely to cause rapid change (Myer et al. 2013).

Fuel reduction treatments with thinning and burning can effectively mitigate wildfire effects (Fulé et al. 2012, Safford et al. 2012, Martinson and Omi 2013) on mortality of large old trees (Ritchie et al. 2007, Prichard et al. 2010, Martinson and Omi 2013) and long-term carbon sequestration (North et al. 2009, Wiedinmyer and Hurteau 2010, North and Hurteau 2011, Loudermilk et al. 2014). Wildfire probability is key for determining if fuel treatments are a net carbon benefit (in the event of a wildfire) or simply a net carbon source (Mitchell et al. 2009, Campbell et al. 2011, Campbell and Ager 2013). Small differences in base analytical assumptions of wildfire likelihood, likely wildfire severity, and the life cycle of carbon after harvest or fire can quickly change interpretation of fuel treatments as a net carbon benefit or cost, so many practitioners simply operate as if they are functionally carbon neutral (Restaino and Peterson 2013).

Mechanical restoration treatments combined with low-mixed severity fire to promote forests with large fire resistant trees are proposed to facilitate dry-forest adaptation to a changing climate while minimizing undesirable state changes (McKinley et al. 2011, Peterson et al. 2011, Stephens et al. 2013). Synergistically, treatments to restore fire adapted forests and woodlands with thinning and fire are proposed to promote a resilient landscape (Haugo et al. 2015), focused on promoting fire resistant stands dominated by large trees of fire tolerant species while retaining variation in forest density and species composition at the landscape scale (e.g., Covington et al. 1997, Kolb et al. 2007, Franklin and Johnson 2012). Here we prioritize forest restoration and fuel reduction treatments in landscapes likely to be resilient to climate change as mapped by Buttrick et al. (2015) and then rescaled to our project area (Figure 9e). These settings tend to have high geophysical diversity and relatively high landscape permeability to migration, making them good locations to focus on treatments intended to maximize biodiversity retention and increased capacity to adapt to climate change.

Structural Restoration Needs Assessment

Central to the SOFRC cohesive restoration strategy and this assessment is the designation of three landscape treatment themes, each with distinct management guidance. These treatment themes articulate a target stand density and structure, given treatment is recommended by the optimization process. Using restoration forestry principles and practices specific to the forest types of southwest Oregon, the varied sets of objectives outlined for each of the mapped treatment themes provide a macro to zoom lens through which to view and discuss restoration need and opportunity in the Rogue Basin.

Proposed management recommendations for these areas outline compositional and structural goals from a desired ecological restoration and fire response perspective, with timber production derived only as a byproduct of meeting restoration goals. The guidance is robust, yet allows agency managers flexibility to use site specific actions as projects and plans require.

Where active management is proposed, managers will use a blend of ecologically restorative thinning to maintain forests with reduced density and prescribed fire to reduce fuels and return natural processes (sunsu Franklin and Johnson 2012, Hessburg et al. 2015). Openings will be created to maintain existing shade intolerant trees (e.g. pines and oaks), foster their regeneration, and restore understory plant diversity. The combination of the treatment themes and stand-based guidance helps promote structural heterogeneity at stand and landscape scales.

Initial treatments will provide flexibility for future management, anticipating that sustained forest resilience will be fostered through the most economically appropriate blend of under-burning, mechanical treatments, and merchantable harvest at regular intervals, tiered to historic fire return intervals and stand productivity. The SOFRC has yet to develop an analysis to estimate ongoing needs for sustainable harvest, however, maintenance treatments with thinning or fire will be needed over the long-term.

Landscape Treatment Themes include:

1) **Fuels Management** – This area occupies a quarter-mile buffer around Communities at Risk as defined in the RA and is largely not in public ownership, limiting access. Here, fire resistant forests of larger trees and simple structure are promoted and the primary goal is to reduce asset losses from fire and create safer suppression conditions by reducing surface and ladder fuels and raising canopy height.

2) **Complex Forest Habitat** – This area identifies the dense, multi-story forest favored by the Northern Spotted Owl, and other species and values consistent with older, complex forest.

   a. **Existing high quality** Northern Spotted Owl (NSO) habitat within older, complex forests and supporting other critical species is protected but where no treatments will occur.
   b. **Near-range emerging** NSO habitat where light thinning will promote multiple canopy layers in relatively simple stands with large trees, accelerating development to high quality complex habitat within 50 years. Treatments to improve habitat function may generate timber byproducts.
   c**. Long-range potential NSO habitat** where more thorough thinning is needed in young stands to accelerate development of large trees with large branches and deep crowns, providing high-quality complex habitat within 50-100 years. Treatments to improve habitat function may generate timber byproducts.

3) **Ecosystem Resilience and Forest Productivity** – This treatment theme embraces broad forest management objectives. Restoration of open forest habitats and promotion of fire and drought resistant tree species is expected to promote long-term sustainable forests resilient to a variety of stressors, and in combination with controlled burning management, the potential to provide economic return from harvest. Restoration goals of this treatment theme include:

i. Maintain and restore diversity of habitat, species, and stand structure
ii. Reduce loss to fire, insects, and drought (increase resistance and resilience)
iii. Conserve old trees and stands in and outside complex forest habitat areas
iv. Establish conditions for controlled underburning to maintain landscape resilience
v. Foster conditions for timber production using restoration forestry principles
vi. Generate ongoing products and employment through long-term maintenance/timber harvest

Acreage of SOFRC treatment themes in the analysis area by forest type, plant series, moisture availability, and insolation are provided in Appendix 2. The most abundant PVT's in the mapped available and accessible landscape are Douglas-fir – Dry, White fir – Intermediate, and Tanoak – Douglas-fir – Moist. Density targets for each treatment theme in terms of Relative Density Index (RDI) and Stand Density Index (SDI) are provided in Appendix 3 and vary by treatment theme, vegetation type and, solar insolation. Proposed density targets and associated removals are used to guide prescription development and are the basis of estimated trees/acre to be removed and subsequent restoration byproduct volume as well as investment needed.

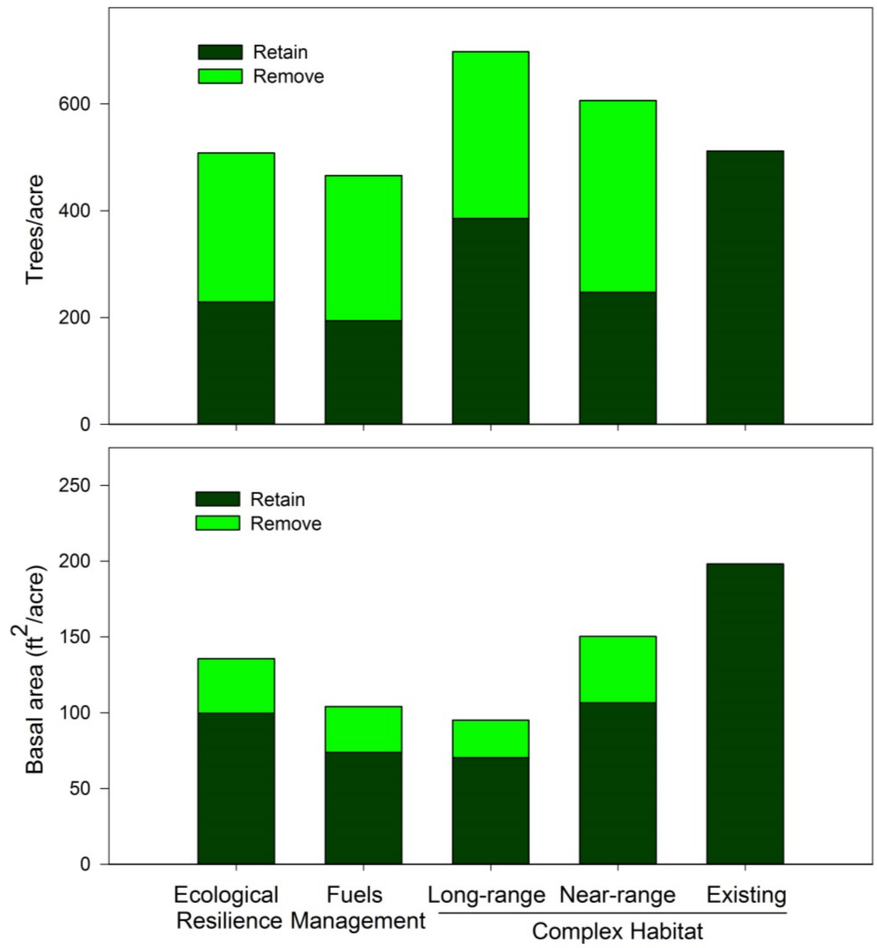

Figure 10: Average existing trees per acre and basal area for each of the treatment themes with proposed trees retained (dark green) and removed (light green) through application of SOFRC restoration strategies to the available and accessible portions of the analysis area.

Work needed and restoration byproduct volume was calculated by comparing desired stand density and structure to existing vegetation using collaboratively derived restoration targets and existing vegetation data from GNN (Landscape Ecology Modeling Mapping and Analysis (LEMMA) 2014) (Figure 10). This analysis predicted likely work needed and restoration byproduct timber volume in treated areas to a 30 m x 30 m pixel (0.22 acres). Meaningful aggregations of volume were emphasized by running a majority filter with an 8 cell neighborhood on predicted restoration volume. We then ran a boundary clean function to remove very isolated pixels. Average current conditions and treatment intensities vary across the treatment themes with the greatest basal area in the existing complex habitat but the highest density of trees per acre in the long-range treatment theme (Figure 10). Similarly, for actively managed treatment themes the target densities vary across the diameter distribution (Figure 11). As articulated below, restoration work needed was further summed to an 18 acre fishnet for identification of potential treatment areas.

To validate assumptions about how treatments would affect canopy cover, a key metric of forest structure, we used the Forest Vegetation Simulator (FVS; Dixon 2002) on a subset of plots representative of 57% of the potentially treatable landscape. For each actively managed treatment theme we selected the 5 most abundant PVT/insolation classes for each treatment theme. This evaluation suggests that the post treatment canopy cover will be marginally higher (~4%) in cool insolation settings than in warm insolation settings, and will average about 42%, 48%, 44%, and 54% canopy cover for the ecological resilience, fuel management, long-range complex, and near-range complex treatment themes respectively. Post treatment canopy cover will be lowest in the least productive PVT's, most notably the Oregon white oak PVT with an average post treatment canopy cover around 25%.

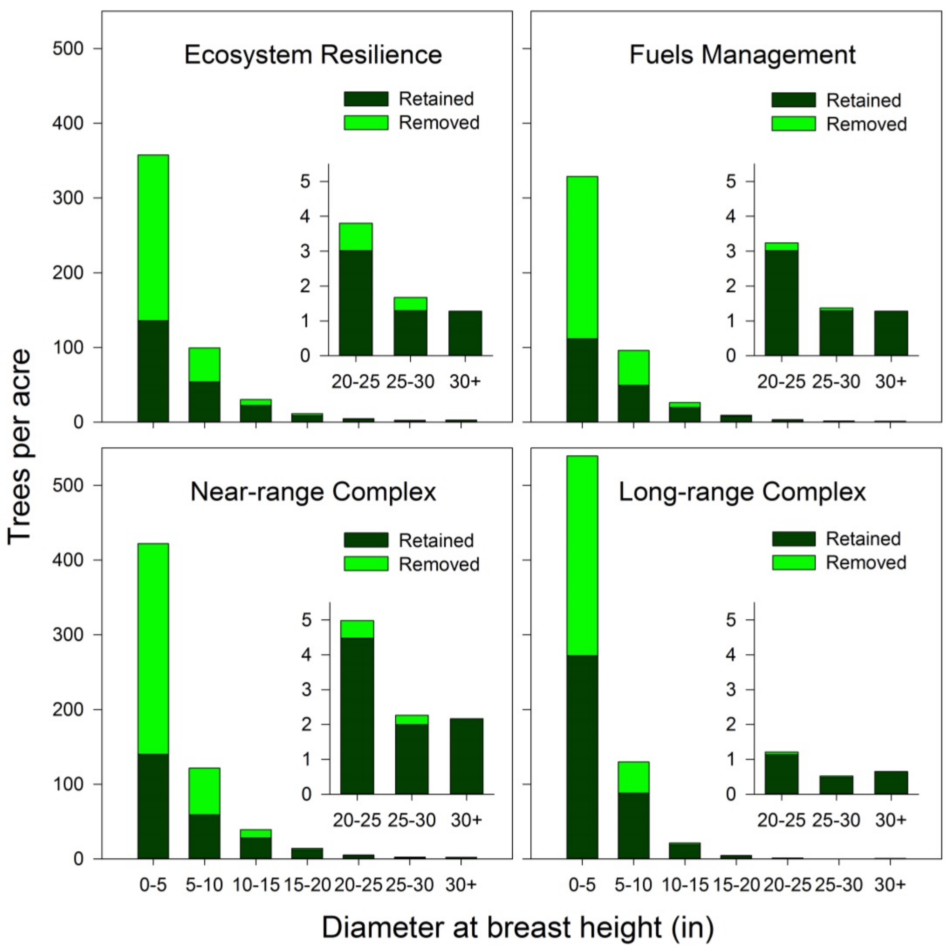

Figure 11: Average existing trees per acre by diameter class (inches) by treatment theme for the available and accessible portions of the analysis area. Application of the SOFRC restoration treatment themes will retain (dark green) or remove (light green) an average number of trees per acre. Inset focuses on trees >20 in. diameter at breast height.

Identifying Treatment Areas

Landscape Treatment Designer (LTD; Ager et al. 2012) was used to identify potential treatment areas optimizing treatment benefit and performance on key indicators. As primary inputs, LTD requires a landscape of polygons to then aggregate into potential treatment areas within specified size and shape constraints. To optimize the tradeoff between analysis resolution and processing time we chose to use an 18 acre fishnet. The program iteratively created aggregations of multiple patches that optimized desired treatment effects based on the five objectives described above 1) mitigating local fire community risk, 2) mitigating large wildfire community risk, 3) promoting resilient landscapes by addressing ecological departure, 4) protecting and promoting Northern Spotted Owl habitat, and 5) promoting landscapes resilient to climate change (Table 6, Figure 9). Patches (treatment areas) were then arrayed in decreasing priority relative to desired outcomes. Once project areas were described, within-project-area boundaries were dissolved and the underlying 30-m resolution raster datasets were queried to report out on performance indicators.

Filters

Treatment placement was constrained by filters to modulate the flow of economically viable byproduct timber volume and conform to land allocation and ecological considerations for no-treatment areas.

<u>Restoration Byproduct Timber</u>

Potential restoration byproduct merchantable volume was calculated as above in the structural restoration needs assessment. To clarify merchantable timber availability and advance the efficiency of restoration projects which include timber harvest, SOFRC generated a logging systems and access tool that takes into account the existing transportation system, topography, and operations awareness to inform potential project scope and design (Table 9). The tool identifies considerations such as fish streams, owl cores, major highways, ridges, and uphill units in order to categorize accessibility by harvest system (i.e., tractor, cable, mixed). It also identifies the part of a landscape with access only by helicopter which require strong markets and logistical fine-tuning. We mapped areas with access limited by the existing system roads, excluding areas which would require new road construction for access (Table 9). Economically viable stands were identified based on the predicted restoration byproduct merchantable volume aggregated to 18 acre fishnet and predominant yarding system for that 18 acre cell (Table 10).

Table 9: Accessibility by ownership and vegetation type under the existing road network (acres). Bureau of Land Management (BLM) and US Forest Service (FS) lands are predominately Medford District BLM or Rogue River Siskiyou National Forest, but include 117,000 acres of neighboring agency lands.

Accessibility/Vegetation	BLM	USFS	Other	Total
Accessible	475,003	670,966	1,153,850	2,299,820
Forest	453,253	638,485	936,945	2,028,683
Non-burnable	17,576	27,940	176,127	221,644
Non-Forest, Burnable	4,174	4,541	40,778	49,493
Helicopter accessible	383,480	603,198	483,936	1,470,614
Forest	373,942	593,477	414,914	1,382,333
Non-burnable	4,945	6,253	52,364	63,562
Non-Forest, Burnable	4,593	3,468	16,658	24,720
Limited access	58,880	545,323	197,872	802,075
Forest	56,609	536,311	154,777	747,698
Non-burnable	386	3,541	32,149	36,076
Non-Forest, Burnable	1,885	5,470	10,945	18,300
Total	**917,363**	**1,819,488**	**1,835,658**	**4,572,508**

Table 10: Economic viability of restoration was modeled based on accessibility and predicted restoration byproduct volume (in thousands of board feet /acre; MBF/ac).

Haul system	Definition	Restoration byproduct (MBF/ac)		
		< 2	2-6	>6
Road based	<200 feet of existing roads			
Skidder	Accessible via existing roads with slopes <35%		**Economically Viable**	
Short cable	200-800 downhill of existing roads			
Long cable	800-1600 downhill of existing roads	**Subsidy Required**		
Helicopter	Within ½ mile of existing roads			
Limited	Inaccessible via existing road system	**Inaccessible**		

<u>No-treatment Filters</u>

Congressionally withdrawn lands were excluded from the analysis. The Federal Land alternative focused on the RRSNF and MBLM. The All-lands alternative treated all ownerships equally. While the All-lands strategy includes minimal acreage of the Klamath, Umpqua, and Fremont-Winema National Forests as well as the Roseburg District BLM, treatment priorities will of course need to be assessed for those administrative units in their entirety. They are only included here from a neighbor-effects perspective.

No treatment was identified for Northwest Forest Plan riparian reserves, Northern Spotted Owl existing NRF in high RHS locations, and all historical ½ mile NSO cores. Site-specific surveys may alter these no-treatment areas. Riparian reserves were mapped using the National Hydrography Dataset (USGS NHD 2015) with perennial streams buffered by 300 feet and intermittent streams buffered by 150 feet. Northern Spotted Owl nest cores will be evaluated with project level surveys and a hierarchical approach as articulated in RA 10 (U.S. Fish & Wildlife Service 2013).

Table 11: Filters used (acres) to determine where treatments could potentially be placed. The portions of the landscape unavailable for treatment often substantially overlap.

	BLM	USFS	Other	Total	Percent of Grand Total
Accessible	**851,621**	**1,275,468**	**1,637,154**	**3,764,243**	**83**
Developed/unburnable	22,966	34,325	226,810	**284,100**	**6**
Congressionally Reserved	14,839	60,655	440	**75,935**	**2**
Riparian Reserve*	165,524	297,144	301,708	**764,376**	**17**
Northern Spotted Owl**	211,666	334,665	122,551	**668,882**	**15**
Inaccessible* **	**58,279**	**542,408**	**196,164**	**796,851**	**17**
Available	137,360	17,682	135,861	**290,903**	**6**
Developed/unburnable	406	3,559	32,057	**36,022**	**1**
Congressionally Reserved	24,413	319,171	1,127	**344,711**	**8**
Riparian Reserve*	9,982	118,504	17,291	**145,777**	**3**
Northern Spotted Owl**	13,062	86,301	11,969	**111,332**	**2**
Available and Accessible	470,715	640,550	1,034,749	**2,146,014**	**47**
Unavailable and/or Inaccessible	439,186	1,177,326	798,568	**2,415,080**	**53**
Grand Total	**909,901**	**1,817,876**	**1,833,318**	**4,561,094**	

*National Hydrography Dataset perennial streams buffered by 300 feet and intermittent streams buffered by 150 feet

** Existing Northern Spotted Owl nesting roosting and foraging habitat in high relative habitat suitability settings or within historical nest cores

***Otherwise available for treatment, but >1/2 mile from existing system roads

Within the existing framework 47% of the landscape is available for active management and within ½ mile of existing system roads (Table 11). This percentage is much lower for Federal strategy which incorporates significant wilderness and unroaded areas while the All-lands strategy incorporates a higher proportion of heavily roaded forest and woodland adjacent to where people live. Viewed another way, 83% of the total assessment area is potentially accessible for treatment, but only 57% of the accessible area is actually available for treatment, due largely to riparian reserve and NSO habitat filters, parts of which overlap.

Prioritized Project Areas

Across the entire analytical area, the Strategy identifies 2.1 million acres of accessible and available treatment settings of all vegetation types, representing 47% of the landscape. Treatment on these acres would accomplish treatment objectives operating within ½ mile of the existing road system outside of reserved no-treatment areas. We found 1,089,000 acres with commercial byproduct timber on USFS and BLM lands. We parsed that into economically viable and subsidy acres. Application of the treatment themes to the available and accessible federal lands (USFS and BLM) would generate 2.1

billion board feet of restoration byproduct, ~0.9 billion board feet (206,000 acres) of that will be economically viable and 1.2 billion board feet (883,000 acres) will require subsidy. The remaining 1.1 million acres of USFS and BLM lands will require subsidy to maintain resilient conditions and to treat vegetation <10 inches diameter at breast height.

We used LTD to delimit individual projects. To provide an even flow of restoration byproduct volume, we divided the available, accessible, economically viable total volume for the USFS and BLM lands (0.9 billion board feet) by 20 years and by 6 projects per year (120 projects). Planning areas were thus constrained to provide 6 million board feet per project. Additionally projects were constrained to include treatment on 8-12,000 acres.

Interim results are provided here(Figures 12 and 13), in terms of acreage summed by treatment theme, objective function, emphasis, treatment of excess closed-canopy forest, and byproduct volume and economics (Appendices 3-6). For both the Federal and All-lands alternatives, the first 15 projects scaled to roughly 11,700 acres, but the proportions of treatment types varied by alternative. These results reflect an even weighting of the five objective functions and will be further vetted, likely resulting in desirable changes. Similarly, we will generate results for 120 project areas to cover the entire available landscape. We will further sort project areas across BLM resource areas and FS ranger districts to translate our landscape scale priorities as a form of decision support for local land and resource managers.

Federal Lands Alternative

We discuss the results of the interim project areas on Forest Service and BLM lands to demonstrate how the selections and data summaries may be used. For example, acreage within the Fuel Management emphasis dominated the first two projects near Grants Pass and Gold Hill and with significant acreage of the Fuel Management treatment theme adjacent to seven other communities also elevated. However, the emphasis varied widely, with the project 5 near Brookings including almost no Fuel Management theme acreage (Appendix 4). The Ecosystem Resilience treatment theme dominated for the remaining thirteen projects, making up the bulk of the treatment overall. The areas treated for NSO predominantly targeted available Near-range stands as a third priority, and treatment to promote the long-range development of habitat amounting to few acres and the least abundant type in nearly all of the top 15 projects.

Another metric for evaluating proposed project areas is to focus on how performance relative to the primary objective functions, as in Appendix 5. This approach highlights the contribution of each function to the cumulative function for each project. The top 15 projects performed best on Climate Resilience, with moderate level for the highest ranked project and generally increasing to as much as 46% of the objective value. The “Northern Spotted Owl” objective function, which includes thinning to reduce stand closure in appropriate settings, ranks second for its contribution to the project cumulative objective function scores. As such this objective function is fulfilled much more completely than simply tallying the acreage in the Long-range and Near-range treatment themes would suggest.

As with the Fuels Management theme, the contributions of both large and local fire risk are variable across the projects. Treatments to promote resilient landscapes focused on thinning excess closed s-classes, though not all treatments were in closed s-classes (Appendix 6). Among projects, the percentage of the objective value addressing ecological departure averaged 18% and was relatively consistent.

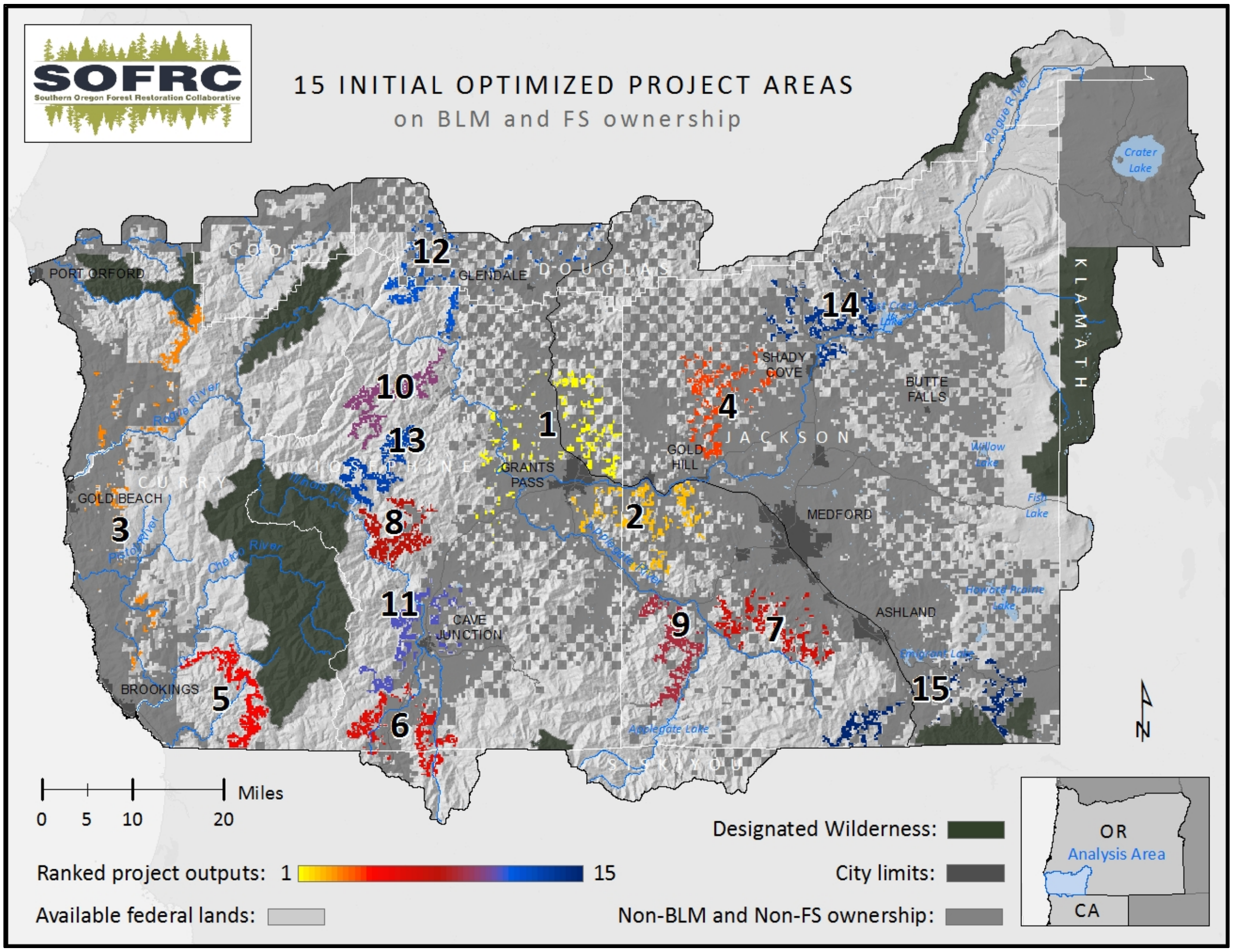

Figure 12: Example results for 15 optimized projects with all five objectives evenly weighted for USDA Forest Service and Bureau of Land Management Lands.

SOFRC did not set volume as an objective function to maximize by project. However, economically viable volume was set as a design constraint in LTD, and each project grew until it provided 6 million board feet of economically viable restoration byproduct volume (Appendix 7). On average, the non-economical acres and volume (requiring subsidy) are roughly double the economically viable acres and volume. The project acres providing economical viable timber ranges widely from 1,746 to nearly 7,000, and these extremes come with the highest and lowest, respectively, cumulative volume requiring subsidy (33 MMBF to as little as 4.3 MMBF). Subsidized treatment which includes only surface and ladder fuels accumulated very little acreage (0 - 3762 acres) in the top priority projects, with a slight tendency toward fewer in the highest priorities. A constraint to spread the cost burden of non-commercial surface and ladder fuel treatment is a factor that could be added.

All-lands scenario

When adding available private forests to the federal lands, the Fuel Management emphasis acreage dominated all the draft 15 projects, with acreage ranging from 40% to 90% of the projects, doubling the result of the Federal Alternative. Treatments targeting the Ecosystem Resilience theme comprised the second most important acreage, followed by acreage tracking the Near-range NSO habitat, and again little acreage accumulated under the theme of Long-range NSO habitat promotion.

Performance on the primary objective functions (Appendix 5) for the All-lands Strategy shows a higher overall objective function score, and, as in the comparison of treatment themes in the Federal Strategy, there is a strong shift to acreage which accomplishes the Local and Large Fire Risk mitigations, with a generally declining contribution from top to the bottom in the list. Here again, an emphasis is placed on treatment accomplishing the Northern Spotted Owl objective function, and that is closely followed by accomplishment of Climate Resilience and then by Ecological Resilience.

In terms of the treatment of excess Closed Forest seral structural states, the All-lands Strategy performed slightly better, adding roughly 13,200 acres, and increasing the average project level treatment by 4%.

In the All-lands Strategy, the public acres treated are reduced dramatically, and the volume constraint was not met in half of the first 15 projects, most of which were ranked in the top half of the priority list (Appendix 7). The All-lands projects pulled in over 2000 acres more economically viable treatment on average, and while the strategy accumulated not quite 75% of the Federal Strategy total restoration byproduct volume, the proportion which required subsidy did not differ (~66%). Subsidized surface and ladder Fuel treatment acres also were quite similar to those in the Federal Strategy.

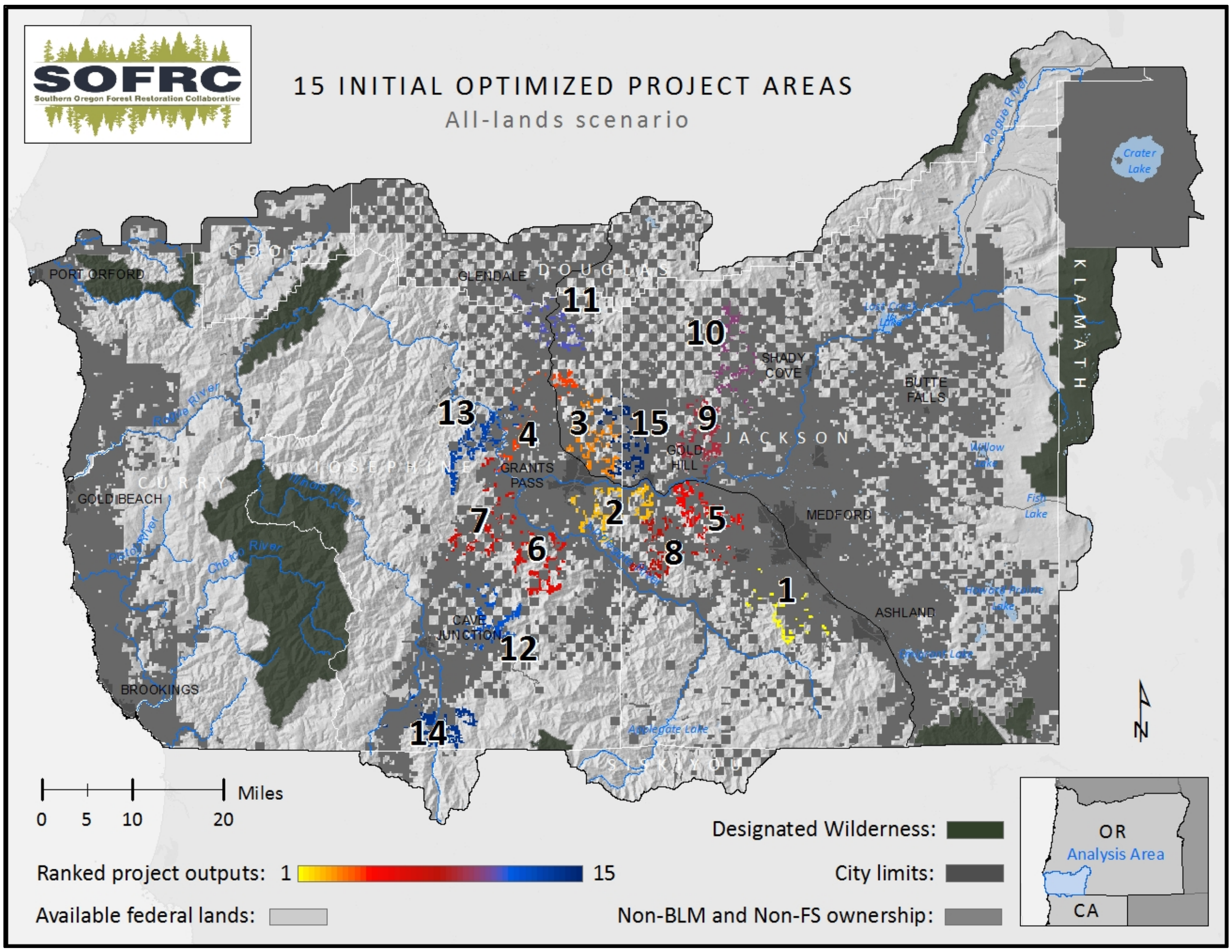

Figure 13: Example results for 15 optimized projects with all five objectives evenly weighted for an All-lands approach.

Comparing Strategy Scenarios

For this version 1 report, the two new Federal and All-lands scenarios are still in development, as the technical team addressed operating limits of the LTD program. The primary two scenarios and the Business-as-Usual comparative scenario will be evaluated on their performance across the entire analysis area, relative to key indicators outlined below. Preferably performance of the alternative scenarios will incorporate an estimate of likely wildfire effect. This evaluation of performance on the final outputs will be discussed among the technical team, project advisors, and key stakeholders to provide input on refinements to the assessment and optimization approach for a refined, or "version 2" of this project. While the vetting of the version 1 is ongoing with available resources, SOFRC will also be assembling additional needed resources and a project plan and time frame for completing the refinements for version 2.

Performance Indicators Proposed:

Landscape resilience based in ecological departure

1. Calculated as in Haugo et al. (2015) – proportion of excess closed forest treated as a proportion of available and as a proportion of the whole– account for changes due to wildfire
2. Change in vegetation strata status
3. Change in "risk" to proportions of seral states

Northern Spotted Owl habitat

1. Acres/proportion of acres treated by treatment category (Table 8)
2. Change in risk to NRF and dispersal

Economics

Use the restoration economics calculator (http://ewp.uoregon.edu/economy) to generate economic investment and return expected in local economic activity, primary, secondary, and induced jobs. Results will be aggregated to the planning unit scale. Key available inputs will be:

1. Acres to be treated
2. Trees per acre to be removed by five-inch diameter class
3. Timber volume
    a. Product type
4. Dollars invested in restoration activities
    b. By activity type
5. Firefighting cost – CFLRP calculator

Wildfire risk

Modified modeled fire behavior and risk, overall and by key HVRA's and sub-HVRA's, including critical aggregations such as the community assets.

Proportion of good and bad fire

A key output of the risk assessment

Overall return on investment, near-term and long-term

Next Steps

This Strategy is a major advance in the ongoing dialogue about strategic, integrative, and cohesive land management. It provides base data layers, including wildfire hazard and risk to high value resources and assets, consideration of climate adaptation, and an analytical approach to make transparent the Collaborative's principled vision. A number of actions will be needed to fully manifest the Strategy and then to translate planning into action. These steps, listed from near- to long-term are:

1. Generate final LTD potential project areas to evaluate performance of the business-as-usual, Federal, and All-lands scenarios on indicators as above. Results will be used to:
    a. Modify fuel conditions for fire behavior modeling to recalculate risk across the landscape for each scenario
    b. Parse the results by district and resource area for local project prioritization
    c. Analyze tradeoffs among objectives to identify project areas consistent with collaboratively developed current and long-term needs.
2. Vet the Strategy to build understanding and cohesion, as well as to gain input from a wide range of stakeholders for the continued development of v.2
    a. Local communities
    b. Community fire service
    c. Local and state government
    d. Federal planners
    e. Regulatory agencies
    f. Wildland fire managers
    g. Environmental groups
    h. Industry groups
    i. State and federal policy makers
3. Assess landscape resilience and NSO habitat as affected by ongoing wildfire to refine estimates of restoration need
4. Improve integration of ongoing fire management with further development and analysis using the Wildfire Risk assessment
    a. Identify particularly exposed HVRA's and portions of the landscape for focused fuel management efforts
    b. Inform wildfire management decisions to address fire behavior, smoke, and risk to HVRA's
5. Evaluate long-term (>20 year) impacts of the Strategy in collaboration with Miles Hemstrom and Emily Henderson of the Institute for Natural Resources using STSim, to build that perspective into v.2

Frequent wildfire historically maintained landscape resilience in the Rogue Basin, but fire exclusion has created a backlog of "treatment", which has been termed a "fire deficit" (North et al. 2012). The fire deficit, in concert with other management practices has resulted in a landscape that lacks variability and resilience, a landscape characterized by 2.1 million acres of excess closed forest (Haugo et al. 2015). The Strategy estimates 2.1 million acres on all lands where treatments could occur given existing constraints. However, 1.0 million acres of the total are on private ownership and will be managed by a diverse array of owner objectives. Another 0.6 million acres occur within the Community at Risk, an important footprint where management will reduce fuels and promote fire adapted communities. However, work in the Community at Risk is unlikely to transition stands from closed to open, as necessary to achieve landscape resilience. Anticipated annual wildfire effects (26,000 acres annually over the last 20 years) will reduce the needed footprint of mechanical treatments.

Assuming 2.1 million acres of forest were to be treated in 20 years, 180 thousand acres would need to be treated annually working predominantly in appropriate closed conditions to transition to more open mid- and late-seral states. There are 1.1 million accessible and available acres on USFS and BLM lands, the vast majority in appropriate conditions and settings for treatment. Treatment of these available and accessible lands over 20 years would require 55,000 acres to be treated annually. In comparison, the federal agencies currently treat only 9,000 acres/year. Thus, mechanical treatments on federal lands would need to increase dramatically to arrive at resilient landscapes within 20 years, not accounting for ingrowth, maintenance, or the effects of wildfire. Maintenance treatments of either thinning or burning would need to be scheduled on a rotating 10-20 year cycle starting immediately, and assuming an average return interval of 15 years would require 74,000 acres of maintenance treatment, prescribed burning or mechanical treatment annually.

As in North et al. (2012) the magnitude of work needed outstrips the current capacity of the federal agencies to complete the work needed to achieve resilient landscapes. Under the existing framework federal treatments impact 1/3 of the acreage that wildfires impact. This situation elevates the need to incorporate managed wildfire to accomplish societal objectives of reducing wildfire risk and promoting resilient landscapes. This will only be achieved with proactive, strategically placed treatments to promote more favorable fire effects combined with managing wildfire to burn under an appropriate range of fire weather conditions, in the right parts of the landscape. We anticipate working with our federal partners and stakeholders to develop an implementation plan to use SOFRC Cohesive Forest Restoration Strategy to increase forest resilience in the Rogue Basin.

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Appendices

Appendix 1a: Non-federal participants in the Wildfire Risk Assessment workshops convened by the Southern Oregon Forest Restoration Collaborative in 2015.

Name	Title	Affiliation
Jack Shipley	Executive Director	Applegate Watershed Council
Ken Wienke	Timber Purchaser	Boise Cascade, Inc.
Kendra Smith	Model Watershed Program Director	Bonneville Environmental Foundation
Robert Kentta	Tribal Council	Confederated Tribe of the Siletz Indians
Neil Benson	Fire Plan Coordinator	Fire Plan
Dave Schott	Owner	Forest Glen Lumber
Eugene Wier	Project Manager	The Freshwater Trust
Guy Sparks	Fire Professional	Grayback Forestry, Inc.
Sean Hendricks	Fire Professional	Grayback Forestry, Inc.
Jim Wolf	Wildfire Operations Chief	Intterra Group, Inc.
Karim Naguib	Information Technology	Jackson County
Jenny Hall	Emergency Management Coordinator	Jackson/Josephine County
Simon Hare	County Commissioner	Josephine County
Jaime Stephens	Science Director	Klamath Bird Observatory
Joe Vaile	Executive Director	Klamath-Siskiyou Wildlands Center
Vince Oredson	Wildlife Habitat Specialist	Oregon Department of Fish and Wildlife
Dan Thorpe	District Forester	Oregon Department of Forestry
Greg Alexander	Medford Unit Forester	Oregon Department of Forestry
Herb Johnson	Prevention Specialist	Oregon Department of Forestry
John O'Connor	Cohesive Wildfire Strategy Coordinator	Oregon Department of Forestry
Matt Krunglevich	Prevention Planner	Oregon Department of Forestry
Charley Phoenix	Fire Science Consultant	Phenix Consulting and Education, Inc.
Joe Scott	Wildfire Modeling Specialist	Pyrologix, LLC
Blair Moody	SOFRC Board	Retired BLM/FS
Ed Reilly	Spatial Analyst	Retired BLM/FS
Steve Ziel	Fire Behavior Modeler	Retired Forest Service
Marty Main	Forester	Small Woodland Services, Inc.
Stanley Petrowski	President and Executive Director	South Umpqua Rural Community Partnership
George McKinley	Executive Director	Southern Oregon Forest Restoration Collaborative
Tobin Smail	Fire and Fuels GIS Specialist	Stinger Ghaffarian Technologies, Inc.
Ashley Lara	Fire Adapted Communities Coordinator	The City of Ashland
Chris Chambers	Forest Division Chief	The City of Ashland
Steve Parks	Fire Adapted Communities Coordinator	The City of Ashland
Darren Borgias	Southwest Oregon Program Director	The Nature Conservancy
Derek Olson	Spatial Analyst	The Nature Conservancy
Kerry Metlen	Forest Ecologist	The Nature Conservancy

Appendix 1b: Federal participants in the Wildfire Risk Assessment workshops convened by the Southern Oregon Forest Restoration Collaborative in 2015.

Name	Title	Agency
Al Mason	Fuels Management Specialist	Medford District BLM
Allen Mitchell	Fire and Fuels Management	Medford District BLM
Bryan Wender	District Botany Lead	Medford District BLM
Dayne Barron	Medford District Manager	Medford District BLM
Jena Volpe	Fire Ecologist	Medford District BLM
Jon Larson	Ashland Fuels	Medford District BLM
Kristi Mastrofini	Ashland Supervisor	Medford District BLM
Mark Metevier	District GIS Program Lead	Medford District BLM
Robin Snider	District Wildlife Lead	Medford District BLM
Terry Fairbanks	District Silviculturist	Medford District BLM
Tony Kerwin	District Planner	Medford District BLM
Yanu Gallimore	Fire Management Specialist	Medford District BLM
Peter Winnick	Soil Conservationist	Natural Resources Conservation Service
Amy Amrhein	Staff to Senator Merkley	United States Senate
Cindy Donegan	Fish and Wildlife Biologist	US Fish and Wildlife Service
Charley Martin	Senior Scientist SGT-EROS	US Geological Survey
Bill Schaupp	Entomologist	USFS Forest Health Protection
Josh Bronson	Forest Pathologist	USFS Forest Health Protection
Nikola Smith	Ecosystem Services Specialist	USFS Pacific Northwest Region
Tara Umphries	Sub-regional Fire Planner	USFS/BLM Pacific Northwest Region
Matt Thompson	Research Forester	USFS Rocky Mountain Research Station
Aimee Ross	Botany Technician	USFS Rogue River-Siskiyou National Forest
Allan Hahn	Natural Resources Staff	USFS Rogue River-Siskiyou National Forest
Brian Long	Recreation	USFS Rogue River-Siskiyou National Forest
Clint Emerson	Gold Beach Botanist	USFS Rogue River-Siskiyou National Forest
Craig Trulock	Deputy Forest Supervisor	USFS Rogue River-Siskiyou National Forest
Don Boucher	Environmental Coordinator	USFS Rogue River-Siskiyou National Forest
Donna Mickley	Siskiyou Mountains District Ranger	USFS Rogue River-Siskiyou National Forest
Eric Hensel	Fire and Aviation Staff Officer	USFS Rogue River-Siskiyou National Forest
Jeff von Kienast	Fisheries and Wildlife Biologist	USFS Rogue River-Siskiyou National Forest
Jon Lamb	Fire and Fuels Management	USFS Rogue River-Siskiyou National Forest
Joni Brazier	Hydrology/Soils	USFS Rogue River-Siskiyou National Forest
Mark Hocken	Range Biologist	USFS Rogue River-Siskiyou National Forest
Monty Edwards	Fire Management Officer	USFS Rogue River-Siskiyou National Forest
Patricia Hochhalter	Ecologist	USFS Rogue River-Siskiyou National Forest
Rob Budge	Deputy Fire Staff - Fuels	USFS Rogue River-Siskiyou National Forest
Rob McWhorter	Forest Supervisor	USFS Rogue River-Siskiyou National Forest
Robert Shoemaker	Minerals Specialist	USFS Rogue River-Siskiyou National Forest
Shannon Downey	Environmental Coordinator	USFS Rogue River-Siskiyou National Forest
Donald Helmbrecht	Wildland Fire Analyst	USFS TEAMS Enterprise Unit

Appendix 2: Acreage of Southern Oregon Forest Restoration Collaborative treatment themes available for treatment and accessible via the existing system roads, by potential vegetation type (PVT) and ownership class.

Potential Vegetation Type	Ecosystem Resilience	Fuel Management	Long-range	Near-range	Total	Percent (%)
Douglas-fir - Dry	298,739	254,206	11,265	81,524	645,733	32.8
Douglas-fir – Moist	37,138	3,503	1,984	9,774	52,399	2.7
Jeffrey pine	29,025	8,838	293	2,456	40,612	2.1
Oregon white oak	43,371	71,668	818	2,090	117,947	6.0
Ponderosa pine - Dry	16,097	24,246	252	1,032	41,627	2.1
Shasta red fir - Dry	2,173	100	0	0	2,273	0.1
Shasta red fir - Moist	7,589	16	84	1,976	9,665	0.5
Sitka spruce	4,235	9,353	0	0	13,588	0.7
Tanoak - Douglas-fir - Dry	103,881	17,809	4,411	19,324	145,424	7.4
Tanoak - Douglas-fir - Moist	181,751	46,847	6,660	13,598	248,855	12.6
Ultramafic	35,548	4,961	191	823	41,524	2.1
Western hemlock - Hyperdry	22,446	1,773	752	3,617	28,588	1.4
Western hemlock - Intermediate	49,725	2,590	1,361	3,550	57,226	2.9
Western hemlock - Moist	38,788	2,473	642	2,586	44,489	2.3
White fir – Cool	65,383	3,088	447	7,693	76,611	3.9
White fir - Intermediate	259,234	40,504	8,294	58,430	366,462	18.6
White fir - Moist	3,127	354	340	1,582	5,403	0.3
Other PVT's	92,760	85,079	869	4,880	183,588	8.7
Ownership						
Bureau of Land Management	286,877	102,735	9,226	63,690	462,528	21.8
U.S. Forest Service	505,527	35,640	11,693	74,406	627,266	29.6
Other ownership	497,893	437,903	17,717	76,736	1,030,249	48.6
Total available and accessible	**1,290,297**	**576,278**	**38,636**	**214,832**	**2,120,043**	

Appendix 3: Restoration density targets in for each treatment theme in terms of Relative Density Index (RDI) and Stand Density Index (SDI) scaled by the maximum SDI (Max SDI) of the seral tree species (seral) tailored to potential vegetation type and solar insolation. Excludes PVT's comprising <1% of the treatable landscape.

				Ecosystem Resilience		Fuel Management		Long-range		Near-range	
Potential Vegetation Type	**Insolation**	**Seral***	**Max SDI**	**RDI**	**SDI**	**RDI**	**SDI**	**RDI**	**SDI**	**RDI**	**SDI**
Douglas-fir - Dry	Cool	PIPO	499	0.35	175	0.40	200	0.30	150	0.45	225
Douglas-fir - Dry	Warm	PIPO	499	0.30	150	0.35	175	0.30	150	0.45	225
Douglas-fir – Moist	Cool	PIPO	499	0.40	200	0.45	225	0.30	150	0.45	225
Douglas-fir – Moist	Warm	PIPO	499	0.35	175	0.40	200	0.30	150	0.45	225
Jeffrey pine	Cool	PIJE	264	0.35	92	0.40	106	0.30	79	0.45	119
Jeffrey pine	Warm	PIJE	264	0.25	66	0.35	92	0.30	79	0.45	119
Oregon white oak	Cool	QUGA	200	0.35	70	0.40	80	0.30	60	0.45	90
Oregon white oak	Warm	QUGA	200	0.30	60	0.35	70	0.30	60	0.45	90
Ponderosa pine - Dry	Cool	PIPO	499	0.30	150	0.40	200	0.30	150	0.45	225
Ponderosa pine - Dry	Warm	PIPO	499	0.25	125	0.35	175	0.30	150	0.45	225
Shasta red fir - Dry	Cool	ABMAS	755	0.45	340	0.45	340	0.30	227	0.45	340
Shasta red fir - Dry	Warm	ABMAS	755	0.40	302	0.40	302	0.30	227	0.45	340
Shasta red fir - Moist	Cool	ABMAS	755	0.45	340	0.45	340	0.30	227	0.45	340
Shasta red fir - Moist	Warm	ABMAS	755	0.40	302	0.40	302	0.30	227	0.45	340
Sitka spruce	Cool	PISI	700	0.45	315	0.45	315	0.30	210	0.45	315
Sitka spruce	Warm	PISI	700	0.40	280	0.40	280	0.30	210	0.45	315
Tanoak - Douglas-fir - Dry	Cool	PSME	600	0.35	210	0.40	240	0.30	180	0.45	270
Tanoak - Douglas-fir - Dry	Warm	PSME	600	0.30	180	0.35	210	0.30	180	0.45	270
Tanoak - Douglas-fir - Moist	Cool	PSME	600	0.35	210	0.45	270	0.30	180	0.45	270
Tanoak - Douglas-fir - Moist	Warm	PSME	600	0.30	180	0.40	240	0.30	180	0.45	270
Ultramafic	Cool	PIJE	294	0.30	88	0.40	118	0.30	88	0.45	132
Ultramafic	Warm	PIJE	294	0.25	74	0.35	103	0.30	88	0.45	132
Western hemlock - Hyperdry	Cool	PSME	600	0.35	210	0.45	270	0.30	180	0.45	270
Western hemlock - Hyperdry	Warm	PSME	600	0.30	180	0.40	240	0.30	180	0.45	270
Western hemlock - Intermediate	Cool	PSME	600	0.45	270	0.45	270	0.30	180	0.45	270
Western hemlock - Intermediate	Warm	PSME	600	0.40	240	0.40	240	0.30	180	0.45	270
Western hemlock - Moist	Cool	PSME	600	0.35	210	0.45	270	0.30	180	0.45	270
Western hemlock - Moist	Warm	PSME	600	0.30	180	0.40	240	0.30	180	0.45	270
White fir – Cool	Cool	ABMAS	750	0.40	300	0.45	338	0.30	225	0.45	338
White fir – Cool	Warm	ABMAS	750	0.35	263	0.40	300	0.30	225	0.45	338
White fir - Intermediate	Cool	PSME	530	0.35	186	0.40	212	0.30	159	0.45	239
White fir - Intermediate	Warm	PSME	530	0.30	159	0.35	186	0.30	159	0.45	239

*Seral tree species: ABMAS=Shasta red fir, PIJE=Jeffrey pine, PIPO=ponderosa pine, PISI=Sitka spruce, PSME=Douglas-fir, QUGA=Oregon white oak

Appendix 4: Interim DRAFT results for 15 optimized projects with all five objectives evenly weighted for the Federal (Rogue River-Siskiyou National Forest and Medford District BLM) and All-lands scenarios. Treated area of all projects was ~12,000 acres but varied among mapped treatment themes. Long-range and near-range treatment themes promote complex Northern Spotted Owl habitat. Fuel reduction in and around the Community at Risk is the priority in the fuel management treatment theme. Overall ecosystem resilience is the overriding objective in the ecosystem resilience treatment theme.

	Treatment Theme Acres			
Project	**Long-Range**	**Near-Range**	**Fuel Management**	**Climate Resilience**
		Federal Strategy		
1	19	1,255	7,419	3,086
2	136	2,431	6,456	2,725
3	116	261	1,085	10,349
4	159	1,799	3,739	6,041
5	35	1,456	4	9,810
6	74	1,014	3,415	7,361
7	202	1,307	4,437	5,742
8	46	851	482	10,411
9	139	851	2,067	8,007
10	202	793	629	10,133
11	22	79	3,765	8,078
12	384	1,265	325	8,600
13	71	718	301	10,647
14	234	825	3,665	7,038
15	216	1,774	1,553	8,097
		All-lands Strategy		
1	68	453	10,662	730
2	64	1,822	8,838	1,152
3	29	1,357	9,112	1,325
4	0	341	10,614	982
5	181	698	9,004	2,038
6	121	1,959	5,621	3,800
7	1	92	8,645	3,053
8	147	2,440	6,612	2,530
9	72	768	6,703	4,233
10	49	2,086	5,879	3,823
11	22	1,250	7,303	3,269
12	123	1,246	4,879	5,484
13	81	1,235	7,115	3,284
14	60	1,209	6,378	4,082
15	74	3,504	4,700	3,328

Appendix 5: Interim DRAFT results for 15 optimized projects with all five objectives evenly weighted for the Federal (Rogue River-Siskiyou National Forest and Medford District BLM) and All-lands scenarios. For each project the treated area contributes to achieving the five underling objectives for active treatments. The highest ranked projects (1) have the highest cumulative objective value. However, project areas vary in the relative contribution of each objective to the overall objective value.

Project	Objective Function Contribution to Objective Value					Cumulative Objective Value	Mean Objective Value
	Local Fire Risk	Large Wildfire Risk	Landscape Resilience	Northern Spotted Owl	Climate Resilience		
Federal Strategy							
1	32%	10%	12%	27%	18%	977	1.47
2	26%	10%	12%	28%	23%	972	1.46
3	1%	0%	30%	36%	33%	817	1.23
4	17%	7%	14%	29%	32%	785	1.18
5	0%	0%	26%	37%	37%	767	1.15
6	11%	3%	16%	31%	39%	705	1.06
7	18%	8%	14%	26%	34%	695	1.04
8	1%	3%	18%	34%	45%	657	0.99
9	5%	3%	16%	32%	43%	637	1.01
10	1%	1%	18%	33%	47%	634	0.95
11	15%	5%	13%	27%	40%	630	0.95
12	3%	1%	21%	36%	41%	612	0.98
13	0%	1%	16%	31%	52%	609	0.91
14	8%	1%	15%	33%	42%	594	0.89
15	5%	2%	24%	23%	46%	570	0.86
All-lands Strategy							
1	49%	14%	9%	16%	12%	1102	1.66
2	41%	9%	11%	26%	14%	1040	1.56
3	42%	10%	10%	23%	14%	1035	1.55
4	46%	14%	11%	19%	10%	1003	1.51
5	41%	16%	11%	17%	16%	961	1.44
6	22%	13%	13%	32%	20%	953	1.43
7	36%	6%	14%	28%	16%	931	1.40
8	25%	10%	12%	28%	24%	888	1.33
9	29%	13%	11%	21%	25%	872	1.31
10	28%	1%	13%	32%	25%	869	1.31
11	32%	4%	13%	28%	22%	865	1.30
12	19%	5%	18%	33%	24%	851	1.28
13	25%	6%	15%	30%	24%	842	1.26
14	24%	3%	17%	30%	27%	805	1.21
15	19%	9%	14%	37%	22%	802	1.20

Appendix 6: Interim DRAFT results for 15 optimized projects with all five objectives evenly weighted for the Federal (Rogue River-Siskiyou National Forest and Medford District BLM) and All-lands scenarios. The majority of treatments occur in excess mid-closed or late-closed seral classes. Treatment of excess closed s-classes addresses ecological departure relative to the total 2.1 million acres of excess closed forest.

		Excess Closed Forests	
Project	**Acres**	**Acres Treated**	**% of Total Treated**
		Federal Strategy	
1	11,988	9,585	0.45
2	11,988	10,036	0.47
3	11,988	10,754	0.50
4	11,988	9,545	0.44
5	11,988	10,655	0.50
6	11,988	6,971	0.32
7	11,988	8,030	0.37
8	11,988	6,959	0.32
9	11,340	8,659	0.40
10	11,988	7,361	0.34
11	11,988	5,065	0.24
12	11,268	9,057	0.42
13	11,988	5,989	0.28
14	11,988	7,797	0.36
15	11,988	9,906	0.46
Total	**178,452**	**126,368**	**5.88**
		All-lands Strategy	
1	11,988	9,290	0.43
2	11,988	10,476	0.49
3	11,988	9,669	0.45
4	11,988	9,701	0.45
5	11,988	8,564	0.40
6	11,988	10,056	0.47
7	11,988	9,924	0.46
8	11,988	8,968	0.42
9	11,988	8,352	0.39
10	11,988	9,617	0.45
11	11,988	9,781	0.46
12	11,988	10,022	0.47
13	11,988	7,588	0.35
14	11,988	8,854	0.41
15	11,988	8,684	0.40
Total	**179,820**	**139,546**	**6.49**

Appendix 7: Interim DRAFT results for 15 optimized projects with all five objectives evenly weighted for the Federal (Rogue River-Siskiyou National Forest and Medford District BLM) and All-lands scenarios. Acres to treat were parsed as federal (Forest Service/BLM) or other, economically viable (economic acres), or acres requiring subsidy with restoration byproduct volume or strictly surface and ladder work needing done with insufficient restoration byproduct to support the work. Restoration byproduct volume (in board feet) was classed as economically viable if it met the density and yarding constraints articulated above.

Project	Acres	Federal Acres	Economic Acres	Subsidy Acres: Merchantable	Subsidy Acres: Non-merchantable	Economic Volume	Volume Requiring Subsidy	Total Volume
Federal Strategy								
1	11,988	11,988	2,718	8,766	504	5,999,836	19,414,955	25,414,791
2	11,988	11,988	2,988	8,478	522	5,124,886	11,499,581	16,624,468
3	11,988	11,988	1,746	10,152	90	5,999,778	32,767,356	38,767,133
4	11,988	11,988	4,176	7,506	306	5,999,948	8,896,265	14,896,213
5	11,988	11,988	6,840	5,148	0	5,878,468	4,321,618	10,200,087
6	11,988	11,988	4,230	7,254	504	5,999,664	8,444,288	14,443,952
7	11,988	11,988	4,608	6,480	900	5,999,918	8,034,081	14,033,998
8	11,988	11,988	5,058	6,318	612	5,999,502	5,808,442	11,807,943
9	11,340	11,340	3,024	7,794	522	5,999,982	13,373,041	19,373,022
10	11,988	11,988	4,212	7,020	756	5,487,623	7,334,842	12,822,465
11	11,988	11,988	4,212	7,092	684	5,999,665	8,247,021	14,246,686
12	11,268	11,268	4,500	6,588	180	5,999,991	12,747,624	18,747,615
13	11,988	11,988	3,870	6,552	1,566	5,998,946	6,592,033	12,590,980
14	11,988	11,988	2,844	8,262	882	5,999,965	12,476,223	18,476,188
15	11,988	11,988	3,924	4,302	3,762	5,999,913	13,349,326	19,349,239
All-lands Strategy								
1	11,988	2,430	5,886	5,040	1,062	1,908,084	7,717,871	9,625,955
2	11,988	5,364	4,356	6,498	1,134	2,653,032	7,142,871	9,795,903
3	11,988	5,040	6,678	4,320	990	5,818,901	7,819,257	13,638,158
4	11,988	3,330	7,200	3,996	792	2,792,698	7,502,350	10,295,048
5	11,988	5,166	4,392	5,076	2,520	2,778,914	4,731,891	7,510,805
6	11,988	4,878	5,904	6,084	0	5,994,668	14,195,585	20,190,253
7	11,988	3,672	7,362	4,518	108	4,742,368	7,757,686	12,500,054
8	11,988	4,500	3,816	7,326	846	955,538	7,955,219	8,910,757
9	11,988	5,400	4,140	6,426	1,422	1,953,563	5,421,821	7,375,384
10	11,988	4,068	8,082	3,474	432	5,936,490	6,508,500	12,444,990
11	11,988	3,528	5,364	6,534	90	5,605,277	11,460,212	17,065,489
12	11,988	5,256	6,786	5,148	54	5,998,606	15,517,823	21,516,428
13	11,988	6,516	6,066	5,778	144	5,999,449	10,153,087	16,152,536
14	11,988	6,336	6,462	5,310	216	5,998,138	7,645,962	13,644,100
15	11,988	4,806	8,172	3,582	234	5,995,684	6,933,254	12,928,938