

2018



Puget Sound Ecological Fire Program 2018 Summary Report



**Ecological Fire Partnership
Land Managing Partners**

Washington – Puget Sound

Center for Natural Lands Management
Fisher Ranch
Joint Base Lewis McChord
The Nature Conservancy
Thurston County
WA Department of Fish and Wildlife
WA Department of Natural Resources
Wolf Haven International
Pacific Rim Institute
Whidbey Camano Land Trust

Oregon

City of Eugene
Lane County
The Nature Conservancy
Oregon Department of Fish and Wildlife
Oregon Department of Forestry
US Army Corps of Engineers
US Bureau of Land Management
US Fish and Wildlife Service
US Forest Service

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Cover: Building blackline during first entry burn at Fisher Ranch - a collaborative project focused on merging grazing and habitat restoration goals near Rochester, WA. (A. Wolf).

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Introduction

It was another hot and smoky summer in South Puget Sound and throughout the Pacific Northwest in 2018. Drier conditions and frequent air quality impacts from large West Coast wildfires greatly reduced our opportunities to conduct priority burning during our peak summer burn window. Having a strong core group of firefighters and a large pool of trained auxiliary firefighters allowed us to make the most of our limited burn window and achieve most of our high priority burn objectives. As late summer rains made burning less effective at home, we transitioned our fire resources south to help out partners in Oregon.

Building on last year's success, we started this burn season in May with some Ponderosa pine understory burning on JBLM – a good strategy to reduce litter buildup without damaging the pines. We continued to make good progress on JBLM through July. Off-installation burning was limited during this time because prairie plants were too green and active. Wildfire smoke and hot/dry conditions limited our burning through much of August – often our busiest month. A few scattered rains in August and more in September created burn opportunities both on and off JBLM until fuels became too green and wet to meet ecological objectives in early October.

We tested a new fire effects index we are developing to help indicate what conditions lead to long duration organic soil/moss smoldering. This smoldering can cause extensive impacts to native plants and invertebrates under certain hot and dry conditions and can also be desirable for degraded sites that will be heavily seeded after the burn. The index provides fire planners with a tool to reduce or pursue these more extreme fire effects.

Overall, the burn season was very productive. We completed the most burns and acres on JBLM and spent more time helping out in Oregon than we did last year. Thurston County burning was limited to five days due to smoke, weather and permitting restrictions. Altogether, we completed 84 prescribed burns on 56 days in South Sound. We also conducted 12 days of fall pile burning at home and assisted with 17 burns (and led three additional) during 15 burn days in Oregon. In total, we had 115 burn operations on 70 days totaling about 5800 acres.



Test fire completed, bringing fire towards drop point Kilo, Upper Weir Prairie (B.Wilken)

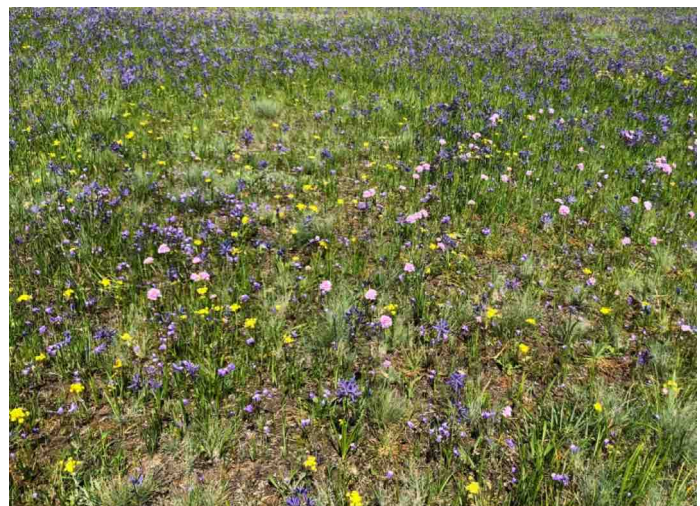
Background

A diverse mosaic of fire dependent prairies once dominated the South Puget Sound region and was scattered throughout the rest of lowland Washington and into the rocky balds of the lowlands. The prairies were interspersed among coniferous and deciduous woodlands and wetlands. Prairie and oak habitats were maintained through frequent anthropogenic fire until around the mid-1800's. As settlement increased, burning was halted and these habitats were converted to agriculture, housing and industry, or were invaded by conifer forest. Lack of managed fire during the past 150 years has contributed to significant habitat loss and impact to native species. Today, residual native prairies are thought to be restricted to about 3% of their former extent.

A robust and collaborative conservation program has evolved over the past few decades to protect and restore the remaining prairie/oak mosaic habitat and its dependent species. Regional planning for these habitats and associated rare species has identified the integrated use of fire as a cornerstone for restoration.

Unable to rely on existing local fire suppression resources to support ecological burns at the needed scale, local conservation partners have implemented a partner-driven prescribed ecological burn program with capacity to accomplish burning at the landscape-level. Prior to 2008, we were only conducting one to two burns annually. Since then, we have steadily scaled up our operational capacity, regularly completing 70-90 burns in a year.

Fire is one of several tools that we utilize in our conservation approach and is not simply an end in itself. Fire is being returned to a highly fragmented system that has been altered by invasive plants and lack of fire. Rare populations of plants and animals also need special consideration when planning fire, especially when habitat structure has been altered by invasives and fuel build-up. Fires are one part of our comprehensive and evolving science-based restoration approach that also includes: additional weed control measures; establishment of native plants through planting and sowing; and species specific strategies to recover the rarest species. On JBLM, burns also target reduction of invasive shrubs for improved military training in low quality habitats, in an effort to reduce training pressure on higher quality prairies and woodlands.



**Spring bloom following 2017 burn, TA15 JBLM (M.McKinley)
and post burn seed sowing at JBLM (L.Wefferling).**

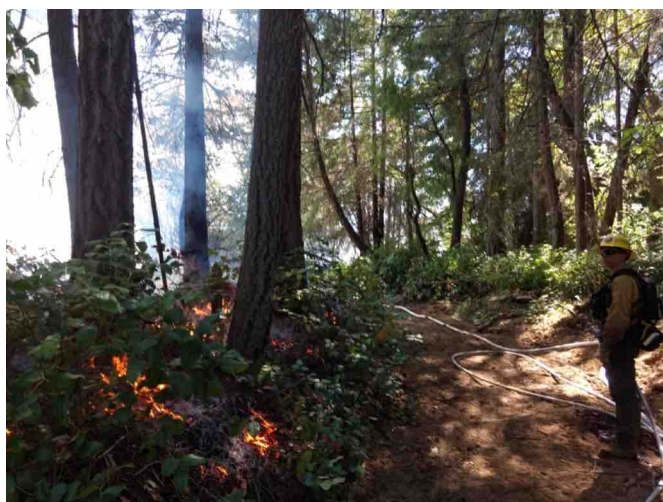
Collaborative Approach

The core principle behind the Puget Sound ecological burn program is collaboration: together we are more effective and efficient at meeting our shared objectives than we are on our own. Indeed, this approach extends to all our ecological management activities. By pooling resources, each partner's overall commitment of resources is reduced, but when combined, the team has remarkable capacity that is more easily sustained over the long-term.



Collaboration is the name of the game. At Sycan, six organizations came together to complete multi-day burn project (M.McKinley).

Joint Base Lewis-McChord (JBLM) has the largest prescribed burn program of any of the Puget Sound partners, but currently has insufficient internal capacity to meet its ecological burn objectives. Center for Natural Lands Management (CNLM) inherited its burn program from The Nature Conservancy (TNC), which has a robust international prescribed fire infrastructure, with a more than 50-year proven track record. CNLM has developed a strong fire management program and continues to be a coordination hub for regional ecological burning. There is a notable deficit in qualified burn bosses west of the Cascades. Both CNLM and JBLM have been able to fill that need by bringing in burn bosses from out of the region and training up local firefighters. These burn bosses are important to support training, provide burn program and planning reviews, and implement burns. The other land-managing partners have significant limitations in their capacity to burn, either having few resources, or limited availability during the summer burn window.



At JBLM, prescribed burners assist on wildfires for suppression training and suppression firefighters help with prescribed fires in exchange (N.Miller)

The collaborative strategy has proven very effective. The Puget Sound Ecological Fire Partnership has demonstrated its capacity and, when conditions allow, can meet most of the current demand for ecological fire in the Puget Sound region. Our collaborative efforts are expanding beyond Puget Sound, as we seek mutually beneficial partnerships with partners throughout Washington and Oregon that share ecological fire objectives. Burn windows of different regions often do not fully overlap, providing opportunities to share resources when and where they are most needed and further improving training and learning exchange.

Additional Information

The appendices of this report provide additional background information. Appendix 1 provides a rationale for ecological burning in Puget Sound prairie, oak and pine habitats. Appendix 2 describes the South Puget Sound's fire program goals. Appendix 3 lists additional supporting documents.

2018 Burn Program Accomplishments

Season Summary

2018 was the second year in a row that was heavily impacted by hot droughty weather and large west coast fires. Though we were unable to complete some of our high priority Thurston County burns, overall, the program demonstrated great resiliency and ended up with another year of impressive results. In total, we completed 2585 acres during 84 prescribed burns on ten different properties in south Puget Sound. We also completed 228 acres of pile burning in the fall. In addition, our Puget prescribed fire crews were able to support ecological burning in Oregon (19 burns, totaling about 3000 acres) thanks to a recently updated fire memorandum of understanding that facilitates responsive exchange of resources and funding. There were several challenges that limited our ability to burn in Thurston County off JBLM, and some priority burn units were left unburned. See Appendix 4 for complete list of burn units.



Building black on burn unit flank at JBLM (M.McKinley)

Weather and Burn Conditions

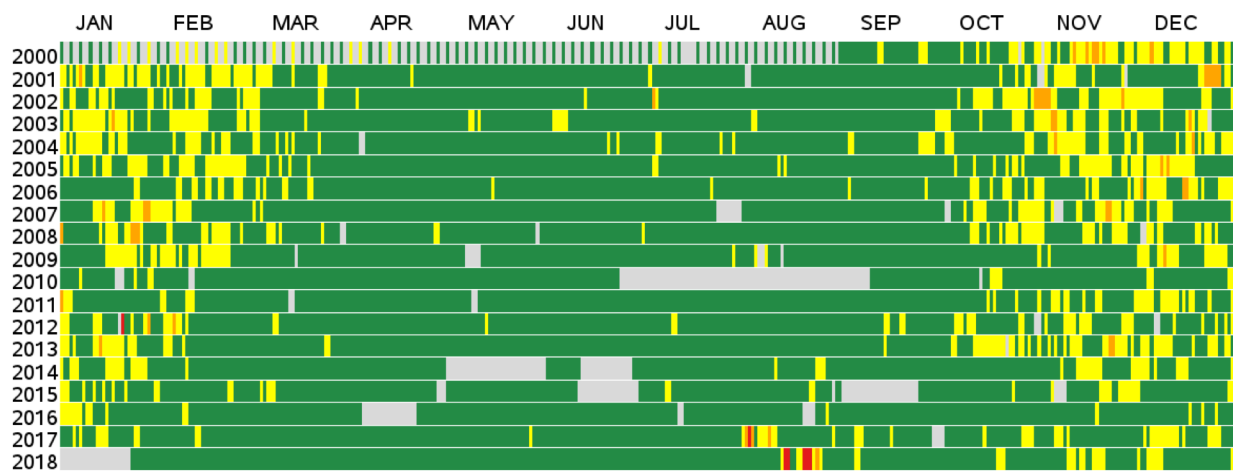
2018 had one of the hottest and driest Julys since we ramped up our burn program in 2008. It was also by far the smokiest summer since at least 2000, with significantly more smoke than last year's extremely smoky season. The tile plots below give a helpful graphic depiction of weather and air quality conditions since 2008. The dry conditions allowed fuels to become well-cured by mid- to late-July and restricted late season green-up until mid-September. September had numerous rain events that helped improve burn conditions, but also limited our ability to burn. All summer long, we were dodging smoke, drought and rain until green-up made prescribed fire ineffective. All together, we burned in Puget Sound from May 1 until October 4. Many of our prime weeks in this window were shut down due to smoke inundation from out-of-region wildfires, which pushed more of our burns to cooler days and promoted a mix of fire effects. Burning conditions in Oregon allowed us to support our partner burns until late October.

Ecological Fire Resources

It was a mixed year for resources. While our core team of dedicated firefighters was smaller than in recent years, our collaboration on JBLM with their Forestry program has continued to improve. Also complicating matters, JBLM was unable to support any burns on ACUB designated properties due to an ongoing audit of the national ACUB program.

	April	May	June	July	August	September
2008	54	65	68	77	76	72
2009	59	67	74	82	75	73
2010	56	62	66	76	76	68
2011	53	60	67	74	77	75
2012	59	65	66	74	79	74
2013	58	67	72	79	78	70
2014	60	68	72	82	81	75
2015	60	68	80	83	80	70
2016	66	69	73	76	80	71
2017	57	68	73	80	83	75
2018	58	71	72	83	80	71

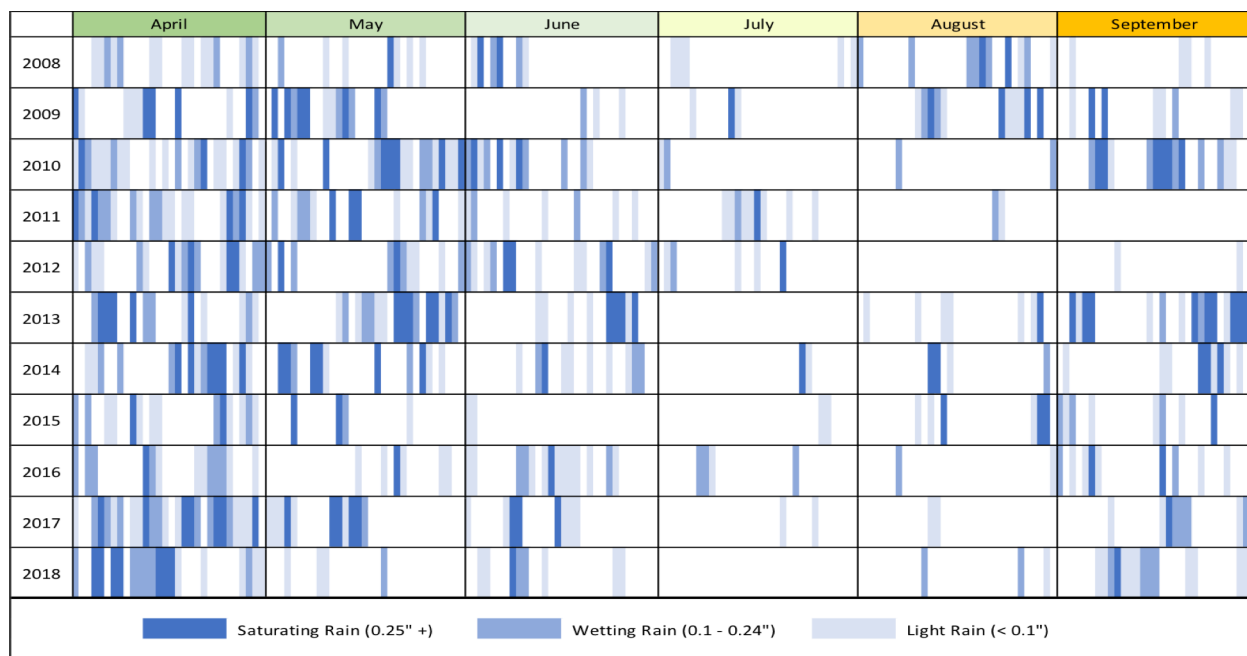
Tile plot of burn season average max temperature for the past 11 years in Olympia (K.Hill)



In total, we had a pool of more than 90 NWCG qualified firefighters among our primary partners. Of these, about 25 of the JBLM Fish and Wildlife and CNLM firefighters formed the core dedicated burn crew. Partners also provided access to five Type 6 engines, four Type 7 engines and six UTV engines, plus fire equipment managed by JBLM's forestry program.

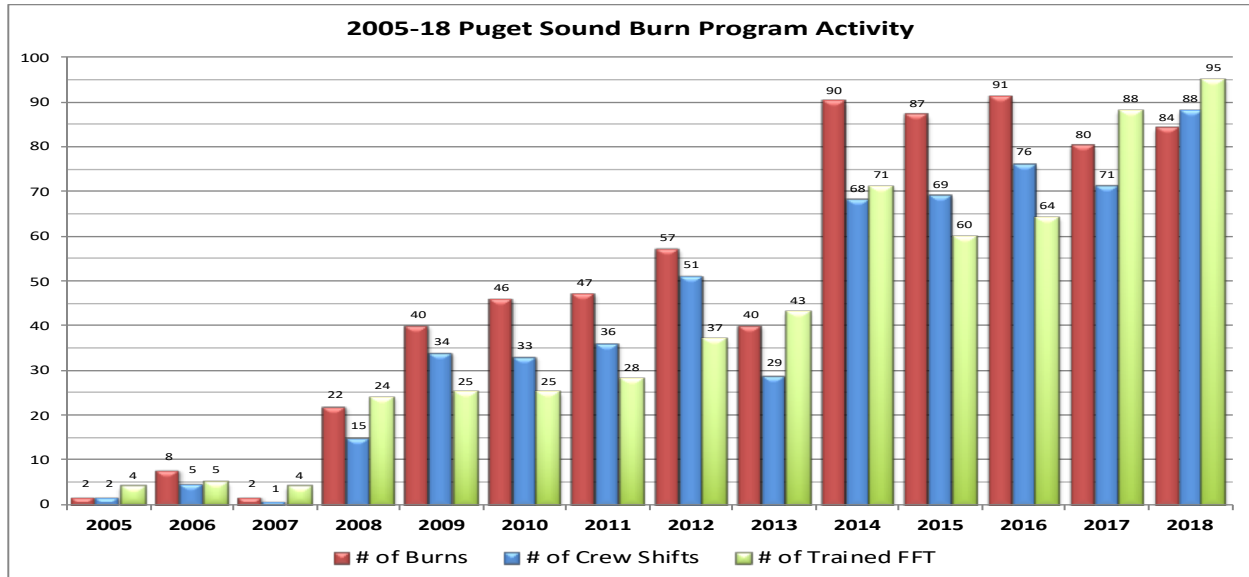
Burn Activity Beyond South Sound

For various reasons, there was no burning in north Puget Sound this year. However, we sent many of our firefighters to assist and gain training experience in Oregon.



Operations

CNLM and JBLM are the two major participants to the South Sound burn program and both continue to play central coordinating, management and implementation roles throughout the region. The ability to conduct numerous burns during our short and unpredictable burn window is made possible by the high degree of cooperation and flexibility from core and external partners and volunteers. The partnership makes concerted efforts to rank burn projects by regional importance, matching burn objectives and regional prioritization with daily changing conditions. Resources work across ownerships to optimize the quantity and quality of our fire activities, often burning with multiple burn teams that may burn on multiple ownerships on the same day.



2005-2018 summary of south and north sound burn activity. A total of 684 burns have been completed since 2008, when our program ramped up.

Operations – Joint Base Lewis-McChord

The JBLM installation is federally owned and has its own fire response capability, placing it outside the jurisdiction of DNR's permitting process and summer burn ban. Controlled burning at JBLM began this year on May 1 (with a focus on early-season Ponderosa pine understory burning) and continued until October 4. JBLM also conducted a significant amount of pile burning this year to support development of a new military training ground that will help reduce pressure on managed habitat areas. Pile burning continued through the middle of November. Throughout the burn season, we took advantage of periods of favorable weather, with periodic no-go days created by rain, smoke intrusions or extreme weather. We curtailed burning for much of August due to smoke intrusions from Canada, and the Pacific Northwest. We were able to make up for these lost days in September in spite of rainy weather. LI together, we completed a total of 72 controlled burns totaling 2467 acres. In addition, there were 12 days of pile burning, covering 228 acres (See Appendix 4 for list of JBLM burns).



Preparing the boiled peanuts for After Action Review after a long burn day (M.McKinley)

2018 was the tenth year that JBLM has implemented its expanded ecological burn program. During August 2012, JBLM delegated responsibility for controlled burning to JBLM Fish and Wildlife. To prepare for this, Fish and Wildlife developed a Prescribed Fire Management Plan, and revamped the burn planning process to better accommodate specific ecological objectives. The FMU planning was implemented in 2013 and continues to be a successful approach, improving operational flexibility and planning efficiency.

We are currently working to establish fuel loading indices to refine our smoke production tonnage calculations. Without

confirmed fuel loadings for our prairies, non-site specific photo series are used. Based on these photo series it is assumed that prairie burns consume $\frac{3}{4}$ tons per acre treated. Preliminary data from fuel load monitoring suggests that fuels on JBLM are representative of the photo series used. Using this fuel loading burning on JBLM is restricted to units 133 acres or smaller in order to meet DNR smoke management permitting requirements. To mitigate for the reduction in unit size, we have made an effort to increase the capacity of the Puget Sound Ecological Fire Partnership to allow for multiple units to be burned per day in different locations. Thanks to support from visiting firefighters and a greatly increased team of qualified firefighters and equipment, we were able to successfully implement this strategy several times this year.

With another large crew of new firefighters this year, we focused on establishing crew cohesion, fireline skill and interoperability. Given the number of operational shifts, JBLM continues to offer an excellent training ground for core and secondary partners, and this provides the added benefit of increasing overall regional prescribed fire expertise.

JBLM Operations Overview

- *Rainier Training Area Complex (Weir and Johnson Prairies, Pines Runway and Pipeline).* Completed 21 burn projects totaling 654 acres. Burns in the RTA targeted general habitat enhancement for Mazama pocket gophers and other rare species, as well as noxious weed control.
- *13th Division Prairie (Training Areas 13-15).* Completed 16 burns totaling 712 acres. Included burns to benefit federally-listed streaked horned lark habitat, future Taylor's checkerspot butterfly release areas, and to promote noxious weed control.
- *Training Area 6.* Completed nine burns totaling 279



Hitching a ride to a wildfire on JBLM, where suppression and prescribed fire efforts are integrated (A. Fox)

- acres in pine woodland and streaked horned lark habitat and to promote noxious weed control.
- *Training Areas 7-12.* Completed 12 burn units totaling 370 acres primarily to benefit oak and pine woodland and prairie edge habitat as well as for Taylor's checkerspot butterfly benefit in TA 7S. Burns within TA 7s occupied TCB habitat required multiple exclusions and softlines which required increased resources and slowed burn operations and reduced the ability to conduct multiple operations in a single day. In 2017 spring pine burns were a focus in TA 10 and 12 pine, with 5 of 7 burns within this FMU occurring prior to July 1st.
 - *Central Impact Area.* We completed three early season burns totaling 103 acres in the AIA during pride week that benefitted Ponderosa pine and hoary elfin butterflies and kinick-kinick patches.
 - *North Artillery Impact Area and vicinity.* We completed six burns in areas surrounding the AIA totaling 244 acres to benefit Mazama pocket gophers and oak and prairie habitats.
 - *South Impact Area and TA 18.* We completed four burns totaling 145 acres for Mazama pocket gophers, fuel reduction and prairie/oak habitat improvement.



Ignitions continue as the rain starts at TA14. September was wetter than normal, but was a very productive month because the summer drought produced highly cured fuels that allowed for rapid drying and delayed green-up and because we were also able to respond quickly to unpredictable burn windows . (N.Waldren)

Operations – Thurston County (non-DoD) Sites

Background – Unlike JBLM, which has fire protection responsibility for its lands, Thurston County burns fall under the regulatory jurisdiction of WA Department of Natural Resources. Target habitat preserves range in size from 50 to over 1000 acres and are often surrounded by private properties. The Nature Conservancy initially coordinated 1-2 South Sound burns per year starting in 2001 at Glacial Heritage. In 2007, the ecological burn program completed the first fire on TNC's Tenalquot Prairie. These early burns relied heavily on support from DNR and local fire districts and were often restricted by county burn bans. Other ACUB prairie preserves had a similarly limited recent history of fire. In 2007, the ecological exemption was successfully applied to prairie burns on non-federal property during the county burn ban. This was a critical step, allowing us to expand our burn window into the preferred period of late July through early October. In 2013, DNR's Commissioner of Public Lands began to impose state-wide summer burn bans during our core burn season. The effort to develop a clear, reliable and responsive exception process with DNR has been ongoing since then.



Burning UW research plots at Glacial Heritage to improve understanding of seasonality on fire effects (K.Hill).



North Scatter Creek burn unit (A.Martin).

Burn unit sizes are generally smaller on ACUB sites than on JBLM due to increased adjacency and sensitivity to neighborhoods, working around populations of rare species and smaller management areas.

Thurston County Operations this Year – Burning in Thurston County was impacted by several things in 2018. In recent years, we have been able to get an early start on units that could be burned with less drying and before the native plants went dormant. This year's list of available units focused on high quality habitat that needed to wait for the dormant season of late July and August – by which time, the air quality impacts from wildfires were starting. The long summer drought also reduced our burn window in August and triggered a Statewide burn ban that went through September. September was wetter than normal, further reducing our ability to burn during our shoulder season. By early October, green-up was well underway and our burns stopped meeting objectives. In addition to all this, one of our primary funding sources, ACUB, remained frozen for the second year.

We were able to get one burn completed on July 25 just before the regional smoke impacts hit. It was our first ever burn at Colvin Ranch, a long-term collaborative project that seeks to integrate habitat restoration and grazing. Our next burn didn't happen until September 19, when DNR gave us an exception to the burn ban. In spite of the late summer rains that started in August, DNR was hesitant to give an exception out of caution for potential public concerns related to last year's wildfire at Scatter Creek (which started on an adjacent private property). By this time, our crew was very cohesive, and the mild conditions provided a large safety margin. We used our few remaining burn days to great effect, burning as many as five units at three sites with one crew in one day. It became too green to burn by end of first week in October. All together, we only burned on five different days in 2018, but in that time we completed 12 units and 118 acres at nine different sites. This included another first ever burn at a new conservation site, Leitner Prairie. By comparison, we managed to complete 16 burn units, totaling 160 acres in 2017 and 27 units and 222 acres in 2016 on Thurston County projects.

List of all completed burns in 2018 on Thurston County (non-JBLM) properties.

Count	Day	Date	Unit Name	Location	Acres	Incident Number
1	1	7/25/18	201-A	Colvin Ranch	3	CR-RX18.07.25A
2	2	9/19/18	2018-B	Fisher Ranch	2	FR-RX18.09.19D
3	2	9/19/18	2018-C	Fisher Ranch	2	FR-RX18.09.19E
4	2	9/19/18	2018-B	Leitner	20	LT-RX18.09.19F
5	2	9/19/18	2018-C	Tenalquot	1	TQ-RX18.09.19G
6	2	9/19/18	2018-A	Tenalquot	2	TQ-RX18.09.19H
7	3	9/20/18	2018-B	Violet Prairie	20	VP-RX18.09.20D
8	3	9/20/18	2018-A	Wolf Haven	6	WH-RX18.09.20C
9	4	10/3/18	2018-K (7 sub-blocks)	Scatter Creek	10.6	SC-RX18.10.03A
10	5	10/4/18	2018-B alternate	Glacial Heritage	24	GH-RX18.10.04A
11	5	10/4/18	UW plots small, med, large arrays	Glacial Heritage	8	GH-RX18.10.04B
12	5	10/4/18	2018-A	Mima Mounds	19	MM-RX18.10.4C
					117.6	

Burn Activity Descriptions by Site

- *Cavness*. The three potential burn units at this site were of lower priority and we were unable to complete any of them this year due to limited burn opportunities.
- *Colvin Ranch*. This was the first time we burned at Colvin Ranch. The burn was follow-up to a tree and brush removal project and was intended to reduce woody debris and litter to improve conditions for reestablishment of native plants.
- *Deschutes Prairie*. There were no burns scheduled at this site in 2018.
- *Fisher Ranch*. We were able to complete two first-entry burns on the southwest side of the ranch. Units were small but complicated by fencing, Scatter Creek and a rental residence right next to the burn unit. In total, four acres were burned as part of site preparation for weed control and native seeding.
- *Glacial Heritage*. We applied fire to two of the seven planned burn units, totaling 32 acres. We were unable to burn during dry conditions, and only burned the research plots and a site that targeted control of broom and did not require removal of moss and ground-level thatch.
- *Leitner Prairie*. This 20-acre unit was a first ever burn at Leitner Prairie. This site is part of a Mazama pocket gopher mitigation effort, and the burn was important preparation for native seeding.
- *Mazama Meadows Preserve*. While we had a permit and burn plan for this site, we did not have committed plans to conduct any burns, due to lack of specific funding. It is hoped that Mazama will become a mitigation site for Mazama pocket gopher.

- *Mima Mounds NAP*. We completed one 19-acre burn at Mima this year. It was the last burn of the season and conditions varied depending on sun exposure. This site is hemmed in by housing, and smoke management is often a challenge.
- *Scatter Creek Wildlife Area*. A wildfire from an adjacent property burned a majority of Scatter Creek South (345 acres) in 2017, reducing the need for burning at this site. It also tends to be a more mesic site, and the September rains and limited acceptable wind directions restricted us to one burn day on the north side of the preserve. We completed seven sub-units in in the K Block with mixed results depending on fuel configuration and drying. Burning at this site promotes weed control and native seed establishment, as well as Checkerspot butterfly recovery (and other rare butterflies) and Mazama pocket gopher habitat.
- *Tenalquot Preserve*. We conducted two high priority, burns at Tenalquot. These burns will benefit weed and conifer control, Mazama pocket gopher habitat and planned Taylor's Checkerspot butterfly release.
- *Violet Prairie*. Completed one 20-acre burn unit at this site, where CNLM is reclaiming old hay fields and restoring them to prairie habitat. This site will be seeded with native plants following the burn.
- *West Rocky Wildlife Area*. We were unable to complete any burns at this site due to limited burn window.
- *Wolf Haven*. One 6-acre burn unit was completed this year. Primary objectives included: benefit for Mazama pocket gopher, weed control, shrub reduction and preparation for subsequent native seeding.



Finishing up at the south end of Mima Mounds Natural Area (A.Martin)

Operations – North Sound and throughout Washington

North Puget Sound has some of the longest running Puget Sound prairie burn work in recent history. Yellow Island is a TNC preserve that has had regular fire since 1987, and the National Park Service has been burning at American Camp on San Juan Island for many years. The South Sound burn program has supported prairie burning projects in the North Sound at TNC's Yellow Island and Ebey's Landing preserves, Fort Casey State Park, Pacific Rim Institute (PRI) and Whidbey Camano Land Trust (WCLT) Naas Preserve since 2006. Burns have supported both restoration and research objectives. The South Sound burn program assists with development and review of burn plans and provides burn bosses and other needed crew and resources. This year, we also started working with State Parks and other San Juan land managing partners to explore opportunities to provide ecological fire management support on other sites.

North Sound. No burns were planned or conducted in the North Sound by our program this year.



Final moments of ignition at PRI prairie, after a busy day on Whidbey Island. (J.Deir)

Operations – Oregon/South Sound Ecological Fire Collaboration

The South Sound burn program and TNC-Oregon have been working towards a more integrated partnership for many years. The finalization of a new Memorandum of Understanding between CNLM and TNC in 2017 marked a milestone in that relationship. This MOU covers TNC Oregon and Washington and facilitates the exchange of funds, making it more feasible to shift resources where and when they are needed most. Our peak burn windows do not overlap, presenting opportunities to optimize deployment of our collaboratively available fire resources, in addition to exchanging knowledge and expertise in the ecological application of fire.

The proximity of Oregon, our mutual support of ecological fire in similar habitats for similar purposes, the offset of our peak burn windows and diverse fuel/burn conditions makes for an ideal informal training exchange between our programs. South Sounders have been able to participate on Oregon burns, and vice-versa on a limited training basis for several years, and the past two years represents a big move forward. Mutual support for fire also helps to improve ongoing collaborative conservation between our regions.



Scouting the unit at Cascade Head Oregon (M.McKinley)

This year, TNC was able to send an experienced prescribed fire practitioner to the South Sound during our peak burn season. CNLM and JBLM were able to send firefighters and engines to Oregon for a total of four weeks at the end of September and most of October. This worked well – the Oregon burn season was just getting started as the Puget Sound burns were slowing down due to green-up and cooler/wetter weather. Funding to support CNLM crews helped to offset Thurston County burn program funding reductions. During the Oregon burn window, we were often able to send resources south for part of the week, and still use them at home on high priority days when we needed to make multiple burn crews. Altogether, the South Sound provided about 140 firefighter days (including travel and standby time) to various Oregon burn projects. We assisted on 19 burns (included three burns that were led by CNLM burn bosses) that totaled more than 2500 acres.

Willamette Valley. Primary partners this year were USFWS and TNC. NRCS provided support in planning and funding burning on private lands under the Wetland Reserve Program in collaboration with the USFWS Partners for Fish and Wildlife Program. Burning in the south Willamette valley was conducted in cooperation with the City of Eugene and Northwest Oregon District Bureau of Land Management. CNLM is exploring ways to become more involved with conservation in the Willamette Valley - a natural extension of the South Sound prairie and oak ecoregion. Fire is a good early step towards growing that collaboration.



Scouting Willow Creek Burn unit (M.McKinley),

CNLM also helped burn at Cascade Head on the Oregon coast, which loosely fits into the Willamette ecological burn effort. It is a soaring 1200' headland with sheer cliffs and tumbling grassy slopes. It is an area of cultural importance to the Grand Ronde Tribe, and the area is currently managed as a natural area by The Nature Conservancy (TNC) and the Forest Service and is a focal point for local collaborative conservation and Oregon silver-spot butterfly conservation. Due to difficult access, burning has been infrequent, leading to brush and forest encroachment. This year's burn was a long narrow 28-acre unit that slalomed about 500 vertical feet down the steep slope. More than 2 miles of hose were installed to get water from the nearest road and then down the hill and around the burn unit. The portable tanks that we filled at the top of the hill were almost 900' higher than the nozzles at the bottom of the unit.



Slowly progressing downwind blackline on a dry day at Sycan Marsh (M.McKinley)

Sycan Marsh. Sycan Marsh Preserve is another TNC collaborative conservation program, located northeast of Klamath Falls in Oregon. It is an area of high conservation value, providing a network of grasslands, wetlands and dry east-Cascades forest. The burning this year was part of a larger research effort involving many partners (EPA, USFS Rocky Mountain Research Station, USFS Pacific Southwest Research Station, and the National Center for Atmospheric Research, Western Wildland Environmental Threat Assessment Center, Missoula Firelab, Oregon State University, and Montana State University), that broke ground on air quality and fire behavior and effects monitoring and modeling. Additionally, the different fuels and burning conditions provided ample learning opportunities for our South Sound crew.

Juniper Hills. This is the first year that South Sound firefighters assisted at TNC's Juniper Hills. Eight of our firefighters assisted with pile and broadcast burning over two days to improve open habitat structure on about 1000 acres.



Night pile and broadcast burning at Juniper Hills (F.Edwards)

2018 Oregon burns completed with Puget Sound assistance

Count	Days	Unit ID#	Start Date	Unit/Block	Location	Acres
1	1	ORWMR-FY18-RX-Mill Hill Prairie	9/17/18	Mill Hill	Finley	6
2	2	OREGON	9/18/18	Kudu North	Noble Oaks	20
3	3	OREGON	9/19/18	Sable North, East, South & West	Noble Oaks	20
4	4	ORBKR-FY18-RX-Area 4	9/25/18	Area 4/10Z	Baskett Slough	28
5	5	ORWMR-FY18-Turtle Flats South	9/26/18	Turtle Flats	Finley	10
6	6	OREGON	9/27/18	Unit 4	Cascade Head	28
7	7	ORBKR-FY18-RX-Field 14R	9/28/18	Field 14R	Basket Slough	8
8	8	OREGON	10/11/18	Elk Express West Windrows	Juniper Hills	491
9	8	OREGON	10/11/18	Main Unit	Willow Creek	30
10	8	OREGON	10/11/18	HOPS Research Plots	Willow Creek	1
11	9	OREGON	10/12/18	Kingston	Kingston Prairie	84
12	9	OREGON	10/12/18	Elk Express West	Juniper Hills	491
13	10	OREGON	10/13/18	Bonnie View partial and piles	Juniper Hills	150
14	11	ORBKR-FY19-RX-SheldonHolt	10/17/18	Sheldon/Holt	Baskett Slough	20
15	11	ORBKR-FY19-RX-Dusky Prairie	10/17/18	Dusky Prairie	Baskett Slough	18
16	12	OREGON	10/18/18	South and Knob	Confluence	16
17	13	OREGON	10/22/18	Brattain Ridge Unit 1 East	Sycan	353
18	14	OREGON	10/23/18	Brattain Ridge Unit 1 West	Sycan	690
19	15	OREGON	10/24/18	Brattain Ridge Unit 2	Sycan	530
						2994



Pine under burning at Sycan Marsh (M.McKinley)

Information Development and Learning Exchange

Burn Program Information Package

Since 2013, partners have prepared or updated a fire program information package, intended to provide rationale for the safe and ecologically responsible application of fire to our prairie and woodland habitats. It is composed of several documents, all of which are available. The primary documents included in the package are:

- Pre-Season Overview of 2018 South Puget Sound Burn Season
- Prescribed burning in the Puget Sound: Rationale for the continued safe application of ecological fire during the summer months
- Scientific background for prescribed fire use in western Washington prairies and oak woodlands

Fire Research Projects Supported by Burn Program

University of Washington Prairie Habitat Restoration for Rare Species Project

Background: Restoration of highly degraded sites, such as abandoned agricultural fields, presents a great opportunity to address the limited availability of decent quality extant habitat to support many prairie dependent rare plant and animal species. This project broke new ground by developing techniques for restoring highly degraded sites through an adaptive, iterative approach. This project significantly increased the breadth of potential sites that can be considered for restoration, and resulted in the creation of new habitats that can support viable populations of target prairie species. There were two locations in South Puget Sound associated with this project: West Rocky Prairie and Glacial Heritage. There were also two locations in North Puget Sound: Pacific Rim Institute and Ebey's Landing Preserve. The project concluded its initial experimental phase in 2012 and entered a maintenance phase, which requires prescribed fire as an integral tool.

An additional experiment has been superimposed onto the three arrays of experimental plots at Glacial Heritage. This experiment tests the effects of fire frequency (annual vs. triannual) and seasonality (early vs. late in the fire season) on plant communities. A no-fire alternative, annual mowing, is also included. In 2018, no early burns occurred due to lack of other burn operations in the area. Late burning occurred on October 4 with mild effects. Overall, the UW restoration site, which we burn portions of each year, continues to support one of the largest population of golden paintbrush anywhere in the world. The population there numbers almost 29,000 flowering plants.

JBLM Fire Effects Monitoring Program

Prudent management necessitates understanding fire's variability across seasons and weather and fuel conditions, as well as fire's role in shaping prairie communities. Our overarching goal for the fire effects monitoring project is to build a multi-year dataset and create a robust model linking burn-day prescriptions to desired restoration outcomes. Such a model may potentially allow for better understanding of what range of restoration outcomes could be achieved under different fire prescriptions. To this end, our objectives for this project are to quantify fuel, weather, and soil conditions during the burn season and use an information-theoretic approach to build robust models that describe the influence of these conditions on burn temperatures and severity. We then examine the relationship of these burn characteristics with changes in vegetation.

While fuel and thatch consumption is usually a primary objective of restoration burns, excessively high soil heating and severity has the potential to result in unwanted effects (e.g., insect or microorganism mortality and soil sterilization). Thus, finding the tipping point conditions between the poor

consumption of late shoulder-season burns and the ‘scorched earth’ burns that can occur in these increasingly dry summers is fundamental to prudent fire management. Extreme soil heating may be especially undesirable in or near areas with Taylor’s checkerspot-occupied habitat and higher-quality units with a strong native seed bank or community already in place.

We have collected data on 50 prescribed burns over four burn seasons from 2015 to 2018. Our analysis uses model-averaging to determine the most important of seven weather and fuel variables that are quantifiable and which can influence burn temperatures and severity (Table 1); we include year as a random effect in all models. Burn intensity and severity have had the strongest relationships with long-term precipitation patterns and time of year, peaking when dry spells are the longest and in mid- to late-summer. Rainfall and timing are essentially proxy variables for live fuel and soil moisture, which are both difficult to measure efficiently on the scale at and frequency with which we monitor. Time-of-burn weather conditions of increased air temperature, wind speed, and solar illuminance, and decreased relative humidity have also been strongly associated with increasing soil burn intensity. Additionally, deeper thatch layers have been related to lower soil heat doses, indicating a possible insulating effect during the burn, or an indirect effect via a reduction of the overall rate of soil drying throughout the summer.

Table 1. Relative importance values of weather and fuel conditions for four burn response variables

Explanatory variable	Range measured	Peak burn temperature – soil surface	Peak burn temperature – 2cm belowground	Heat dose – 2cm belowground	Cover of higher soil severity classes
Cumulative 0.5” of rain	3 – 94 days	0.98	1.00	0.96	1.00
Air temperature	61.3 – 86.2 °F	0.95	0.92	0.29	0.23
Time of year	July 11 – Sep 22	0.92	1.00	0.59	0.65
Wind speed	2.3 – 10.1 mph	0.68	0.96	0.63	0.39
Thatch depth	0.5 – 8.4 cm	0.34	0.83	0.92	0.17
Soil moisture	0.0 – 14.3 %	0.29	0.42	0.35	0.18
Relative humidity	31.0 – 71.8 %	0.05	0.08	0.71	0.15
<i>Explanation of variance (fixed effects only):</i>		52%	69%	66%	51%
<i>Explanation of variance (random effect of year):</i>		19%	11%	5%	5%

We have also recently added a light meter that measures total solar illuminance to our monitoring toolkit; preliminary data indicate that greater cloud cover or lower sun incidence angle are indeed associated with lower soil heat dose and severity.

The effect of burn temperatures and severity on vegetation patterns can be difficult to discern, as many other factors are affecting growth and composition by the following spring – post-burn weather patterns, site-specific species suites, and restoration activities. After accounting for some of these factors, however, we have found higher burn intensity to be somewhat associated with increases in cover of exotic annual forbs ($R^2_{\text{marg}} = 0.23$) and decreased cover of exotic woody vegetation (i.e., Scotch broom; $R^2_{\text{marg}} = 0.25$) the following spring.

In 2017, an additional opportunity arose to compare two very different burn severities among relatively consistent vegetation. A blackline was burned in the TA15 south creek unit at the end of the summer under very dry conditions, while the remainder of the unit was burned the following week after more than ¾ of an inch of rain had cumulatively fallen. This allowed paired quadrats to be placed on each side of the dividing line, and both severity areas were treated and seeded similarly during post-burn fall activities. The quadrats were then monitored in spring 2018 for percent cover of all species present and analyzed with paired t-tests of total functional group cover. The high-severity blackline quadrats had

more exotic cover ($p = 0.006$) and less native cover ($p = 0.002$) – specifically less native perennial grass cover (i.e., *Festuca roemerii*; $p = 0.026$) – than their corresponding quadrats in the low-severity area.

While hotter fires that can dig into the soil are desirable in many cases – for areas with an abundance of Scotch broom or low-quality areas that will be heavily seeded, for example – the data indicate that extremely hot burns are potentially detrimental not only to soil organisms that have lethal temperature limits, but also to native bunchgrasses that are less tolerant of exceedingly high temperatures.

The KIN

Summers in western Washington in recent years have been warmer and drier than historical averages (Figure 1). Less water availability, combined with the increasing potential evapotranspiration that comes with increasing spring and summer temperatures, would be expected to produce lower live fuel and soil moistures. Recent fire management has focused on reducing the occurrence of extreme soil heating and its potentially detrimental effects in higher quality burn units. Based on the results of our analysis, this year we introduced a beta version of a new decision-making tool called the KIN. The KIN is a simple numerical index that combines number of days since rain (short-term precipitation patterns), number of days for the last 0.5" of rain to accumulate (long-term precipitation patterns), and Julian calendar day (time of year). These are essentially the fixed conditions that form the backdrop to each burn day, and that will affect the dryness of fuels as they cure.

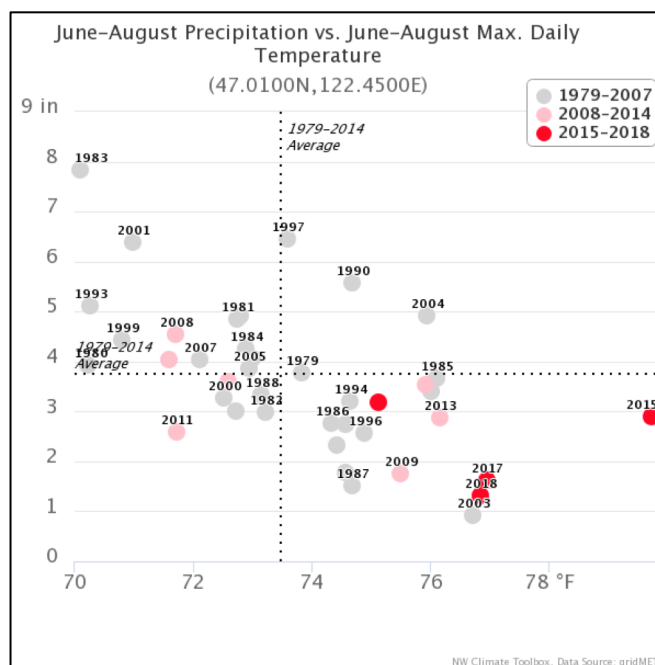


Figure 1. Precipitation and maximum temperatures in June-August at JBLM from 1979-2018. Source: NW Climate Toolbox, Data: gridMET.

In 2018 we used the KIN to inform what weather conditions to burn in each day for high-quality units, and sometimes whether to burn them at all. When the KIN reached a pre-defined threshold of 280, we opted for “low-end” conditions that mainly occur in the morning (lower temperatures, higher RH, and lower sun incidence angle or greater cloud cover) when burning units designated as high-quality. Further, burning of high-quality units when the KIN went above 320 was limited.

The KIN by itself is only a moderate predictor of soil burn temperatures, but the addition to the index of time-of-burn weather conditions that have been found to have some influence and that are easy to

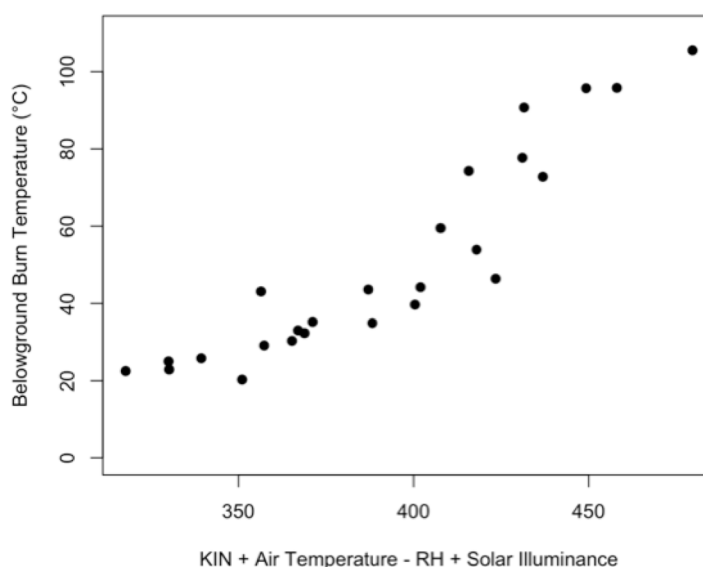


Figure 2. Burn temperatures 2cm belowground as a function of the KIN with air temperature and solar illuminance added and RH subtracted.

make prescriptions for – air temperature, RH, and solar illuminance – yields a strong relationship (Figure 2; $R^2 = 0.89$).

Using this relationship, in 2019 we will recommend a more refined sliding scale of threshold conditions under which to burn high-quality units as the KIN increases (Table 2), effectively aiming for increasingly lower-end weather conditions as the summer progresses without significant rainfall.

Table 2. Recommended conditions for burning high-quality prairie as the KIN increases.

KIN	Temperature	RH	Solar Illuminance
250 – 270	< 80°F	> 45%	< 95klux
270 – 290	< 75°F	> 50%	< 85klux
290 – 310	< 75°F	> 55%	< 75klux
310 – 330	< 70°F	> 55%	< 65klux
330 – 350	< 70°F	> 60%	< 55klux
350 +	< 65°F	> 65%	< 45klux

In June 2018, we installed continuously-logging weather stations (rain gauge and air temperature) at three sites on JBLM – Training Area 15, Johnson, and Upper Weir – in order to capture localized summer precipitation events and be able to generate site-specific KIN values.

As climate change progresses, available burn windows for some types of burn units may either decrease or shift earlier or later in the year; future fire effects monitoring will focus on what kinds of effects occur when burning in these other windows. We will also begin to focus on particular questions related to fire effects, such as species-specific vegetation responses, varying ignition patterns, and potentially other types of fuel loads such as shrub or oak understories. In addition, we will compare our soil burn temperatures to the results of current studies examining the effects of heat exposure on seeds of various prairie species.

Agricultural Conversion Study at Scatter Creek-Violet Prairie Preserve

Table 3: Site preparation and seeding treatment schedule (2014-19) for the Agricultural Conversion Study. Spring/summer monitoring years are designated by '(M)'.

	2014	2015	2016	2017	2018	2019
Trt 1	Burn+Glyphosate; Seed FERO	Garlon/Fusilade; Seed Forbs	(M) Burn+ Glyphosate	(M)	Burn+ Glyphosate; Seed (M)	(M)
	Burn+Glyphosate; Seed FERO +Forbs	(M)	(M) Burn+ Glyphosate	(M)	Burn+ Glyphosate; Seed (M)	(M)
Trt 2	Glyphosate	Glyphosate	Glyphosate; Seed FERO	Garlon; Seed Forbs (M)	(M)	(M)
		Glyphosate; Seed FERO+Forbs	Glyphosate; Seed FERO +Forbs	(M)	(M)	(M)
Trt 3	-----	-----	Graze;	Graze (M)	Graze; (M)	Graze; (M) + Seed
			Graze;	Graze (M)	Graze; (M)	Graze; (M) + Seed

Recovery of Taylor's checkerspot in lowland Puget Sound requires the establishment of new populations on multiple sites across its historical range. There is a need to seek out new sites that can be restored to a suitable condition to ensure that sufficient reintroduction-ready habitat is available for future larval-release efforts. To that end, CNLM set up eight treatment areas ranging from 2-4 acres at Violet Prairie-Scatter Creek, a site with a long history of mixed agricultural use. The site prep treatments include 1) Burn-1yr Herbicide, 2) Burn-2yr Herbicide, 3) 3yr Herbicide, and 4) Grazing, each crossed with either a Fescue-only or a Fescue-Forb mix (Table 3). While this is not a fully replicated design and treatments have been applied in different years, it will allow for an initial pilot evaluation of treatment effectiveness. We applied two seeding treatments within each site prep treatment: 1) fescue and forbs (32 sp) all at once, and 2) fescue in yr 1, then forbs in yr 2. These two seeding regimens allow for application of different post-seeding herbicide treatments. Only grass-specific herbicides can be used in seeding regimen 1, due to potential negative impacts on establishing native forbs. However, both grass-specific and broadleaf-specific herbicides can be used in seeding regimen 2 for the first year after seeding. This may allow for additional control of aggressive agricultural weeds present in the seed bank.

We conducted vegetation monitoring annually in sixteen nested frequency (0.1m², 1m², 4m²) plots along four evenly spaced 100m-long transects running W-E throughout each unit (4 nested frequency plots per transect). We recorded the following metrics in June of each year: presence of seeded species (in each nested plot), presence of all non-native species (in each nested plot), percent cover bare ground (in 1m² plot), percent cover non-native species (in 1m² plot), and percent cover native species (in 1m² plot).

Monitoring results from 2018 show that the non-native species cover in the burn + herbicide units has followed a decreasing trajectory over time, dropping from an average of 47% in year one to 28% in year three post-treatment (Figure 4a). The non-native cover in the units that received three years of herbicide and delayed forb seeding was only 16% two-years post-treatment. This suggests



Figure 3: Burned & Seeded areas (left) and untreated areas (right) in the Agricultural Conversion study

that delaying forb seeding to allow for an additional year of broadleaf herbicide treatment may be worthwhile in areas that have just received herbicide treatments as site prep. As expected, native species cover increased over time, from <10% in year one post-treatment to over 30% by year three (Figure 4b).

Non-native species richness varied across the treatments, ranging from 7 to 18 species across the units (Figure 4c). While overall non-native cover has decreased, we continue to see new weeds on the prairie each year. Native species richness has also been quite variable over time, rarely reaching over 11 species per 4m² (Figure 4d). While most treatments experienced a general increase in native species richness (Figure 3), the 3-year herbicide treatment with simultaneous seeding of fescue and forbs experienced a dramatic drop in native richness. This was likely due to the arrival and spread of *Vulpia myuros*, an annual grass responsible for nearly all of the non-native cover in that unit. This species tends to lay flat by mid-season, prohibiting any light from reaching the surface and restricting growth of any other plants growing underneath. Additional burning and herbicide treatments were applied in late 2018 to address this new challenge.

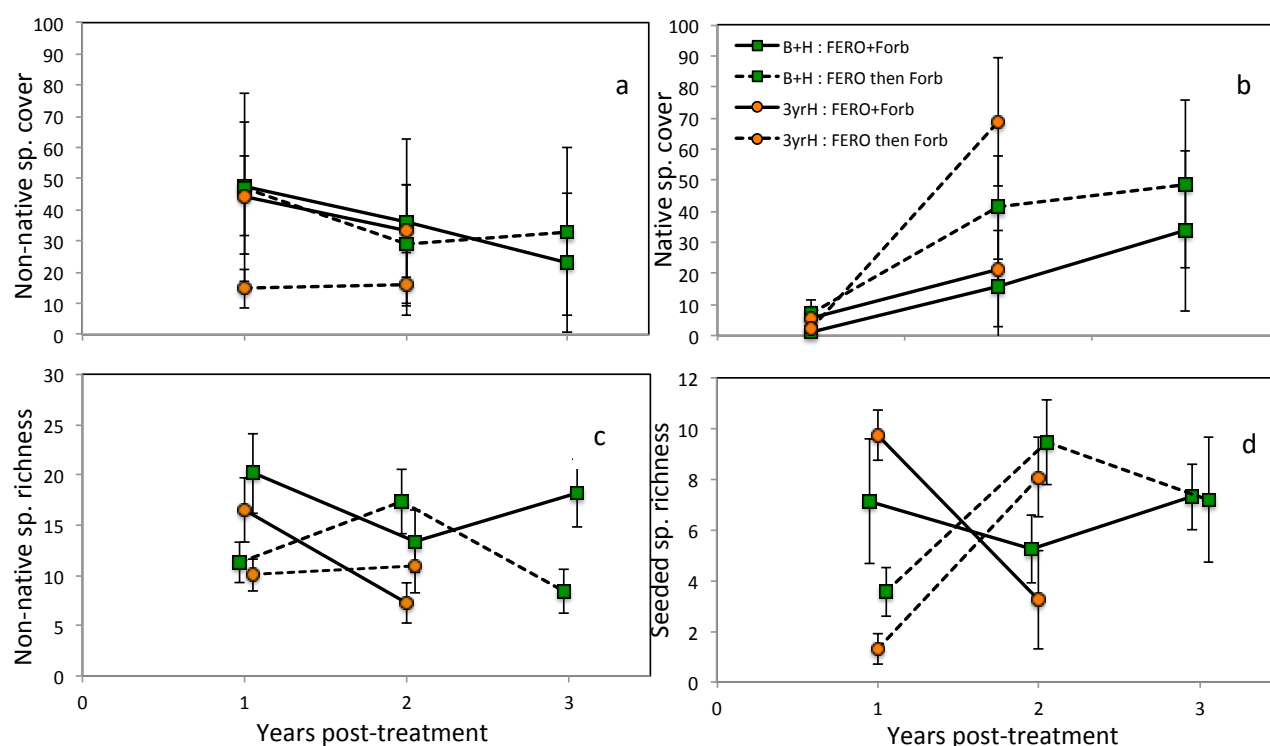
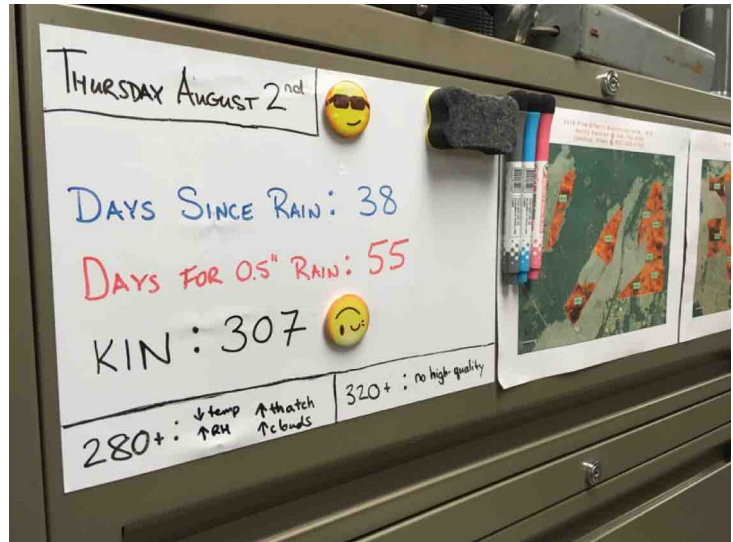


Figure 4: Estimates of a) non-native species cover, b) native species cover, c) non-native species richness, and d) seeded species richness within Burn + Glyphosate (green shapes) and 3yr Glyphosate (orange shapes) treatments. Solid lines represent units seeded with fescue and forbs simultaneously, while hashed lines represent units with forbs seeded one year after fescue. Averages ± 1 SD are presented (n=16).

Ecological Fire Management Planning

Prairie and rare species management entails comprehensive planning that balances a given site's capacity to provide ecological benefit for multiple species over the short and long term and also considers how that site best fits into regional conservation strategies. All our sites have specific plans (such as site conservation action plans) and many fall into regional planning for habitat or species management. All sites where we burn include fire as a management objective and often consider prescribed ecological fire to be one of the cornerstones of their management plans.



This was our first year using a new index method (KIN) to use fuel and weather conditions to moderate fire effects (K.Hill)

Partnership and Burn Program Sustainability

Puget Sound Burn Program partners recognize the need for a core fireline leadership team and a pool of additional firefighters that is large enough to make the most of our narrow burn window. We follow the standards of NWCG, and leadership qualifications are advanced through fireline experience, specific coursework and performance evaluations. There are many benefits to cultivating a robust leadership pool. More experienced firefighters provide better oversight for newer to prescribed burners. Improved



Out of region burns, like this one at Noble Oaks in Oregon provide outstanding leadership opportunities in new conditions and with new burn crews (B.Wilken)

leadership increases overall team technical and production capacity and improves the likelihood of early detection and resolutions for emerging problems. It also provides increased flexibility in crew assignments, and a given burn is not dependent on the participation of one or two key participants.

In addition to a core group of firefighters that have primary responsibilities to support the burn program, our operations depend on participation from a larger pool of regionally available firefighters. This group includes: land management staff that are only able to participate on a handful of burns each year; agencies that do not have specific land management objectives but participate on controlled burns as training opportunities; and organizations and individuals that are seeking fireline experience. Our program's success is attributable to the willingness of these varied groups and individuals to come together.

South Sound burns are also good for partnership building, and we regularly integrate burn crews from regional fire organizations. This type of exchange

increases the familiarity of local suppression teams with our South Sound burn program and vice versa. It also provides these firefighters with fireline training and opportunities to get signed off on NWCG position qualification tasks. On our burns, firefighters benefit from exposure to a wide variety of operational, ecological and fuel conditions and repeated opportunities to perform in leadership roles.

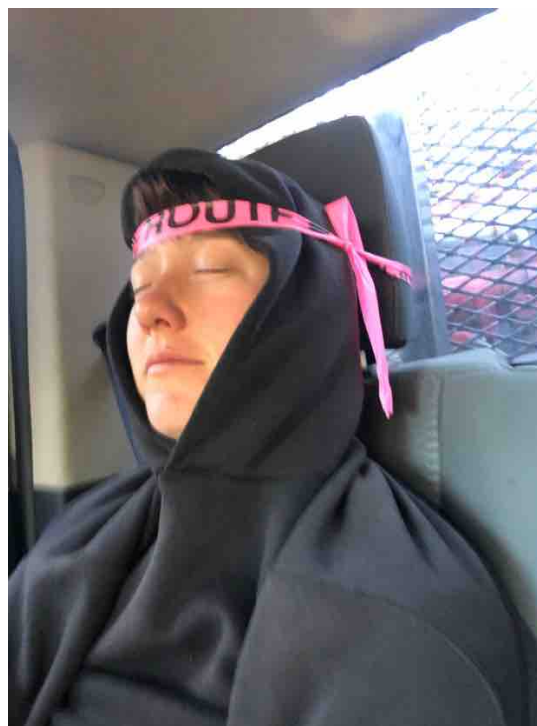
Community Outreach

Community outreach for specific prescribed ecological fires consists mostly of neighbor and agency notifications, press releases, Facebook posts and announcements to local radio and news services. Outreach also occurs at community events such as Howl-ins at Wolf Haven, Earth Day and Kids Day at JBLM and Prairie Appreciation Day at Glacial Heritage. Prairie Appreciation Day is an annual event that regularly draws 1,000 or more people from around Puget Sound to come learn about prairie and oak habitats. The event supports a fire booth which offers information on the role of fire in these habitats and how it is safely managed for ecological benefit.

Field Training and Training Exchanges

Classroom and fireline training and training exchanges provide unparalleled opportunities for learning, networking and cross-boundary integration. Participating with other burn programs offers direct learning and a chance to see your home program with fresh eyes. From the beginning, these exchanges have been an important strategy to support programmatic growth and improvement. Every year, we make a focused effort to move firefighters through a range of experiences and advance them in their qualifications and experience.

In addition to the routine exchange of firefighters between South Sound partners, our burn program provided opportunities to partner organizations and individuals to get fireline experience and training. In total, we had more than 185 firefighter days' worth of support from AmeriCorps, Vet Corps, JBLM natural resource interns, volunteers, DNR and local fire departments. While this resource pool consists mostly of entry-level firefighters, they regularly helped us to reach target staffing levels and many of them will take their experiences forward as they develop careers in natural resources.



Travel between burn sites in Oregon can take a while, and any help catching a nap in the backseat is appreciated (M.McKinley)

This year, our exchanges with out-of-region burn programs primarily occurred through our partnership with Oregon TNC. This will likely be the model for our future exchanges. Burning with Oregon TNC offers a good variety of burn conditions, allows for more flexible and responsive travel logistics, strengthens relationships in the greater region and fosters cross-region training/learning. In total, we sent firefighters out of region for over 140 firefighter-days (including travel and non-burn days).

NWCG Course Training

Classroom training is an important part of the NWCG qualification process, and can also help firefighters to network and learn from new people. The Puget Sound burn program did not provide any NWCG training courses this year. Five JBLM firefighters participated in six courses at DNR's western Washington fire training academy in the spring and two others took advantage of courses held through the Department of Defense. We offered the annual refresher course (RT-130) to 42 partner and other regional firefighters. We also qualified 31 Type 2 Firefighters by providing the required courses online (S-130, S-190, I-100 and I-700) and an intensive field training day.



Firefighters practice using fire shelters. Forty-two firefighters completed their annual safety refresher with our program. (M.McKinley)

Ecoregional and Statewide Networking



Priority Action Areas for the WPFC:

- Training, Certification and Expertise Exchange
- Policy Influence and Issues Resolution
- Public Understanding, Outreach and Education
- Partnering and Collaboration
- Council Operations, Funding & Communications

Washington Prescribed Fire Council

The Washington Prescribed Fire Council (WPFC) held its 7th annual conference in Hood River, OR in association with the Oregon Prescribed Fire Council on February 26th – 28th, 2018. The joint meeting this year provided an opportunity for both Councils to share experiences, expand networks and discuss solutions to shared challenges. Leaders from both WA and OR natural resource agencies (Hillary Franz, WA DNR Commissioner of Public Lands; Peter Daugherty, Oregon State Forester) shared their progressive visions for the future of forest policy and management in their states. We learned about burning on private lands throughout both states and how cooperative burn associations can help. Day 2 focused on landscape level restoration, TREX successes and smoke management strategies and plans in each state. Day 3 involved a well-attended field tour and discussion of the thinning and prescribed burning activities by the Mt. Adam Resource Stewards in the Mt. Adams Community Forest.

Northwest Fire Science Consortium

The Northwest Fire Science Consortium was very productive again this year with several well-attended webinars, two videos, a fire fact sheet on measures of fire behavior, several research briefs and one research synthesis. One event that was especially relevant to the Puget Sound Ecological Fire Program was the Research Brief entitled “Burning for butterflies: Identifying weather and fuel conditions that protect and promote butterfly habitat.” This brief summarized Kathryn Hill’s thesis work on the south Puget Sound prairies. Additional resources can be found on the Northwest Fire Science Consortium website:

<http://www.nwfirescience.org/home>



Appendix 1: Importance of Ecological Fire Management

The unparalleled benefit of fire for the management of native grasslands and hardwood savanna is well documented. In the Puget Sound region, more than a century of fire exclusion has led to the loss of thousands of acres of prairie and oak habitat following the unrestricted invasion of conifer forests. In recent decades, exotic species invasions continue to exacerbate habitat loss and degradation. The list of benefits provided by fire for these habitats is extensive, and has been the subject of considerable research. The majority of these benefits cannot be effectively replicated by other means. Below are some of the key ecological benefits of fire.

- Fire is the foundational disturbance that shaped and maintained prairie habitat for thousands of years. Prairie plant and animal species evolved in the presence of fire and have developed complex adaptations and dependency on fire. Without fire, the degradation and loss of prairie habitat and associated species continues.
- Frequent low-intensity fires reduce fuel loads and produce less severe fire behavior – a benefit to both public safety and the habitat itself.
- Many of our grasslands have over 100 years of litter, moss and thatch buildup due to fire exclusion. Fires conducted during the dry season reduce accumulations and expose mineral soil to promote native seed establishment, and are the only research tested means to effectively enhance these key aspects of native prairie habitat.
- Noxious and other invasive weed species have become a major threat to grassland habitats. Fire has proven very effective at controlling Scotch broom and other invasives, and prepares sites for more effective control of invasives that are not killed by fire.
- Several studies in Puget Sound and beyond show that many native plant species in these fire-dependent ecosystems experience higher germination success when exposed to smoke and ash.
- Fires release nutrients and contribute to soil building. Charcoal enhances water retention and nutrient storage capacity. Fires help moderate soil pH in favor of native species.
- Multiple fire applications maintain a mosaic of plant communities in varying stages of succession, providing a diverse set of resources and conditions for both plant and animal species.
- Fires reduce the density and distribution of pathogens and parasites.



Federally listed golden paintbrush responds very well to fire. Glacial Heritage (M.McKinley).

Appendix 2: Program Goals

Program partners recognize fire as invaluable for restoring our fire dependent ecological communities. The primary goal of our burn program is to responsibly integrate fire as a critical natural resources management tool, while holding public and firefighter safety paramount. To that end, all partners have adopted and exceeded the current standards for fire management, firefighter training and risk management as established by the National Wildfire Coordinating Group (NWCG) PMS-310.1.

Below is a conceptual framework that outlines the burn program's approach to fire management. The remainder of this report is structured to reflect this framework.

South Puget Sound Ecological Fire Program Goals Framework

I. Operations, Safety and Continual Improvement

Partners have sufficient funding, equipment, staff availability and training to safely achieve planned ecological burn objectives. Robust burn planning and permit approval processes are in place that are developed and implemented with the best available information, supporting a long-term sustainable regional burn program.

II. Information Development and Exchange

Fire operations, ecological management and science programs are integrated, and together direct regional efforts to assess and meet information needs. Operations encourage and support implementation of research and monitoring before, during and after burns.

III. Ecological Fire Management Planning

Prescribed fire and wildfire activities are guided by mid to long-range fire management plans that are regionally integrated with long-range ecological objectives.

IV. Partnership and Burn Program Sustainability

The multi-partner ecological burn program remains cohesive, resilient and responsive to challenges, and able to implement burning at the scale required to meet ecological objectives:

- The use of fire for ecological benefit is supported by a cooperative infrastructure of local and regional practitioners that have the knowledge, skills and qualifications to successfully and safely implement prescribed ecological burns during constrained burn windows. This is accomplished through fireline experience, specific coursework, performance evaluations and exchange of expertise from around the nation.
- Regulatory agencies support ecological burning and have good working relationships with partners.
- Local affected communities are aware of our ecological fire program and are generally supportive of the goals.
- Partners have planned for risks associated with fire management and have sound operational and administrative structures in place to minimize and buffer against risks.

V. Ecoregional and Statewide Networking

Washington state and the Willamette-Puget Sound-Georgia Basin Ecoregion have a network of fire practitioners to facilitate information sharing among partners. The network extends outward to agencies, legislators, the public, and to adjacent fire managing programs. As a united body, practitioners are able to address external and internal challenges proactively and with a broad base of support.

Appendix 3: Other Available Supporting Documents

Fire program related documents available from Center for Natural Lands Management:

- Overview of 2018 Projected South Puget Sound Burn Season (off-JBLM)
- Prescribed burning in the Puget Sound: Rationale for the continued safe application of ecological fire during the summer months
- Scientific background for prescribed fire use in western Washington prairies and oak woodlands



Appendix 4: Burn Season Summary Table

2018 Summary of Completed Prescribed and Pile Burns – supported or led by CNLM/JBLM

Count	Unit ID#/Sign In	Start Date	Unit/Block	Location/FMU	Acres	Project	Type	Lead Entity	Crew Shift	Days
1	JB-RX18.05.01A	5/1/18	TA6Pine_12	CIA	24	JBLM	RX	JBLM FW	1	1
2	JB-RX18.05.02A	5/2/18	TA6Pine_15&16	CIA	31	JBLM	RX	JBLM FW	2	2
3	JB-RX18.05.03A	5/3/18	CIAPine_13&14	CIA	48	JBLM	RX	JBLM FW	3	3
4	JB-RX18.05.03B	5/3/18	CIAPrairie_05&04	CIA	28	JBLM	RX	JBLM FW	4	3
5	JB-RX18.05.24A	5/24/18	UWE_04	Upper Weir	17	JBLM	RX	JBLM FW	5	4
6	JB-RX18.06.06A	6/6/18	UWE_03	Upper Weir	6	JBLM	RX	JBLM FW	6	5
7	JB-RX18.06.13A	6/13/18	TA12N_09 (FFT2 Day)	TA 10 and 12 pine	1	JBLM	Blackline	JBLM FW	7	6
8	JB-RX18.06.18A	6/18/18	TA12N_07 & 09	TA 10 and 12 Pine	29	JBLM	RX	JBLM FW	8	7
9	JB-RX18.06.19A	6/19/18	TA12N_01	TA 10 and 12 pine	21	JBLM	RX	CNLM	9	8
10	JB-RX18.06.20A	6/20/18	TA12N_05	TA 10 and 12 pine	22	JBLM	RX	CNLM	10	9
11	JB-RX18.06.21A	6/21/18	TA12N_02 & 08	TA 10 and 12 pine	45	JBLM	RX	JBLM FW	11	10
12	JB-RX18.06.25A	6/25/18	DNR burn	Lower Weir	1	JBLM	Blackline	JBLM FW	12	11
13	JB-RX18.06.26A	6/26/18	TA06Pine_4 & TA06N_17	TA06	39	JBLM	RX	CNLM	13	12
14	JB-RX18.06.27A	6/27/18	TA06 Pine_02 & 03	TA06	41	JBLM	RX	CNLM	14	13
15	JB-RX18.06.28A	6/28/18	CB_04 & 05	Coyote Bridge	28	JBLM	RX	JBLM FW	15	14
16	JB-RX18.07.02A	7/2/18	TA10_03	TA 10 and 12 Pine	15	JBLM	RX	CNLM	16	15
17	JB-RX18.07.05A	7/5/18	13W_06 & 11	13th Div West	85	JBLM	RX	CNLM	17	16
18	JB-RX18.07.09A	7/9/18	WS_02	Weir Slope	8	JBLM	RX	CNLM	18	17
19	JB-RX18.07.10A	7/10/18	WS_01	Weir Slope	19	JBLM	RX	JBLM FW	19	18
20	JB-RX18.07.11A	7/11/18	JT_07	Johnson Prairie	16	JBLM	RX	CNLM	20	19
21	JB-RX18.07.12A	7/12/18	13LS_10	13th Div East	41	JBLM	RX	JBLM FW	21	20
22	JB-RX18.07.16A	7/16/18	SIA_17 & 18	SIA	42	JBLM	RX	CNLM	22	21
23	JB-RX18.07.17A	7/17/18	MP1_1	MP 1	80	JBLM	RX	JBLM FW	23	22
24	JB-RX18.07.18A	7/18/18	MAP_07, 08 & 09	Marion	37	JBLM	RX	CNLM	24	23
25	JB-RX18.07.19A	7/19/18	MAP_04,05 & 06	Marion	34	JBLM	RX	CNLM	25	24
26	JB-RX18.07.24A	7/24/18	SOS_04	Scouts Out/TA 5	25	JBLM	RX	CNLM	26	25
27	JB-RX18.07.24B	7/24/18	SOS_12	Scouts Out/TA 4	23	JBLM	RX	JBLM FW	27	25
28	CR-RX18.07.25A	7/25/18	201-A	Colvin Ranch	3	Thurston	RX	CNLM	28	26
29	JB-RX18.07.26A	7/26/18	TA06E_02	TA06	21	JBLM	RX	CNLM	29	27
30	JB-RX18.07.31A	7/31/18	TA06_16 & 15 (FF Fetch Day)	TA06	7	JBLM	RX	JBLM FW	30	28
31	JB-RX18.08.01A	8/1/18	TA06N_15 & 16	TA06	52	JBLM	RX	CNLM	31	29
32	JB-RX18.08.01B	8/1/18	TA06E_4, 8 & 9	TA06	26	JBLM	RX	JBLM FW	32	29
33	JB-RX18.08.02A	8/2/18	13W_04 & 01	13th Div West	25	JBLM	RX	JBLM FW	33	30
34	JB-RX18.08.03A	8/3/18	13LN_09	13th Div East	45	JBLM	RX	CNLM	34	31
35	JB-RX18.08.06A	8/6/18	UWP_05	Upper Weir	13	JBLM	RX	CNLM	35	32
36	JB-RX18.08.09A	8/9/18	TA06N_10	TA06	15	JBLM	RX	CNLM	36	33
37	JB-RX18.08.09B	8/9/18	TA06N_14	TA06	13	JBLM	RX	CNLM	37	33
38	JB-RX18.08.10A	8/10/18	UWP_06 & 07	TA 21	60	JBLM	RX	CNLM	38	34
39	JB-RX18.08.13A	8/13/18	TA15N_02	TA 15	47	JBLM	RX	CNLM	39	35
40	JB-RX18.08.28A	8/28/18	TA 7S_06, 07 & 04	TA07S	7	JBLM	RX	CNLM	40	36
41	JB-RX18.08.29A	8/29/18	TA6E_05 & 06	TA06	58	JBLM	RX	CNLM	41	37
42	JB-RX18.08.30A	8/30/18	TA7S_06	TA07S	5	JBLM	RX	CNLM	42	38
43	JB-RX18.09.04A	9/4/18	13LN_03	TA 14	113	JBLM	RX	CNLM	43	39
44	JB-RX18.09.07A	9/7/18	UWP_01	Upper Weir	27	JBLM	RX	JBLM FW	44	40
45	JB-RX18.09.07B	9/7/18	LW_04	Lower Weir	63	JBLM	RX	JBLM FW	44	40
46	JB-RX18.09.10A	9/10/18	13LS_09	13th Div East	41	JBLM	RX	JBLM FW	45	41
47	JB-RX18.09.12A	9/12/18	15S_04 & 05	TA 15	26	JBLM	RX	JBLM Forestry	46	42
48	JB-RX18.09.13A	9/13/18	T_01 & 02, 15N_03 & 05	TA 15	22	JBLM	RX	CNLM	47	43
49	JB-RX18.09.17A	9/17/18	13LN_01, 10, 11 & 13	TA 14	89	JBLM	RX	JBLM FW	48	44
50	JB-RX18.09.17B	9/17/18	13LS_02 & 07	TA 14	54	JBLM	RX	JBLM FW	48	44
51	ORWMR-FY18-RX-Mill Hill Prairie	9/17/18	Mill Hill	Finley	6	OR	RX	USFWS	49	44
52	JB-RX18.09.18A	9/18/18	15S_07	TA 15	32	JBLM	RX	JBLM FW	50	45
53	JB-RX18.09.18B	9/18/18	15N_04 & 06	TA 15	23	JBLM	RX	CNLM	51	45
54	JB-RX18.09.18C	9/18/18	13LN_07	TA 14	25	JBLM	RX	CNLM	51	45
55	JB-RX18.09.18D	9/18/18	15S_06	TA 15	11	JBLM	RX	JBLM FW	52	45
56	OREGON	9/18/18	Kudu North	Noble Oaks	20	OR	RX	TNC	53	45
57	FR-RX18.09.19D	9/19/18	2018-B	Fisher Ranch	2	Thurston	RX	CNLM	54	46
58	FR-RX18.09.19E	9/19/18	2018-C	Fisher Ranch	2	Thurston	RX	CNLM	54	46
59	JB-RX18.09.19A	9/19/18	LW_06, 01 & 02	Lower Weir	130	JBLM	RX	JBLM Forestry	55	46
60	JB-RX18.09.19B	9/19/18	UWE_01, 02 & WS_07	Upper Weir	28	JBLM	RX	JBLM Forestry	56	46

Table continued on next page

2018 Summary of Completed Prescribed and Pile Burns – supported or led by CNLM/JBLM (continued)

Count	Unit ID#/Sign In	Start Date	Unit/Block	Location/FMU	Acres	Project	Type	Lead Entity	Crew Shift	Days
61	JB-RX18.09.19C	9/19/18	UWE_03	Upper Weir	12	JBLM	RX	JBLM FW	57	46
62	LT-RX18.09.19F	9/19/18	2018-B	Leitner	20	Thurston	RX	CNLM	58	46
63	TQ-RX18.09.19G	9/19/18	2018-C	Tenalquot	1	Thurston	RX	CNLM	58	46
64	TQ-RX18.09.19H	9/19/18	2018-A	Tenalquot	2	Thurston	RX	CNLM	58	46
65	OREGON	9/19/18	Sable North, East, South & West	Noble Oaks	20	OR	RX	CNLM	59	46
66	JB-RX18.09.20A	9/20/18	JP_3, 12 & 13	Johnson Prairie	26	JBLM	RX	CNLM	60	47
67	JB-RX18.09.20B	9/20/18	TA20_04	TA 20	15	JBLM	RX	CNLM	61	47
68	JB-RX18.09.20C	9/20/18	TA20_01	TA 20	25	JBLM	RX	CNLM	62	47
69	VP-RX18.09.20D	9/20/18	2018-B	Violet Prairie	20	Thurston	RX	CNLM	63	47
70	WH-RX18.09.20C	9/20/18	2018-A	Wolf Haven	6	Thurston	RX	CNLM	63	47
71	JB-RX18.09.21A	9/21/18	UWP_08 & 02	Upper Weir	145	JBLM	RX	JBLM Forestry	64	48
72	JB-RX18.09.24A	9/24/18	T_04	TA 15	33	JBLM	RX	CNLM	65	49
73	JB-RX18.09.24B	9/24/18	SIA_16 & 17	SIA	32	JBLM	RX	JBLM Forestry	66	49
74	JB-RX18.09.25A	9/25/18	RH_14, 15, 01, 04 & 08	Rumble Hill	85	JBLM	RX	JBLM FW	67	50
75	ORBKR-FY18-RX-Area 4	9/25/18	Area 4/10Z	Baskett Slough	28	OR	RX	USFWS	68	50
76	JB-RX18.09.26A	9/26/18	TA8_10, 11, 17 & 18	TA 8	66	JBLM	RX	JBLM Forestry	69	51
77	JB-RX18.09.26B	9/26/18	TA20_02 & 03	TA 20	24	JBLM	RX	JBLM FW	70	51
78	ORWMR-FY18-Turtle Flats South	9/26/18	Turtle Flats	Finley	10	OR	RX	USFWS	71	51
79	JB-RX18.09.27A	9/27/18	NAMW_05	North AIA	9	JBLM	RX	JBLM Forestry	72	52
80	JB-RX18.09.27B	9/27/18	NAEG_04	North AIA	22	JBLM	RX	JBLM FW	73	52
81	JB-RX18.09.27C	9/27/18	LO_02	Lynch Hill	0.25	JBLM	RX	JBLM Forestry	74	52
82	OREGON	9/27/18	Unit 4	Cascade Head	28	OR	RX	TNC	75	52
83	JB-RX18.09.28A	9/28/18	JT_06 & JO_10 & 11	Johnson Prairie	10	JBLM	RX	JBLM FW	76	53
84	JB-RX18.09.28B	9/28/18	LW_11	Lower Weir	1	JBLM	RX	JBLM Forestry	77	53
85	ORBKR-FY18-RX-Field 14R	9/28/18	Field 14R	Baskett Slough	8	OR	RX	TNC	78	53
86	JB-RX18.10.02A	10/2/18	TA6E_03	TA 6	70	JBLM	RX	JBLM Forestry	79	54
87	SC-RX18.10.03A	10/3/18	2018-K (7 sub-blocks)	Scatter Creek	10.6	Thurston	RX	CNLM	80	55
88	GH-RX18.10.04A	10/4/18	2018-B alternate	Glacial Heritage	24	Thurston	RX	CNLM	81	56
89	GH-RX18.10.04B	10/4/18	UW plots small, med, large arrays	Glacial Heritage	8	Thurston	RX	CNLM	81	56
90	JB-RX18.10.04A	10/4/18	UWE_03	Upper Weir	8	JBLM	RX	JBLM FW	82	56
91	MM-RX18.10.4C	10/4/18	2018-A	Mima Mounds	19	Thurston	RX	CNLM	83	56
92	JB-RX18.10.04B	10/4/18	Piles	Anzio	1	JBLM	Piles	JBLM Forestry	84	56
93	JB-RX18.10.09A	10/9/18	Piles	Anzio	12	JBLM	Piles	JBLM Forestry	85	57
94	JB-RX18.10.10A	10/10/18	Piles	Anzio	8	JBLM	Piles	JBLM Forestry	86	58
95	JB-RX18.10.11A	10/11/18	Piles	Anzio	12	JBLM	Piles	JBLM Forestry	87	59
96	OREGON	10/11/18	Elk Express West Windrows	Juniper Hills	491	OR	Piles	TNC	88	59
97	OREGON	10/11/18	Main Unit	Willow Creek	30	OR	RX	TNC	89	59
98	OREGON	10/11/18	HOPS Research Plots	Willow Creek	1	OR	RX	TNC	90	59
99	OREGON	10/12/18	Kingston	Kingston Prairie	84	OR	RX	TNC	91	60
100	OREGON	10/12/18	Elk Express West	Juniper Hills	491	OR	RX	TNC	92	60
101	OREGON	10/13/18	Bonnie View partial and piles	Juniper Hills	150	OR	RX	TNC	93	61
102	ORBKR-FY19-RX-SheldonHolt	10/17/18	Sheldon/Holt	Baskett Slough	20	OR	RX	USFWS	94	62
103	ORBKR-FY19-RX-Dusky Prairie	10/17/18	Dusky Prairie	Baskett Slough	18	OR	RX	USFWS	94	62
104	JB-RX18.10.18A	10/18/18	Piles	Anzio	13	JBLM	Piles	JBLM Forestry	95	63
105	OREGON	10/18/18	South and Knob	Confluence	16	OR	RX	CNLM	96	63
106	JB-RX18.10.22A	10/22/18	Piles	Anzio	11	JBLM	Piles	JBLM Forestry	97	64
107	OREGON	10/22/18	Brattain Ridge Unit 1 East	Sycan	353	OR	RX	TNC	98	64
108	JB-RX18.10.23A	10/23/18	Piles	Anzio	33	JBLM	Piles	JBLM Forestry	99	65
109	OREGON	10/23/18	Brattain Ridge Unit 1 West	Sycan	690	OR	RX	TNC	100	65
110	JB-RX18.10.24A	10/24/18	Piles	Anzio	33	JBLM	Piles	JBLM Forestry	101	66
111	OREGON	10/24/18	Brattain Ridge Unit 2	Sycan	530	OR	RX	TNC	102	66
112	JB-RX18.10.25A	10/25/18	Piles	Anzio	39	JBLM	Piles	JBLM Forestry	103	67
113	JB-RX18.11.05A	11/5/18	Piles	Anzio	18	JBLM	Piles	JBLM FW	104	68
114	JB-RX18.11.06A	11/6/18	Piles	Anzio	18	JBLM	Piles	JBLM FW	105	69
115	JB-RX18.11.14A	11/14/18	Piles	Anzio	30	JBLM	Piles	JBLM Forestry	106	70

	Acres	Count
JBLM Total	2695	84
JBLM RX	2467	72
JBLM Piles	228	12
Thurston	118	12
OR	2994	19
Combined Total	5807	115