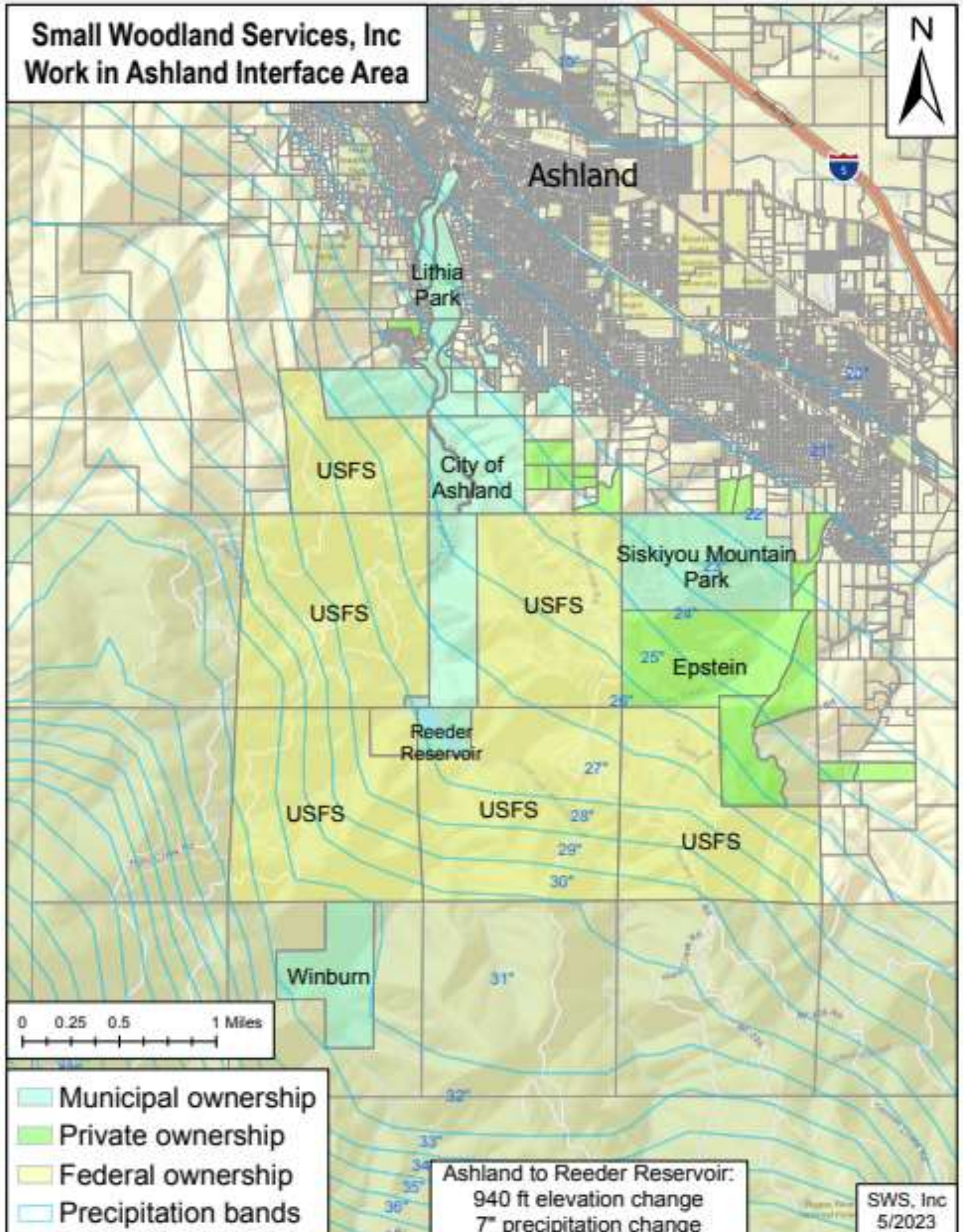
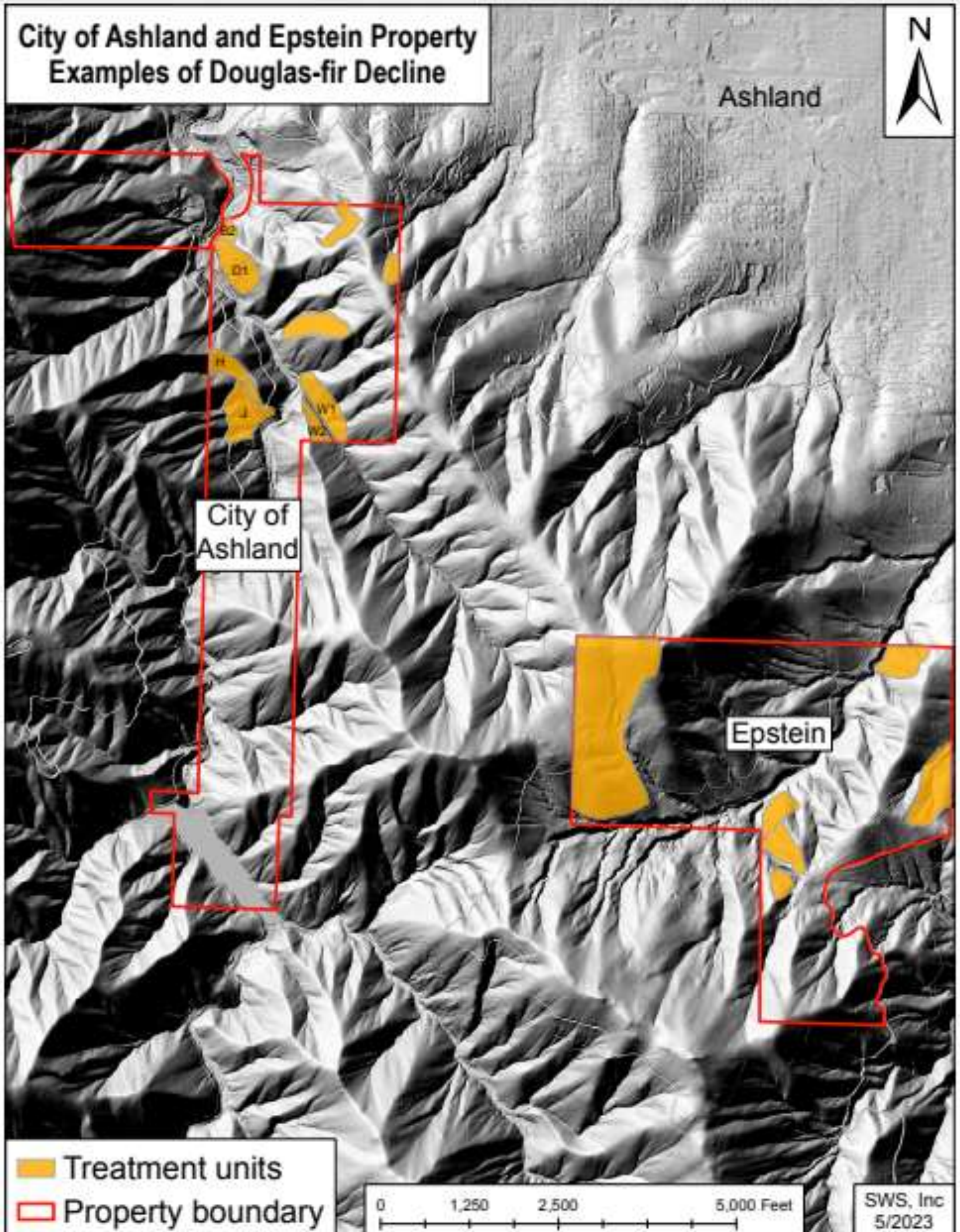

Small Woodland Services, Inc
Work in Ashland Interface Area
N
Ashland
Lithia Park
USFS
City of Ashland
Siskiyou Mountain Park
USFS
USFS
Epstein
Reeder Reservoir
USFS
USFS
USFS
Winburn
0 0.25 0.5 1 Miles
Municipal ownership
Private ownership
Federal ownership
Precipitation bands
Ashland to Reeder Reservoir:
940 ft elevation change
7" precipitation change
SWS, Inc
5/2023
22"
24"
25"
26"
27"
28"
29"
30"
31"
32"
33"
34"
35"
36"


City of Ashland and Epstein Property
Examples of Douglas-fir Decline
N
Ashland
City of Ashland
Epstein
Treatment units
Property boundary
0
1,250
2,500
5,000 Feet
SWS, Inc
5/2023

Major insect and disease-related mortality of conifers

-1988-89
-1993-4
-2001-02
-2014-15
-current

Looking northwest from Crowson Reservoir, ~2001

City of Ashland Helicopter Thinning (2004)


City Forest Lands
Restoration Project
PHASE II

City of Ashland "Alice Trail"- 1997

"Alice Trail"- post thinning/slash treatment 1998

“Alice Trail”- 2015

Summary of Potential Management Strategies (Main 2006, 2010)

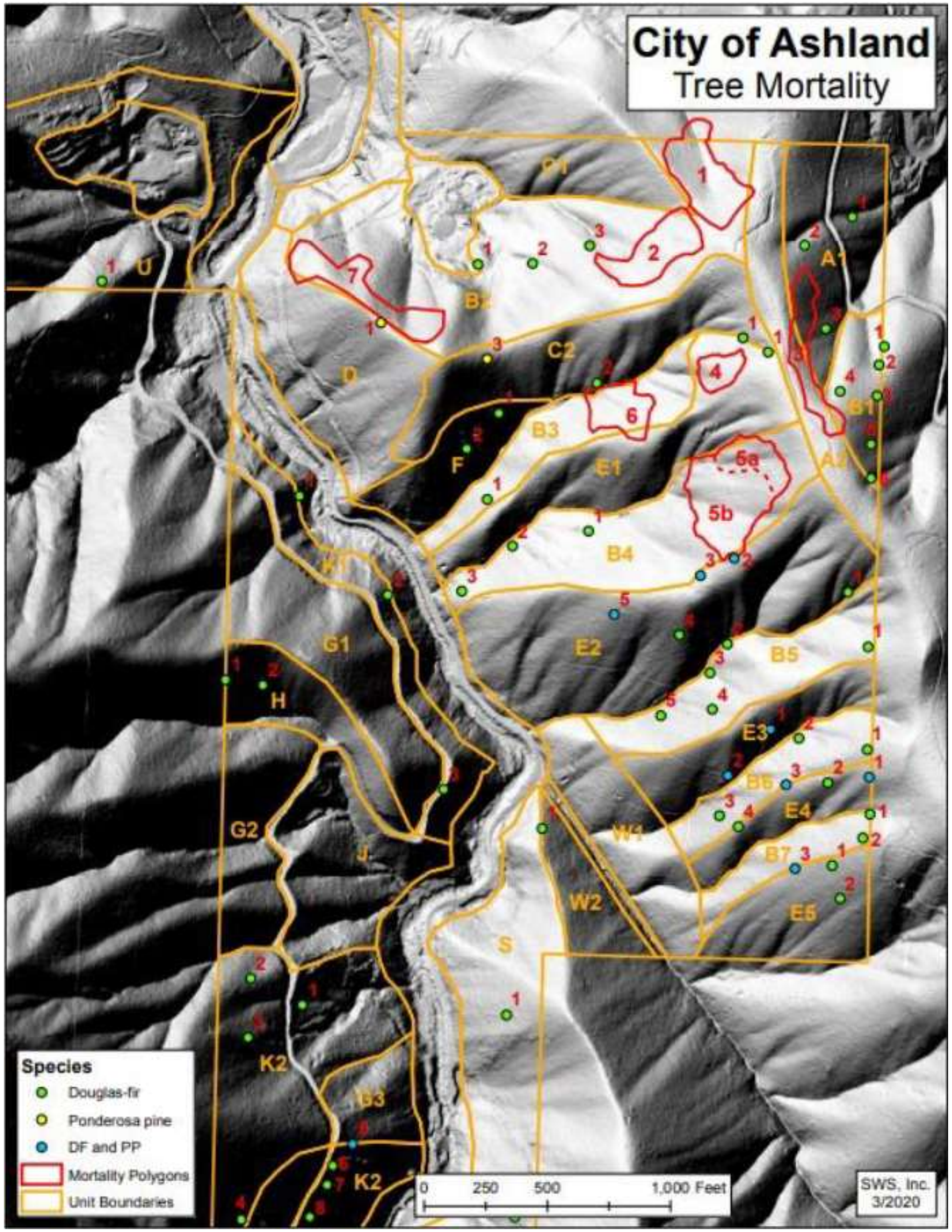
- **Encourage retention** of the most vigorous Douglas-fir possible
- **Maintain stand integrity** in the largest patch sizes possible (avoid artificially creating stringers of small patches of Douglas-fir)
- **Reduce densities** of developing hardwoods and shrubs on the edges of existing stands of Douglas-fir
- **Utilize prescribed underburning** to minimize understory development
- **Emphasize increasing tree species diversity** through retention and promotion of pines, incense cedar and hardwoods (especially California oak) in thinning regimes
- **Balance hardwood retention** within the vicinity of preferred conifers given the increased competition they offer for moisture and site resources
- **Plant** a mixture of ponderosa pine, sugar pine (blister rust resistant) and incense cedar in openings where appropriate.

Insect-related DF Mortality over past 30 years on City Ownership

(Main and Schmidt 2020)

1. Endemic-frequent, ongoing and generally of lower severity.

2. Outbreak- infrequent higher levels of mortality; usually associated with droughts.



Strategy

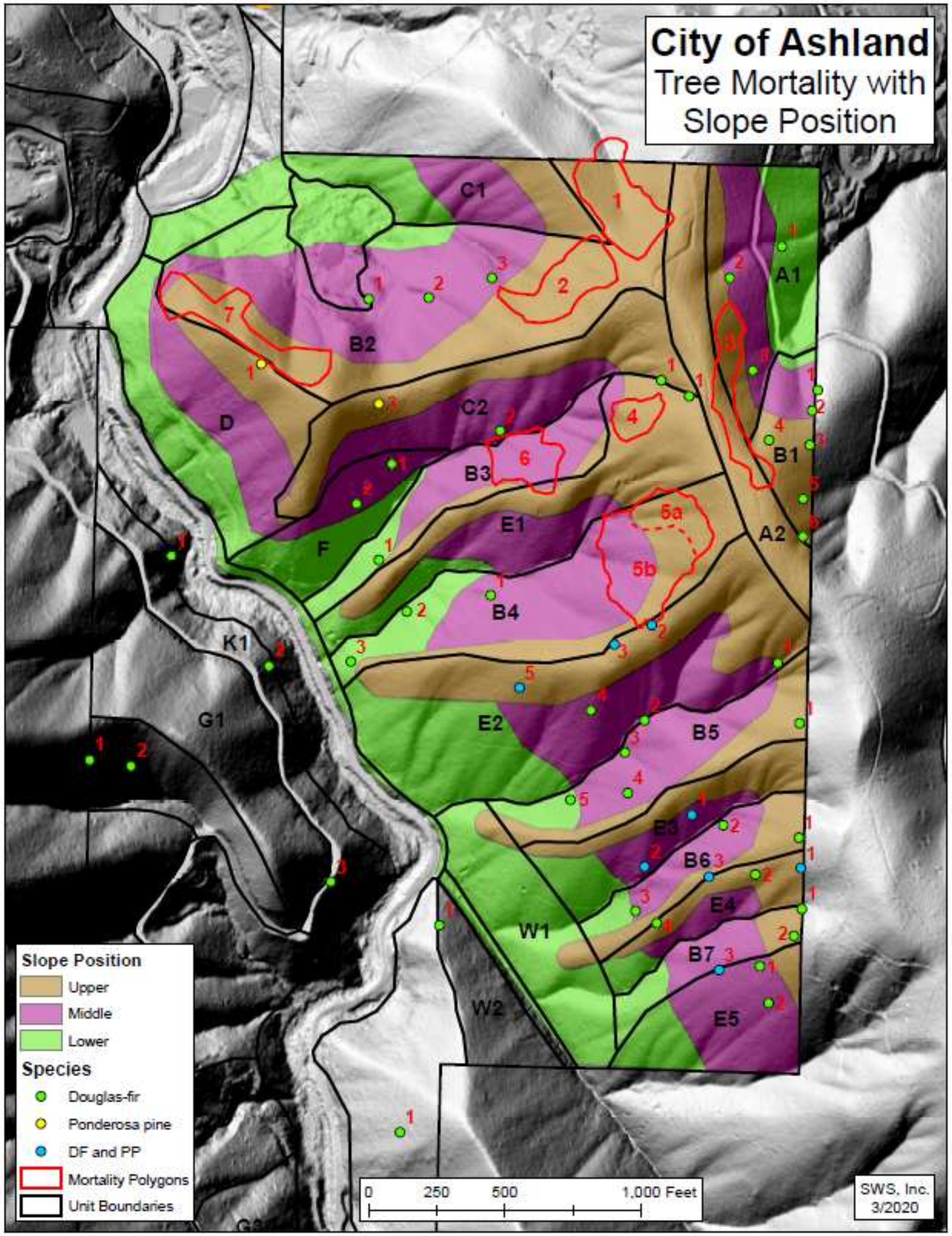
Use more frequent low severity silvicultural treatments to avoid major pulses of outbreak levels of mortality that can:

1) create a high amount of fuels
2) burn at high intensities for long duration with effects on soils
3) contribute to possibilities for severe erratic fire behavior
4) be very expensive to treat using manual slash treatment methods.

Source: Main and Schmidt. 2020. City of Ashland 2020 Mortality Monitoring Results and Analysis

Table 2: Estimated conifer snags 8”+ DBH by slope position, Units A-F, W1

Slope Position	Acres	Douglas-fir	Pine	Total	Snags/Acre
Upper	60.2	429	10	439	7.3
Middle	51.4	175	6	181	3.5
Lower	37.6	35	0	35	0.9


City of Ashland
Tree Mortality with Slope Position
Slope Position
Upper
Middle
Lower
Species
Douglas-fir
Ponderosa pine
DF and PP
Mortality Polygons
Unit Boundaries
0 250 500 1,000 Feet
SWS, Inc.
3/2020
C1
B2
A1
D
C2
B3
B1
E1
F
A2
B4
K1
G1
E2
B5
E3
B6
E4
W1
B7
W2
E5
5a
5b

Factors that Predict DF Mortality on the Lower City Ownership

(Main and Schmidt 2020)

1. Elevation
2. Topographic slope position
3. Aspect
4. Stand edges
5. Size of interior habitat
6. 80-120 year homogenous stands of dense suppressed DF (i.e. polygons)

- all of which influence water availability and/or moisture stress for trees!

Table 7: Simple risk rating for Douglas-fir mortality in the lower City of Ashland ownership[1]

(Positive numbers indicate increased likelihood of mortality, lower numbers indicate decreased likelihood of mortality; Scale is from +2 to -2).

Variable	Polygons[2]						Example Units				
	1	2	3	5[3]	6	7	K1[4]	N	P	Q	J[4]
Elevation	+2	+2	+2	+1	+1	+2	+2	-2	-1	-1	+2
Topographical position	+2	+2	+2	+2	+1	+2	-2	0	0	0	-2
Aspect	-1	+1	-1	+1	+1	0	-2	-1	+1	-1	0
Stand edge/interior habitat	+2	-1	+2	+1	+2	+1	+1	-2	-1	-1	-1
Excessive stand density[5]	+2	+2	+2	+1	+2	+1	+1	+2	0	+1	-1
Total	**+7**	**+6**	**+7**	**+6**	**+7**	**+6**	**0**	**-3**	**-1**	**-2**	**-2**

[1]This table is provided as a conceptual framework for assessment to help understand how multiple variables can be assessed to provide a rating for any individual site/stand. The variables should also probably be weighted in importance although a much more elaborate analysis (e.g.. multivariate analysis) would be needed to provide this type of information and is well outside the scope of this paper. The influence of each variable presented varies greatly between sites but all have various levels of relationships with moisture availability.

[2]Polygon 4 was excluded because it was in a portion of the prescribed underburn that had no Douglas-fir mortality.

[3]The 2018 prescribed burn was an additional influence on mortality in Polygon 5.

[4]Close proximity to riparian areas and more favorable microclimate conditions wereanother influence on the low levels of mortality in Units K1 and J.

[5]Generally in even-aged 80-120 year old stands with much reduced stand differentiation; in these situations, stand level dynamics seem to have greater influence (i.e. they tend to act as a single unit with reduced potential for individual tree release) and adjustments through thinning can be more problematic..

Annual Cooperative Aerial Mortality Survey- Number of Dead Trees, Rogue/Illinois Valleys, Siskiyou Foothills, Umpqua Interior Foothills, and Inland Siskiyou Bioregions

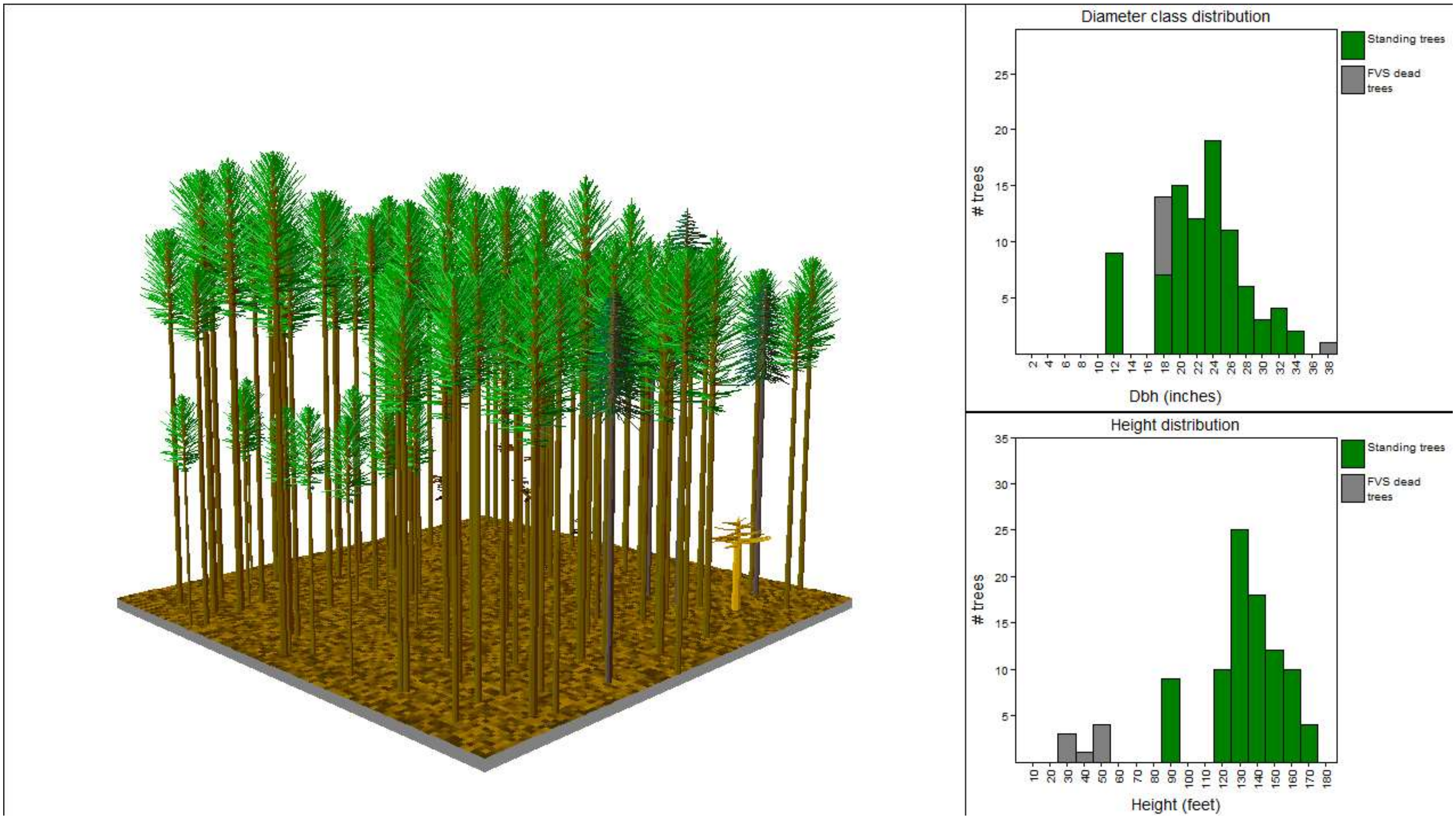
Species	2000	2001	2002
Sugar Pine	112	144	699
Ponderosa Pine	249	417	20,986
Douglas-fir	413	321	32,148

Source: Southwest Oregon Forest Insect and Disease Service Center

We have created ideal habitat for DF decline from FFB and others through management practices over the past 100+ years that have utilized higher severity disturbance and encouraged its continuation, including current levels of insect related mortality in dense even aged stands now common on the landscape.

Infrequent, High Severity Disturbance

Even-aged stand structure initiated after high severity disturbance

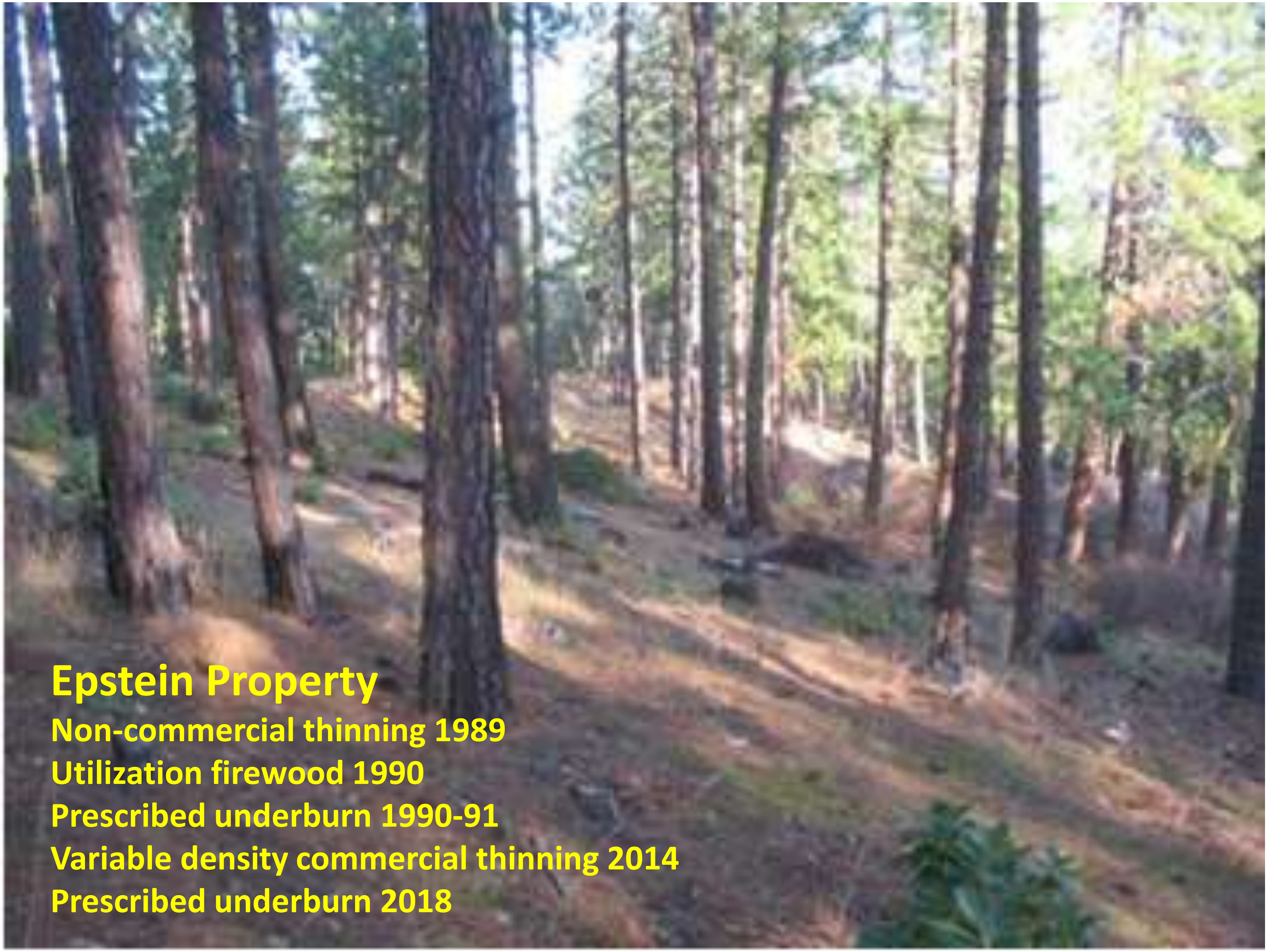



Unit LW-B4
City of Ashland

Plant Responses to Disturbance

(Rowe, 1981)

TYPE	DESCRIPTION	EXAMPLE	PREFERRED FIRE TYPE
Invaders	Highly dispersive, short-lived, pioneering	Fireweed, thistles, many grasses	High intensity
Evaders	Long-lived propagules stored in soil or canopy	Serotinous cones (canopy); whiteleaf manzanita, wedge-leaf ceanothus (soil)	High intensity
Avoiders	Shade tolerant, late successional species that slowly invade and have limited adaptation to fire	Hemlocks, western juniper, most true firs	Fire suppression
Resisters	Survive low intensity fires relatively unscathed	Douglas-fir, ponderosa pine	Low intensity
Endurers	Ability to resprout from root crown, lateral roots, or aerial crown	Oaks, Pacific madrone, various shrubs	High intensity


Epstein Property
Non-commercial thinning 1989
Utilization firewood 1990
Prescribed underburn 1990-91
Variable density commercial thinning 2014
Prescribed underburn 2018

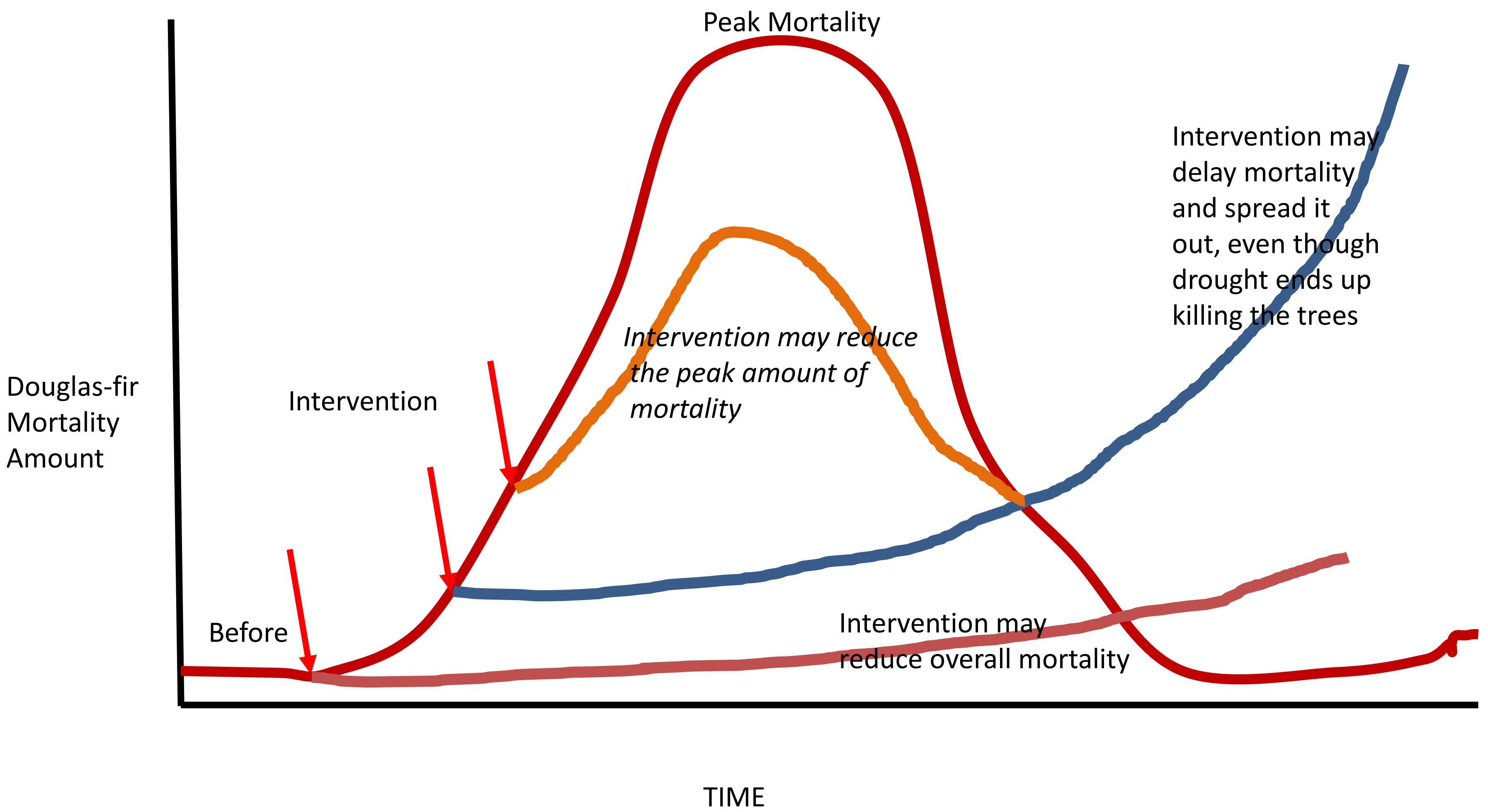
Unit E2, City of Ashland, 2013

- 1996-97 – Non-commercial thinning, piling, burning (Small Woodland Services Inc.)
- 2004 – Helicopter thinning (Superior Helicopters), piling, burning (SWS).
- 2013 – Prescribed underburn (Grayback Forestry)
- 2014- Plant ponderosa pine seedlings (SWS)

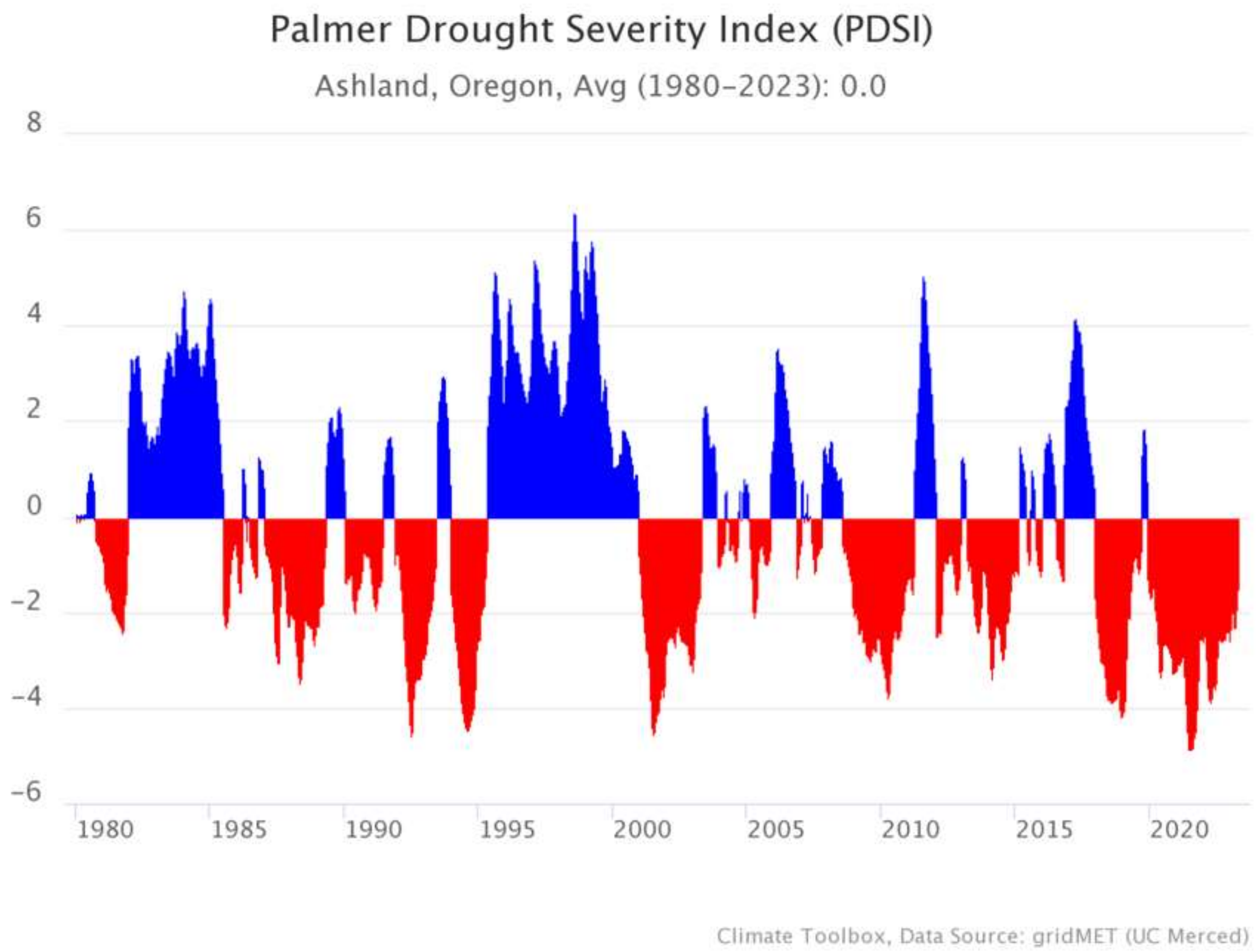
Restoring frequent low severity disturbance through multiple conservative interventions (i.e. adjusting stand density, species and structure so that a more desirable and sustainable functional process can occur)

With ongoing drought, there are advancing levels of cumulative stress at various scales of reference, from landscapes to individual trees. Insect populations respond to these conditions. When and how can we utilize stand management i.e. “planned disturbance” to reduce cumulative stress? Are there thresholds that can help us decide if and when and to what degree to thin?

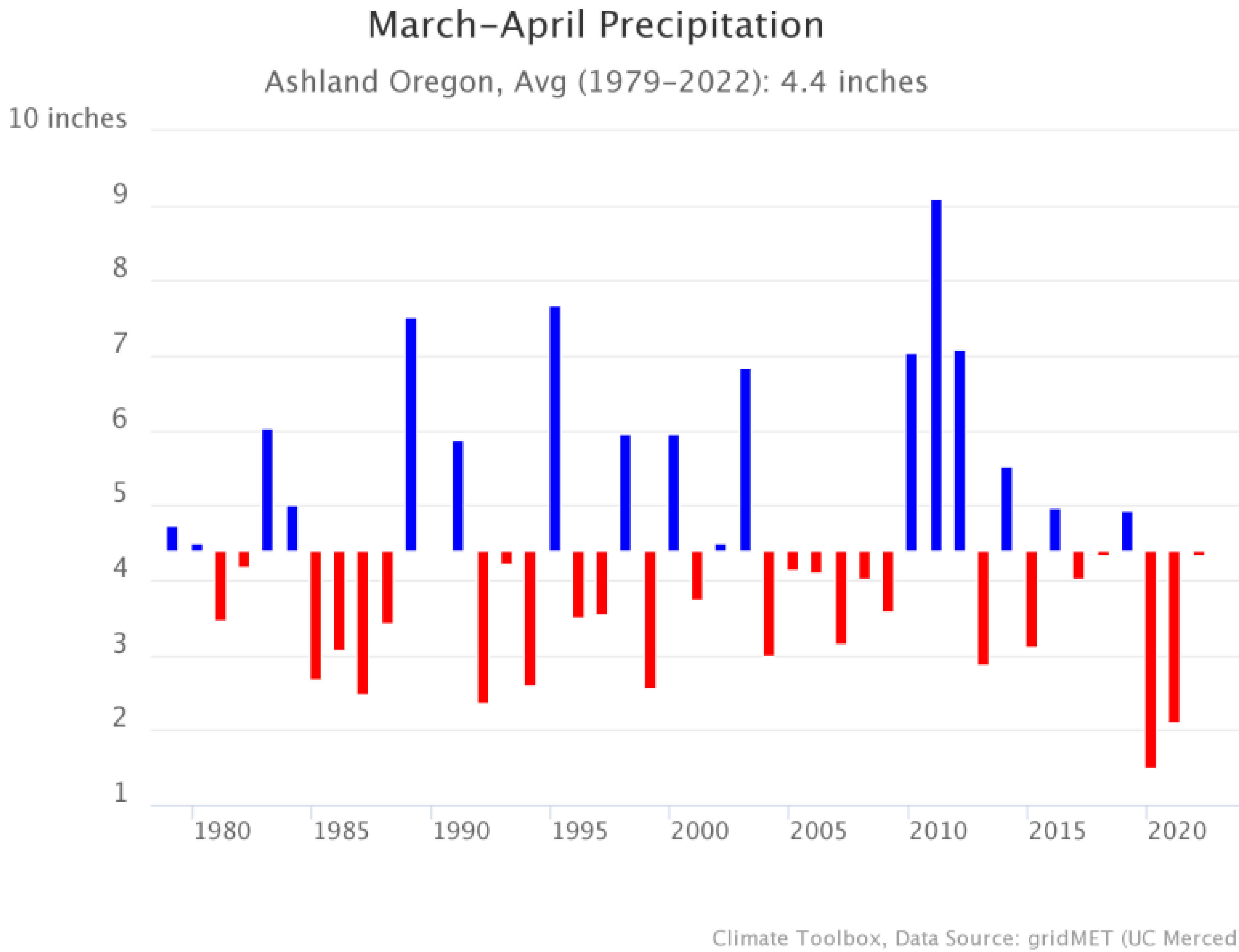
DF mortality over time

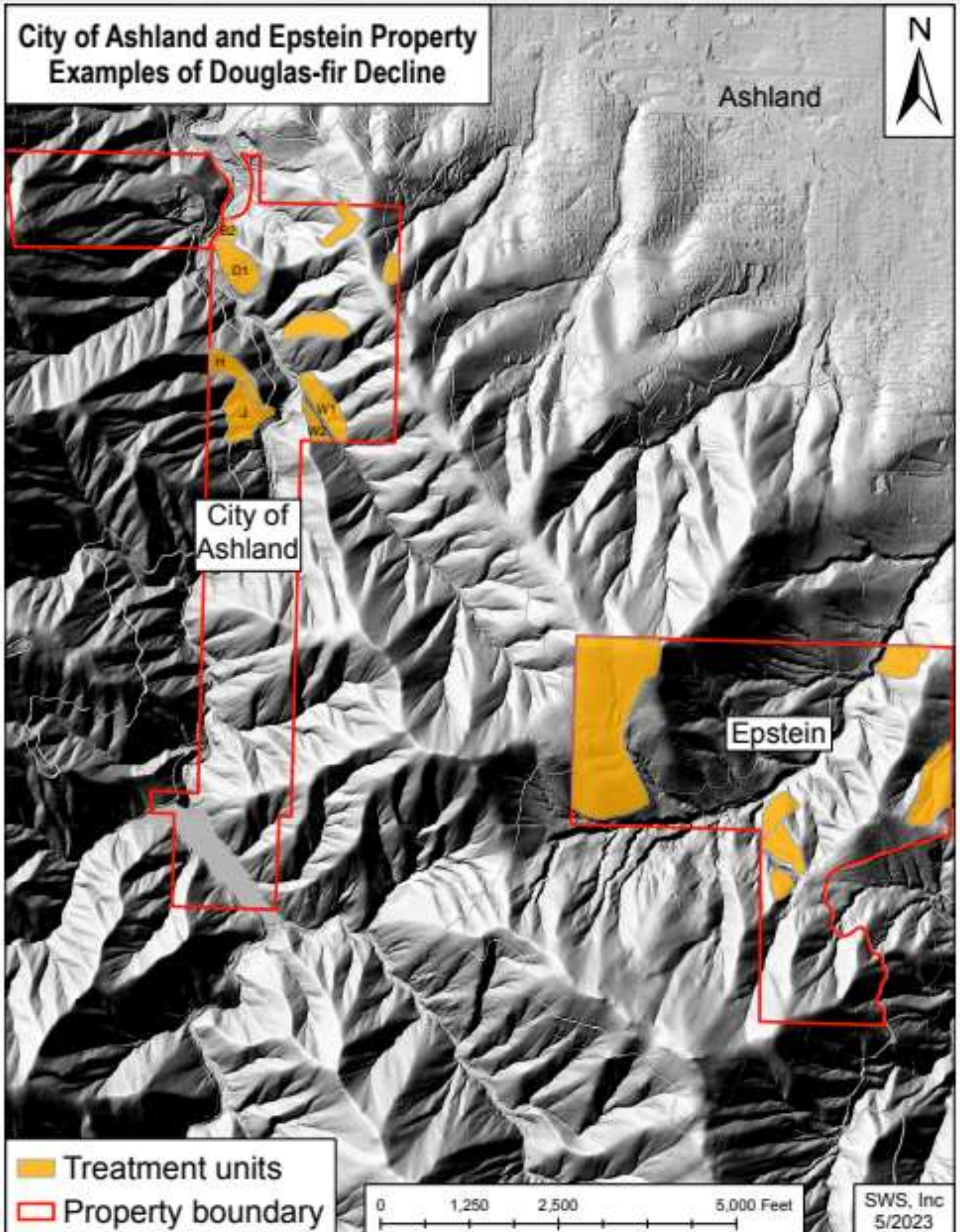


Early intervention is preferable



Palmer Drought Severity Index (PDSI)
Ashland, Oregon, Avg (1980–2023): 0.0
8
6
4
2
0
-2
-4
-6
1980
1985
1990
1995
2000
2005
2010
2015
2020
Climate Toolbox, Data Source: gridMET (UC Merced)


March–April Precipitation
Ashland Oregon, Avg (1979–2022): 4.4 inches
10 inches
9
8
7
6
5
4
3
2
1
1980
1985
1990
1995
2000
2005
2010
2015
2020
Climate Toolbox, Data Source: gridMET (UC Merced)


City of Ashland and Epstein Property
Examples of Douglas-fir Decline
N
Ashland
City of Ashland
Epstein
Treatment units
Property boundary
0
1,250
2,500
5,000 Feet
SWS, Inc
5/2023

Thinning in Stands Affected or Potentially Affected by Douglas-fir Decline

1. Landscape Level Factors

Elevation
Topographic Slope Position- slight changes can be significant
Aspect- slight changes can be significant
Precipitation

2. Site Level Features

Soil Type and Depth
Site Productivity
Stand Edges- what kind? why are they there? what is adjacent the stand edge?

3. Stand Level Features

Assessment of stand level cumulative stress
Degree of current Douglas-fir decline/mortality
Disturbance history, including "planned disturbance"
Stand conditions- structure (e.g. complexity versus even-aged), composition (e.g. other suitable leave tree species), density (e.g. constant assessment of retained basal area)

4. Individual Microsite Features

Stand differentiation
Crown condition
Radial growth
Bole symptoms- woodpecker activity, pitch streaming, pitch jewels
Proximity of recent mortality and/or older mortality
Spatial patterning-inherent potential above and below-ground advantages to clumping that may become more important with climate change (internal shading for heat control; greater wind resistance; more vigorous below-ground community including hydraulic re-distribution, resource sharing, etc)

5. Other Key Considerations

-Douglas-fir as a species can be both drought and fire tolerant. However, Douglas-fir is not well-suited to grow for 100- 125+ years at high densities without disturbance is an artifact of a post-contact disturbance regime likely has very little historical analog, regardless of site. Even on relatively harsh, droughty sites, Douglas-fir was likely at least a minor part of many historic species compositions.

-Thresholds of potential for thinning as an effective treatment to meet objectives: i.e. where and when and under what conditions can a stand dominated by Douglas-fir respond to thinning in a way that can produce some level of resistance to Douglas-fir decline? Acknowledge, however, that on some sites, post-thinning release of desired trees is not guaranteed; you may release the understory more dramatically than the trees, with long--term effects on tree release/survival. Use understory species as site indicators in helping to develop those thresholds

-Other values- it may be very important to try to maintain a stand for some length of time, to extend the life of a stand through thinning, particularly given the unknown length of drought events- social values (e.g. small woodland owners attachment to place); important structural values from a fire perspective (e.g. fuel discontinuity between ground and crown), extending root holding capacity over time on steeper unstable slopes, etc.

-Consider the use of shading to minimize the effects of extreme heat events on desired trees; consider retaining clumps of trees that provide internal shading, thinning more heavily around the retained clump. Avoid thinning in ways that suddenly exposes a formerly shaded tree- it can take 3 years or more for a conifer to switch from shade to sun needles during which time there is additional cumulative stress.

RHP Property

Howard Prairie Lake area

“Ecologically logged 3 times since 1995 to emulate historic disturbance regimes and to create a multi-aged, mixed species stand condition.”

Big tree in center

-33” dbh Douglas-fir
-Estimated 1000 board feet merchantable volume
-Current value: ~ $350
-Last year value: ~$650


Prescribed underburning , Main Property, 2016

Frequent low severity fire builds induced defense in Ponderosa Pine

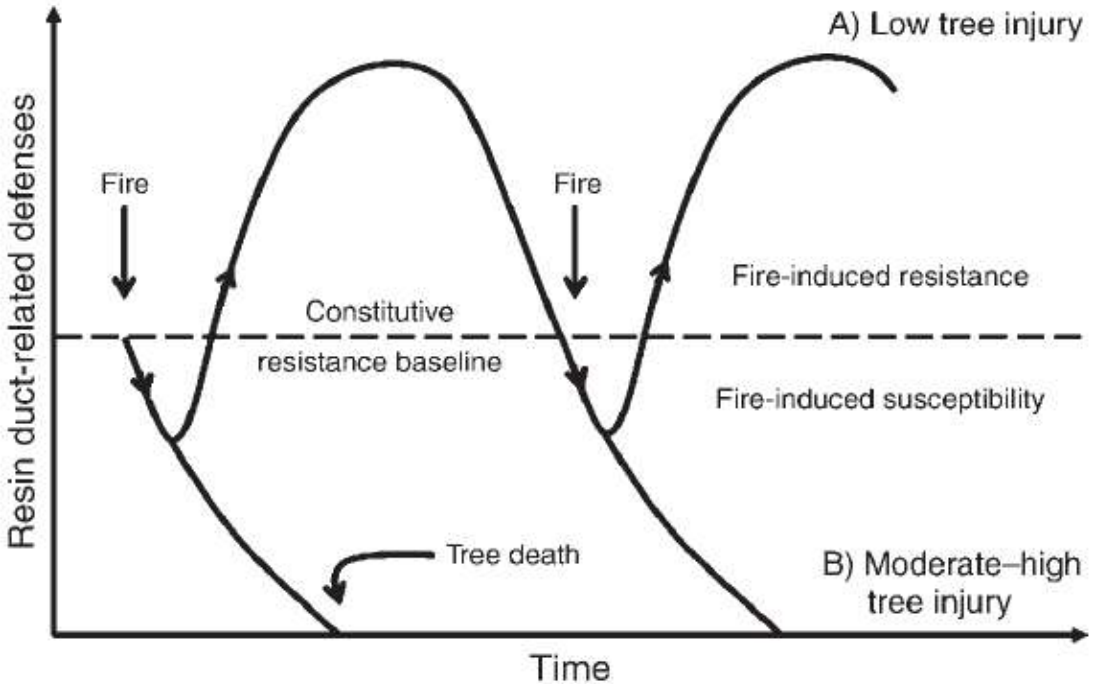


FIG. 4. Hypothesized conceptual model of fire-induced resin duct-related defenses (e.g., resin ducts, flow, and chemistry) in conifers. (A) For trees with low levels of injury, fire causes a brief (days, up to 1 growing season) reduction in resistance to bark beetle attacks (i.e., fire-induced susceptibility) before induced resin ducts form, followed by a period of increased resistance that lasts for several years (i.e., fire-induced resistance) before returning to constitutive levels as induced resin ducts lose connectivity due to annual tree growth. The exact timing and magnitude of this switch is dependent on the specific bark beetle and tree species involved, growing season length, and post-fire climate. (B) Fire increases susceptibility to attack for trees with moderate to high levels of injury and the probability of tree death. Additional research is needed to understand how defense components interact to affect overall fire-induced tree resistance.

Source: Hood et.al. 2015. Low-severity fire increases tree defense against bark beetle attacks.

Species Composition Affected by Change in Disturbance Regime

Township 39 South, Range 1 East

(% basal area by species)

Date	PP	SP	DF	Oak,Madrone
1899	60	15	20	5
2003*		7	64	29
2003**		4	20	76

*plots in areas with one major wildfire, 1901/1910

**plots in areas with 2 major wildfires, 1901/10 + 1959

Primary Stand Characteristics to Adjust with Vegetation Management to Achieve Desired Ownership Objectives

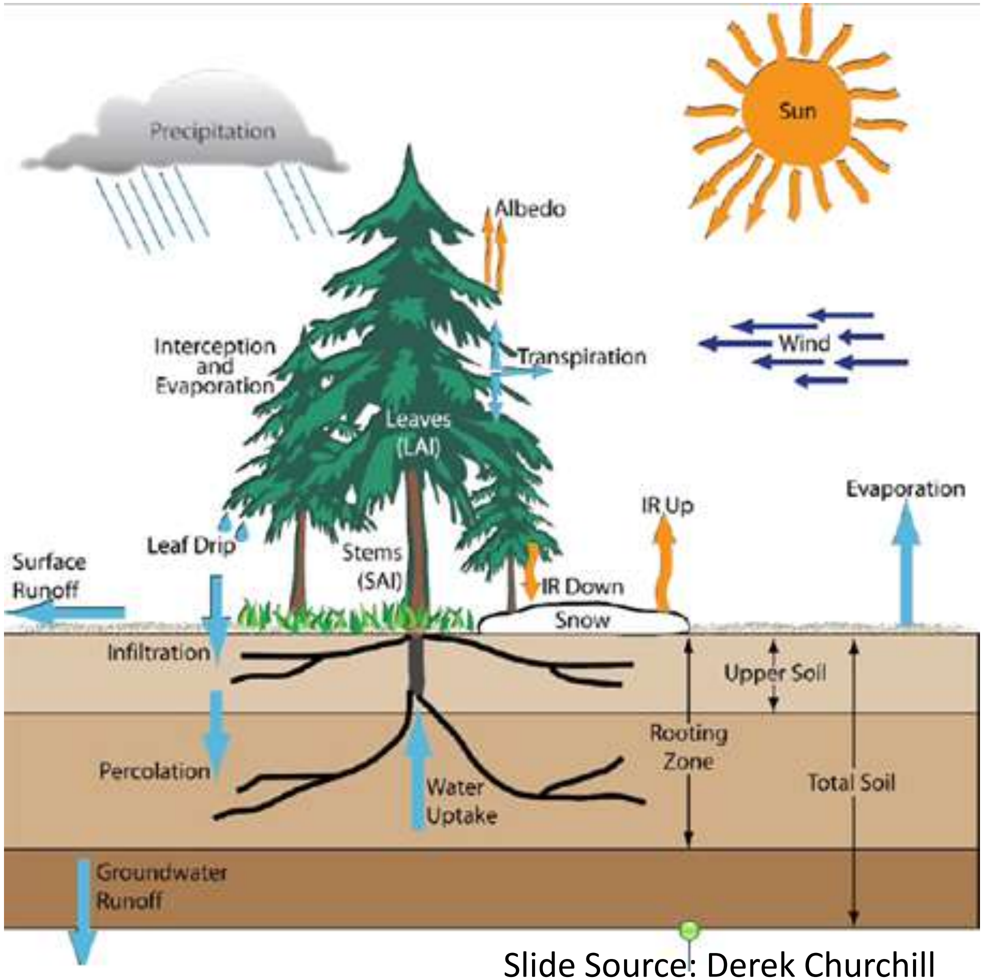
1. Stand density
2. Species composition
3. Stand structure

It is adjustments in these three characteristics that then allow for **development of functional processes and disturbance regimes** that can most closely match ownership objectives.

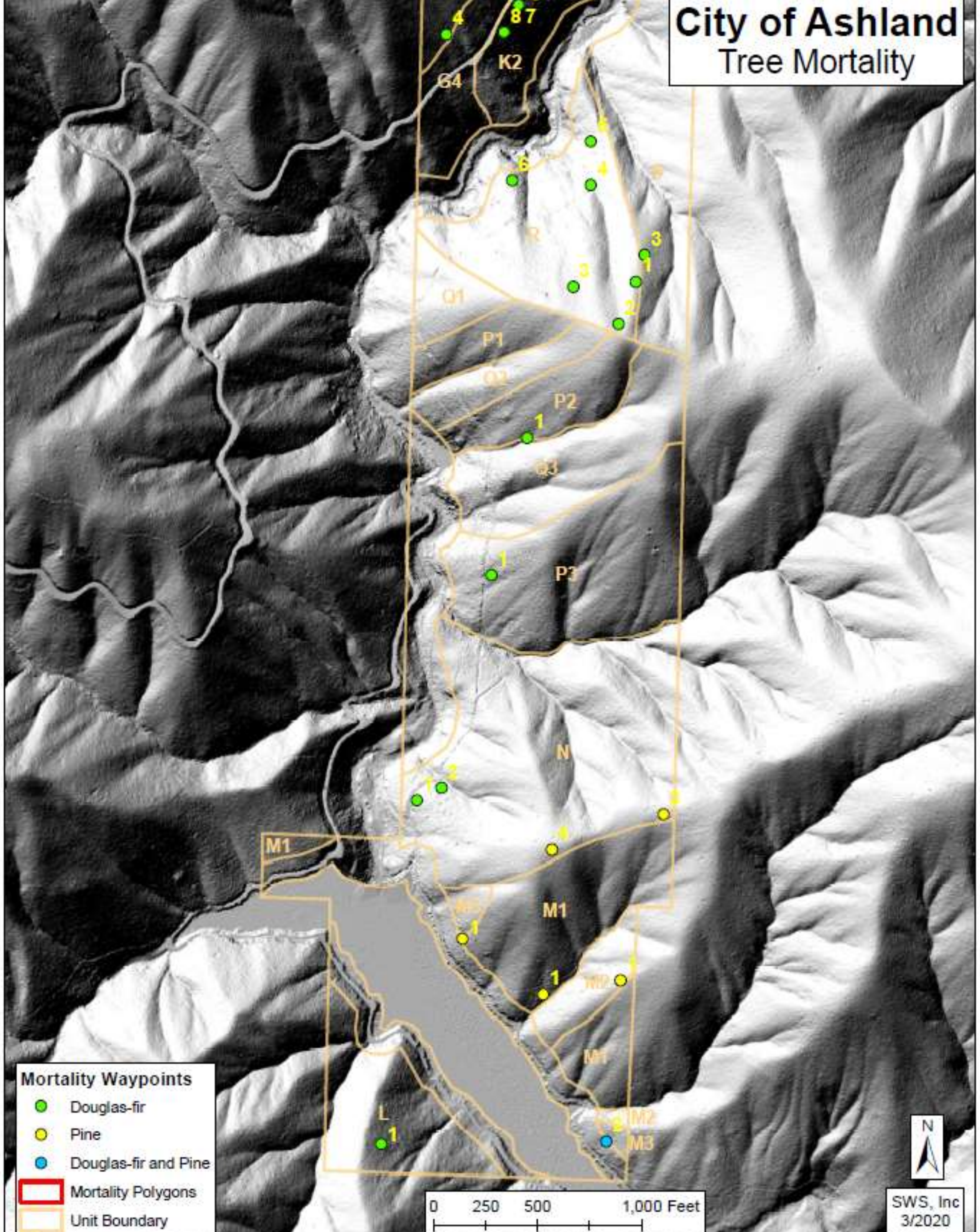
Drought Stress on Individual Plant Level

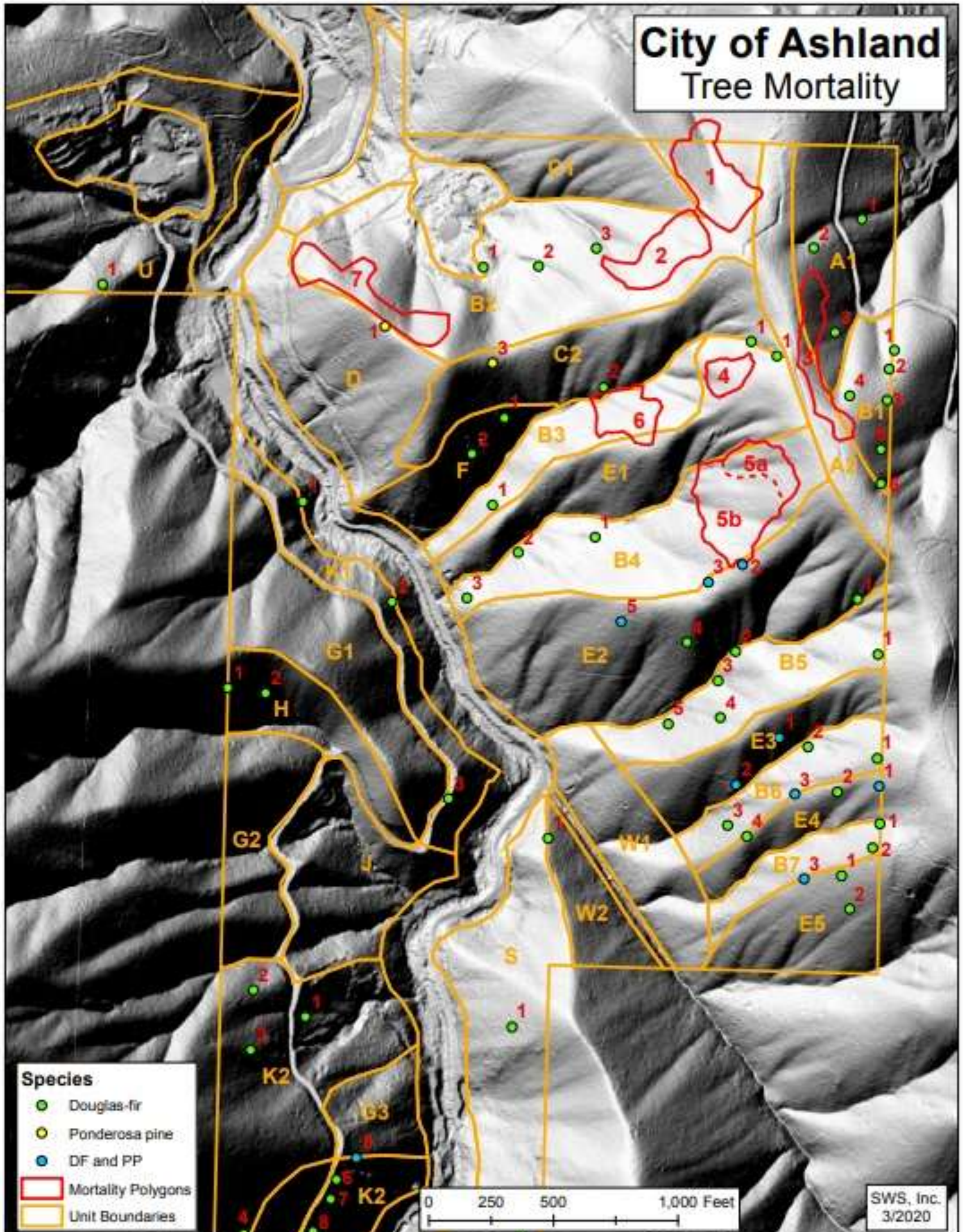
• Has both aboveground and belowground mechanisms which interact with their environments in quite different ways, changing with species, age, sites and other factors

• Appropriate management response for individual trees will depend on an increased understanding of these two biological mechanisms and integrating them amidst rapidly changing climatic factors. For example, increasing available water by increasing space alone may not always be as important as understanding methods by which trees access and uptake additional water belowground and transpire it aboveground.



Slide Source: Derek Churchill


City of Ashland
Tree Mortality
K2
G4
R
Q1
P1
Q2
P2
Q3
P3
N
M1
M2
M3
L
Mortality Waypoints
Douglas-fir
Pine
Douglas-fir and Pine
Mortality Polygons
Unit Boundary
0 250 500 1,000 Feet
N
SWS, Inc
3/2020


City of Ashland
Tree Mortality
Species
Douglas-fir
Ponderosa pine
DF and PP
Mortality Polygons
Unit Boundaries
0
250
500
1,000 Feet
SWS, Inc.
3/2020
U
D1
B2
A1
C2
D
B3
F
E1
B1
A2
5a
5b
B4
G1
E2
B5
H
E3
B6
E4
W1
G2
B7
E5
W2
S
K2
G3